ORTHOPAEDIC TRAUMA ASSOCIATION

6300 North River Road, Suite 727
Rosemont, IL 60018-4226
Phone: (847) 698-1631
FAX: (847) 823-0536
E-mail: ota@aaos.org

Ross K. Leighton, MD

Welcome to the 30th Annual Meeting of the OTA!

WOW, where does the time go? This is a special anniversary for the OTA, and we have planned an exceptional meeting experience for all attendees. We have continued to improve the educational programs of the meeting and we feel there is really something for everyone, no matter what part of orthopaedic trauma you feel most aligned (lower extremity, upper extremity, spine, pelvis, or foot and ankle). Evidence-based practice is emphasized, as well as consensus-based practice in those areas where large studies just do not exist to date. This year we had a record number of abstracts and the program committee has selected only the best for your education.

Our symposia have become ever more popular, and our speakers come from all over the world, bringing the most up-to-date techniques and protocols for your indulgence. We are extremely happy to welcome Brazil as our Guest Nation and they promise to bring excitement and style to the meeting. It should be fun!

Socially, we hope you will join your colleagues Thursday evening for a night of fun at the Tampa Aquarium. We know the environment will be conducive to meeting new friends and reacquainting with old colleagues and friends from the past. We hope you will participate and enjoy the planned events along with the educational activities.

I always find these meetings bring back energy and enthusiasm to my practice and I hope you will take some of this back to yours.
We have one of the best jobs in the world.
Thirty years is a great time to celebrate!

Best wishes for a fabulous meeting,

Ross K. Leighton, MD
OTA President

©Tampa Convention Center / VisitTampa

Welcome

Find a Surgeon

OTA Membership Directory available at www.ota.org.
Search by name or location. Directory updated weekly.
Email addresses available via the 'Members Only' page.

Attendance at the OTA Annual Meeting authorizes the OTA to capture your image or likeness in photographic, digital video, or other electronic format, and authorizes the OTA to use said image or likeness in marketing materials to promote OTA, including print, electronic and on the internet. OTA warrants that its use of the image or likeness will not be in a negative manner.
OTA has no control over the use of the image or likeness by third parties and therefore makes no express or implied warranties on any use by third parties.

Orthopaedic Trauma Association

6300 N. River Road, Suite 727
Rosemont, IL 60018-4226, USA
Phone: (847)698-1631
Fax: (847)823-0536
e-mail: ota@aaos.org
Home Page: www.ota.org

We're Moving!
Effective December 4, 2014, our new address is:
9400 W. Higgins Road, Rosemont, IL 60018-4976

OTA Staff

Kathleen A. Caswell, *Executive Director*
Diane Vetrovec Dobberstein, *Manager, Education and Research*
Paul M. Hiller, *Society Coordinator*
Melanie L. Hopkins, *Fellowship Coordinator*
Darlene A. Meyer, *Society Coordinator*
Sharon M. Moore, *Society Manager*
Alivia Payton, *Education/Research Program Administrator*

TABLE OF CONTENTS

SCIENTIFIC POSTERS *West Hall*

Open: Thursday 2:30 pm – Saturday 1:30 pm

TECHNICAL EXHIBITS *West Hall*

Open:	Thursday	2:30 pm	-	5:00 pm
	Friday	9:00 am	-	5:00 pm
	Saturday	9:00 am	-	1:30 pm

SPEAKER READY ROOM *2nd Floor (near registration)*

4:00 pm - 6:00 pm – Tuesday
Open 6:00 am - 6:30 pm – Wednesday thru Saturday.

NOTE: Cameras (including digital and video cameras) may NOT be used in any portion of the meeting.

ORTHOPAEDIC TRAUMA ASSOCIATION

ORTHOPAEDIC TRAUMA ASSOCIATION HISTORY

PAST PRESIDENTS

Ramon B. Gustilo, MD, Founding President	
Michael W. Chapman, MD	1985-87
Charles C. Edwards, MD	1987-88
John A. Cardea, MD	1988-89
Bruce D. Browner, MD	1989-90
Joseph Schatzker, MD	1990-91
Richard F. Kyle, MD	1991-92
Robert A. Winquist, MD	1992-93
Peter G. Trafton, MD	1993-94
Kenneth D. Johnson, MD	1994-95
Alan M. Levine, MD	1995-96
Lawrence B. Bone, MD	1996-97
James F. Kellam, MD	1997-98
David L. Helfet, MD	1998-99
Andrew R. Burgess, MD	1999-00
M. Bradford Henley, MD, MBA	2000-01
Donald A. Wiss, MD	2001-02
Thomas A. Russell, MD	2002-03
Marc F. Swiontkowski, MD	2003-04
Roy Sanders, MD	2004-05
Paul Tornetta, III, MD	2005-06
Michael J. Bosse, MD	2006-07
Jeffrey O. Anglen, MD	2007-08
J. Tracy Watson, MD	2008-09
David C. Templeman, MD	2009-10
Timothy J. Bray, MD	2010-11
Andrew N. Pollak, MD	2011-12
Robert A. Probe, MD	2012-13
Andrew H. Schmidt, MD	2013-14

ANNUAL MEETINGS

September 14 - 15, 1985	New York, New York, USA
November 20 - 22, 1986	San Francisco, California, USA
November 19 - 21, 1987	Baltimore, Maryland, USA
October 27 - 29, 1988	Dallas, Texas, USA
October 19 - 21, 1989	Philadelphia, Pennsylvania, USA
November 7 - 10, 1990	Toronto, Ontario, Canada
October 31 - November 2, 1991	Seattle, Washington, USA
October 1 - 3, 1992	Minneapolis, Minnesota, USA
September 23 - 25, 1993	New Orleans, Louisiana, USA
September 22 - 24, 1994	Los Angeles, California, USA
September 29 - October 1, 1995	Tampa, Florida, USA
September 27 - 29, 1996	Boston, Massachusetts, USA
October 17 - 19, 1997	Louisville, Kentucky, USA
October 8 - 10, 1998	Vancouver, British Columbia, Canada
October 22 - 24, 1999	Charlotte, North Carolina, USA
October 12 - 14, 2000	San Antonio, Texas, USA
October 18 - 20, 2001	San Diego, California, USA
October 11 - 13, 2002	Toronto, Ontario, Canada
October 9 - 11, 2003	Salt Lake City, Utah, USA
October 8 - 10, 2004	Hollywood, Florida, USA
October 20 - 22, 2005	Ottawa, Ontario, Canada
October 5 - 7, 2006	Phoenix, Arizona, USA
October 18 - 20, 2007	Boston, Massachusetts, USA
October 15 - 18, 2008	Denver, Colorado, USA
October 7 - 10, 2009	San Diego, California, USA
October 13 - 16, 2010	Baltimore, Maryland, USA
October 12 - 15, 2011	San Antonio, Texas, USA
October 3 - 6, 2012	Minneapolis, Minnesota, USA
October 9 - 12, 2013	Phoenix, Arizona, USA

ORTHOPAEDIC TRAUMA ASSOCIATION ORGANIZATION

2014 BOARD OF DIRECTORS

Ross K. Leighton, MD
President

Theodore Miclau, III, MD
President Elect

Steven A. Olson, MD
2nd President Elect

Brendan M. Patterson, MD
CFO

Heather A. Vallier, MD
Secretary

Andrew H. Schmidt, MD
Immediate Past President

ORTHOPAEDIC TRAUMA ASSOCIATION ORGANIZATION

2014 BOARD OF DIRECTORS, continued

Robert A. Probe, MD
2nd Past President

Michael T. Archdeacon, MD
Member-at-Large

Kenneth A. Egol, MD
Member-at-Large

Douglas W. Lundy, MD
Member-at-Large

Thomas F. Higgins, MD
Annual Program

ORTHOPAEDIC TRAUMA ASSOCIATION ORGANIZATION

NOMINATING
(Elected Committee)
Andrew Schmidt, (Chair 2015 Slate)
Cory Collinge
Clifford Jones
Robert Ostrum
David Templeman

MEMBERSHIP
(Elected Committee)
Clifford Jones (Chair)
Richard Buckley
Hans-Christoph Pape
David Sanders
Peter Cole

ANNUAL MEETING ARRANGEMENTS
Roy Sanders & H. Claude Sagi
(Tampa, FL 2014 Local Hosts)
Jeffrey Smith
(San Diego, CA 2015 Local Host)

ANNUAL PROGRAM
Thomas Higgins (Chair)
Robert O'Toole (Co-Chair)
Michael Gardner
Pierre Guy
David Hak
Stephen Kottmeier
Michael McKee
Gilbert Ortega
David Sanders
Basic Science Sub-Committee
Chair (*ex officio*): Edward Harvey
Coding Course
Chair (*ex officio*): Scott Broderick

Basic Science Sub-Committee
Edward Harvey (Chair)
Mohit Bhandari
Joseph Borrelli
Aaron Nauth
Emil Schemitsch
Gerard Slobogean
Research Committee Chair (*ex officio*):
Brett Crist

BY-LAWS & HEARINGS
James Stannard (Chair)
Chad Coles
Alexandra Schwartz

CLASSIFICATION & OUTCOMES
Craig Roberts (Chair)
Andrew Evans
Roman Hayda
Matthew Karam
Daniel Stinner
Nirmal Tejwani
Gregory Zych
Julie Agel (Presidential Consultant)
James Kellam (Presidential Consultant)
J. Lawrence Marsh (Presidential Consultant)

DISASTER MANAGEMENT PREPAREDNESS
Christopher Born (Chair)
Mark McAndrew
Christian Mamczak
Eric Pagenkopf
Mark Richardson
David Teague
Philip Wolinsky

EDUCATION
William Ricci (Chair)
Martin Boyer
Samir Mehta
Marrku Nousiainen
Robert Ostrum
Marcus Sciadini
Paul Tornetta, III
OKO Ex-Officio Member:
Thomas DeCoster
Ex-officio Resident Member:
Jennifer Leighton, MD

Education Sub-Committee
Kyle Jeray – RCFC, Chair
Toni McLaurin – RCFC, Co-Chair
Gregory Della Rocca – Spring RCFC Chair
Brian Mullis – Spring RCFC Co-Chair
Kenneth Koval – Resident Syllabus Update, Chair
Brett Crist – RATTC, Chair
Matthew Mormino – RATTC, Co-Chair
Frank Liporace – AAOS/OTA Course, Chair (2013 – 2014)
Kenneth Koval – AAOS/OTA Course, Chair (2015)
Roy Sanders – JOT Editor
Erik Kubiak – Video Library Subcommittee

EVIDENCE BASED QUALITY, VALUE, SAFETY
William Obremskey (Chair)
Jaimo Ahn
Bruce Browner
Chad Coles
Cory Collinge
Arvind Nana
Paul Tornetta, III
Michael Zlowodzki

FELLOWSHIP & CAREER CHOICES
Mark Lee (Chair)
Madhav Karunakar
Dirk Leu
Frank Liporace
Jason Nascone
Michael Prayson
Roy Sanders
Lisa Taitsman
David Zamorano
Presidential Consultant:
J. Tracy Watson
Ex-Officio Fellow Members:
Jason Sansone, Jennifer Wood

Fellowship Match Compliance Sub-Committee
Gregory Schmeling (Chair)
Animesh Agarwal
Clifford Jones
Steven Kottmeier
Robert Probe

FINANCE AND AUDIT
Brendan Patterson, CFO, Chairman
David Hak (past CFO)
Douglas Dirschl

FUND DEVELOPMENT
Steven Morgan (chair)
Peter Althausen
John France
Ed Perez
Michael Sirkin
Rena Stewart
J. Tracy Watson
Ex-officio: Brendan Patterson, OTA CFO
Ex-officio: Brett Crist, Research Chair

HEALTH POLICY & PLANNING
Michael Suk (Chair)
Sam Agnew
Alex Jahangir
Clifford Jones
Gerald Lang
Samir Mehta
Manish Sethi
Todd Swenning
Bruce Ziran
Ex-Officio: Bruce Browner, EBQVS Liaison
Ex-Officio: Philip Wolinsky, COT Chair

INTERNATIONAL RELATIONS
William DeLong (Oversight)

International
Peter Giannoudis (Chair)
Ney Amaral
Amir Matityahu
Cyril Mauffrey
Max Morandi
Hans-Christoph Pape
Toney Russell

Humanitarian
Saqib Rehman (Chair)
Jeffrey Anglen
Amir Matityahu
Steven Morgan
Edward Rodriguez
Pat Yoon
Lewis Zirkle
Ex-Officio Liaison: Christopher Born

MILITARY
CDR Mark Fleming Chair (Walter Reed)
Lt. COL Wade Gordon (USAF)
COL(R) Roman Hayda
CDR Kevin M. Kuhn (USN)
Lt. COL Christopher LeBrun (USAF)
LCDR Christopher Smith (USN)
MAJ Daniel Stinner (USA)
CAPT William Todd (USN, Hospital Ships)
MAJ Eric Verweibe (USA)

PAST PRESIDENT LIAISON
Andrew Schmidt,
Immediate Past President (Chair)
All Past OTA Presidents

PRACTICE MANAGEMENT
Scott Broderick (Chair)
Paul Appleton
Lisa Cannada
Anthony Infante
James Krieg
Frank Liporace
Brent Norris
Presidential Consultants:
Brad Henley; William Creevy

PUBLIC RELATIONS
Jeffrey Smith (Chair)
Josh Gary
Jake Heiney
Alex Jahangir
Josh Langford
Hassan Mir
Jason Sansone

Ad Hoc
Ortho Info Project Team:
Co-Chairs: Robert Dunbar and Jason Lowe

Newsletter
Hassan Mir, Editor
Joshua Gary, Co-editor

Social Media
Lisa Taitsman

RESEARCH
Brett Crist (Chair)
Romney Andersen
Donald Anderson
Timothy Bhattacharyya
Victor De Ridder
Kelly LeFaivre
Saam Morshed
Brian Mullis
David Ring
George Russell
Andrew Trenholm
Walter Virkus

ORTHOPAEDIC ORGANIZATIONAL LIAISONS
AAOS Board of Specialty Societies
Steven Olson – Presidential Line Representative
Lisa Cannada – Communications
Michael Suk – Health Policy
William Ricci – Education
Brett Crist – Research
David Templeman – BOS Chair
Lisa Cannada – BOS Match Oversight Committee Chair
Mark Lee – BOS Match Oversight Committee OTA Rep
Kathleen Caswell – ED Representative

ACS COT (American College of Surgeons Committee on Trauma)
COT Orthopaedic Members
Philip Wolinsky (Chair)
Gregory Della Rocca
James Ficke
Gregory Georgiadis
Langdon Hartsock
M. Bradford Henley
Mark McAndrew
Bruce Ziran

Other Orthopaedic Liaison Positions
Peter Trafton – USBJDI Treasurer
Marc Swiontkowski – EWI Civilian Rep Co-Chair (2014 – 2015)
Andrew Schmidt – EWI Civilian Rep Co-Chair (2016 – 2017)

PROJECT TEAMS

OTA Online Education Project Team
Co-Chairs: Bill Ricci and Lisa Taitsman

Anniversary Project Team
Co-Chairs: Ross Leighton and Roy Sanders

AO / OTA Collaboration
Chair: Ted Miclau

Database Project Team
Chair: Doug Lundy

OMeGA / OTA Fellowship Funding
Chair: Ted Miclau

Research Think Tank
Chair: Greg Della Rocca
Co-Chair: Todd Mckinley

DISTINGUISHED VISITING SCHOLAR PROGRAM

OTA expresses tremendous gratitude to the following OTA / AAOS Members who have served as Distinguished Visiting Scholars for at least two weeks assisting the Military Orthopaedic Surgeons in Landstuhl who treat the soldiers injured in Afghanistan and Iraq prior to their return to the United States:

Dennis J. Beck, MD
Lawrence B. Bone, MD
Christopher T. Born, MD
Joseph Borrelli, Jr., MD
Michael J. Bosse, MD
Andrew R. Burgess, MD
Jens R. Chapman, MD
Cory A. Collinge, MD
Thomas A. DeCoster, MD
Gregory J. Della Rocca, MD, PhD
James Dunwoody, MD
Mitchel B. Harris, MD
Langdon A. Hartsock, MD
Dolfi Herscovici, Jr., MD
Thomas F. Higgins, MD
Daniel S. Horwitz, MD
James J. Hutson, Jr., MD
Kyle J. Jeray, MD
Clifford B. Jones, MD
Jonathan P. Keeve, MD
James C. Krieg, MD
Jackson Lee, MD
L. Scott Levin, MD
David W. Lhowe, MD
Dean G. Lorich, MD
David W. Lowenberg, MD
Mark P. McAndrew, MD
Michael D. McKee, MD
Toni M. McLaurin, MD
Michael A. Miranda, MD
Steven J. Morgan, MD
Brett C. Norris, MD
Steven A. Olson, MD
William T. Obremskey, MD
Gregory M. Osgood, MD
Brendan M. Patterson, MD
Laura J. Prokuski, MD
Edward K. Rodriguez, MD, PhD
Melvin P. Rosenwasser, MD
John T. Ruth, MD
H. Claude Sagi, MD
Bruce J. Sangeorzan, MD
Andrew H. Schmidt, MD
R. Bruce Simpson, Jr., MD
Carla S. Smith, MD
CDR Joseph E. Strauss, DO
Marc F. Swiontkowski, MD
David C. Teague, MD
Peter G. Trafton, MD
Bruce H. Ziran, MD
Robert D. Zura, MD

ORTHOPAEDIC TRAUMA ASSOCIATION

IN MEMORIAM

OTA remembers the following members who have made contributions to OTA's organizational missions, to education, to the practice of orthopaedics, and to the science of musculoskeletal trauma research.

E. Frederick Barrick, MD (2004)
Mc Lean, Virginia

Fred F. Behrens, MD (2005)
Newark, New Jersey

John Border, MD (1997)
Buffalo, New York

Spencer L. Butterfield, MD (2007)
Cincinnati, Ohio

James Bradley Carr, MD (2011)
Roanoke, Virginia

Thomas H. Comfort, MD (1990)
Minneapolis, Minnesota

John F. Connolly, MD (2007)
Orlando, Florida

Kathryn E. Cramer, MD (2005)
Detroit, Michigan

Bertram Goldberg, MD (1995)
Englewood, Colorado

Edward T. Habermann, MD (2009)
Chappaqua, New York

J. Paul Harvey, Jr., MD (2010)
Pasadena, California

Kenneth D. Johnson, MD* (2003)
Placitas, New Mexico

Emile Letournel, MD (1994)
Paris, France

Alan Marc Levine, MD* (2009)
Baltimore, Maryland

CDR Michael T. Mazurek, MD (2009)
San Diego, California

Spencer Roy McLean, MD (2013)
Calgary, Alberta, Canada

William J. Mills, III, MD (2011)
Anchorage, Alaska

Maurice Müeller, MD (2009)
Bern, Switzerland

John A. Ogden, MD (2011)
Atlanta, Georgia

Howard Rosen, MD (2000)
New York, New York

Joseph F. Slade, III, MD (2010)
Guilford, Connecticut

Phillip G. Spiegel, MD (2008)
Englewood, Florida

Clifford H. Turen, MD (2013)
Dover, Delaware

A memorial page honoring the lives and work of OTA members has been established on the OTA website membership link.

*OTA Past President

MEMORIAL AWARDS

OTA honors the memory of the orthopaedic traumatologists listed on page 7 in memory of their commitment to education, research and patient care.

2013 – ***Yelena Bogdan, MD, Resident Award Winner***
Healing Time and Complications in Surgically Treated Atypical Femur Fractures Associated With Bisphosphonate Use: A Multicenter Series
Yelena Bogdan, MD[1]; Paul Tornetta, III, MD[1]; Thomas A. Einhorn, MD[1]; Pierre Guy, MD[2]; Lise Leveille, MD[2]; Juan Robinson, MD[3]; Nikkole Haines, MD[4]; Daniel S. Horwitz, MD[5]; Clifford B. Jones, MD[6]; Emil H. Schemitsch, MD[7]; H. Claude Sagi, MD[8]; Daniel Stahl, MD[9]; Megan Brady, MD[10]; David W. Sanders, MD[11]; Thomas G. Higgins, MD[12]; Michael Kain, MD[13]; Cory A. Collinge, MD[14]; Stephen A. Kottmeier, MD[15]; Darin Freiss, MD[16];
[1]Boston University Medical Center, Boston, Massachusetts, USA;
[2]University of British Columbia, Vancouver, British Columbia, Canada
[3]Dalhousie University, Halifax, Nova Scotia, Canada;
[4]Carolinas Medical Center, Charlotte, North Carolina, USA;
[5]Geisinger, Danville, Pennsylvania, USA;
[6]Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA;
[7]St. Michael's Hospital, Toronto, Ontario, Canada;
[8]Tampa General Hospital, Tampa, Florida, USA;
[9]Scott & White Hospital, Temple, Texas, USA;
[10]MetroHealth Medical Center, Cleveland, Ohio, USA;
[11]London Health Sciences Centre, London, Ontario, Canada;
[12]University of Utah, Salt Lake City, Utah, USA;
[13]Lahey Clinic, Burlington, Massachusetts, USA;
[14]Fort Worth, Texas, USA;
[15]Stony Brook University, Stony Brook, New York, USA;
[16]Oregon Health & Science University, Portland, Oregon, USA

2012 – ***Charles J. Jordan, MD, Resident Award Winner***
•Incidence of Posterior Wall Nonunion and Efficacy of Indomethacin Prophylaxis for Heterotopic Ossification After Operative Fixation of Acetabular Fractures: A Randomized Controlled Trial
Charles J. Jordan, MD; Rafael Serrano-Riera, MD; H. Claude Sagi, MD;
Orthopaedic Trauma Service, Florida Orthopaedic Institute, Tampa, Florida, USA

2011 – ***Rachel Y. Goldstein, MD, MPH, Resident Award Winner***
Δ Efficacy of Popliteal Block in Postoperative Pain Control After Ankle Fracture Fixation: A Prospective Randomized Study
Rachel Y. Goldstein, MD, MPH; Nicole Montero, BA; Toni M. McLaurin, MD;
Kenneth A. Egol, MD; Nirmal C. Tejwani, MD;
NYU Hospital for Joint Diseases, New York, New York, USA

2010 – ***Dirk Leu, MD, Resident Award Winner***
Spica Casting in Pediatric Femur Fractures: A Prospective Randomized Controlled Study of 1-Leg versus 1.5-Leg Spica Casts
Dirk Leu, MD; Erkula Gurkan, MD; M. Catherine Sargent, MD; Michael C. Ain, MD;
Arabella I. Leet, MD; John E. Tis, MD; Gregory M. Osgood, MD; Paul D. Sponseller, MD;
Johns Hopkins Hospital, Baltimore, Maryland, USA

CPT Daniel J. Stinner, MD; MAJ(P), Resident Award Winner
•Negative Pressure Wound Therapy (NPWT) Reduces Effectiveness of Antibiotic Beads
CPT Daniel J. Stinner, MD, MAJ(P); LTC Joseph R. Hsu, MD; Joseph C. Wenke, MD;
United States Army Institute of Surgical Research, Fort Sam Houston, Texas, USA

Δ OTA Grant

2009 – ***Scott Ryan, MD (n) Resident Award Winner***
Knee Pain After Tibial Nailing Correlates with Union
Paul Tornetta, III, MD (3,5A, 7-Smith &Nephew; 8-Exploramed);
Cassandra Dielwart, MD (n); Elizabeth Krall Kaye, PhD (n);
Boston University Medical Center, Boston, Massachusetts, USA

2008 – ***Priyesh Patel, MD Resident Award Winner***
Transsacral Fixation: What Defines the Safe Zone?
*Paul Tornetta, III, MD**;** Priyesh Patel, MD; Jorge Soto, MD;*
Boston University Medical Center, Boston, Massachusetts, USA

2007 – ***Michael Zlowodzki, MD Resident Award Winner***
Patient Function following Femoral Neck Shortening and Varus Collapse after Cancellous Screw Fixation of Isolated Femoral Neck Fractures: A Multicenter Cohort Study
Michael Zlowodzki, MD *(a-Osteosynthesis and Trauma Care Foundation; AO North America);*
Ole Brink, MD, PhD (n); *Julie Switzer, MD (n); Scott Wingerter, MD (n);*
James Woodall Jr., MD (n); David R. Bruinsma (n); Brad A. Petrisor, MD (n);
Philip J. Kregor MD (n); Mohit Bhandari, MD, MSc (n);
University of Minnesota, Minneapolis, Minnesota, USA

For two years, the OTA instituted a Kenneth D. Johnson Fellowship Award to honor the memory of the contributions to the field of Orthopaedic Traumatology by founding member and past-president, Kenneth D. Johnson, MD. Dr. Johnson is remembered as an academic instructor skilled in teaching and passionate about the work of the OTA and improving the treatment for trauma patients.

2006 – ***Marc A. Tressler, DO, Kenneth D. Johnson Fellowship Award***
Vanderbilt University Fellowship Program, Nashville, Tennessee, USA;
Hosted by Harborview Medical Center, Seattle, Washington, USA

2005 – ***Max Talbot, MD, Kenneth D. Johnson Fellowship Award***
University of Minnesota, Fellowship Program, Minneapolis, Minnesota, USA;
Hosted by Emil H. Schemitsch, MD, University of Toronto, Toronto, Ontario, Canada

OTA/SIGN SCHOLARSHIP

The Orthopaedic Trauma Association funds two scholarships annually for SIGN members to attend the OTA Annual Meeting. Information regarding SIGN can be found on http://signfracturecare.org.

Congratulations to the following OTA/SIGN Scholarship Winners:

2014 – ***Hilario M. Diaz, MD, FPOA****, Davao City, Philippines*
Henry Ndasi, MD*, Mutengene, Cameroon*

2013 – ***Billy Thomson Haonga, MD****, Dar -Se Salaam, Tanzania*
Innocent Chiedu Ikem, MD*, Ile-Ife, Osun State, Nigeria*

2012 – ***Dr. Shahab ud Din****, Hayatabad, Peshawar, KPK, Pakistan*
Dr. Luigi Andrew Sabal*, Bajada, Davao City, Philippines*

2011 – ***Dr. Tobias Otieno Ondiek****, Kijabe, Kenya*
COL. Mohammad Ismail Wardak, MD, MS*, Kabul, Afghanistan*

2010 – ***Edmund Ndalama Eliezer, MD****, Dar es Salaam, Tanzania*

2009 – ***Rizwan Akram, MD****, Lahore, Punjab, Pakistan*
Patrick Sekimpi, MD*, Kampala, Uganda*

2008 – ***Duong Bunn, MD****, Phnom Penh, Cambodia*
Oleg Gendin, MD*, Krasnoyarsk, Russia*

2007 – ***Thwit Lwin, MD****, Yangon, Myanmar*
Kibor Leilei, MD*, Eldoret, Kenya*

FOUNDERS' LECTURE

2001 – Honoring the Career of Michael W. Chapman, MD
Recent Advances in the Cellular and Molecular Biology of Post Traumatic Arthritis
A. Hari Reddi, PhD
(Supported by Howmedica)

2000 – A Tribute to Howard Rosen, MD — Standing on the Shoulders of Giants
Joseph Schatzker, MD

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

JOHN BORDER, MD, MEMORIAL LECTURE

Supported in part by AO/North America and OTA
This lectureship was established to honor the memory of Dr. John Border. John Border was instrumental in the development of modern trauma care and in particular, modern orthopaedic trauma care. He was the pioneer in the concept of total care and the implications of the orthopaedic injuries on the total management of the trauma patient. He was also a surgeon scientist, using both his clinical observations and basic science research to further his patient care in Orthopaedic Trauma.

2013 – Skeletal Trauma: Global Conundrum
Bruce D. Browner, MD

2012 – Orthopaedic Trauma – My Perspective
James F. Kellam, MD, FRCS(C), FACS

2011 – Femoral Neck Fracture Management - WWJD (John)?
Marc F. Swiontkowski, MD

2010 – Travels with John 2.0
Sigvard T. Hansen, Jr., MD

2009 – Trauma Surgery Is Not Supposed To Be Easy
Lawrence B Bone, MD

2008 – Orthopaedic Trauma Education: Industrial Strength?
Peter G. Trafton, MD

2007 – Once and Future Trauma Systems: Role of the Orthopaedic Surgeon
A. Brent Eastman, MD, FACS

2006 – Forty Years of Pelvic Trauma – Looking Back, Looking Forward
Marvin Tile, MD

2005 – Delaying Emergency Fracture Care – Fact or Fad
Robert N. Meek, MD

2004 – The Future of Education in Orthopaedic Surgery
Michael W. Chapman, MD

2003 – Tracking Patient Outcomes: Lessons Learned and Future Directions in Trauma Orthopaedics
Ellen J. MacKenzie, PhD

2002 – Thoughts on Our Future Progress in Acetabular and Pelvic Fracture Surgery
Joel M. Matta, MD

2001 – Cancelled

2000 – The Metamorphosis of the Trauma Surgeon to the Reconstructionist
Jeffrey W. Mast, MD

1999 – The Changing Role of Internal Fixation – A Lifetime Perspective
Professor Martin Allgower, MD

1998 – Travels with John: Blunt Multiple Trauma
Sigvard T. Hansen, Jr., MD

1997 – Trauma Care in Europe before and after John Border: The Evolution of Trauma Management at the University of Hannover
Professor Harald Tscherne, MD

EDWIN G. BOVILL, Jr., MD AWARDS

Dedicated to Edwin G. Bovill, Jr., MD, (1918 - 1986)
Surgeon, traumatologist, educator, academician, and gentleman;
co-founder of the Orthopaedic Trauma Association.

(The outstanding scientific paper from the Annual Meeting date as listed.)

2013 – Δ Early Weight Bearing and Mobilization Versus Non–Weight Bearing and Immobilization After Open Reduction and Internal Fixation of Unstable Ankle Fractures: A Randomized Controlled Trial
Niloofar Dehghan, MD[1]*; Richard Jenkinson, MD*[2]*; Michael McKee, MD*[1]*;*
Emil H. Schemitsch, MD[1]*; Aaron Nauth, MD*[1]*; Jeremy Hall, FRCSC*[1]*; David Stephen, MD*[2]*;*
Hans J. Kreder, MD[2]*;*
[1]*St. Michael's Hospital - University of Toronto, Toronto, Ontario, Canada*
[2]*Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada*

2012 – Δ Operative Versus Nonoperative Treatment of Acute Dislocations of the Acromioclavicular Joint: Results of a Multicenter Randomized, Prospective Clinical Trial
Michael D. McKee, MD*; Stéphane Pelet, MD, PhD, FRCSC;*
Milena R. Vicente, RN, CCRP;
The Canadian Orthopaedic Trauma Society (COTS) Group;
St. Michael's Hospital, Toronto, Ontario, Canada

2011 – Posterolateral Antiglide Versus Lateral Plating for SE Pattern Ankle Fractures: A Multicenter Randomized Control Trial
Paul Tornetta, III, MD[1]*; Laura S. Phieffer, MD*[2]*; Clifford B. Jones, MD*[3]*; Janos P. Ertl, MD*[4]*;*
Brian H. Mullis, MD[4]*; Kenneth A. Egol, MD*[5]*; Michael J. Gardner, MD*[6]*; William M. Ricci, MD*[6]*;*
David C. Teague, MD[7]*; William Ertl, MD*[7]*; Cory A. Collinge, MD*[8]*; Ross K. Leighton, MD*[9]*;*
Ojas Joshi, MS[1]
[1]*Boston University Medical Center, Boston, Massachusetts, USA;*
[2]*Ohio State University Medical Center, Columbus, Ohio, USA;*
[3]*Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA;*
[4]*Indiana University, Indianapolis, Indiana, USA;*
[5]*NYU Hospital for Joint Disease, New York, New York, USA;*
[6]*Washington University, St. Louis, Missouri, USA*
[7]*University of Oklahoma, Oklahoma City, Oklahoma, USA;*
[8]*Orthopaedic Associates – Fort Worth, Fort Worth, Texas, USA;*
[9]*Halifax Infirmary, Halifax, Nova Scotia, Canada*

Δ Efficacy of Popliteal Block in Postoperative Pain Control After Ankle Fracture Fixation: A Prospective Randomized Study
Rachel Y. Goldstein, MD, MPH*; Nicole Montero, BA; Toni M. McLaurin, MD;*
Kenneth A. Egol, MD; Nirmal C. Tejwani, MD
NYU Hospital for Joint Diseases, New York, New York, USA

2010 – Operative versus Nonoperative Treatment of Unstable Lateral Malleolar Fractures: A Randomized Multicenter Trial
David W. Sanders, MD *(3B, 5-Smith & Nephew Richards Canada; 5-Synthes Canada);*
Christina A. Tieszer (n); Canadian Orthopedic Trauma Society (n);
University of Western Ontario, London, Ontario, Canada

Δ OTA Grant

2009 – Nonoperative Immediate Weightbearing of Minimally Displaced Lateral Compression Sacral Fractures Does Not Result in Displacement
Gillian Sembler, MD (n); John Lien, MD (n);
Paul Tornetta, III, MD *(3, 5A, 7-Smith & Nephew; 8-Exploramed);*
Boston University Medical Center, Boston, Massachusetts, USA

2008 – Piriformis versus Trochanteric Antegrade Nailing of Femoral Fractures: A Prospective Randomized Study
James P. Stannard, MD *(a-Smith + Nephew, Synthes);*
David A. Volgas, MD (a-Biomet (Interport-Cross), Smith + Nephew, Synthes, Pfizer);
Larry S. Bankston, MD (n); Jonathan K. Jennings (n);
Rena L. Stewart, MD (a-Synthes, Wyeth, OTA); Jorge E. Alonso, MD (e-Synthes);
The University of Alabama at Birmingham, Birmingham, Alabama, USA

2007 – A Randomized Trial of Reamed versus Non-Reamed Intramedullary Nail Insertion on Rates of Reoperation in Patients with Fractures of the Tibia
Mohit Bhandari, MD (n);
McMaster University, Hamilton, Ontario, Canada

2006 – Δ A Multicenter Prospective Randomized Controlled Trial of Open Reduction and Internal Fixation versus Total Elbow Arthroplasty for Displaced Intra-articular Distal Humeral Fractures in Elderly Patients
Michael D. McKee, MD; *Christian JH. Veillette, MD; and the Canadian Orthopaedic Trauma Society: Emil H. Schemitsch, MD; Jeremy A. Hall, MD; Lisa M. Wild, BScN;*
Robert McCormack, MD; Thomas Goetz, MD; Bertrand Perey, MD; Mauri Zomar, RN;
Karyn Moon, RN; Scott Mandel, MD; Shirley Petit, RN; Pierre Guy, MD; Irene Leung, BScPT;
(all authors - a-OTA/Zimmer Grant)
St. Michael's Hospital, University of Toronto, Toronto, Ontario, Canada
(Δ-OTA/Aventis Pharmaceuticals)

2005 – Δ A Multicenter Randomized Control Trial of Non-Operative and Operative Treatment of Displaced Clavicle Shaft Fractures
Michael D. McKee, MD, FRCS(C)*; Jeremy A. Hall, MD, FRCS(C); and the Canadian Orthopaedic Trauma Society: Hans S. Kreder, MD; Robert McCormack, MD; David M.W. Pugh, MD;*
David W. Sanders, MD; Richard Buckley, MD; Emil H. Schemitsch, MD; Lisa M. Wild, RN;
Scott Mandel, MD; Rudolph Reindl, MD; Edward J. Harvey, MD; Milena V. Santos, RN;
Christian J. Veilette, MD; Daniel B. Whelan, MD; James P. Waddell, MD; David J.G. Stephen, MD;
Terrence Axelrod, MD; Gregory Berry, MD; Bertrand Perey, MD; Kostas Panagiotopolus, MD;
Beverly Bulmer, Mauri Zomar; Karyn Moon, Elizabeth Kimmel, Carla Erho, Elena Lakoub;
Patricia Leclair; Bonnie Sobachak; Trevor Stone, MD; Lynn A. Crosby, MD; Carl J. Basamania, MD;
(all authors a-OTA/DePuy Grant; Zimmer, Inc. Grant)
St. Michael's Hospital, University of Toronto, Toronto, Ontario, Canada
(Δ-OTA/DePuy, a Johnson and Johnson Company)

2004 – The Gold Standard in Tibial Plateau Fractures? A Prospective Multicenter Randomized Study of AIBG vs. Alpha-BSM
Thomas A. Russell, MD; Sam Agnew, MD; B. Hudson Berrey, MD; Robert W. Bucholz, MD;
Charles N. Cornell, MD; Brian Davison, MD; James A. Goulet, MD; Thomas Gruen, MS;
Alan L. Jones, MD; ***Ross K. Leighton, MD (a-DePuy, USA; a,b,e-ETEX)****; Peter O'Brien, MD;*
Robert F. Ostrum, MD; Andrew Pollak, MD; Paul Tornetta, III, MD; Thomas F. Varecka, MD;
Mark S. Vrahas, MD

Δ OTA Grant

2003 – Previously Unrecognized Deficits after Nonoperative Treatment of Displaced, Mid-Shaft Fracture of the Clavicle Detected by Patient-Based Outcome Measures and Objective Muscle Strength Testing
Michael D. McKee, MD, FRCS(C)*; Elizabeth M. Pedersen, MD; Lisa M. Wild, BScN; Emil H. Schemitsch, MD, FRCS(C); Hans J. Kreder, MD; David J.G. Stephen, MD, FRCS(C)*
(a-University of Toronto Scholarship Fund)

Syndesmotic Instability in Weber B Ankle Fractures: A Clinical Evaluation
Paul Tornetta, III, MD*; Erik Stark, MD; William R. Creevy, MD*
(a-Stryker Howmedica Osteonics)

2002 – A Randomized Controlled Trial of Indirect Reduction and Percutaneous Fixation versus Open Reduction and Internal Fixation for Displaced Intraarticular Distal Radius Fractures
Hans J. Kreder, MD, FRCS(C); ***Douglas P. Hanel, MD****; Julie Agel, MA, ATC; Michael D. McKee*

2001 – Pertrochanteric Fractures: Is There an Advantage to an Intramedullary Nail?
Richard E. Stern, MD*; Christophe Sadowski, MD; Anne Lübbeke, MD; Marc Saudan, MD; Nicolas Riand, MD; Pierre Hoffmeyer, MD*

***Stress Examination of SE-Type Fibular Fractures**
Paul Tornetta, III, MD; *Timothy McConnell, MD****; William R. Creevy, MD***
(all authors – a-Aircast Foundation)

2000 – Δ Prospective Randomized Clinical Multi-Center Trial: Operative versus Nonoperative Treatment of Displaced Intra-Articular Calcaneal Fractures
Richard E. Buckley, MD*; Robert G. McCormack, MD; Ross K. Leighton, MD; Graham C. Pate, MD; David P. Petrie, MD; Robert D. Galpin, MD*
(Δ-OTA Administered Research Grant)

1999 – Δ The Effect of Sacral Malreduction on the Safe Placement of Iliosacral Screws
Mark Cameron Reilly, MD; *Christopher M. Bono, MD; Behrang Litkoihi, BS; Michael S. Sirkin, MD; Fred Behrens, MD*
(Δ-OTA Administered Research Grant)

1998 – A Prospective Comparison of Antegrade and Retrograde Femoral Intramedullary Nailing
Robert F. Ostrum, MD*; Animesh Agarwal, MD; Ronald Lakatos, MD; Attila Poka, MD*

1997 – Accelerated Bone Mineral Loss following a Hip Fracture: A Prospective Longitudinal Study
Douglas R. Dirschl, MD*; Richard C. Henderson, MD, PhD; Ward C. Oakley, MD*

1996 – None Awarded

1995 – Safe Placement of Proximal Tibial Transfixation Wires with Respect to Intracapsular Penetration
J. Spence Reid, MD*; Mark Vanslyke; Mark J.R. Moulton; Thomas Mann, MD*

1994 – Compartment Pressure Monitoring in Tibial Fractures
Margaret M. McQueen, FRCS*; James Christie, FRCS; Charles M. Court-Brown, MD, FRCS*

1993 – The Intraoperative Detection of Intraarticular Screws Placed during Acetabular Fracture Fixation
Thomas DiPasquale, DO*; Kurt Whiteman; C. McKirgan; Dolfi Herscovici*

* Something of value received.
Δ OTA Grant

1992 – Operative Results in 120 Displaced Intra-Articular Calcaneal Fractures: Results Using a Prognostic CAT Scan Classification
Roy Sanders, MD; *Paul Fortin, MD; Thomas DiPasquale, DO*

1991 – Severe Open Tibial Shaft Fractures with Soft Tissue Loss Treated by Limb Salvage with Free Tissue Transfer or Early Below Knee Amputation
Gregory Georgiadis, MD; *Fred Behrens, MD; M. Joyce; A. Earle*

1990 – Timing of Operative Intervention in the Management of Acute Spinal Injuries
J. Schlegel; *H. Yuan; B. Frederickson; J. Bailey*

ACKNOWLEDGMENTS

The Orthopaedic Trauma Association gratefully acknowledges the following foundations, companies, and individuals for their generous financial support received through OTA and through OREF to fund OTA reviewed research grants and educational programs.

2014 OTA RESEARCH DONORS
(as of July, 2014)

Platinum Award ($150,000 - $249,999)

Arthrex® smith&nephew

Gold Award ($100,000 - $149,999)

CardinalHealth DePuy Synthes COMPANIES OF Johnson & Johnson stryker®

Silver Award ($75,000 - $99,999)

BIOMET TRAUMA zimmer Personal Fit. Renewed Life.™

Copper Award ($25,000 - $49,999)

FOT

Sponsor Award ($5,000 - $24,999)

bioventus™ pfs med INC Exceeding Orthopaedic Trauma Standards Since 1993

Thank You

OTA Legacy Society

The OTA is pleased to honor the following individuals and organizations who have reached a lifetime giving level of $10,000 or greater.

James C. Binski, MD
Christopher T. Born, MD
William R. Creevy, MD
Florida Orthopaedic Institute, Tampa, FL
Roman B. Gustilo, MD
Ross K. Leighton, MD
Theodore Miclau, III, MD
Orthopaedic Specialists of North America, Phoenix, AZ
Thomas (Toney) A. Russell, MD
Andrew H. Schmidt, MD
Jeffrey M. Smith, MD
Marc F. Swiontkowski, MD
David C. Templeman, MD
Paul Tornetta, III, MD
UCSF/SFGH Orthopaedic Trauma Institute

2014 Members Award ($1,000 - $4,999)

Jeffrey Anglen, Michael Archdeacon, Lawrence Bone, Michael Bosse, Timothy Bray, Bruce Browner, Bruce Buhr, Andrew Burgess, John Cardea, Michael Chapman, Curt Comstock, William Creevy, William De Long, Kenneth Egol, Stuart Gold, Bradford Henley, Alan Jones, David Helfet, James Kellam, Hans Kreder, Richard Kyle, Ross Leighton, Douglas Lundy, J. Lawrence Marsh, Theodore Miclau, III, Brian Mullis, Timothy O'Mara, Todd Oliver, Mark Olson, Steven Olson, Brendan Patterson, Andrew Pollak, Michael Prayson, Robert Probe, *Reno Orthopaedic Clinic Physicians[1], William Ricci, Toney Russell, Roy Sanders, Andrew Schmidt, Jeffrey Smith, Marc Swiontkowski, David Templeman, Paul Tornetta, Peter Trafton, Heather Vallier, J. Tracy Watson, John Weinlein, Sharese White, Ryan Will, Donald Wiss

2014 Friends Award ($250 - $999)

Mark Adams, Daniel Altman, Emil Azer, Karl Bergmann, Yelena Bogdan, Lisa Cannada, Kathleen Caswell, Nicholas DiNicola, John Durham, Darin Friess, Michael Gardner, Clifford Jones, William Kurtz, Michael McKee, Toni McLaurin, Matthew Mellon, Rafael Neiman, William Obremskey, Mark Reilly, Craig Roberts, Robert Schultz, John Schwappach, Robert Simpson, Michael Sirkin, Craig Smith, Michael Swords, John Vander Schilden, Darius Viskontas, Gregory Vrabec, Ryan Will, John Wixted, Patrick Yoon, Lewis Zirkle

2014 Associates Award (up to $249)

Hua Chen, Diane Vetrovec Dobberstein, Mark Kelly, Sharon Moore, Jonathan Scherl[2]

2014 OTA Memorial Fund Donation Received

[1]In memory of Dosch Macleod; [2]In memory of Dr. Jim Carr

ACKNOWLEDGMENTS

2013 OTA RESEARCH DONORS

Diamond Award ($250,000 and above)

smith&nephew

Gold Award ($100,000 - $149,999)

DePuy Synthes
COMPANIES OF Johnson & Johnson

stryker®

zimmer
Personal Fit. Renewed Life.™

Silver Award ($75,000 - $99,999)

BIOMET
TRAUMA

Bronze Award ($50,000 - $74,999)

FOT

Copper Award ($25,000 - $49,999)

bioventus™

Sponsor Award ($5,000 - $24,999)

Medtronic

pfs med inc
Exceeding Orthopaedic Trauma Standards Since 1993

2013 ENDOWMENT DONATIONS

Joseph Cass, Clifford Jones, Fred Kolb, James Nepola,
Orthopaedic Trauma Association, David Weisman, Bruce Ziran

Sincere

ACKNOWLEDGMENTS

2013 Sponsor Award ($5,000 - $24,999)
Ramon B. Gustilo

2013 Members Award ($1,000 - $4,999)
Daniel Altman[1], Michael Bosse, Timothy Bray, Bruce Buhr, Lisa Cannada, Curt Comstock, William Creevy, Gregory Della Rocca, Douglas Dirschl, Stuart Gold, James Goulet, David Hak, Steven Haman, Thomas Higgins, Kyle Jeray, Hans Kreder, Ross Leighton, Paul Levin, Douglas Lundy, R. Bruce Lutz, Simon Mears, Theodore Miclau, III, Steven Morgan, Timothy O'Mara, William Obremskey, Mark Olson, Andrew Pollak, Michael Prayson, Robert Probe, William Ricci, Matthew Rudloff, Thomas Russell, Andrew Schmidt, Daniel Sheerin, Jeffrey Smith, Scott Smith, David Teague, David Templeman, Paul Tornetta, III, Heather Vallier, John Weinlein, David Weisman, Sharese White

2013 Friends Award ($250 - $999)
Mark Adams, A. Herbert Alexander, Paul Appleton, Emil Azer, James Binski, Timothy Bonatus, Christopher Born, Christina Boulton, Kathleen Caswell, Brett Crist, Carl DePaula, Nicholas DiNicola, Christopher Doro, W. Andrew Eglseder Jr., Darin Friess, Michael Gardner, David Goodspeed, John Gorczyca, Gerald Greenfield Jr., Sigvard Hansen, Mary Haus, Roman Hayda, David Helfet, William Hennrikus, Catherine Humphrey, Kyros Ipaktchi, Utku Kandemir, Steven Kates, John Ketz, James Krieg, William Kurtz, Paul Lafferty, Joseph Lane, Gerald Lang, Richard Lange, Dean Lorich, Steven Louis, Thuan Ly, John Lyden, Theodore Manson, Meir Marmor, J. Lawrence Marsh, Robert McClellan, Matthew Mormino, Saam Morshed, Jason Nascone, Robert O'Toole, James Pape, Murat Pekmezci, Laura Phieffer, Matthew Putnam, Thomas Raih, Mark Reilly, Regis Renard, Craig Roberts, Edward Rodriguez, Melvin Rosenwasser, David Sanders, Bruce Sangeorzan, Andrew Saterbak, Susan Scherl, Gregory Schmeling, John Schwappach, Marcus Sciadini, Milan Sen, Robert Simpson, Michael Sirkin, R. Malcolm Smith, James Stannard, Marc and Beth Swiontkowski, Lisa Taitsman, David Volgas, Gregory Vrabec, J. Tracy Watson, Lawrence Webb, David Wellman, Matthew Weresh, Edward Yang, Patrick Yoon, Lewis Zirkle

2013 Associates Award (up to $249)
Yelena Bogdan, Glenn Diekmann, Harold Frisch, Jake Heiney, Shepard Hurwitz, Peter Krause, John Lee, Kevin Luttrell, Bryan Ming, Neil Richman, Dominique Rouleau, Steven Steinlauf, Kyle Swanson, Michael Swords, Laura Tosi, Aleksander Tosic, Jason Wild, Ryan Will, Marc Zussman

2013 OTA Memorial Fund Donation Received
[1]In memory of Dr. Theodore Altman

Thanks

CENTER FOR ORTHOPAEDIC TRAUMA ADVANCEMENT
ACKNOWLEDGMENTS

COTA is grateful for the 2014-2015 financial support from
Smith & Nephew, Inc., Stryker Orthopaedics, and *DePuy Synthes Trauma.*

$875,000

$500,000

$150,000

- **20 Fellowship Grants Awarded 2014-2015 = $1,275,000**
- **COTA/Smith Nephew Education Awards 2014-2015 = $55,000**

TOTAL COTA AWARDS 2010 - 2014

- **87 COTA Fellowship Grants Awarded since 2010 = $4,281,712**
- **COTA Smith Nephew Research Awards since 2010 = $379,089**

website: www.cotagrants.org
Contact: office@cotagrants.org or hopkins@aaos.org

CENTER FOR ORTHOPAEDIC TRAUMA ADVANCEMENT ACKNOWLEDGMENTS

COTA 2014-2015 Academic Year Fellowship Programs Awarded:

Allegheny General Hospital, Drexel University School of Medicine, Pittsburgh, PA
– *Daniel Altman, MD, Director*

Carolinas Medical Center, Charlotte, NC
– *Madhav Karunaker, MD, Director*

Hospital for Special Surgery, New York, NY
– *David Helfet, MD, Director*

Massachusetts General Hospital & Brigham and Women's Hospitals Combined
– *Mark S. Vrahas, MD, Director*

Orlando Health Fellowship, Orlando, FL
– *George J. Haidukewych, MD, Director*

Reno Orthopaedic Trauma Fellowship, Reno, NV
– *Timothy J. Bray, MD, Director*

Saint Louis University, St. Louis, MO
– *J. Tracy Watson, MD, Director*

San Diego Trauma Fellowship, San Diego, CA
– *Jeffrey M. Smith, MD, Director*

Tampa General Hospital, Tampa, FL
– *H. Claude Sagi, MD, Director*

University of California, Davis Medical Center, Sacramento, CA
– *Mark A. Lee, MD, Director*

University of California, SFGH Orthopaedic Trauma Institute, San Francisco, CA
– *Theodore Miclau, MD, Director*

University of Maryland, R. Adams Cowley Shock Trauma Center, Baltimore, MD
– *Robert O'Toole, MD, Director*

University of Minnesota, Regions Hospital Orthopaedic Trauma, Minneapolis, MN
– *Peter A. Cole, MD, Director*

University of Missouri, Orthopaedic Trauma Fellowships, Columbia, MO
– *Brett D. Crist, MD, Director*

University of Tennessee, Erlanger Health Systems, Chattanooga, TB
– *Peter J. Nowotarski, MD, Director*

University of Texas Health Science Center, Houston, TX
– *Timothy Achor, MD, Director*

University of Washington, Harborview Medical Center, Seattle, WA
– *David Barei, MD, Director*

Vanderbilt University Orthopaedic Trauma Fellowship, Nashville, TN
– *Jason Evans, MD, Director*

Wake Forest University Health Sciences, Winston-Salem, NC
– *Eben Carroll, MD, Director*

Washington University, Barnes-Jewish Hospital, St. Louis, MO
– *William M. Ricci, MD, Director*

CONGRATULATIONS
2013-2014 OTA Fellowship Graduating Class:

Ereny Bishara, MD and **Corbett Winegar, MD**
Allegheny General Hospital, Drexel University College of Medicine, Pittsburgh, PA
– *Daniel T. Altman, MD, Director*

Colin Crickard, MD, **Steven Gross, MD** and **Luke Harmer, MD**
Carolinas Medical Center, Charlotte, NC
– *Madhav Karunakar, MD, Director*

Michael Robertson, MD
Case Western Reserve Medical School, MetroHealth Medical Center, Cleveland, OH
– *John H. Wilber, MD, Director*

Carol Lin, MD
Cedars Sinai Medical Center, Los Angeles, CA
– *Donald A. Wiss, MD, Director*

Zachary Love, MD
Duke University Medical Center, Durham, NC
– *Robert D. Zura, MD, Director*

Lauren Crocco, MD and **Colin Heinle, MD**
Harvard Orthopaedic Trauma, Massachusetts General Hospital &
Brigham and Women's Hospital, Boston, MA
– *Mark Vrahas, MD, Director*

David Dewar, MD, **Z. Deniz Olgun, MD** and **Wesley Tran, MD**
Hospital for Special Surgery, New York, NY
– *David L. Helfet, MD, Director*

Damayea Hargett, MD
Mercer Medical Center, Central Georgia, Macon, GA
– *Lawrence X. Webb, MD, Director*

Raymond Chan, MD, **John Gentile, MD** and **Ryan Zitzke, MD**
Ohio University, Grant Medical Center, Columbus, OH
– *Attila Poka, MD, Director*

Emily Squyer, MD
Ortho Indy, St. Vincent Hospital, Indianapolis, IN
– *Timothy Weber, MD, Director*

Jennifer Bruggers, MD
Orthopaedic Trauma Surgeons of Northern California, Carmichael, CA
– *Paul Gregory, Jr. MD, Director*

2013-2014 OTA Fellowship Graduating Class, continued

Rachel Sotsky, MD
Penn State University, College of Medicine, Hershey, PA
– J. Spence Reid MD, Director

Blake Miller, MD
Rutgers, New Jersey Medical School, Newark, NJ
– Mark Reilly, MD, Director

Kartheek Reddy, MD
San Diego Trauma Fellowship, San Diego, CA
– Jeffrey M. Smith, MD, Director

Holly Pilson, MD
Sonoran Orthopaedic Trauma Surgeons, Scottsdale, AZ
– Anthony S. Rhorer, MD, Director

Daemeon Nicolaou, MD
St. Louis University, Saint Louis, MO
– J. Tracy Watson, MD, Director

Micah Berry, MD
Stanford University, Redwood City, CA
– Michael J. Bellino, MD, Director

James Bair, MD, **Greg Herzog, MD** and **Brian Kistler, MD**
Tampa General Hospital, Tampa, FL
– H. Claude Sagi, MD, Director

Michael Anderson, MD
Twin Cities Orthopaedic Adult Reconstruction and Trauma Fellowship, Minneapolis, MN
– Richard Kyle, MD, Director

Jayson Bell, MD and **Ethan Lea, MD**
University of California, Davis Medical Center, Sacramento, CA
– Mark A. Lee, MD, Director

Aaron Dickens, MD
University of California, San Diego, San Diego, CA
– Alexandra K. Schwartz, MD, Director

Mary Herzog, MD and **Michael Kuhne, MD**
University of California, San Francisco General Hospital, San Francisco, CA
– Theodore Miclau, MD, Director

Richard Thomas, MD
University of Central Florida, Orlando Health, Orlando, FL
– George Haidukewych, MD, Director

2013-2014 OTA Fellowship Graduating Class, continued

Natalie Casemyr, MD
University of Colorado, Denver Health, Denver, CO
– *David Hak, MD, Director*

Alaa Kalloub, MD, **Jason McKean, MD** and **Dan Severance, MD**
University of Louisville, Louisville, KY
– *David Seligson, MD, Director*

Justin Fowler, MD, **Jennifer Hagen, MD**, **C. Max Hoshino, MD**, **Justin Krajca, MD**, **Brendan O'Daly, MD** and **Brian Weatherford, MD**
University of Maryland, R. Adams Cowley Shock Trauma Center, Baltimore, MD
– *Robert V. O'Toole, MD, Director*

John Kurylo, MD
University of Minnesota, Hennepin County Medical Center, Minneapolis, MN
– *David C. Templeman, MD, Director*

Alistair Demcoe, MD and **Timothy O'Connor, MD**
University of Minnesota, Regions Hospital, St. Paul, MN
– *Peter A. Cole, MD, Director*

Holly Eltrevoog, MD and **Vivien Fongue, MD**
University of Missouri, Columbia, MO
– *Brett D. Crist, MD, Director*

Annie Knierim, MD
University of Nevada School of Medicine,
Reno Orthopaedic Trauma Fellowship, Reno, NV
– *Timothy Bray, MD, Director*

Stephen Becher, MD
University of New Mexico Hospital, Albuquerque, NM
– *Thomas A. DeCoster, MD, Director*

Azad Dadgar, MD
University of Oklahoma, Tulsa, Tulsa, OK
– *Brent Norris, MD, Director*

Jessica Chiang, MD
University of Pittsburgh, Pittsburgh, PA
– *Ivan S. Tarkin, MD & Gary Gruen, MD, Directors*

Michael Loewen, MD
University of Rochester Orthopaedic Trauma Fellowship, Rochester, NY
– *Catherine Humphrey, MD, Director*

2013-2014 OTA Fellowship Graduating Class, continued

Robert Kinzinger, MD
University of Tennessee - Campbell Clinic, Memphis, TN
– *Edward A. Perez, MD, Director*

Ryan Ficco, MD
University of Tennessee/Erlanger Health Systems, Chattanooga, TN
– *Peter J. Nowotarski, MD, Director*

Michael Holzman, MD, **Prism Schneider, MD** and **Jason Tank, MD**
University of Texas Health Science Center, Houston, TX
– *Timothy S. Achor, MD, Director*

Kerellos Nasr, MD
University of Texas, Parkland Hospital & Health System, Dallas, TX
– *Charles M. Reinert, MD & Adam J. Star, MD, Directors*

Thomas Fishler, MD, **Jonah Hebert-Davies, MD**, **James Learned, MD**, **Milton Little, MD** and **Clay Spitler, MD**
University of Washington, Harborview Medical Center, Seattle, WA
– *David P. Barei, MD, Director*

Mark Trump, MD
USC Keck School of Medicine, Los Angeles County, Los Angeles, CA
– *Jackson Lee, MD, Director*

Chad Corrigan, MD and **David Joyce, MD**
Vanderbilt University Medical Center, Nashville, TN
– *Jason Evans, MD, Director*

Gregory Daut, MD
Wake Forest University, Winston Salem, NC
– *Eben A. Carroll, MD, Director*

Michael Linn, MD
Washington University School of Medicine/Barnes-Jewish Hospital, Saint Louis, MO
– *William M. Ricci, MD, Director*

Nick Quercetti, MD
Wright State University, Dayton, OH
– *Michael J. Prayson, MD, Director*

Brent Dressler, MD
York Hospital, York, PA
– *Thomas DiPasquale, DO, Director*

A special thank you to Industry Partners:
Smith & Nephew, Stryker and DePuy Synthes.

OTA 2014 RESEARCH GRANT AWARD RECIPIENTS

(January 1, 2014 - December 31, 2014 Grant Cycle)

CLINICAL GRANT APPLICATIONS (up to $40,000/year, 2 year grant cycle)

Title: **Hemostasis In Open Acetabulum and Pelvic Ring Surgery Using Tranexamic Acid: A Prospective, Randomized, Controlled Study**
Principal Investigator: **Brett Crist, MD**
Co-Principal Investigator: **William Harvin, MD**
Awarded Funds: **$41,524**

Title: **Muscle Atrophy Regulation in Older Adults with Hip Fracture and Potential Anabolic Approaches**
Principal Investigator: **Micah Drummond, MD**
Co-Principal Investigator: **Thomas Higgins, MD**
Awarded Funds: **$72,910**

BASIC RESEARCH GRANTS (up to $50,000 with $25,000/year max up to 2-year grant cycle)

Title: **Targeting Intracellular Staphylococcus Aureus to Lower Recurrence of Orthopaedic Infection**
Principal Investigator: **Laura Phieffer, MD**
Co-Principal Investigators: **Paul Stoodly, MD** & **Jeffrey Granger, MD**
Research Consultant: **Jason Calhoun, MD**
Awarded Funds: **$29,529**

Title: **Integrin Signaling and Hyaline Cartilage Response to Blunt Trauma**
Principal Investigator: **Gregory Della Rocca, MD, PhD**
Co-Principal Investigator: **Aaron Stoker, MD**
Awarded Funds: **$49,330**

Title: **Mediators of Acute Kidney Injury Following Orthopedic Trauma in Obese Rats**
Principal Investigator: **Robert Hester, MD**
Co-Principal Investigator: **George Russell, MD**
Awarded Funds: **$50,000**

Title: **Therapeutic Application of Carbon Monoxide (CO), Liberated From A Novel CO- Releasing Molecule (CORM-3), in a Large Animal Model of Limb Compartment Syndrome**
Principal Investigator: **Abdel-Rahman Lawendy, MD**
Awarded Funds: **$50,000**

Title: **Promoting Ischemic Fracture Healing by Blocking Inhibitors of Vascularization**
Principal Investigator: **Jaimo Ahn, MD**
Co-Principal Investigator: **Kurt Hankenson, MD**
Awarded Funds: **$50,000**

Title: **The Use of Autologous Endothelial Progenitor Cells (Epcs) for the Healing of a Bone Defect in a Large Animal Model**
Principal Investigator: **Aaron Nauth, MD**
Co-Principal Investigator: **Emil Schemitsch, MD**
Awarded Funds: **$50,000**

TOTAL AWARDED: $393,293

OTA 2014 RESIDENT RESEARCH GRANT AWARD RECIPIENTS

2014 RESIDENT GRANT RECIPIENTS *(January 1, 2014 - December 31, 2014 Grant Funding Cycle)*

Title: **Effects of Upper Extremity Immobilization and Use of a Spinner Knob on Vehicle Steering: A Prospective Study In Patients with Distal Radius Fractures**
Principal Investigator: **Lyle Jackson, MD**
Co-Principal Investigator: **Kyle Jeray, MD**
Awarded Amount: **$17,129**

Title: **Hypoxia Mimicking Agents for the Induction of Guided Angiogenesis in Calcium Phosphate Scaffolds for Bone Tissue Engineering of Posttraumatic Bone Defects**
Principal Investigator: **Justin Drager, MDCM, HBSc**
Co-Principal Investigator: **Edward Harvey, MD**
Awarded Amount: **$19,621**

Title: **Effects of Selective Serotonin Reuptake Inhibitors Upon Fracture Healing**
Principal Investigator: **Siddhant Kumar Mehta, MD**
Co-Principal Investigator: **George Russell, MD**
Awarded Amount: **$19,911**

Title: **The Effect of Timing of Amino-bisphosphonate Therapy on Fracture Healing in Osteoporosis: A Mammal Model**
Principal Investigator: **Jesse Otero, MD, PhD**
Co-Principal Investigator: **Nepola James, MD**
Awarded Amount: **$20,000**

Title: **Development and Deployment of a Statewide Hip Fracture Morbidity and Mortality Risk Calculator**
Principal Investigator: **Andrew Pugely, MD**
Co-Principal Investigator: **J Lawrence Marsh, MD**
Awarded Amount: **$20,000**

TOTAL RESIDENT GRANTS AWARDED: $96,661

2014 RESIDENT GRANT RECIPIENTS *(June 1, 2014 - May 31, 2015 Grant Cycle)*

Principal Investigator: **Stephen Warner, MD, PhD** Co-Investigator: **Joseph Lane, MD**
Title: **Efficacy of NSAIDs for Pain Control Following Intertrochanteric Hip Fracture Fixation: A Randomized, Controlled Trial**

Principal Investigator: **Michael Olsen, MD, PhD** Co-Investigator: **Emil Schemitsch, MD, FRCSC**
Title: **Biomechanical Determination of the Optimal Overlap Between a Sliding Hip Screw Plate and a Retrograde Intramedullary Nail for Repairing an Ipsilateral Intertrochanteric and Femur Shaft Fracture**

Principal Investigator: **Adam Wegner, MD, PhD** Co-Investigator: **Mark Lee, MD**
Title: **Nox 4 as a Mediator of Post-Traumatic Osteoarthritis and a Potential Target for Treatment**

Principal Investigator: **David Tennent, MD** Co-Investigator: **Daniel Stinner, MD**
Title: **Locally Applied Vancomycin Powder: Effective or Gone Before We Know It?**

Principal Investigator: **Anthony Bratton, MD** Co-Investigator: **John Callaci, PhD**
Title: **The Effect of Chronic Binge Alcohol Consumption on BMP-2 Antagonist Expression in a Rat Model**

Affiliate Meetings

Meeting Name	Meeting Room	Day/Time
METRC Research Coordinator Training Meeting	*Marriott (2nd Floor)* *Florida Salon V*	Wednesday, 10/15 8:00 am – 3:00 pm
Missouri Orthopaedic Institute **Pelvic & Acetabular Masters Meeting**	*Marriott (2nd Floor)* *Florida Salons I-IV*	Wednesday, 10/15 10:00 am – 6:00 pm
METRC Annual Meeting	*Marriott (2nd Floor)* *Meeting Rooms 5-6*	Wednesday, 10/15 4:00 pm – 7:00 pm
New York Metro Trauma Club	*Convention Center* *Room 17 (1st Floor)*	Wednesday, 10/15 5:30 pm – 6:30 pm
METRC Research Coordinators Reception	*Marriott (1st Floor)* *Il Terrazzo*	Wednesday, 10/15 7:00 pm – 8:00 pm
Ortho Trauma Research Consortium	*Marriott (2nd Floor)* *Meeting Room 5*	Thursday, 10/16 7:00 am – 8:00 am
COTS Investigator Meeting	*Marriott (2nd Floor)* *Florida Salons I-IV*	Thursday, 10/16 7:00 am – 12:00 pm
Faith Investigators Meeting	*Marriott (2nd Floor)* *Meeting Room 5*	Thursday, 10/16 12:00 pm – 1:00 pm
Faith 2 Investigators Meeting	*Marriott (2nd Floor)* *Meeting Room 5*	Friday, 10/17 7:00 am – 8:00 am
North America Scapula Consortium Meeting	*Marriott (2nd Floor)* *Florida Salons I-II*	Friday, 10/17 11:30 am – 1:00 pm
HEALTH/FLOW Study Meeting	*Marriott (3rd Floor)* *Meeting Room 12*	Friday, 10/17 11:30 am – 1:30 pm
JOT Editorial Board Lunch	*Marriott (2nd Floor)* *Meeting Room 7*	Friday, 10/17 11:50 am – 12:40 pm
Foundation for Orthopedic Trauma Meeting	*Marriott (2nd Floor)* *Meeting Room 5*	Friday, 10/17 5:30 pm – 7:30 pm

OTA GRATEFULLY ACKNOWLEDGES THE FOLLOWING EXHIBITORS FOR THEIR SUPPORT OF THE 30TH ANNUAL MEETING:

Booth #	Company Names	City, State
732	**ACell Inc.**	Columbia, MD
614	**Acumed**	Hillsboro, OR
715	**Advanced Biologics**	Carlsbad, CA
327	**Advanced Orthopaedic Solutions**	Torrance, CA
202	**AO Trauma North America**	Paoli, PA
737	**Acelity (KCI, Lifecell, Systagenix)**	San Antonio, TX
734	**Applied Biologics, LLC**	Scottsdale, AZ
627	**Arthrex Inc.**	Naples, FL
714	**Bacterin International Holdings Inc.**	Belgrade, MT
817	**BayCare Medical Group**	Clearwater, FL
212	**BioAccess Inc**	Baltimore, MD
736	**Biocomposites Inc.**	Wilmington, NC
322	**Biomet Trauma**	Warsaw, IN
413	**Bioventus LLC**	Durham, NC
542	**Bone Foam Inc.**	Plymouth, MN
728	**Carbofix Orthopedics Inc.**	Collierville, TN
536	**Cardinal Health**	Waukegan, IL
631	**CFI Medical Solutions**	Fenton, MI
637	**Citieffe Inc.**	Eads, TN
606	**Conventus Orthopaedics**	Maple Grove, MN
502	**Depuy Synthes**	West Chester, PA
622	**DJO Inc.**	Vista, CA
222	**ECA Medical**	Thousand Oaks, CA
725	**Ellipse Technologies Inc.**	Irvine, CA
TT02	**Elsevier (Saunders/Mosby)**	Gaithersburg, MD
218	**Emcare Acute Care Surgery**	Dallas, TX
717	**Enova Illumination**	Saint Paul, MN
312	**ETEX Corporation**	Cambridge, MA
208	**Fastform Medical Inc.**	Scottsdale, AZ
704	**FORE**	Temple Terrace, FL
608	**Gauthier Biomedical**	Grafton, WI
701	**Harvest Technologies Corp**	Plymouth, MA
214	**Hospital Corporation of America (HCA)**	Brentwood, TN
314	**Hunter Medical**	Columbia, TN
616	**Inion Inc.**	Delray Beach, FL
738	**Innomed Inc.**	Savannah, GA
311	**Innovision Inc.**	Memphis, TN
321	**Intelligent Implant Systems LLC**	Charlotte, NC

EXHIBITORS LISTING, continued

Booth #	Company Names	City, State
731	**Invibio**	Mahwah, NJ
628	**Invuity Inc.**	San Francisco, CA
226	**I.T.S. USA**	Winter Springs, FL
737	**KCI (An Acelity Company)**	San Antonio, TX
206	**Lifelink Tissue Bank**	Tampa, FL
702	**Lilly USA LLC.**	Indianapolis, IN
708	**Medartis**	Exton, PA
727	**Medmix Systems AG**	Rotkreuz
524	**Medtronic**	Memphis, TN
706	**Memorial Healthcare System**	Hollywood, FL
712	**Microware Precision Co. Ltd.**	Logan, UT
602	**Mizuho OSI**	Union City, CA
636	**New Clip Technics**	Haute-Goulaine
718	**Orthofix**	Lewisville, TX
724	**Orthopedic Sciences Inc.**	Seal Beach, CA
325	**Orthoview**	Jacksonville, FL
318	**Pacific Instruments**	Honolulu, HI
707	**Pacira Pharmaceuticals**	Parsippany, NJ
415	**Paradigm Biodevices Inc.**	Rockland, MA
811	**Pelvic Binder Inc.**	Dallas, TX
522	**PFS Med Inc.**	Springfield, OR
417	**Quintus Composites**	Camp Verde, AZ
721	**Sawbones/Pacific Research Labs**	Vashon, WA
232	**Sectra**	Linköping, Sweden
705	**SI-BONE Inc.**	San Jose, CA
703	**Skeletal Dynamics**	Miami, FL
316	**Skeletal Kinetics**	Cupertino, CA
302	**Smith & Nephew Inc.**	Memphis, TN
723	**Starr Frame LLC**	Richardson, TX
726	**Sonoma Orthopedic Products Inc.**	Santa Rosa, CA
512	**Stryker**	Mahwah, NJ
632	**Synergy Surgicalists**	Bozeman, MT
722	**The Orthopaedic Implant Company**	Reno, NV
833	**Toby Orthopaedics**	Miami, FL
635	**TriMed Inc.**	Valencia, CA
317	**Vivorte Inc.**	Louisville, KY
TT01	**Wolters Kluwer Health | Lippincott Williams & Wilkins**	Philadelphia, PA
624	**Wound Care Technologies, Inc.**	Chanhassen, MN
332	**Zimmer**	Warsaw, IN
638	**Zyga Technology Inc.**	Minnetonka, MN

2014 Guest Nation – Brazil

It is a great honor to welcome João Antonio Matheus Guimarães, MD, Daniel Balbachevsky, MD, Paulo Barbosa, MD and Tito Rocha, MD of the Brazilian Society of Orthopaedic Trauma to the 30th OTA Annual Meeting. We look forward to an enlightening session from our Brazilian colleagues.

The Guest Nation program was initiated in 2011 in recognition of the importance and benefits of sharing knowledge and experience with international colleagues.

International Trauma Care Forum
(*Room 15-16)*
Wednesday, October 15 – 7:30 am - 5:30 pm

Guest Nation Symposium:
Fractures Around the Knee Joint
2:02 pm - 3:20 pm
Brazil – Distal Femoral Fractures:
What to Do with the Difficult Multifragmented Fracture Patterns
Daniel Balbachevsky, MD

USA – Comminuted Patella Fractures:
Is There an Ideal Method of Treatment?
Andrew H. Schmidt, MD

Brazil – Posterior Shearing Tibial Plateau Fractures:
My Preferred Method of Treatment
Paulo Barbosa, MD

Brazil – Floating Knee Injuries:
How Can We Optimize the Outcome?
João Antonio Matheus Guimarães, MD

OTA International Reception
(The Landing)
Wednesday, October 15 – 5:30 - 6:30 pm
All International Attendees Invited

Annual Meeting Guest Nation Presentation
(*Ballroom B/C)*
Friday, October 17 – 10:59 am

"Evolution of Trauma Care System in Brazil: Current Status"
Tito Rocha, MD
National Institute of Traumatology and Orthopaedics
Ministry of Health, Rio de Janeiro, Brazil

ORTHOPAEDIC TRAUMA ASSOCIATION

ORS Orthopaedic Research Society

2014 Basic Science Focus Forum

Wednesday, October 15, 2014

6:00 am **Speaker Ready Room**
(Room 13-14)

6:30 am **Registration**
(2nd Floor)

Continental Breakfast
(Outside Meeting Room)

7:25 am **Introduction**
Edward J. Harvey, MD, Program Chair

7:30 – 8:35 am

SYMPOSIUM 1: BIOMECHANICAL CONCEPTS FOR FRACTURE FIXATION

(Notes p. 149)

Moderators: *Emil H. Schemitsch, MD*
Michael Bottlang, PhD

7:30 am **Radial Head and Coronoid Fractures: Biomechanical Evidence for Modern Approaches**
Aaron Nauth, MD

7:40 am **Unstable Sacral Fractures: Is Standard Iliosacral Screw Fixation Adequate?**
M.L. "Chip" Routt, MD

7:50 am **Periprosthetic Femur Fractures: 90/90 Fixation Versus a Single Locking Plate?**
Emil H. Schemitsch, MD

8:00 am **Distal Femur Fractures: Far Cortical Versus Conventional Locking Screws: Is There a New Gold Standard?**
Michael Bottlang, PhD

8:10 am **Syndesmosis Injuries: What Is the Ideal Fixation Construct?**
Kenneth A. Egol, MD

8:20 am Discussion

Key: Δ = presentation was funded by an OTA administered grant
Names in bold = **Presenter**

See pages 99 - 147 for financial disclosure information.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

8:35 – 9:15 am

PAPER SESSION 1: BIOMECHANICALLY-DIRECTED FIXATION

Moderators: *Emil H. Schemitsch, MD*
Michael Bottlang, PhD

8:35 am
Overview
Michael Bottlang, PhD

8:42 am
(p. 150)
PAPER #1
How to Use Fluoroscopic Imaging to Prevent Intra-Articular Screw Perforation During Locked Plating of Proximal Humerus Fractures: A Cadaveric Study
Jason Allen Lowe, MD[1]*; Shafagh Monazzam, MD*[2]*; Blaine T. Walton, MD*[1]*;*
Elisha M. Nelson, ARRT[2]*; Philip R. Wolinsky, MD*[2]*;*
[1]*University of Alabama, Birmingham, Alabama, USA;*
[2]*University of California Davis, Sacramento, California, USA*

8:48 am
(p. 152)
PAPER #2
Cortical Bone Drilling Induced Heat Production with Common Drill Devices
Andrew Palmisano, MD*; Bruce Li-Jung Tai, PhD; Barry Belmont, MS;*
James R. Holmes, MD; Albert Shih, PhD;
University of Michigan, Departments of Orthopaedic Surgery and Mechanical Engineering, Ann Arbor, Michigan, USA

8:54 am
(p. 154)
PAPER #3
Can Views of the Proximal Femur Be Reliably Used to Predict Malrotation After Femoral Nailing? A Cadaveric Validation Study
Andrew G. Dubina*; Michael R. Rozak, BA, BS; Robert V. O'Toole, MD;*
R Adams Cowley Shock Trauma Center, Department of Orthopaedics,
University of Maryland School of Medicine, Baltimore, Maryland, USA

9:00 am
(p. 155)
PAPER #4
Polyether Ether Ketone (PEEK) Carbon Fiber Composites May Improve Healing of Fractures Stabilized with Intramedullary Nails
Jo Wilson, PhD; Matthew Cantwell;
Invibio Ltd, Thornton-Cleveleys, United Kingdom

9:06 am
Discussion

9:15 am - 9:35 am
Break

See pages 99 - 147 for financial disclosure information.

9:35 – 10:30 am

SYMPOSIUM 2: BONE GRAFT SUBSTITUTION AND AUGMENTATION

(Notes p. 156) Moderators: *Aaron Nauth, MD*
Peter V. Giannoudis, MD

9:35 am **Selecting the Right Bone Graft Substitute for Your Patient**
Aaron Nauth, MD

9:45 am **BMPs: Is There Still a Role in 2014?**
Peter V. Giannoudis, MD

9:55 am **Bone Marrow Aspirate and Autologous Stem Cells: Are They Effective?**
Joseph M. Lane, MD

10:05 am **Injectable Calcium Phosphates and Sulfates: When I Use Them and Which One I Use**
J. Tracy Watson, MD

10:15 am Discussion

10:30 – 11:35 am

PAPER SESSION 2: INFLAMMATION AND BONE HEALING

Moderators: *Aaron Nauth, MD*
J. Tracy Watson, MD

10:30 am **Overview**
Aaron Nauth, MD

10:36 am (p. 157) PAPER #5 **•Montelukast Sodium Enhances Fracture Repair: Is There a Dose Response?**
Daniel Mandell, MD; ***John J. Wixted, MD****; Christopher Raskett, BS; Vivek Venugopal, BS; Jane B. Lian, PhD; Paul J. Fanning, PhD; University of Massachusetts Medical School, Worcester, Massachusetts, USA*

10:42 am (p. 158) PAPER #6 **ΔPossible Inhibitory Effect of Bone Marrow–Derived Mesenchymal Stem Cell Application on BMP-2–Mediated Bone Healing in a Critical Size Defect Model**
Motasem I. Refaat, MD*; Joel C. Williams, MD; Dominik R. Haudenschild, PhD; Mark A. Lee, MD; University of California Davis, Sacramento, California, USA*

Δ OTA Grant

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Basic Science Focus Forum – WEDNESDAY, OCTOBER 15, 2014

10:48 am
(p. 160)
PAPER #7

Effects of Reamer-Irrigator-Aspirator Wastewater on Bone Regeneration
Derek J. Klaus, MD[1]*; Douglas Crowder*[2]*; Ethan Scott, BS*[3]*, Steve Fening, PhD*[4]*;*
Fayez Safadi, PhD[3]*; Eric T. Miller, MD*[1]*;*
[1]*Department of Orthopaedic Surgery, Summa Health System, Akron, Ohio, USA;*
[2]*Department of Biomedical Engineering, University of Akron, Akron, Ohio, USA;*
[3]*Department of Anatomy and Neurobiology, Northeast Ohio Medical University, Rootstown, Ohio, USA;*
[4]*Austen BioInnovation Institute, Akron, Ohio, USA*

10:54 am
(p. 162)
PAPER #8

Is Impaired Fracture Healing in Cigarette Smokers Related to Carbon Monoxide Exposure?
John J. Wixted, MD*; Vivek Venugopal, BS; Christopher Raskett, BS;*
Jane B. Lian, PhD; Paul J. Fanning, PhD;
University of Massachusetts Medical School, Worcester, Massachusetts, USA

11:00 am Discussion

11:10 am
(p. 163)
PAPER #9

ΔThe Temporal and Spatial Development of Vascularity in a Healing Displaced Fracture
Nicholas A. Mignemi, BS[1]*; Masato Yuasa, MD*[2]*; Joey V. Barnett, PhD*[1]*;*
Justin M.M. Cates, MD, PhD[1]*; Jeffry S. Nyman, PhD*[1]*;*
William T. Obremskey, MD, MPH[1]*; Atsushi Okawa, MD, PhD*[2]*;*
Herbert S. Schwartz, MD[1]*; Christopher M. Stutz, MD*[1]*;*
Jonathan G. Schoenecker, MD, PhD[1]*;*
[1]*Vanderbilt University, Nashville, Tennessee, USA;*
[2]*Tokyo Medical and Dental University, Tokyo, Japan*

11:16 am
(p. 165)
PAPER #10

ΔModulating the Vasculature at a Fracture Through the Therapeutic Application of Placental Stem Cells
Chelsea S. Bahney, PhD[1]*; Aaron J. Taylor, BS*[1]*; Ali Sadat, DDS*[1]*;*
Kathryn Tormos, PhD[2]*; Theodore Miclau III, MD*[1]*; Emin Maltepe, MD, MPH*[2]*;*
Ralph S. Marcucio, PhD[1]*;*
[1]*Department of Orthopaedic Surgery, University of California, San Francisco, San Francisco, California, USA;*
[2]*Department of Pediatrics, University of California, San Francisco, San Francisco, California, USA*

11:22 am
(p. 167)
PAPER #11

Osteogenic, Stem Cell, and Molecular Characterization of the Human Biomembrane ("Induced Membrane") from Trauma Patients
Gabriella Ode, MD*; Gretchen Hoelscher, MS; Jane Ingram, BS; Synthia Bethea, BS;*
James Kellam, MD; Madhav Karunakar, MD; Michael J. Bosse, MD;
Helen E. Gruber, PhD;
Department of Orthopaedic Surgery, Carolinas HealthCare System, Charlotte, North Carolina, USA

11:28 am Discussion

11:35 am - 12:35 pm Lunch

Δ OTA Grant
See pages 99 - 147 for financial disclosure information.

12:35 – 1:35 pm

SYMPOSIUM 3: THE MANGLED EXTREMITY - FUNCTIONALITY THROUGH MECHANICS OR BIOLOGICS?

(Notes p. 169)

Moderators: *Edward J. Harvey, MD*
Lisa K. Cannada, MD

12:35 pm **Current Concepts for Infection Management in High MESS Legs**
Philip Wolinsky, MD

12:45 pm **Heterotopic Ossification in Trauma and Amputations**
Roman Hayda, MD

12:55 pm **New Concepts in Residual Limb Management and Rehabilitation**
Lisa K. Cannada, MD

1:05 pm **The Peg Leg or the Six Million Dollar Man- Where Are We?**
Danielle Melton, MD

1:15 pm Discussion

1:35 – 3:25 pm

PAPER SESSION 3: MESS

Moderators: *Edward J. Harvey, MD*
Philip Wolinsky, MD

1:35 pm **Overview**
Edward J. Harvey, MD

1:45 pm
(p. 170)
PAPER #12
Pharmacological Treatment of Compartment Syndrome with Phenylephrine and Dobutamine Was Similar to Fasciotomy
Xuhui Liu, MD; James M. Mok, MD; Heejae Kang, BS; Julie Jin, BS; Alexandar Boehme, BS; Erik N. Hansen, MD; Mark Rollins, MD; Hubert T. Kim, MD; ***Utku Kandemir, MD****;*
Department of Orthopaedic Surgery, University of California San Francisco, San Francisco, California, USA

1:51 pm
(p. 172)
PAPER #13
ΔCarbon Monoxide Releasing Molecule-3 (CORM-3) Diminishes the Oxidative Stress and Leukocyte Migration Across Human Endothelium in an In Vitro Model of Compartment Syndrome
Aurelia Bihari, MS*; Gediminis Cepinskas, DVM, PhD; David Sanders, MD; Abdel-Rahman Lawendy, FRCS;*
London Health Sciences Centre, London, Ontario, Canada

Δ OTA Grant

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Basic Science Focus Forum – WEDNESDAY, OCTOBER 15, 2014

1:57 pm
(p. 173)
PAPER #14

Use of the Reamer/Irrigator/Aspirator During Intramedullary Nailing Decreases Carotid and Cranial Embolic Events

Anna N. Miller, MD[1]*; Dwight D. Deal, BS*[1]*; James Green, BS*[2]*;*
Tim T. Houle, PhD[1]*; William R. Brown, PhD*[1]*; Clara R. Thore, PhD*[1]*;*
David Stump, PhD[1]*; Lawrence X. Webb, MD*[3]*;*
[1]*Wake Forest School of Medicine, Winston-Salem, North Carolina, USA;*
[2]*DePuy Synthes, West Chester, Pennsylvania, USA;*
[3]*Mercer University School of Medicine, Macon, Georgia, USA*

2:03 pm Discussion

2:10 pm
(p. 174)
PAPER #15

•Superoxide Dismutase Mimetic Disrupts Bacterial Biofilms in an Infected Fracture Model

Sarah E. Lindsay[1,2]*; James D. Crapo, MD*[1]*;* ***Elizabeth A. Regan, MD, PhD***[1]*;*
National Jewish Health, Denver, Colorado, USA;
Stanford University, Palo Alto, California, USA

2:18 pm
(p. 176)
PAPER #16

•Rifampin and Minocycline-Containing Coating for Orthopaedic Implants with Potent In Vivo Activity

Mark Schallenberger, MS*; Todd R. Meyer, PhD;*
Bacterin International, Belgrade, Montana, USA

2:26 pm
(p. 177)
PAPER #17

ΔIn Vivo Chemistry and Implantable Biomaterial for Targeting Therapeutics

José M. Mejía Oneto, MD, PhD[1]*; Munish C. Gupta, MD*[1]*; Kent Leach, PhD*[1]*;*
Mark A. Lee, MD[1]*; Maksim Royzen, PhD*[2]*;*
[1]*University of California, Davis Medical Center, Sacramento, California, USA;*
[2]*University at Albany, State University of New York, Albany, New York, USA*

2:34 pm
(p. 179)
PAPER #18

Sonication Has the Potential to Improve Culture Yield in Patients with Clinical Infection

Hemil Hasmukh Maniar, MD*; Kristin McPhillips, MD, MPH; Jove Graham, PhD;*
Michael Foltzer, MD; Thomas R. Bowen, MD; Daniel S. Horwitz, MD;
Geisinger Medical Center, Danville, Pennsylvania, USA

2:42 pm Discussion

2:52 pm
(p. 181)
PAPER #19

Pulsatile Lavage of Open Musculoskeletal Wounds Causes Muscle Necrosis and Dystrophic Calcification

Astor Devon Robertson, MBBS[1]*; Stephen Zhao, BS*[1]*; Thao Nguyen, MD*[1]*;*
David E. Jaffe, MD[1]*; Carla Hebert, BS*[1]*; William Lawrence Fourney, PhD*[2]*;*
Joseph Stains, PhD[1]*; Vincent D. Pellegrini Jr, MD*[3]*;*
[1]*University of Maryland School of Medicine, Baltimore, Maryland, USA;*
[2]*University of Maryland, College Park, Maryland, USA;*
[3]*Medical University of South Carolina, Charleston, South Carolina*

Δ OTA Grant
See pages 99 - 147 for financial disclosure information.

2:58 pm
(p. 183)
PAPER #20

Failure of Indomethacin and Radiation to Prevent Blast-Induced Heterotopic Ossification in an Animal Model

Astor Devon Robertson, MBBS[1]; *Stephen Zhao, BS*[1]; *Thao Nguyen, MD*[1]; *Robert E. Holmes, MD*[2]; *David E. Jaffe, MD*[1]; *Juong G. Rhee, PhD*[1]; *William Lawrence Fourney, PhD*[3]; *Joseph Stains, PhD*[1]; *Vincent D. Pellegrini Jr, MD*[2]; [1]*University of Maryland School of Medicine, Baltimore, Maryland, USA;* [2]*Medical University of South Carolina, Charleston, South Carolina, USA;* [3]*University of Maryland, College Park, Maryland, USA*

3:04 pm
(p. 185)
PAPER #21

The Surgeon's Catch-22: A Prospective Study on Inflammation, Wound Failure, and Heterotopic Ossification in Combat Wounds

Donald N. Hope, MD; *Jonathan A. Forsberg, MD; Benjamin K. Potter, MD; Elizabeth M. Polfer, MD; Eric A. Elster, MD, FACS; Walter Reed National Military Medical Center, Bethesda, Maryland, USA; Naval Medical Research Center, Silver Spring, Maryland, USA*

3:10 pm Discussion

3:25 pm - 3:45 pm Break

3:45 – 4:50 pm

SYMPOSIUM 4: BIGGER DATA - BIGGER PROBLEMS?

(Notes p. 186) Moderators: *Mohit Bhandari, MD, PhD, FRCSC*
Gerard P. Slobogean, MD, MPH, FRCSC

3:45 pm **What is Big Data?**
Gerard P. Slobogean, MD, MPH, FRCSC

4:00 pm **NHS Database- What It Can and Cannot Do**
Peter V. Giannoudis, MD

4:10 pm **Scandinavian Data-Ongoing Challenges and Successes**
Frede Frihagen, MD, PhD

4:20 pm **Designing Studies That Utilize Large Databases: The Basics**
Mary L. Forte, PhD

4:30 pm **The Future of Large Scale Databases: Will They Replace the Clinical Trial?**
Saam Morshed, MD, PhD

4:40 pm Discussion

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

4:50 – 5:30 pm

PAPER SESSION 4: INTERNATIONAL RESEARCH STUDIES

Moderators: *Mohit Bhandari, MD, PhD, FRCSC*
Gerard P. Slobogean, MD, MPH, FRCSC

4:50 pm
(Notes p. 187)

INORMUS Invited Paper - Trauma Worldwide Data Set
Mohit Bhandari, MD, PhD, FRCSC

4:56 pm
(p. 188)
PAPER #22

Changing the System: Improving Outcome From Major Trauma by Developing a National System of Regional Major Trauma Networks
Christopher G. Moran, MD, FRCS(Ed)[1]*; Maralyn Woodford*[2]*;*
Fiona Lecky, FRCS, MSc, PhD[2]*; Antoinette Edwards, BA*[2]*;*
Timothy Coats, MBBS, FRCS, MD[2]*; Keith Willett, MD, FRCS*[3]*;*
[1]*NHS England, Nottingham University Hospital, Nottingham, United Kingdom;*
[2]*Trauma Audit and Research Network, University of Manchester, Manchester, United Kingdom;*
[3]*NHS England, Oxford, United Kingdom*

5:02 pm
(p. 189)
PAPER #23

Increased Systemic Complications in Open Femoral Shaft Fractures Are Associated with the Degree of Soft-Tissue Injury Rather Than New Injury Severity Score (NISS) Values: A Nationwide Database Analysis
Christian D. Weber, MD[1]***; Rolf Lefering, PhD***[2]***; Thomas Dienstknecht, MD***[1]***;***
Philipp Kobbe, MD, PhD[1]*; Richard M. Sellei, MD*[1]*; Frank Hildebrand, MD, PhD*[1]*;*
Hans-Christoph Pape, MD, PhD, FACS[1]*;*
Trauma Registry of the German Trauma Society;
[1]*RWTH Aachen University Medical Center, Department of Orthopedic Trauma, Aachen, Germany;*
[2]*Institute for Research in Operative Medicine (IFOM), University of Witten/Herdecke, Cologne-Merheim Medical Center, Cologne, Germany*

5:08 pm
(p. 190)
PAPER #24

Anatomic Region and the Risk of Adverse Events in Orthopaedic Trauma: An Analysis of 19,000 Patients
Cesar S. Molina, MD; Rachel V. Thakore, BS; Eduardo J. Burgos, MD;
William T. Obremskey, MD, MPH, MMHC; ***Manish K. Sethi, MD****;*
Vanderbilt University, Nashville, Tennessee, USA

5:14 pm Discussion

5:30 pm Adjourn to International Reception

See pages 99 - 147 for financial disclosure information.

ORTHOPAEDIC TRAUMA ASSOCIATION

ORS Orthopaedic Research Society

2014 Basic Science Focus Forum

Thursday, October 16, 2014

6:00 am **Speaker Ready Room**
(Room 13-14)

6:30 am **Registration**
(2nd Floor)

7:00 am **Continental Breakfast**
(Outside Meeting Room)

7:25 am **Introduction**
Edward J. Harvey, MD, Program Chair

7:30 – 8:40 am **SYMPOSIUM 5: ADVANCES IN ARTICULAR CARTILAGE INJURY AND TREATMENT - WHERE WE ARE AND WHERE WE'RE GOING**

(Notes p. 192) Moderators: *Joseph Borrelli Jr, MD*
Susanna Chubinskaya, PhD

7:30 am **Cartilage's Response to Injury**
Dominik Haudenschild, PhD

7:40 am **Current/Futures Chondroprotective Products**
Susanna Chubinskaya, PhD

7:50 am **Chondroplasty/Microfracture/Cells for Treatment of Cartilage Injuries**
Seth Gasser, MD

8:00 am **OsteoChondral Allografts in 2014**
James Stannard, MD

8:10 am **Joint Preservation: Treatment of Intra-articular Malunions**
Christian Krettek, MD, FRACS

8:20 am Discussion

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Basic Science Focus Forum – THURSDAY, OCTOBER 16, 2014

8:40 – 9:09 am

PAPER SESSION 5: ARTICULAR PATHOLOGY

Moderators: *Joseph Borrelli Jr, MD*
Susanna Chubinskaya, PhD

8:40 am
Overview
Joseph Borrelli Jr, MD

8:45 am
(p. 193)
PAPER #25
ΔThe Dose-Response Effect of the Mast Cell Stabilizer, Ketotifen Fumarate, on Post-Traumatic Joint Contractures
***Prism Schneider, MD, PhD, FRCSC**; Herman Johal, MD, MPH; Andrew R. Buckley; Kevin A. Hildebrand, MD, FRCSC; University of Calgary, Calgary, Alberta, Canada*

8:51 am
(p. 195)
PAPER #26
ΔPresence and Degree of Matrix Metalloproteinases and Aggrecan Breakdown Products in the Setting of Acute Intra-Articular Fracture
***Justin Haller, MD**; Molly McFadden, PhD; David L. Rothberg, MD; Erik Kubiak, MD; Thomas F. Higgins, MD; University of Utah Department of Orthopaedics, Salt Lake City, Utah, USA*

8:57 am
(p. 197)
PAPER #27
Pre-Injury Depletion of Macrophages Results in Increased Acute Joint Inflammation Following Articular Fracture
*Karsyn N. Bailey; Bridgette D. Furman, BS; Kelly A. Kimmerling, MS; Chia-Lung Wu, PhD; Janet L. Huebner; Virginia B. Kraus, PhD; Farshid Guilak, PhD; **Steven A. Olson, MD;** Duke University Medical Center, Durham, North Carolina, USA*

9:03 am Discussion

9:09 am - 9:25 am Break

Δ OTA Grant
See pages 99 - 147 for financial disclosure information.

9:25 – 10:30 am

SYMPOSIUM 6: OSTEOPOROSIS- ARE WE CLOSER TO GOLD STANDARDS?

(Notes p. 199) Moderator: *Theodore Miclau III, MD*

9:25 am **Fracture Models: Diaphyseal and Metaphyseal Healing**
Volker Alt, MD

9:35 am **Mechanical Testing: Selection of a Model**
Loren L. Latta, PE, PhD

9:45 am **Medical Management**
Joseph M. Lane, MD

9:55 am **Atypical Femur Fractures – New Information**
Kenneth A. Egol, MD

10:05 am **Augmentation of Fixation: Selection of an Optimal Material**
Meri Tibi Marmor, MD

10:15 am Discussion

10:30 – 11:04 am

PAPER SESSION 6: BONE DENSITY AND MODELING

Moderator: *Theodore Miclau III, MD*

10:30 am **Overview**
Theodore Miclau III, MD

10:40 am
(p. 200)
PAPER #28

Is There a Future for Femoroplasty in Hip Fracture Prevention? Introducing Anisotropy Restoring Femoroplasty
Edward K. Rodriguez, MD, PhD*; Leandro Grimaldi, MD; Aidin Masoudi, MD; Ara Nazarian, PhD;*
Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA

10:46 am
(p. 201)
PAPER #29

Comparison of Femoral Head Rotation and Varus Collapse Between a Single and Integrated Dual Screw Intertrochanteric Hip Fracture Fixation Device Using a Chair Rise Biomechanical Model
Aniruddh Nayak, MS[1]*; Ian Smithson, MD*[2]*; Seth Cooper, MD*[2]*; Jacob Cox, MD*[1]*; Scott Marberry, MD*[1]*; Brandon G. Santoni, PhD*[1,2]*; Roy Sanders, MD*[3]*;*
[1]*Foundation for Orthopaedic Research & Education, Tampa, Florida, USA;*
[2]*Department of Orthopaedics & Sports Medicine, University of South Florida, Tampa, Florida, USA;*
[3]*Orthopaedic Trauma Service, Florida Orthopaedic Institute, Tampa, Florida, USA*

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Basic Science Focus Forum – THURSDAY, OCTOBER 16, 2014

10:52 am (p. 203) PAPER #30	**Traumatic Fracture Healing in Geriatric Mice Shows Decreased Callus Formation with Associated Deficiencies in Cell Cycle and Immune Cell Function** ***Luke A. Lopas, BS****; Nicole S. Belkin, MD; Patricia L. Mutyaba, BS; Lee McDaniel, MS; Kurt D. Hankenson, DVM, MS, PhD; Jaimo Ahn, MD, PhD; University of Pennsylvania, Philadelphia, Pennsylvania, USA*
10:58 am	Discussion
11:04 am - 12:45 pm	**ADJOURN TO INDUSTRY SYMPOSIA** *(First Floor)*

ORTHOPAEDIC TRAUMA ASSOCIATION

2014 Annual Meeting

Thursday, October 16, 2014

6:00 am **Speaker Ready Room**
(2nd Floor)

6:30 am **Registration**
(2nd Floor)

11:04 am - 12:45 pm **INDUSTRY SYMPOSIA** (on-site registration available)
Lunch Included *(First Floor)*

1:00 pm **Welcome and Industry Donor Awards** *(Ballroom B/C)*
Ross K. Leighton, MD – OTA President
Thomas F. Higgins, MD – Program Chair
Roy Sanders, MD – Local Host

1:20 – 2:50 pm **SYMPOSIUM I: CONTEMPORARY DEBATES IN ORTHOPAEDIC TRAUMA**

(Notes p. 207) Moderator: *Michael Suk, MD, JD* *(Ballroom B/C)*
Faculty: *Bruce D. Browner, MD*, *Lisa K. Cannada, MD*, *A. Alex Jahangir, MD*, *Clifford B. Jones, MD*, *Gerald J. Lang, MD*, *Douglas W. Lundy, MD*, *Samir Mehta, MD*, *Philip R. Wolinsky, MD*

1:20 pm **OTA Health Policy Chairman Update**
Michael Suk, MD

Proposition 1: "The US Should Adopt a Standardize Approach to Hip Fracture Care"
1:30 pm *Faculty*
2:00 pm Open Microphone

Proposition 2: "Implementation of the Accountable Care Act is Good for Orthopedic Trauma"
2:10 pm *Faculty*
2:40 pm Open Microphone

Key: Δ = presentation was funded by an OTA administered grant
Names in bold = **Presenter**

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

THURSDAY, OCTOBER 16, 2014

2:50 pm - 3:20 pm Refreshment Break
Visit Scientific Posters & Technical Exhibits
(All in West Hall)

(Ballroom B/C)
3:20 – 5:10 pm

SCIENTIFIC PAPER SESSION I
FOOT / ANKLE / PILON

Moderators - David W. Sanders, MD & Steven R. Papp, MD

3:20 pm
(p. 208)
PAPER #31

Does Ankle Aspiration for Acute Ankle Fractures Result in Pain Relief? A Prospective Randomized Double-Blinded Placebo-Controlled Trial
Timothy J. Ewald, MD, BS, MSc; Pamela K. Holte, CNP; Joseph R. Cass, MD; William W. Cross III, MD; ***S. Andrew Sems, MD****;*
Mayo Clinic, Rochester, Minnesota, USA

3:26 pm
(p. 209)
PAPER #32

Continuous Popliteal Sciatic Nerve Block for Ankle Fractures Reduces Postoperative Opioid Requirements and Rebound Pain: A Prospective Randomized Comparative Trial
David Ding, MD; Arthur Manoli III, BS; David Galos, MD; Sudheer Jain, MD; ***Nirmal C. Tejwani, MD, FRCS****;*
NYU Langone Medical Center Hospital for Joint Diseases, New York, New York, USA

3:32 pm Discussion

3:37 pm
(p. 211)
PAPER #33

Intraoperative O-Arm Evaluation on the Effect of Ankle Position on Accuracy of Syndesmotic Reduction
Paul M. Lafferty, MD; ***Timothy Hiesterman, MD; Amir R. Rizkala, MD****;*
Ryan D. Horazdovsky, MD, Peter A. Cole, MD;
University of Minnesota, St. Paul, Minnesota, USA

3:43 pm
(p. 213)
PAPER #34

A Prospective Study to Compare Open Reduction and Ligament Repair Versus Percutaneous Screw Fixation of the Tibia Fibular Syndesmosis
David Sanders, MD; A. Walid Hamam, MD; ***Christina Tieszer, CCRP****;*
Abdel-Rahman Lawendy, MD;
Western University/London Health Sciences Centre, London, Ontario, Canada

3:49 pm
(p. 215)
PAPER #35

Syndesmotic Fixation in Supination–External Rotation Ankle Fractures: A Prospective Randomized Study at a Minimum of 4 Years of Follow-up
Tero Kortekangas, MD*; Harri Pakarinen, MD, PhD; Olli Savola, MD, PhD; Jaakko Niinimäki, MD, PhD; Sannamari Lepojärvi, MD; Pasi Ohtonen, MSc; Tapio Flinkkilä, MD, PhD; Jukka Ristiniemi, MD, PhD;*
Oulu University Hospital, Oulu, Finland

3:55 pm Discussion

4:00 pm
(p. 216)
PAPER #36

Syndesmotic Malreduction Results in Poorer Clinical Outcomes in Supination and Pronation External Rotation IV Ankle Fractures
Richard M. Hinds, MD*; Patrick C. Schottel, MD; Matthew R. Garner, MD; David L. Helfet, MD; Dean G. Lorich, MD;*
Hospital for Special Surgery; New York, New York, USA

See pages 99 - 147 for financial disclosure information.

4:06 pm
(p. 217)
PAPER #37

ΔOutcomes a Decade After Surgery for Unstable Ankle Fracture: Functional Recovery Does Not Decay with Time

Stephen Gould, MD, MPH[1]; Deirdre Regan, BA[1]; Arthur Manoli III, BS[1]; Kenneth J. Koval, MD[2]; Nirmal C. Tejwani, MD[1]; ***Kenneth A. Egol, MD[1,3]****;*
[1]NYU Hospital for Joint Diseases, New York, New York, USA;
[2]Orlando Regional Medical Center, Orlando, Florida, USA;
[3]Jamaica Medical Center, Jamaica, New York, USA

4:12 pm
(p. 219)
PAPER #38

Functional Outcome After Ankle Fractures and Ankle Fracture-Dislocations: A Prospective Study

Chad Ferguson, MD[1]*; Michael Ruffolo, MD[1]; J. Kent Ellington, MD[2]; Rachel Seymour, PhD[1]; CAPT (ret) Michael J. Bosse, MD[1]; CMC-OC Ankle Fracture Research Group[1,2];*
[1]Carolinas Medical Center, Charlotte, North Carolina, USA;
[2]OrthoCarolina, Charlotte, North Carolina, USA

4:18 pm
(p. 220)
PAPER #39

Correlation Between the Lauge-Hansen Classification and Ligament Injury in Ankle Fractures

Stephen Warner, MD, PhD*; Matthew R. Garner, MD; Richard M. Hinds, MD; Dean G. Lorich, MD;*
Hospital for Special Surgery, New York, New York, USA

4:24 pm

Discussion

4:29 pm
(p. 221)
PAPER #40

The Early and Medium-Term Results of Early Primary Open Reduction and Internal Fixation of AO43-B/C Tibial Pilon Fractures: A Prospective Cohort Study

Daniel Deakin, FRCS*; Pierre Guy, MD; Peter J. O'Brien, MD; Henry M. Broekhuyse, MD; Jeremie Larouche, MD; Piotr A. Blachut, MD; Kelly A. Lefaivre, MD;*
University of British Columbia, Vancouver, British Columbia, Canada

4:35 pm
(p. 223)
PAPER #41

Type C Tibial Pilon Fractures: Rate and Risk Factors for Complications Following Early Operative Intervention

Andrew D. Duckworth; Nicholas D. Clement, MRCSEd; Stuart A. Aitken, MD; ***Timothy O. White, MD, FRCS****;*
Edinburgh Orthopaedic Trauma Unit, Royal Infirmary of Edinburgh, Edinburgh, United Kingdom

4:41 pm
(p. 225)
PAPER #42

Percutaneous Reduction and Screw Fixation in Displaced Intra-Articular Fractures of the Calcaneus

Saran Tantavisut, MD*; J. Lawrence Marsh, MD; Phinit Phisitkul, MD; Matthew D. Karam, MD; Brian O. Westerlind, BA; Yubo Gao, PhD;*
University of Iowa Hospitals and Clinics, Iowa City, Iowa, USA

4:47 pm
(p. 227)
PAPER #43

Evaluation of Vitamin D Levels and Outcomes After Ankle Fracture Fixation

Stephen Warner, MD, PhD*; Matthew R. Garner, MD; Joseph Nguyen, MPH; Dean G. Lorich, MD;*
Hospital for Special Surgery, New York, New York, USA

Δ OTA Grant

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

THURSDAY, OCTOBER 16, 2014

4:53 pm Discussion

5:10 pm - 5:40 pm
(Notes p. 228)

President's Message

(General Session Room - Ballroom B/C)

Ross K. Leighton, MD

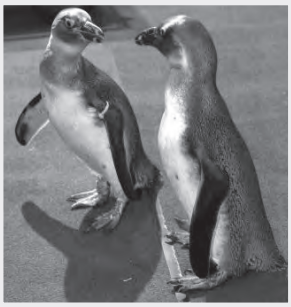
"The Orthopaedic Trauma Association – Enhancing the Care of the Patient – Past, Present, and Future"

Introduction: Thomas A. (Toney) Russell, MD

5:40 pm - 6:40 pm **OTA BUSINESS MEETING**
(OTA Members Only) *(General Session Room - Ballroom B/C)*

7:00 pm - 9:00 pm **WELCOME RECEPTION**

Join the OTA for cocktails and a generous assortment of hors d'oeuvres at The Florida Aquarium.



The Florida Aquarium is a 15-minute walk (.7 miles away) from the Convention Center. Trolley rides are available for $2.50 one way.

See pages 99 - 147 for financial disclosure information.

ORTHOPAEDIC TRAUMA ASSOCIATION

2014 Annual Meeting

Friday, October 17, 2014

6:00 am	**Speaker Ready Room** *(2nd Floor)*
6:15 am	**Registration** *(2nd Floor)*
6:30 am	**Scientific Posters** (Technical Exhibits Open at 9:00 am) *(West Hall)*
	Continental Breakfast *(Outside Breakout Session Rooms)*
6:30 am - 7:45 am (Notes p. 229)	**Concurrent Breakout Sessions** Case Presentations Skills Labs

6:30 – 7:45 am **CASE PRESENTATIONS** ***No Tickets Required***

Treatment of Pelvic Fractures *(Ballroom B/C)*
Moderator: *Paul Tornetta III, MD*
Faculty: *Robert V. O'Toole, MD; Robert Ostrum, MD; H. Claude Sagi, MD* and *Jodi Siegel, MD*

Distal Humerus Fractures: Tips and Tricks *(Room 3-4)*
Moderator: *Utku Kandemir, MD*
Faculty: *Michael J. Gardner, MD; Michael D. McKee, MD* and *Milan K. Sen, MD*

2 Minutes - 2 Slides: Tips and Tricks for Nailing and Plating Long Bone Fractures *(Room 1-2)*
Moderator: *Pierre Guy, MD*
Faculty: *Matt L. Graves, MD; Thomas F. Higgins, MD; Christian Krettek, MD, FRACS* and *David C. Templeman, MD*

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

FRIDAY, OCTOBER 17, 2014

6:30 – 7:45 am **SKILLS LABS** *Tickets Required*

(SL1) **SIGN Fracture Care International** *(Room 13)*
Lab Leader: *Lewis G. Zirkle Jr, MD*
Faculty: *Larry (Hilario) Diaz, MD; Justin C. Haller, MD; Henry Ndasi, MD; John Staeheli, MD; Paul S. Whiting, MD; Frederic Wilson, MD and Patrick Yoon, MD*

(SL2) **IM Fixation of Proximal Tibial Fractures** *(Room 14)*
Lab Leader: *Roy Sanders, MD*
Faculty: *Daniel R. Dziadosz, MD; Steven P. Haman, MD; Joshua Langford, MD; William M. Ricci, MD and Anjan R. Shah, MD*

(Ballroom B/C)

8:00 – 9:03 am

SCIENTIFIC PAPER SESSION II
HIP/FEMUR

Moderators - Gilbert R. Ortega, MD, MPH & Hrayr G. Basmajian, MD

8:00 am
(p. 231)
PAPER #44

Prospective, Randomized Evaluation of Optimal Implant Position of Gamma3 and PFNA for the Treatment of AO/OTA 31-A2 Fractures: Is Central Positioning Always the Best?
James N. Irvine Jr, MD[1]*; Jennifer L. D'Auria, BS*[1]*; Constantin Dlaska, MD*[2]*; Julia Kottstorfer, MD*[2]*; Harald Wolf, MD*[2]*; Stefan Hajdu, MD*[2]*; Harald K. Widhalm, MD*[2]*;*
[1]*University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA;*
[2]*Medical University of Vienna, Vienna, Austria*

8:06 am
(p. 233)
PAPER #45

Incidence, Magnitude, and Predictors of Shortening in Young Femoral Neck Fractures
Gerard P. Slobogean, MD, MPH, FRCSC*; David J. Stockton, MD; Andrew Yamada, BSc; Henry M. Broekhuyse, MD; PiotrA. Blachut, MD; Peter J. O'Brien, MD, FRCSC; Pierre Guy, MD; Kelly A. Lefaivre, MD; University of British Columbia, Vancouver, British Columbia, Canada*

8:12 am
(p. 235)
PAPER #46

Cephalomedullary Nail Fixation of Intertrochanteric Fractures: Are Two Proximal Screws Better than One?
Rafael Serrano-Riera, MD*; James A. Blair, MD; Katherine Downes, PhD; Roy Sanders, MD;*
Orthopaedic Trauma Service, Florida Orthopaedic Institute, Tampa, Florida, USA

8:18 am Discussion

See pages 99 - 147 for financial disclosure information.

8:23 am
(p. 237)
PAPER #47

Management and Outcomes of Femoral Head Fractures
John A. Scolaro, MA, MD[1]*; Geoff Marecek, MD*[2]*; Reza Firoozabadi, MD*[3]*;*
James C. Krieg, MD[4]*; Milton Lee (Chip) Routt, MD*[5]*;*
[1]*University of California, Irvine, Orange, California, USA;*
[2]*University of Southern California–Los Angeles, California, USA;*
[3]*Harborview Medical Center, University of Washington, Seattle, Washington, USA;*
[4]*Rothman Institute, Thomas Jefferson University, Philadelphia, Pennsylvania, USA;*
[5]*The University of Texas–Health Sciences Center at Houston, Houston, Texas, USA*

8:29 am
(p. 239)
PAPER #48

The Clinical Study of the Treatment of Femoral Shaft Nonunions After Nailing with Augmentation Plating Versus Exchange Nailing
Bosong Zhang, MD*; Yunbang Liang, MD; Xiaofeng Gong, MD; Manyi Wang, MD;*
Jishuitan Hospital, Beijing, China

8:35 am
(p. 240)
PAPER #49

The Results of a Systematic Approach to Exchange Nailing for the Treatment of Aseptic Femoral Nonunions
Eli A. Swanson, MD; Eli C. Garrard, MD; Derek T. Bernstein, MD;
Daniel P. O'Connor, PhD*; Mark R. Brinker, MD;*
Fondren Orthopedic Group, Texas Orthopedic Hospital, Houston, Texas, USA

8:41 am

Discussion

8:46 am
(p. 241)
PAPER #50

Working Length and Proximal Screw Constructs in Plate Osteosynthesis of Distal Femur Fractures
William H. Harvin, MD; Gregory J. Della Rocca, MD, PhD;
Yvonne M. Murtha, MD; David A. Volgas, MD; James P. Stannard, MD;
Brett D. Crist, MD*;*
University of Missouri, Columbia, Missouri, USA

8:52 am
(p. 242)
PAPER #51

Construct Characteristics Predisposing to Nonunion After Locked Lateral Plating of Distal Femur Fractures
Edward K. Rodriguez, MD, PhD[1,2]*; Lindsay M. Herder*[1,2]*;*
Jordan Morgan, BS[2,3]*; David Zurakowski, PhD*[2,4]*; Michael J. Weaver, MD*[2,3]*;*
Paul T. Appleton, MD[1,2]*; Mark S. Vrahas, MD*[2,5]*;*
[1]*Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA;*
[2]*Harvard Orthopedic Trauma Service, Boston, Massachusetts, USA;*
[3]*Brigham and Women's Hospital, Boston, Massachusetts, USA;*
[4]*Children's Hospital,, Boston, Massachusetts, USA;*
[5]*Massachusetts General Hospital, Boston, Massachusetts, USA*

8:58 am

Discussion

9:03 am - 9:33 am

Refreshment Break
Visit Scientific Posters & Technical Exhibits
(All in West Hall)

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

FRIDAY, OCTOBER 17, 2014

9:33 am - 10:48 am **Concurrent Breakout Sessions**
(Notes p. 244) ***(Mini Symposia, Skills Labs and General Session run concurrently.)***
Mini-Symposia
Skills Labs
Scientific Paper Session III: Geriatric

9:33 – 10:48 am **MINI SYMPOSIA** ***No Tickets Required***

OTA Trauma Registry Database *(Room 1-2)*
Moderators: *Julie Agel, ATC* and *Douglas W. Lundy, MD*

Circular Fixation: Applications for the Trauma Surgeon *(Room 3-4)*
Moderator: *Kevin J. Pugh, MD*
Faculty: *Animesh Agarwal, MD; Joseph R. Hsu, MD* and *J. Tracy Watson, MD*

Rib Fracture Fixation and the Surgical Management of Flail Chest Injuries: State of the Art *(Room 5-6)*
Moderator: *Michael D. McKee, MD*
Faculty: *Peter Althausen, MD; Niloofar Dehghan, MD; John C. Mayberry, MD; Aaron Nauth, MD; Emil H. Schemitsch, MD* and *Gerard P. Slobogean, MD*

9:33 – 10:48 am **SKILLS LABS** ***Tickets Required***

(SL3) **ORIF Distal Tibia and Fibula Fractures** *(Room 15)*
Leader: *Matt L. Graves, MD*
Faculty: *David P. Barei, MD, FRCSC; Patrick F. Bergin, MD; Christopher Finkemeier, MD; Jason W. Nascone, MD* and *Timothy G. Weber, MD*

(SL4) **ORIF Distal Radius Fractures** *(Room 16)*
Leader: *David C. Ring, MD*
Faculty: *Cory A. Collinge, MD; Brett D. Crist, MD; Andrew D. Duckworth, MD; Saqib Rehman, MD; Melvin P. Rosenwasser, MD; Andrew H. Schmidt, MD* and *Thomas F. Varecka, MD*

See pages 99 - 147 for financial disclosure information.

(Ballroom B/C)

9:33 – 10:48 am

SCIENTIFIC PAPER SESSION III
GERIATRIC

Moderators - Pierre Guy, MD & Stephen L. Kates, MD

9:33 am
(p. 246)
PAPER #52

Hip Fractures Are Risky Business: An Analysis of the NSQIP Data
Rachel V. Thakore, BS; ***Cesar S. Molina, MD****; Eduardo J. Burgos, MD;*
William T. Obremskey, MD, MPH, MMHC; Manish K. Sethi, MD;
Vanderbilt University, Nashville, Tennessee, USA

9:39 am
(p. 248)
PAPER #53

Trauma Triage Scores Inadequately Assess Geriatric Patients
Matthew Wilson, MD[1]*; Sanjit R. Konda, MD*[2]*; Rachel Seymour, PhD*[1]*;*
Madhav A. Karunakar, MD[1]*; Carolinas Trauma Network Research Group*[1]*;*
[1]*Carolinas Medical Center, Charlotte, North Carolina, USA;*
[2]*NYU Hospital for Joint Diseases, New York, New York, USA*

9:45 am
(p. 250)
PAPER #54

Development and Validation of a Geriatric Trauma Triage Score
Sanjit R. Konda, MD[1]*; Rachel Seymour, PhD*[2]*; Arthur Manoli III, BS*[1]*;*
Madhav A. Karunakar, MD[2]*; Carolinas Trauma Network Research Group*[2]*;*
[1]*NYU Hospital for Joint Diseases, New York, New York, USA;*
[2]*Carolinas Medical Center, Charlotte, North Carolina, USA*

9:51 am

Discussion

9:56 am
(p. 252)
PAPER #55

Does Anesthesia Type Influence Risk of Perioperative Complications in Hip Fracture Surgery?
Rachel V. Thakore, BS; Cesar S. Molina, MD; ***Paul S. Whiting, MD****;*
William T. Obremskey, MD, MPH, MMHC; Manish K. Sethi, MD;
Vanderbilt University, Nashville Tennessee, USA

10:02 am
(p. 254)
PAPER #56

Efficacy of Scheduled Intravenous Acetaminophen Pain Management Protocol in Hip Fractures
Alexander J. Bollinger, MD[1,2]*; Paul D. Butler, MD*[1,2]*; Matthew S. Nies, MD*[2]*;*
Debra L. Sietsema, PhD[2,3]*; Clifford B. Jones, MD*[2,3]*; Terrence J. Endres, MD*[2,3]*;*
[1]*Grand Rapids Medical Education Partners, Grand Rapids, Michigan, USA;*
[2]*Michigan State University College of Human Medicine,*
Grand Rapids, Michigan, USA;
[3]*Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA*

10:08 am
(p. 255)
PAPER #57

The Effect of Preoperative Transthoracic Echocardiogram on Mortality and Surgical Timing in Elderly Hip Fracture Patients
Kevin Luttrell, MD[1]*; Arvind D. Nana, MD*[1,2]*;*
[1]*John Peter Smith Hospital Orthopaedic Surgery Residency Program,*
Fort Worth, Texas, USA;
[2]*Harris Methodist Hospital, Fort Worth, Texas, USA*

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

FRIDAY, OCTOBER 17, 2014

10:14 am
(p. 257)
PAPER #58

Improving Care for Older Patients with Hip Fracture

Christopher G. Moran, MD, FRCS(Ed)[1]*; Chris Boulton, BA*[2]*; Antony Johansen*[2]*;*
Robert Wakeman[2]*; Keith Willett, MD, FRCS*[3]*;*
[1]*NHS England, Nottingham University Hospital, Nottingham, United Kingdom;*
[2]*National Hip Fracture Database, Royal College of Physicians,*
London, United Kingdom;
[3]*NHS England, Oxford, United Kingdom*

10:20 am Discussion

10:25 am
(p. 258)
PAPER #59

Surgery Versus Cast Immobilization for Displaced Intra-Articular Distal Radius Fractures in Elderly Patients: A Randomized Controlled Multicenter Trial

Christoph Bartl[1]*; Dirk Stengel, MD, PhD, MSc*[2]*; Thomas Bruckner, Dipl Math*[3]*;*
Florian Gebhard, MD, PhD[1]*; the ORCHID Study Group;*
[1]*Department of Orthopaedic Trauma Surgery, Ulm University, Ulm, Germany;*
[2]*Department of Orthopaedic Trauma Surgery and Clinical Research,*
Unfallkrankenhaus Berlin, Berlin, Germany;
[3]*Department of Biostatistics, Heidelberg University, Heidelberg, Germany*

10:31 am
(p. 259)
PAPER #60

Determinants of Functional Outcome in Distal Radius Fractures in High Functioning Elderly Patients

Jeremie Larouche, MD, FRCSC*; Jeffrey Pike, MD;*
Gerard P. Slobogean, MD, MPH, FRCSC; Pierre Guy, MD;
Henry M. Broekhuyse, MD; Peter J. O'Brien, MD, FRCSC; Kelly A. Lefaivre, MD;
Division of Orthopaedic Trauma, Department of Orthopaedic Surgery,
University of British Columbia, Vancouver, British Columbia, Canada

10:37 am
(p. 261)
PAPER #61

A Comparison of Primary Total Elbow Arthroplasty Versus Secondary Total Elbow Arthroplasty (Following Failed Internal Fixation) for Distal Humeral Fractures of the Elderly

James M. Dunwoody MD, FRCSC; Justin L. Hodgins, MD;
Milena R. Vicente, RN, CCRP*; Laura Schemitsch, BA; Patrick Henry, MD, FRCSC;*
Jeremy Hall, MD, FRCSC; Michael D. McKee, MD, FRCSC;
St. Michael's Hospital and the University of Toronto, Toronto, Ontario, Canada

10:43 am Discussion

See pages 99 - 147 for financial disclosure information.

10:48 am – 11:11 am (Notes p. 263)

Guest Nation – Brazil

The OTA is honored to welcome Brazil as the 2014 Guest Nation. We are pleased to have the opportunity for collaboration with our Brazilian colleagues, and a chance to recognize their contributions and achievements.

10:48 am

Best International Forum Paper:
What Is the Cell Composition and Characteristics of Fibrous Tissue Harvested from the Nonunion Site of Long Bone Atrophic Nonunions?
Richard Cuthbert, BSc; Ahmed Lotfy; Hiang Boon Tan, MBBS; Elena Jones, PhD; ***Peter Giannoudis, MD***

10:56 am

Guest Nation Introduction
Ross K. Leighton, MD

10:59 am

Guest Nation Presentation
Tito Rocha, MD
National Institute of Traumatology and Orthopaedics
Ministry of Health, Rio de Janeiro, Brazil

"Evolution of Trauma Care System in Brazil: Current Status"

11:07 am Discussion

11:11 am – 11:41 am (Notes p. 264)

John Border, MD Memorial Lecturer

(General Session Room - (Ballroom B/C)

Andrew R. Burgess, MD
Professor, Vice Chair UT Health Medical School, Houston, Texas

"Long Term Careers in Orthopaedic Trauma: System Design and Career Development"

Introduction: Stephen H. Sims, MD

11:41 am - 12:40 pm Lunch
Visit Scientific Posters & Technical Exhibits
(All in West Hall)

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

FRIDAY, OCTOBER 17, 2014

11:41 am – 12:40 pm

New Member Luncheon
(tickets required)
(Room 10-11)

11:41 am – 12:40 pm

Kathy Cramer, MD Memorial
Women in Orthopaedic Trauma Luncheon *(tickets required)*
(The Landing)

Chairs: *Laura S. Phieffer, MD and Lisa M. Truchan, MD*

11:55 am – 12:40 pm **GUIDED POSTER TOURS** ***Tickets Required***

(PT1) **International** *(West Hall)*
Guide: *Peter V. Giannoudis, MD*

(PT2) **Hip, Femur, Geriatric** *(West Hall)*
Guide: *Michael R. Baumgaertner, MD*

12:41 – 2:19 pm **SYMPOSIUM II: DAMAGE CONTROL ORTHOPAEDICS – WHERE ARE WE AFTER A DECADE (CENTURY) OF DEBATE AND RESEARCH?**

(Notes p. 265) Moderators: *Todd O. McKinley, MD* *(Ballroom B/C)*
Steven A. Olson, MD
Faculty: *Carl J. Hauser, MD* *Hans Christoph Pape, MD*
Robert V. O'Toole, MD

12:41 pm **Historical Perspective - Early Total Care and Ortho Damage Control**
Steven A. Olson, MD

12:52 pm **Mitchondrial DAMPs and Inflammation After Trauma**
Carl J. Hauser, MD

1:03 pm **Basic & Clinical Science - Systemic Response to Injury and the Polytrauma Patient**
Hans Christoph Pape, MD

1:14 pm **Translating Basic Science to Clinical Science**
Todd O. McKinley, MD

1:25 pm **Future Directions and Opportunities in Damage Control**
Robert V. O'Toole, MD

1:36 pm Discussion

See pages 99 - 147 for financial disclosure information.

1:56 pm
(p. 266)
PAPER #62

Evaluation of the Relationship Between Fractures and Hyponatremia
Kalyani Murthy, MD, MS[1]*; Navneet Pala, MD*[1]*; Olexandra Koshkina, MD, MS*[1]*;*
Janis Breeze, MPH[2]*; Jessica Paulus, ScD*[2]*; Andrew Marcantonio, DO, MBA*[1]*;*
Mary Beth Hodge, MD[1]*;*
[1]*Lahey Health and Medical Center, Burlington, Massachusetts, USA;*
[2]*Tufts Clinical and Translational Science Institute, Tufts University, and Institute for Clinical Research and Health Policy Studies, Tufts Medical Center, Boston, Massachusetts, USA*

2:02 pm
(p. 267)
PAPER #63

Can Thrombelastography Predict Venous Thromboembolic Events in Patients with Severe Extremity Trauma?
Prism S. Schneider, MD, PhD[1]*; Bryan A. Cotton, MD*[2]*; Matthew Galpin, RC*[1]*;*
Zayde Radwan, MD[1]*; John W. Munz, MD*[1]*; Timothy S. Achor, MD*[1]*;*
Mark L. Prasarn, MD[1]*;* ***Joshua L. Gary, MD***[1]*;*
[1]*Department of Orthopaedic Surgery, University of Texas Health Science Center, Houston, Texas, USA;*
[2]*Department of Surgery and the Center for Translational Injury Research (CeTIR), University of Texas Health Science Center, Houston, Texas, USA*

2:08 pm
(p. 269)
PAPER #64

Prediction of Pulmonary Embolism in Trauma Patients: A Risk Assessment Model Based Upon 38,000 Patients
Sheena R. Black, MD[1]*; Jeffrey T. Howard, MA*[2]*; Paul C. Chin, MD, PhD*[1]*;*
Adam J. Starr, MD[1]*;*
[1]*Department of Orthopaedic Surgery, University of Texas Southwestern Medical Center, Dallas, Texas, USA;*
[2]*Department of Demography, University of Texas at San Antonio, San Antonio, Texas, USA*

2:14 pm Discussion

(Ballroom B/C)

2:19 – 3:30 pm

SCIENTIFIC PAPER SESSION IV
PELVIS AND ACETABULUM

Moderators - Stephen Kottmeier, MD & M.L. Chip Routt, MD

2:19 pm
(p. 270)
PAPER #65

Role of Acute Negative-Pressure Wound Therapy Over Primarily Closed Surgical Incisions in Hip, Pelvis, and Acetabular Fracture Surgery: A Prospective Randomized Trial
Brett D. Crist, MD, FACS*; Michael S. Khazzam, MD;*
Gregory J. Della Rocca, MD, PhD; Yvonne M. Murtha, MD; James P. Stannard, MD;
University of Missouri, Columbia, Missouri, USA

2:25 pm
(p. 271)
PAPER #66

Early Treatment of Associated Pattern Acetabular Fractures Via an Anterior Approach Does Not Increase Blood Loss or Need for Transfusion
Cesar S. Molina, MD*; Priya G. Sivasubramaniam, BA; Andrew R. Fras, MD;*
Chad M. Corrigan, MD; Hassan D. Mir, MD, MBA; Jason M. Evans, MD;
Vanderbilt University, Nashville, Tennessee, USA

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

FRIDAY, OCTOBER 17, 2014

2:31 pm
(p. 272)
PAPER #67

The Value of Thromboelastography in Orthopaedic Trauma Pelvic Fracture Resuscitation

Christiaan N. Mamczak, DO[1,2]*; Bryan A. Boyer, MD*[1,2]*; Scott Thomas, MD*[2,3]*;*
Braxton Fritz, BS[4]*; Edward Evans, BA, CCP*[2]*; Benjamin Speicher, BA*[2]*;*
Mark Walsh, MD[2,4]*;*
[1]*Beacon Orthopaedic Trauma Surgery, South Bend, Indiana, USA;*
[2]*Memorial Hospital of South Bend, South Bend, Indiana, USA;*
[3]*General & Vascular Surgery PC, South Bend, Indiana, USA;*
[4]*Indiana University School of Medicine, South Bend, Indiana, USA*

2:37 pm Discussion

2:42 pm
(p. 274)
PAPER #68

Posterior Wall Acetabular Fractures and Stability

Reza Firoozabadi, MD, MA[1]*; Clay A. Spitler, MD*[1]*; Calvin L. Schlepp, MD*[1]*;*
Benjamin Hamilton, MS[2]*; Julie Agel, MA*[1]*; Paul Tornetta III, MD*[3]*;*
[1]*Harborview Medical Center/University of Washington, Seattle, Washington, USA;*
[2]*Case Western Reserve University, Cleveland, Ohio, USA;*
[3]*Boston University School of Medicine, Boston, Massachusetts, USA*

2:48 pm
(p. 276)
PAPER #69

Nonoperative Treatment of Posterior Wall Fractures of the Acetabulum After Dynamic Stress Examination Under Anesthesia: Revisited

Andrew McNamara, MD*; John Boudreau, MD; Berton R. Moed, MD;*
Saint Louis University, Saint Louis, Missouri, USA

2:54 pm Discussion

2:59 pm
(p. 278)
PAPER #70

CT Scan After Acetabulum Fracture ORIF: Is There Value?

Michael T. Archdeacon, MD, MSE; ***Steven K. Dailey, MD;*** *Kaylan N. McClary, BS;*
Department of Orthopaedic Surgery, University of Cincinnati, Cincinnati, Ohio, USA

3:05 pm
(p. 279)
PAPER #71

Neurologic Injury in Operatively Treated Acetabular Fractures

Yelena Bogdan, MD[1]*; Paul Tornetta III, MD*[1]*; Clifford B. Jones, MD, FACS*[2]*;*
Emil H. Schemitsch, MD[3]*; Daniel S. Horwitz, MD*[4]*; David Sanders, MD*[5]*;*
Reza Firoozabadi, MD[6]*; Juan de Dios Robinson, MD*[7]*; Andrew Marcantonio, MD*[8]*;*
[1]*Boston University Medical Center, Boston, Massachusetts, USA;*
[2]*Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA;*
[3]*St Michael's Hospital, Toronto, Ontario, Canada;*
[4]*Geisinger Health System, Danville, Pennsylvania, USA;*
[5]*London Health Sciences Center, London, Ontario, Canada;*
[6]*Harborview Medical Center, Seattle, Washington, USA;*
[7]*Dalhousie University, Halifax, Nova Scotia, Canada;*
[8]*Lahey Clinic, Burlington, Massachusetts, USA*

3:11 pm Discussion

3:16 pm
(p. 281)
PAPER #72

Does Removal of the Symphyseal Cartilage in Symphyseal Dislocations Have Any Effect on Final Alignment and Hardware Failure?

Paul Tornetta III, MD[1]*;* ***Kyle Lybrand, MD***[1]*; John Kurylo, MD*[1]*;*
Jordan Gross, BS[1]*; David C. Templeman, MD*[2]*;*
[1]*Boston University Medical Center, Boston, Massachusetts, USA;*
[2]*Hennepin County Medical Center, Minneapolis, Minnesota, USA*

See pages 99 - 147 for financial disclosure information.

3:22 pm
(p. 283)
PAPER #73

Biomechanical Analysis of Lumbopelvic Fixation Versus Posterior Sacroiliac and Anterior Pubic Symphysis Fixation in an Unstable Vertical Sacral Fracture Cadaveric Model

Ehsan Jazini, MD[1]*; Oliver O. Tannous, MD*[1]*; Eric Belin, MD*[1]*;*
Christopher M. Hoshino, MD[1]*; Robert V. O'Toole, MD*[1]*; Noelle Klocke, MS*[2]*;*
Mir Hussain, MS[2]*; Brandon Bucklen, PhD*[2]*; Steven C. Ludwig, MD*[1]*;*
[1]*University of Maryland Orthopaedics Associates/R Adams Cowley Shock Trauma, Baltimore, Maryland, USA;*
[2]*Globus Medical, Audubon, Pennsylvania, USA*

3:28 pm — Discussion

3:33 pm - 4:00 pm — Refreshment Break
Visit Scientific Posters & Technical Exhibits
(All in West Hall)

4:00 - 5:35 pm
(Notes p. 285)

Concurrent Sessions
(Mini Symposia and General Session run concurrently.)
Mini Symposia
Scientific Paper Sessions V and VI

4:00 – 5:35 pm

MINI SYMPOSIA

From the Operating Room to the Boardroom - Applying an MBA to Benefit Orthopaedic Traumatology *(Room 1-2)*
Moderator: *Hassan R. Mir, MD, MBA*
Faculty: *Peter L. Althausen, MD, MBA; M. Bradford Henley, MD, MBA; Douglas W. Lundy, MD, MBA; Craig S. Roberts, MD, MBA* and *George V. Russell, MD, MBA*

Biologic Solutions in the Management of Nonunions and Patients at Risk for Delayed Healing *(Room 3-4)*
Moderator: *Samir Mehta, MD*
Faculty: *Jaimo Ahn, MD, PhD; Robert P. Dunbar Jr, MD; James C. Krieg, MD* and *Robert D. Zura, MD*

History of Nailing *(Room 5-6)*
Moderator: *Philip Procter, PhD*
Faculty: *Thomas A. (Toney) Russell, MD*

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

(Ballroom B/C)

4:00 – 4:32 pm

SCIENTIFIC PAPER SESSION V
POLYTRAUMA

Moderators - Michael J. Gardner, MD & Robert P. Dunbar Jr, MD

4:00 pm
(p. 286)
PAPER #74

Clinical Indications for CT Angiography in Lower Extremity Trauma
Joseph T. Patterson, MD[1]*; Thomas Fishler, MD*[2]*; Daniel D. Bohl, MPH*[3]*;*
Michael P. Leslie, DO[3]*;*
[1]*University of California, San Francisco, Department of Orthopaedic Surgery, San Francisco, California, USA;*
[2]*Harborview Medical Center, Seattle, Washington, USA;*
[3]*Yale University School of Medicine, Department of Orthopaedics and Rehabilitation, New Haven, Connecticut, USA*

4:06 pm
(p. 288)
PAPER #75

Immediate Weight Bearing as Tolerated Has Improved Outcomes Compared to Non-Weight Bearing After Surgical Stabilization of Midshaft Clavicle Fractures in Polytrauma Patients
Brian P. Cunningham, MD[1] *; Gilbert R. Ortega, MD*[2]*; Anthony S. Rhorer, MD*[1]*;*
Brian Miller, MD[1]*; Hrayr Basmajian, MD*[3]*; Ryan McLemore, PhD*[1]*;*
Kelly A. Jackson, NP-C[4]
[1]*Banner Good Samaritan, Phoenix, Arizona, USA;*
[2]*Sonoran Orthopedic Trauma Surgeons, Scottsdale, Arizona, USA;*
[3]*Loma Linda University Medical Center, Loma Linda, California, USA;*
[4]*Scottsdale Healthcare, Scottsdale, Arizona, USA*

4:12 pm
(p. 290)
PAPER #76

Management of Clavicle Fractures in Patients with Thoracic Trauma
Geoffrey S. Marecek, MD[1]*; David P. Barei, MD*[2]*; Julie Agel, MA, ATC*[2]*;*
Thomas K. Varghese, MD, MA, FACS[2]*; Daphne M. Beingessner, MD*[2]*;*
[1]*University of Southern California, Los Angeles, California, USA;*
[2]*Harborview Medical Center, Seattle, Washington, USA*

4:18 pm
(p. 291)
PAPER #77

The Association of Ipsilateral Rib Fracture(s) with Displacement of Midshaft Clavicle Fractures
Matthew Ellington, MD*; Daniel Jupiter, PhD; Kindyle L. Brennan, PhD;*
Michael L. Brennan, MD; Daniel L. Stahl, MD;
Scott and White Memorial Hospital, Temple, Texas, USA

4:25 pm Discussion

See pages 99 - 147 for financial disclosure information.

(Ballroom B/C)

4:32 – 5:35 pm

SCIENTIFIC PAPER SESSION VI
PEDIATRICS/RECONSTRUCTION

Moderators - David J. Hak, MD & Cyril Mauffrey, FRCS (ORTHO), MD

4:32 pm
(p. 292)
PAPER #78

Is There a Higher Risk of Infection with Delayed Treatment of Pediatric Seymour Fractures?
Bryan A. Reyes, MD; *Christine A. Ho, MD;*
Children's Medical Center-Texas Scottish Rite Hospital for Children, Dallas, Texas, USA

4:38 pm
(p. 293)
PAPER #79

All Lateral Versus Medial and Lateral Flexible Intramedullary Nails for the Treatment of Pediatric Femoral Shaft Fractures
J. Matthew Cage, DO; Sheena R. Black, MD; Robert L. Wimberly, MD; Jay B. Cook, MD; W. Taylor Gheen, BA; ***Anthony I. Riccio, MD****;*
Childrens Medical Center/Texas Scottish Rite Hospital for Children, Dallas, Texas, USA

4:44 pm
PAPER #80

WITHDRAWN

4:50 pm

Discussion

4:55 pm
(p. 295)
PAPER #81

Pediatric Pelvic Ring Injuries: How Benign Are They?
Christiane G. Kruppa, MD[1,2]*; Justin D. Khoriaty, BS*[3]*;*
Debra L. Sietsema, PhD[3,4]*; Marcel Dudda, MD*[1]*;*
Clifford B. Jones, MD, FACS[3,4]*;*
[1]*Department of Surgery, BG-University Hospital Bergmannsheil, Bochum, Germany;*
[2]*Grand Rapids Medical Education Partners, Grand Rapids, Michigan, USA;*
[3]*Michigan State University, Grand Rapids, Michigan, USA;*
[4]*Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA*

5:01 pm
(p. 297)
PAPER #82

Iliosacral Screw Pathways in the Pediatric Population: Are There Safe Bony Corridors?
Joshua L. Gary, MD[1]*; Matthew B. Burn, MD*[2]*; Michael Holzman, MD*[1]*;*
John W. Munz, MD[1]*; John Heydemann, MD*[1]*; Matthew Galpin, RC*[1]*;*
Timothy S. Achor, MD[1]*; Manickam Kumaravel, MD, FRCS*[3]*;*
[1]*University of Texas Health Science Center–Houston, Department of Orthopaedic Surgery, Houston, Texas, USA;*
[2]*Houston Methodist Hospital–Texas Medical Center, Houston, Texas, USA;*
[3]*University of Texas Health Science Center–Houston, Department of Radiology, Houston, Texas, USA*

5:07 pm

Discussion

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

FRIDAY, OCTOBER 17, 2014

5:12 pm
(p. 299)
PAPER #83

Risk of Hip Arthroplasty After Open Reduction Internal Fixation of a Fracture of the Acetabulum: A Matched Cohort Study
Sam Si-Hyeong Park, MD; *Patrick Henry, MD; David Wasserstein, MD; Michael Paterson, MSc; Hans J. Kreder, MD; Richard J. Jenkinson, MD; Sunnybrook Health Sciences Center, University of Toronto, Toronto, Ontario, Canada*

5:18 pm
(p. 301)
PAPER #84

Clinical Outcome and Survival of Total Hip Arthroplasty After Acetabular Fracture: A Case-Control Study
Zachary Morison, MSc; *Dirk Jan Moojen, MD; Aaron Nauth, MD; Jeremy Hall, MD; Michael D. McKee, MD; James P. Waddell, MD; Emil H. Schemitsch, MD; St. Michael's Hospital, University of Toronto, Toronto, Ontario, Canada*

5:24 pm
(p. 303)
PAPER #85

A Predictive Model for Complications After Flap Coverage of Open Tibia Fractures
Brian M. Weatherford, MD[1]; *Andrew G. Dubina, BS*[1]; *Renan C. Castillo, PhD*[2]; *Jean-Claude D'Alleyrand, MD*[1,3]; *Raymond Pensy, MD*[1]; *W. Andrew Eglseder, MD*[1]; *Robert V. O'Toole, MD*[1]; [1]*R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA;* [2]*Center for Injury Research & Policy, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA;* [3]*Walter Reed National Military Medical Center, Bethesda, Maryland, USA*

5:30 pm — Discussion

5:35 pm — Adjourn to Poster Tours

5:35 – 6:30 pm

OTA Military Reception
(*Landing*)
Hosted by the OTA Board of Directors and the OTA Military Committee
(All Active Duty Military, Retired Military and all Landstuhl Distinguished Visiting Scholar participants invited.)

5:45 – 6:30 pm — **'SUDS AND SCIENCE' GUIDED POSTER TOURS** — ***Tickets Required***

(PT3) **Foot and Ankle** *(West Hall)*
Guide: *Paul Tornetta III, MD*

(PT4) **Upper Extremity** *(West Hall)*
Guide: *Michael D. McKee, MD*

See pages 99 - 147 for financial disclosure information.

ORTHOPAEDIC TRAUMA ASSOCIATION

2014 Annual Meeting

Saturday, October 18, 2014

6:00 am	**Speaker Ready Room** *(2nd Floor)*
6:15 am	**Registration** *(2nd Floor)*
6:30 am	**Scientific Posters** (Technical Exhibits Open at 9:00 am) *(West Hall)*
	Continental Breakfast *(Outside Breakout Session Rooms)*
6:30 am - 7:45 am (Notes p. 305)	**Concurrent Breakout Sessions** ***(Case Presentations and Skills Labs run concurrently.)*** Case Presentations Skills Labs

6:30 – 7:45 am **CASE PRESENTATIONS** *No Tickets Required*

Humeral Shaft Fractures: When and How to Fix Surgically (Was Sarmiento Wrong?) *(Room 1-2)*
Moderator: *Lisa K. Cannada, MD*
Faculty: *Clifford B. Jones, MD* and *William T. Obremskey, MD*

Periprosthetic Fractures *(Ballroom B-C)*
Moderator: *Erik Kubiak, MD*
Faculty: *George J. Haidukewych, MD; Mark C. Reilly, MD* and *Mark S. Vrahas, MD*

Distal Femur Cases *(Room 3-4)*
Moderator: *Jason W. Nascone, MD*
Faculty: *Christopher Doro, MD; Michael J. Gardner, MD; Conor P. Kleweno, MD* and *Hobie Summers, MD*

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

SATURDAY, OCTOBER 18, 2014

6:30 – 7:45 am **SKILLS LABS** *Tickets Required*

(SL5) **Knee or Ankle Spanning Ex-Fix** *(Room 13)*
Leader: *Edward A. Perez, MD*
Faculty: *Hassan R. Mir, MD; Amer J. Mirza, MD; Matthew I Rudloff, MD; John C. Weinlein, MD* and *William Wood Cross, MD*

(SL6) **ORIF of Anterior Acetabular Fractures** *(Room 14)*
Leader: *Michael T. Archdeacon, MD*
Faculty: *Cory A. Collinge, MD; Hassan Riaz Mir, MD; Milton L. "Chip" Routt, MD; Nirmal C. Tejwani, MD* and *Rahul Vaidya, MD*

8:00 – 9:30 am **SYMPOSIUM III: TIBIAL PLATEAU FRACTURES: OPTIMIZING SURGICAL MANAGEMENT AND TECHNIQUE IN 2014**

(Notes p. 307) Moderator: *Michael D. McKee, MD* *(Ballroom B/C)*
Faculty: *Ross K. Leighton, MD*, *Aaron Nauth, MD*, *Emil H. Schemitsch, MD*, *Paul Tornetta III, MD*, *Mark S. Vrahas, MD*

8:00 am **Lateral Plateau Fractures: Evidence Based Management**
Ross K. Leighton, MD

8:10 am **Bicondylar Plateau Fractures: Single Plate Versus Dual Plate Fixation**
Paul Tornetta, III, MD

8:20 am **Complex Fractures of the Plateau: When to Use a Posterior Approach**
Mark S. Vrahas, MD

8:30 am **Combined Fracture and Ligamentous Injuries: When to Fix Both**
Aaron Nauth, MD

8:40 am **Managing Complications in Tibial Plateau Surgery**
Emil H. Schemitsch, MD

8:50 am Cases and Discussion
All Faculty

9:30 am - 10:00 am Refreshment Break
Visit Scientific Posters & Technical Exhibits
(All in West Hall)

10:00 am - 11:30 am **Concurrent Breakout Sessions**
(Notes p. 308) ***(Mini Symposia and General Session run concurrently.)***
Mini Symposia
Scientific Paper Session VII: Upper Extremity

See pages 99 - 147 for financial disclosure information.

10:00 – 11:30 am

MINI SYMPOSIA

From Good to Great: Improving your Treatment of Acetabular Fractures *(Room 1-2)*
Moderators: *Jaimo Ahn, MD, PhD* and *Samir Mehta, MD*
Faculty: *David L. Helfet, MD; Steven A. Olson, MD; Mark C. Reilly, MD; Milton L. "Chip" Routt, MD* and *Mark S. Vrahas, MD*

Managing Nonunion: Theory and Practice *(Room 3-4)*
Moderator: *Christopher G. Moran, FRCS*
Faculty: *Pierre Guy, MD; R. Malcolm Smith, MD* and *John J. Wixted, MD*

How to Establish and Run a Fragility Fracture Program *(Room 5-6)*
Moderator: *James A. Goulet, MD*
Faculty: *Peter Althausen, MD; Joseph M. Lane, MD; Debra Sietsema, PhD, RN* and *Marc F. Swiontkowski, MD*

(Ballroom B/C)

10:00 am – 12:24 pm

SCIENTIFIC PAPER SESSION VII
UPPER EXTREMITY

Moderators - Robert V. O'Toole, MD & Stephen M. Quinnan, MD

10:00 am
(p. 309)
PAPER #86

Operative Treatment of Dislocated Midshaft Clavicle Fractures: Plate or Intramedullary Pin Fixation? A Randomized Controlled Trial
*Olivier A. van der Meijden, MD[1]; R. Marijn Houwert, MD, PhD[1]; Martijn Hulsmans[1]; **Frans-Jasper G. Wijdicks, PhD[1]**; Marcel G.W. Dijkgraaf, PhD[2]; Sven A.G. Meylaerts, MD, PhD[3]; Eric R. Hammacher, MD, PhD[4]; Michiel H.J. Verhofstad, MD, PhD[5,6]; Egbert J.M.M. Verleisdonk, MD, PhD[1];*
[1]Department of Surgery, Diakonessenhuis, Utrecht, The Netherlands;
[2]Clinical Research Unit, Academic Medical Center, Amsterdam, The Netherlands;
[3]Department of Surgery, Medical Center Haaglanden, The Hague, The Netherlands;
[4]Department of Surgery, St. Antonius Hospital, Nieuwegein, The Netherlands;
[5]Department of Surgery, St. Elisabeth Hospital, Tilburg, The Netherlands;
[6]Department of Surgery, Erasmus Medical Center, Rotterdam, The Netherlands

10:06 am
(p. 310)
PAPER #87

Reconstruction Plate Compared with Flexible Intramedullary Nailing for Midshaft Clavicular Fractures: A Prospective, Randomized Clinical Trial
***Fernando Brandao, MD**; Kodi E. Kojima, MD; Jorge dos Santos Silva, MD; Rames Mattar Jr, MD;*
Department of Orthopedics and Traumatology, University of Sao Paulo, Sao Paulo, Brazil

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

SATURDAY, OCTOBER 18, 2014

10:12 am
(p. 311)
PAPER #88

Does Insurance Status Affect the Management of Acute Clavicle Fractures?
Ryan Bliss, MD; Arthur M. Mora, MHA; ***Peter C. Krause, MD****;*
Louisiana State University Health Science Center, New Orleans, Louisiana, USA

10:18 am

Discussion

10:23 am
(p. 312)
PAPER #89

Long-Term Outcome of Isolated Stable Radial Head Fractures
Andrew D. Duckworth*; Neil R. Wickramasinghe, MBBS;*
Nicholas D. Clement, MRCS Ed; Charles M. Court-Brown, MD;
Margaret M. McQueen, MD;
Edinburgh Orthopaedic Trauma Unit, Royal Infirmary of Edinburgh,
Edinburgh, United Kingdom

10:29 am
(p. 313)
PAPER #90

Radial Head Replacement for Complex Unstable Fractures of the Radial Head
Andrew D. Duckworth*; Neil R. Wickramasinghe, MBBS;*
Nicholas D. Clement, MRCS Ed; Charles M. Court-Brown, MD;
Margaret M. McQueen, MD;
Edinburgh Orthopaedic Trauma Unit, Royal Infirmary of Edinburgh,
Edinburgh, United Kingdom

10:35 am

Discussion

10:40 am
(p. 314)
PAPER #91

Early Mobilization Versus Plaster Immobilization of Simple Elbow Dislocations: Results of the FuncSiE Multicenter Randomized Clinical Trial
Gijs I.T. Iordens, MD[1]; Esther M.M. Van Lieshout, PhD[1]; Niels W.L. Schep[2];
Jeroen De Haan[3]; Wim E. Tuinebreijer, MD, PhD, MSc, MA[1]; Ed F. Van Beeck[4];
Peter Patka, MD, Dmed, PhD[5]; Michael H.J. Verhofstad[1];
Dennis Den Hartog, PhD[1]*; (on behalf of FuncSiE trial investigators)*
[1]Trauma Research Unit, Department of Surgery, Erasmus MC,
University Medical Center Rotterdam, Rotterdam, The Netherlands;
[2]Trauma Unit, Department of Surgery, Academic Medical Center,
Amsterdam, The Netherlands;
[3]Department of Surgery, Westfriesgasthuis, Hoorn, The Netherlands;
[4]Department of Public Health, Erasmus MC, University Medical Center Rotterdam,
Rotterdam, The Netherlands;
[5]Department of Emergency Medicine, Erasmus MC, University Medical Center
Rotterdam, Rotterdam, The Netherlands

10:46 am
(p. 315)
PAPER #92

Manipulation Under Anesthesia as a Treatment of Posttraumatic Elbow Stiffness
Daniel H. Doty, MD*; Clay A. Spitler, MD; Peter J. Nowotarski, MD;*
D. Marshall Jemison, MD;
University of Tennessee College of Medicine Chattanooga,
Chattanooga, Tennessee, USA

10:52 am
(p. 316)
PAPER #93

Galeazzi Fractures: Are Distal Radioulnar Joint (DRUJ) Injuries Predicted by Current Guidelines?
Paul Tornetta, III, MD; ***Tony Tsismenakis, MD****;*
Boston University Medical Center, Boston, Massachusetts, USA

See pages 99 - 147 for financial disclosure information.

10:58 am Discussion

11:03 am (p. 318) PAPER #94

Modern Treatment of 3 and 4-Part Proximal Humerus Fractures ORIF Demonstrates Better Range of Shoulder Motion Than Reverse Total Shoulder Arthroplasty

Kenneth A. Egol, MD; *Christina Capriccioso, BSE; Thomas Wright, MD; Pierre Henri Flurin, MD; Joseph D. Zuckerman, MD; NYU Hospital for Joint Diseases, New York, New York, USA*

11:09 am (p. 319) PAPER #95

Operative Versus Nonoperative Management of Humerus Fractures

Reza Firoozabadi, MD, MA[1]; *Edward Westrick, MD*[2]; *Benjamin Hamilton, MS*[3]; *Bradford Henley, MD, MBA*[1]; [1]*Harborview Medical Center/University of Washington, Seattle, Washington, USA;* [2]*Allegheny General Hospital, Pittsburgh, Pennsylvania, USA;* [3]*Case Western Reserve University, Cleveland, Ohio, USA*

11:15 am Discussion

11:21 am (p. 320) PAPER #96

A Randomized Controlled Trial of Percutaneous Fixation with Kirschner Wires Versus Volar Locking-Plate Fixation in the Treatment of Adult Patients with a Dorsally Displaced Fracture of the Distal Radius

Matthew L. Costa, MD, FRCS; Amar Rangan, MD, FRCS; ***Andrew C. Gray, MD, FRCS***; *Warwick Clinical Trials Unit, University of Warwick, Coventry, United Kingdom*

11:27 am (p. 321) PAPER #97

Clinical Trial in the Treatment of A2-OTA Type Fractures of the Distal Radius by Casting

Amir R. Kachooei, MD; *Ali Moradi, MD; Taghi Peivandi, MD; Mohammad H. Ebrahimzadeh, MD; Orthopedic Research Center, Mashhad University of Medical Sciences, Mashhad, Iran*

11:33 am (p. 323) PAPER #98

Volar Locking Plate Versus External Fixator/Cast Fixation for the Treatment of Distal Radius Fractures: A Randomized, Controlled Prospective Trial

Lidia Koval, MBBS[1]; *Herwig Drobetz, MD*[2]; [1]*The Prince Charles Hospital, Brisbane, Queensland, Australia;* [2]*Mackay Base Hospital, Mackay, Queensland, Australia*

11:39 am Discussion

11:44 am (p. 324) PAPER #99

Open Reduction and Internal Fixation of the Distal Radius: Catastrophic Thinking Leads to Stiff Fingers

Teun Teunis, MD; *Arjan G. Bot, MD; Emily R. Thornton, BSc; David Ring, MD, PhD; Massachusetts General Hospital - Harvard Medical School, Boston, Massachusetts, USA*

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

SATURDAY, OCTOBER 18, 2014

11:50 am
(p. 325)
PAPER #100

The Role of Depression in Outcomes of Low-Energy Distal Radius Fractures in Patients Over 55 Years Old
Jane Yeoh, BSc, MD; Jeffrey Pike, MD, MPH, FRCSC; Henry Broekhuyse, MD, FRCSC; Peter O'Brien, MD, FRCSC; ***Kelly A Lefaivre, BScH, MD, MSc, FRCSC****;*
Division of Orthopaedic Trauma, Department of Orthopaedic Surgery, University of British Columbia, Vancouver, British Columbia, Canada

11:56 am — Discussion

12:01 pm
(p. 327)
PAPER #101

Efficacy of Postoperative Pain Control After Distal Radius Fracture Fixation: A Prospective Randomized Study
David Galos, MD; David P. Taormina, MS; Alexander Crespo, BS; David Ding, MD; Anthony Sapienza, MD; Sudheer Jain, MD; ***Nirmal C. Tejwani, MD, FRCS;***
NYU Langone Medical Center Hospital for Joint Diseases, New York, New York, USA

12:07 pm
(p. 329)
PAPER #102

Radiation Exposure to the Surgeon's Hands: A Practical Comparison of Large and Mini C-Arm Fluoroscopy
Michael M. Vosbikian, MD[1]*; Charles F. Leinberry, MD*[2]*; Derek Watson, RT*[3]*; Asif M. Ilyas, MD*[2]*;*
[1]*Thomas Jefferson University Hospital – Department of Orthopaedic Surgery, Philadelphia, Pennsylvania, USA;*
[2]*The Rothman Institute at Thomas Jefferson University Hospital, Philadelphia, Pennsylvania, USA;*
[3]*Nazareth Hospital – Department of Radiology, Philadelphia, Pennsylvania, USA*

12:13 pm
(p. 330)
PAPER #103

Dorsal Screw Penetration With the Use of Volar Plating of Distal Radius Fractures: How Can You Best Detect?
Brian W. Hill, MD*; Irshad A. Shakir, MD; Lisa K. Cannada, MD;*
Saint Louis University, St. Louis, Missouri, USA

12:19 pm — Discussion

12:24 pm - 1:24 pm — Lunch
Visit Scientific Posters & LAST OPPORTUNITY TO VISIT Technical Exhibits
(All in West Hall)

12:35 – 1:20 pm — **GUIDED POSTER TOURS** — ***Tickets Required***

(PT5) **Knee/Tibia** *(West Hall)*
Guide: *J. Tracy Watson, MD*

(PT6) **Reconstruction/General Interest** *(West Hall)*
Guide: *Michael J. Gardner, MD*

See pages 99 - 147 for financial disclosure information.

1:24 pm - 2:54 pm **Concurrent Breakout Sessions**
(Notes p. 332) ***(Mini Symposia and General Session run concurrently.)***
Mini Symposia
Scientific Paper Session VIII: Knee/Tibial Plateau

1:24 – 2:54 pm

MINI SYMPOSIA

Coding Update and Challenging Case Review *(Room 1-2)*
Moderator: *J. Scott Broderick, MD*
Faculty: *William R. Creevy, MD* and *Austin Hill, MD*

Management Strategies for Physeal Fractures Around the Knee and Ankle *(Co-branded by the Pediatric Orthopaedic Society of North America)* *(Room 3-4)*
Moderator: *David A. Podeszwa, MD*
Faculty: *Christine A. Ho, MD; Anthony I. Riccio, MD* and *Robert L. Wimberly, MD*

How Do You Decide Who Should be a "Co-Author"? The Expert Panel Perspective *(Sponsored by the Journal of Orthopaedic Trauma)* *(Room 5-6)*
Moderator: *Craig S. Roberts, MD*
Faculty: *Thomas A. DeCoster, MD; Ellen J. Mackenzie, PhD* and *Marc F. Swiontkowski, MD*

Developing a Successful Clinical Research Program *(Room 12)*
Moderator: *Heather A. Vallier, MD*
Faculty: *Mary A. Breslin, BA* and *William T. Obremskey, MD, MPH*

(Ballroom B/C)

SCIENTIFIC PAPER SESSION VIII
KNEE/TIBIAL PLATEAU

1:24 – 2:44 pm

Moderators - Thomas F. Higgins, MD & James P. Stannard, MD

1:24 pm (p. 333) PAPER #104
Removal of Implants After Open Reduction and Internal Fixation of Tibial Plateau Fractures Improves Clinical Outcomes
Matthew R. Garner, MD*; Marschall B. Berkes, MD; Amelia Ni, BA; Jackie Birnbaum, BA; Dean G. Lorich, MD; Hospital for Special Surgery, New York, New York, USA*

1:30 pm (p. 334) PAPER #105
Comparing Outcomes Between Hinged Knee Bracing and No Bracing After Open Reduction and Internal Fixation of Tibial Plateau Fractures
Aakash Chauhan, MD, MBA*; Alan Slipak, BS; Kathryn Peticca, BS; Gregory T. Altman, MD; Daniel T. Altman, MD; Allegheny General Hospital, Pittsburgh, Pennsylvania, USA*

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

SATURDAY, OCTOBER 18, 2014

1:36 pm
(p. 336)
PAPER #106

ΔRandomized Clinical Trial of Supra- Versus Infrapatellar Tibial Nailing: A Pilot Study

Daniel S. Chan, MD; *Barbara Steverson, RN; Rafael Serrano-Riera, MD; Anthony F. Infante, DO; David T. Watson, MD; H. Claude Sagi, MD; Roy Sanders, MD;*
Orthopaedic Trauma Service, Tampa General Hospital, Tampa, Florida, USA; Florida Orthopaedic Institute, Tampa, Florida, USA

1:42 pm — Discussion

1:47 pm
(p. 338)
PAPER #107

Type III Open Tibia Fractures: Immediate Antibiotics and Earliest Possible Wound Coverage Minimize Infections

William D. Lack, MD[1]; *Madhav A. Karunakar, MD*[2]; *Marc Angerame, MD*[2]; *Rachel Seymour, PhD*[2]; *Stephen H. Sims, MD*[2]; *James F. Kellam, MD*[2]; *Michael J. Bosse, MD*[2];
[1]*Loyola University Medical Center, Maywood, Illinois, USA;*
[2]*Carolinas Medical Center, Charlotte, North Carolina, USA*

1:53 pm
(p. 339)
PAPER #108

Damage Control Plating in Open Tibial Shaft Fractures: A Cheaper and Equally Effective Alternative to Spanning External Fixation

Aaron M. Perdue, MD; Arnold J. Silverberg, BS; Rachel V. Thakore, BS; Vasanth Sathiyakumar, BA; Daniel J. Stinner, MD; Hassan R. Mir, MD; David J. Polga, MD; William T. Obremskey, MD, MPH, MMHC; ***Manish K. Sethi, MD****;*
Vanderbilt University, Nashville, Tennessee, USA

1:59 pm
(p. 340)
PAPER #109

The Gustilo-Anderson Classification System as Predictor of Nonunion and Infection in Open Tibia Fractures

Rachel V. Thakore, BS; Elvis L. Francois, BA; Michael A. Siuta, PhD; Michael A. Benvenuti, BS; Anne K. Smith, BS; Samuel K. Nwosu, MS; Kristin Archer, PhD, DPT; Jesse M. Ehrenfeld, MD, MPH; ***William T. Obremskey, MD, MPH, MMHC****; Manish K. Sethi, MD;*
Vanderbilt University, Nashville, Tennessee, USA

2:05 pm — Discussion

2:10 pm
(p. 342)
PAPER #110

Prediction of Tibial Nonunions at 3 Months After Intramedullary Nailing

Justin Fowler, MD[1]; *Andrew G. Dubina, BS*[1]; *Renan C. Castillo, PhD*[2]; *Christina L. Boulton, MD*[1]; *Jason W. Nascone, MD*[1]; *Marcus F. Sciadini, MD*[1]; *Christopher T. LeBrun, MD; Robert V. O'Toole, MD*[1];
[1]*R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA;*
[2]*Center for Injury Research & Policy, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA*

Δ OTA Grant

See pages 99 - 147 for financial disclosure information.

2:16 pm
(p. 344)
PAPER #111

Does Progressive Radiographic Healing Result in Better Function? A Prospective Evaluation of PCS and RUST Scoring in Tibial Shaft Fractures Treated with IM Nailing

Paul Tornetta, III, MD[1]; *David Sanders, MD*[2]; *Emil Schemitsch, MD*[3]; *Yves LaFlamme, MD*[4]; *Diane Heels-Ansdell, MSc*[5]; *Jason Busse, PhD*[5]; *Mohit Bhandari, MD, MSc, PhD*[5];
[1]*Boston University Medical Center, Boston, Massachusetts, USA;*
[2]*Victoria Hospital, London, Ontario, Canada;*
[3]*St. Michael's Hospital, Toronto, Ontario, Canada;*
[4]*University of Montreal, Montreal, Quebec, Canada;*
[5]*McMaster University, Hamilton, Ontario, Canada*

2:22 pm Discussion

2:27 pm
(p. 346)
PAPER #112

The Incidence of Deep Vein Thrombosis and Pulmonary Embolism in Fractures of the Tibia: An Analysis of the National Trauma Data Bank

Ronald T. Auer, MD; *John T. Riehl, MD;*
University of Louisville, Louisville, Kentucky, USA

2:33 pm
(p. 348)
PAPER #113

Ankle Injuries in Spiral Distal Tibial Shaft Fractures: Results From an Institutional Change in Imaging Protocol

Stephen Warner, MD, PhD; *Patrick C. Schottel, MD; Matthew R. Garner, MD; David L. Helfet, MD; Dean G. Lorich, MD;*
Hospital for Special Surgery, New York, New York, USA

2:39 pm Discussion

2:44 pm - 3:14 pm Refreshment Break *(Foyer Ballroom B/C)*

(Ballroom B/C)

3:14 – 5:05 pm

SCIENTIFIC PAPER SESSION IX
TOPICS OF GENERAL INTEREST

Moderators - Michael D. McKee, MD & Kyle J. Jeray, MD

3:14 pm
(p. 349)
PAPER #114

ΔDo Postoperative Prophylactic Antibiotics Decrease the Risk of Postoperative Infection After ORIF?--A Prospective Double-Blinded Randomized Placebo-Controlled Trial

Brett D. Crist, MD; David D. Greenberg, MD; Gregory J. Della Rocca, MD, PhD; Yvonne M. Murtha, MD; David A. Volgas, MD; ***James P. Stannard, MD****;*
University of Missouri, Columbia, Missouri, USA

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

SATURDAY, OCTOBER 18, 2014

3:20 pm
(p. 350)
PAPER #115

Regional and Seasonal Variations in Posttraumatic Infections After Open Fracture

H. Claude Sagi, MD[1]; *Seth Cooper, MD[1]; David Donohue, MD[1]; David P. Barei, MD, FRCS(C)[2]; Justin C. Siebler, MD[3]; Michael T. Archdeacon, MD[4]; Marcus F. Sciadini, MD[5]; Michelle Romeo, MD[5]; Patrick F. Bergin, MD[6]; Thomas F. Higgins, MD[7];*
[1]Orthopaedic Trauma Service, Florida Orthopaedic Institute, Tampa, Florida, USA;
[2]Harborview Medical Center, University of Washington, Seattle, Washington, USA;
[3]Creighton University, Omaha, Nebraska, USA;
[4]University of Cincinnati, Cincinnati, Ohio, USA;
[5]R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA;
[6]University of Mississippi, Jackson, Mississippi, USA;
[7]University of Utah, Salt Lake City, Utah, USA

3:26 pm
(p. 352)
PAPER #116

The Effect of Acute High-Dose Vitamin D Supplementation on Fracture Union in Patients With Hypovitaminosis D: A Pilot Study

Nikkole Marie Haines, MD; *Laurence Kempton, MD; Rachel Seymour, PhD; Madhav A. Karunakar, MD; TRACC (Trauma Research Collaborative of the Carolinas: Michael J. Bosse, MD; Joseph R. Hsu, MD; Stephen H. Sims, MD; James F. Kellam, MD) Carolinas Medical Center, Charlotte, North Carolina, USA*

3:32 pm

Discussion

3:37 pm
(p. 354)
PAPER #117

Statistical Significance in Trauma Research: Too Unstable to Trust?

Paul Tornetta III, MD[1]; Mohit Bhandari, MD, MSc, PhD[2];
Robert L. Parisien, MD[1]; *Jesse Dashe, MD[1]; Patrick Cronin[1];*
[1]Boston University Medical Center, Boston, Massachusetts, USA;
[2]McMaster University, Hamilton, Ontario, Canada

3:43 pm
(p. 356)
PAPER #118

Are We Evidence-Based? The Effect of Level I Evidence on Surgical Decision-Making

Paul Tornetta III, MD[1]; Andrew Jawa, MD[1]; Mohit Bhandari, MD, MSc, PhD[2]; Jason L. Pittman, MD, PhD[1]; Scott Koenig, MD[1];
[1]Boston University Medical Center, Boston, Massachusetts, USA;
[2]McMaster University, Hamilton, Ontario, Canada

3:49 pm
(p. 358)
PAPER #119

Determining Preinjury Physical Function Scores in Orthopaedic Trauma Patients

Ami R. Stuart, PhD; *Erik Kubiak, MD; Man Hung, PhD; David Rothberg, MD; Thomas F. Higgins, MD; Charles L. Saltzman, MD;*
University of Utah, Salt Lake City, Utah, USA

3:55 pm

Discussion

4:00 pm
(p. 360)
PAPER #120

Reduction of Radiation Exposure From C-Arm Fluoroscopy During Orthopaedic Trauma Operations With Introduction of Real-Time Dosimetry

Rita Baumgartner, MD[1]; *Kiley Libuit, BS[2]; Dennis Ren, BA[2]; Omar Bakr, BS[2]; Nathan Singh, MD[2]; Utku Kandemir, MD[2]; Meir Tibi Marmor, MD[2]; Saam Morshed, MD PhD[2];*
[1]Duke University, Durham, North Carolina, USA;
[2]University of California, San Francisco, San Francisco, California, USA

See pages 99 - 147 for financial disclosure information.

4:06 pm
(p. 362)
PAPER #121

ΔAssessing the Oncogenic Risk to Patients From Fluoroscopy During Trauma Surgery
Michael J. Beebe, MD; *Peter A. Jenkins, PhD, CHP; Erik N. Kubiak, MD; David L. Rothberg MD, Thomas F. Higgins, MD; University of Utah Department of Orthopaedics, Salt Lake City, Utah, USA*

4:12 pm Discussion

4:17 pm
(p. 364)
PAPER #122

Adverse Events in Orthopaedic Surgery: Is Trauma More Risky? An Analysis of the NSQIP Data
Cesar S. Molina, MD; *Rachel V. Thakore, BS; Eduardo J. Burgos, MD; William T. Obremskey, MD, MPH, MMHC; Manish K. Sethi, MD; Vanderbilt University, Nashville, Tennessee, USA*

4:23 pm
(p. 366)
PAPER #123

Diagnosis of Fracture Is Associated with Lower Satisfaction with Physician Performance Among Orthopaedic Surgery Patients
John S. Vorhies, MD; *Julius A. Bishop, MD; Stanford Hospital and Clinics Department of Orthopaedic Surgery, Redwood City, California, USA*

4:29 pm
(p. 368)
PAPER #124

Does Physician Reimbursement Correlate to Risk in Orthopaedic Trauma?
Rachel V. Thakore, BS; Cesar S. Molina, MD; William T. Obremskey, MD, MPH, MMHC; ***Manish K. Sethi, MD*** *Vanderbilt University, Nashville, Tennessee, USA*

4:35 pm Discussion

4:40 pm
(p. 370)
PAPER #125

Cerebral Fat Emboli and Cognitive Impairment Following Reamed Intramedullary Nailing
Kristin R. Archer, PhD; *Christine M. Abraham, MA; Justin E. Richards, MD; John A. Barwise, MB, ChB; William T. Obremskey, MD, MPH; Vanderbilt University Medical Center, Nashville, Tennessee, USA*

4:46 pm
(p. 372)
PAPER #126

Sexual Function Is Impaired Following Common Orthopaedic Trauma
Brandon S. Shulman, BA[1]; David P. Taormina, MS[1]; Bianka Patsalos-Fox[1]; Roy I. Davidovitch, MD[1]; ***Kenneth A. Egol, MD[1,2]***; *[1]NYU Hospital for Joint Diseases, New York, New York, USA; [2]Jamaica Medical Center, Jamaica, New York, USA*

4:52 pm
(p. 374)
PAPER #127

Familiar Faces: The Prevalence of Recidivism in Trauma Patients
Juliann C. Koleszar, BS; ***Heather A. Vallier, MD***; *MetroHealth Medical Center, Cleveland, Ohio, USA*

4:58 pm Discussion

5:03 pm Closing Remarks and ADJOURN

See you next year in San Diego, California, October 7 - 10, 2015

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

ORTHOPAEDIC TRAUMA ASSOCIATION

2014 Annual Meeting Scientific Posters

West Hall will be open:
Thursday 2:30 pm through
Saturday 1:30 pm

Key: Δ = presentation was funded by an OTA administered grant
Names in bold = **Presenter**

FOOT and ANKLE

Poster #1 (p. 375)
Risk Factors for Thromboembolic Events After Ankle Fracture
Bryce A. Basques, BS; *Christopher P. Miller, MD; Nicholas S. Golinvaux, BA; Daniel D. Bohl, MPH; Jonathan N. Grauer, MD;*
Yale School of Medicine, New Haven, Connecticut, USA

Poster #2 (p. 376)
Comparison of Syndesmotic Malreduction Assessment Methods in a Supination-External Rotation IV Ankle Fracture Cohort
Richard M. Hinds, MD; *Matthew R. Garner, MD; Patrick C. Schottel, MD; David L. Helfet, MD; Dean G. Lorich, MD;*
Hospital for Special Surgery; New York, New York, USA

Poster #3 (p. 377)
A Comparison of Anatomic Plating Versus Tubular Plating in the Treatment of Fibula Fractures
Justin Kane, MD[1]; *Andrew Kay, BA*[1]; *Joseph Daniel, DO*[2]; *David Pedowitz, MD*[2]; *Steven Raikin, MD*[2]; *James Krieg, MD*[2];
[1]*Thomas Jefferson University Hospital, Philadelphia, Pennsylvania, USA;*
[2]*Rothman Institute, Philadelphia, Pennsylvania, USA*

Poster #4 (p. 378)
Open Ankle Fractures and Early Fixation: Are They Safe to Fix? A 10-Year Review of Isolated Open Ankle Injuries
David Joyce, MD; Rachel V. Thakore, BS; Vasanth Sathiyakumar, BA; William T. Obremskey, MD, MPH, MMHC; ***Manish K. Sethi, MD***;
Vanderbilt University, Nashville, Tennessee, USA

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Poster #5
(p. 380)

The Impact of Diabetes on Hospital Length of Stay, Cost, and Inpatient Mortality Following Open Reduction and Internal Fixation of Ankle Fractures: An Argument for Increased Hospital Reimbursement

Deirdre Regan, BA[1]; Arthur Manoli, BS[1]; Sanjit Konda, MD[1];
Kenneth A. Egol, MD[1,2];
[1]NYU Hospital for Joint Diseases, New York, New York, USA;
[2]Jamaica Medical Center, Jamaica, New York, USA

Poster #6
(p. 381)

Comparison of Closed AO/OTA Type 43-C Distal Tibial Pilon Fractures Treated with Open Reduction and Internal Fixation Versus Ilizarov External Fixation

Prism S. Schneider, MD, PhD, FRCSC[1]*; Krishna C. Vemulapalli[1];*
Stephen Davis, MD[1]; Milan Sen, MD[1]; Timothy S. Achor, MD[1]; Mark Brinker, MD[2];
[1]University of Texas Health Science Center, Houston, Texas, USA;
[2]Texas Orthopaedic Hospital, Houston, Texas, USA

Poster #7
(p. 382)

Ankle Fracture Complexity Does Not Predict Functional Outcome: A New Validated Scoring System Contradicts Established Belief

Michael Maceroli, MD*; Michael Stanton, MD; Russell LaFrance, MD;*
John Gorczyca, MD; Adolph Flemister, MD;
University of Rochester, Rochester, New York, USA

Poster #8
(p. 384)

Syndesmotic Overcompression After Fixation of Acute Syndesmotic Injuries

Steven M. Cherney, MD*; Jacob A. Haynes, MD; Amanda Spraggs-Hughes, MA;*
Christopher M. McAndrew, MD; William M. Ricci, MD; Michael J. Gardner, MD;
Washington University School of Medicine, St. Louis, Missouri, USA

Poster #9
(p. 385)

Initial Management of Unstable Complex Ankle Injuries: The Use of Emergency Department Versus Operating Room External Fixation

Philip K. McClure, MD*; Stephen Klinge, MD; Dale Cassidy, MD;*
Roman Hayda, MD; Christopher T. Born, MD;
Rhode Island Hospital Department of Orthopedics, Brown University,
Providence, Rhode Island, USA

Poster #10
(p. 387)

A New Technique for Identification and Stabilization of Dislocating Peroneal Tendons Following Open Treatment of Intra-Articular Calcaneus Fractures

Michael A. Maceroli, MD[1]*; Edward Shields, MD[1]; Roy W. Sanders, MD[2];*
John Ketz, MD[1];
[1]University of Rochester Medical Center, Rochester, New York, USA;
[2]Florida Orthopaedic Institute, Tampa, Florida, USA

Poster #11
(p. 388)

Reliability and Sensitivity of Fluoroscopic and Radiographic Assessment of Articular Congruency in Operatively Treated Ankle Fractures Is Poor

Matthew R. Garner, MD*; Peter D. Fabricant, MD, MPH; Patrick C. Schottel, MD;*
Marschall B. Berkes, MD; Andre D. Shaffer, MD; Amelia Ni, BA;
Dean G. Lorich, MD;
Hospital for Special Surgery, New York, New York, USA

See pages 99 - 147 for financial disclosure information.

Poster #12
(p. 389)

Analysis of PITFL Injuries in Unstable Ankle Fractures
***Stephen J. Warner, MD, PhD**; Matthew R. Garner, MD; Patrick C. Schottel, MD; Richard M. Hinds, MD; Dean G. Lorich, MD;*
Hospital for Special Surgery, New York, New York, USA

Poster #13
(p. 391)

Measurement of 91 Normal Distal Tibiofibular Syndesmoses by Computed Tomography
***Samuel L. Rosenbaum, MD**; John J. Lee, MD; Mark Hake, MD; Sven A. Holcombe, MS; Stewart C. Wang, MD, PhD; James A. Goulet, MD;*
Department of Orthopaedic Surgery, University of Michigan, Ann Arbor, Michigan, USA

Poster #14
(p. 393)

Nonunions of Fifth Metatarsal Fractures: Our Institutional Experience
***Michalis Panteli, MD**; Ippokrates Pountos, MD; Peter Giannoudis, MD, FRCS;*
Academic Unit of Trauma and Orthopaedics, University of Leeds, Leeds, United Kingdom

POSTERS

TIBIA

Poster #15
(p. 394)

The Efficacy of a Single-Incision Versus Two-Incision Four-Compartment Fasciotomy of the Leg: A Cadaveric Model
***Meredith Neal, LCDR MC USN**; Andrew Henebry, LT MC USN; Christiaan N. Mamczak, LCDR MC USN; Robert Ruland, CAPT MC USN;*
Department of Orthopaedic Surgery, Naval Medical Center, Portsmouth, Virginia, USA

Poster #16
(p. 395)

Determination of Radiographic Healing: An Assessment of Consistency Using RUST and Modified RUST in Metadiaphyseal Fractures
*Jody Litrenta, MD[1]; **Paul Tornetta III, MD**[1]; Mohit Bhandari, MD, MSc, PhD[2]; Clifford B. Jones, MD[3]; Samir Mehta, MD[4]; Robert O'Toole, MD[5]; Robert Ostrum, MD[6]; Stephen Kottmeier, MD[7]; Kenneth Egol, MD[8]; William Ricci, MD[9]; Emil Schemitsch, MD[10]; Daniel Horwitz, MD[11];*
[1]Boston University Medical Center, Boston, Massachusetts, USA;
[2]McMaster University, Hamilton, Ontario, Canada;
[3]Orthopaedic Associates of Grand Rapids, Grand Rapids, Michigan, USA;
[4]University of Pennsylvania, Philadelphia, Pennsylvania, USA;
[5]University of Maryland Medical Center, Baltimore, Maryland, USA;
[6]Carolinas Medical Center, Charlotte, North Carolina, USA;
[7]Stony Brook Medical Center, East Setauket, New York, USA;
[8]NYU Langone Medical Center, New York, New York, USA;
[9]Washington University, St. Louis, Missouri, USA;
[10]St. Michael's Hospital, Toronto, Ontario, Canada;
[11]Geisinger Health System, Danville, Pennsylvania, USA

Poster #17
(p. 397)

Single-Stage Orthoplastic Reconstruction of Gustilo-Anderson Grade III Open Tibial Fractures Greatly Reduces Infection Rates
***John A. Mathews**; Jayne Ward; Michael B. Kelly;*
Frenchay Hospital, North Bristol Trust, Bristol, United Kingdom

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Poster #18
(p. 398)

Does Obesity Impact the Perioperative Course of Patients with Isolated Diaphyseal Tibia Fractures?

Matthew J. Schessler, MD*; Alan Slipak, BS; Michael Palmer, MD; Mark C. Miller, PhD; Edward R. Westrick, MD; Gregory T. Altman, MD; Daniel T. Altman, MD;*
Allegheny General Hospital, Pittsburgh, Pennsylvania, USA

Poster #19
(p. 399)

Open Distal Tibial Shaft Fractures: A Retrospective Comparison of Medial Plate Versus Nail Fixation

Rachel V. Thakore, BS; Vasanth Sathiyakumar, BA; Elvis L. Francois, BA; Michael A. Siuta, PhD; Michael A. Benvenuti, BS; Anne K. Smith, BS; Jesse M. Ehrenfeld, MD, MPH; Jason M. Evans, MD; William T. Obremskey, MD, MPH, MMHC; ***Manish K. Sethi, MD****;*
Vanderbilt University, Nashville Tennessee, USA

Poster #20
(p. 401)

Evidence-Based Fit Assessment of Anatomic Distal Medial Tibia Plates

Andreas Petersik, PhD[1]*; Walter W. Virkus, MD*[2]*; Rainer Burgkart, MD*[3]*; Geert von Oldenburg*[1]*;*
[1]*Stryker Trauma GmbH, Schoenkirchen, Germany;*
[2]*IU Health, Indianapolis, Indiana, USA;*
[3]*Clinic of Orthopaedics and Sports Orthopaedics, Technical University of Munich, Munich, Germany*

Poster #21
(p. 402)

The Role of Appositional Screw Fixation in Minimally Invasive Plate Osteosynthesis for Distal Tibial Fracture

Yougun Won, MD[1]*; Hyung-Keun Song, MD*[2]*; Dong-Hyun Kang, MD*[1]*; Sung-Jun Kim, MD*[1]*; Kyu-Hyun Yang, MD, PhD*[1]*;*
[2]*Yonsei University College of Medicine, Seoul, Korea;*
[2]*Aju University College of Medicine, Suwon, Korea*

Poster #22
(p. 404)

Antibiotic Elution Profiles of Two Methods of Nail Preparations

Matthew R. Karek, MD[1]***;*** *Raul Vaidya, MD*[1,2]*; Nancy M. Jackson, PhD*[1,3]*; Jeffrey C. Flynn, PhD*[1,3]*; David C. Markel, MD*[1,3]*;*
[1]*Detroit Medical Center/Providence Hospital Orthopaedic Surgery Residency Program, Detroit, Michigan, USA;*
[2]*Detroit Receiving Hospital, Detroit, Michigan, USA;*
[3]*Providence Hospital and Medical Centers, Southfield, Michigan, USA*

Poster #23
(p. 405)

An Alternative Approach to Intramedullary Nailing of the Tibia: The SeMid Technique (Semi-Extended Midvastus Tibial Nailing)

Thomas H. Sanders, MD*; A. Stephen Malekzadeh, MD; Daniel Dziadosz, MD; Cary Schwartzbach, MD; Lolita Ramsey, PhD;*
INOVA Fairfax Hospital, Falls Church, Virginia, USA

See pages 99 - 147 for financial disclosure information.

Poster #24
(p. 407)

Management of Distal Metaphyseal Tibia Fractures with the SIGN Intramedullary Nail in Three Developing Countries

Kyle R. Stephens, DO[1]*; Faseeh Shahab, MBBS*[2]*; Daniel Galat, MD*[3]*;*
Duane Anderson, MD[4]*; Shahab Ud Din, MBBS, FCPS (Ortho)*[2]*;*
Paul S. Whiting, MD[5]*; Douglas W. Lundy, MD*[6]*;*
[1]*Henry Ford Macomb Hospital, Clinton Township, Michigan, USA;*
[2]*Lady Reading Hospital, Peshawar, Pakistan;*
[3]*Tenwek Hospital, Bomet, Kenya;*
[4]*Soddo Christian Hospital, Soddo, Ethiopia;*
[5]*Tufts University, Boston, Massachusetts, USA;*
[6]*Resurgens Orthopaedics, Marietta, Georgia, USA*

Poster #25
(p. 408)

Development of Compartment Syndrome Negatively Impacts Length of Stay and Cost Following Tibia Fracture

Alexander M Crespo, BS[1]*; Arthur Manoli III, BS*[1]*; Sanjit R. Konda, MD*[1,2]*;*
Kenneth A. Egol, MD[1,2]*;*
[1]*NYU Langone Medical Center, Hospital for Joint Diseases,*
New York, New York, USA;
[2]*Jamaica Hospital Medical Center, Jamaica, New York, USA*

Poster #26
(p. 410)

Open Tibia Fractures Treated with Intramedullary Nailing: Effects of Provisional Plate Stabilization

Meryl Ludwig, MD[1]*;* ***Robert A. Hymes, MD***[2]*; Lolita Ramsey, RN, PhD*[2]*;*
Michael Pitta, MD[1]*; Jeff E. Schulman, MD*[2]*;*
[1]*Georgetown University Medical Center, Washington, District of Columbia, USA;*
[2]*Inova Fairfax Medical Campus, Falls Church, Virginia, USA*

Poster #27
(p. 412)

Single- Versus Two-Stage Repair for Infected Tibial Nonunions

Daniel S. Chan, MD*; K. Cronin, MD; M. Lago, MD; H. Claude Sagi, MD;*
Roy Sanders, MD;
Orthopaedic Trauma Service, Tampa General Hospital
Florida Orthopaedic Institute, Tampa Florida

Poster #28
(p. 413)

Autogenous Iliac Crest Bone Grafting Revisited: The Most Reliable Solution for Tibial Nonunions

David P. Taormina, MS[1]*; Sanjit R. Konda, MD*[1]*; Roy I. Davidovitch, MD*[1]*;*
Kenneth A. Egol, MD[1,2]
NYU Hospital for Joint Diseases, New York, New York, USA;
Jamaica Hospital Medical Center, Jamaica, New York, USA

KNEE and TIBIAL PLATEAU

Poster #29
(p. 415)

Return to Sports After Major Trauma—Fact or Fiction?
A Series of 465 Cases with a Minimum Follow-up of 10 Years

Christian D. Weber, MD[1]*; Thomas Dienstknecht, MD*[1]*; Klemens Horst, MD*[1]*;*
Magdalena J. Bader[1]*; Boris A. Zelle, MD*[2]*; Hans-Christoph Pape, MD, PhD, FACS*[1]*;*
[1]*RWTH Aachen University Medical Center, Department of Orthopedic Trauma,*
Aachen, Germany;
[2]*University of Texas, Health Science Center, San Antonio, Texas, USA*

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Poster #30
(p. 416)

Traumatic Proximal Tibiofibular Dislocation: A Marker of Severely Traumatized Extremities

Greg A. Herzog, MD; *Rafael Serrano-Riera, MD; H. Claude Sagi, MD;*
Orthopaedic Trauma Service, Florida Orthopaedic Institute, Tampa, Florida, USA

Poster #31
(p. 417)

A Biomechanical Comparison of Transosseous Versus Anchor Technique for Patellar Tendon Repair

MAJ Joseph T. Lanzi Jr, MD; *CDT Justin Felix; MAJ Christopher J. Tucker, MD;*
Kenneth L. Cameron, PhD, MPH; John Rogers, PhD; LTC Brett D. Owens, MD;
LTC(P) Steven J. Svoboda, MD; John A. Feagin Jr;
West Point Sports Medicine Fellowship, Keller Army Community Hospital,
West Point, New York, USA

Poster #32
(p. 418)

Fracture Mapping of the Tibial Plateau

Rik J. Molenaars, MSc; *Job N. Doornberg, MD, PhD; Jos J. Mellema, MD;*
Peter Kloen, MD, PhD;
Department of Orthopaedic Surgery, Academic Medical Center;
Orthotrauma Research Center, Amsterdam, The Netherlands

Poster #33
(p. 420)

Tibial Eminence Involvement with Tibial Plateau Fracture Leads to Slower Recovery

Sanjit R. Konda, MD; *Arthur Manoli III, BS; Roy I. Davidovitch, MD;*
Kenneth A. Egol, MD;
NYU Hospital for Joint Diseases, New York, New York, USA

Poster #34
(p. 422)

Management of External Fixation Devices for Staged Surgery

Colin Crickard, MD; *Rachel Seymour, PhD; Madhav Karunakar, MD;*
Carolinas Medical Center, Charlotte, North Carolina, USA

Poster #35
(p. 423)

Knee Arthrofibrosis Following Tibial Plateau Fracture

Justin Haller, MD; *David Holt, MD; Molly McFadden, PhD; Thomas Higgins, MD;*
Erik Kubiak, MD;
University of Utah Department of Orthopaedics, Salt Lake City, Utah, USA

Poster #36
(p. 425)

Risk Factors for Infection in Tibia Plateaus with Compartment Syndrome

Brian Etier, MD; Emily Keener, DO; ***Jason Lowe, MD****;*
University of Alabama at Birmingham, Birmingham, Alabama, USA

Poster #37
(p. 426)

Extensor Mechanism Injuries of the Knee: Patient Demographics and Comorbidities

Matthew R. Garner, MD; *Elizabeth B. Gausden, MD; Marschall B. Berkes, MD;*
Amelia Ni, BA; Dean G. Lorich, MD;
Hospital for Special Surgery, New York, New York, USA
New York Presbyterian Hospital, New York, New York, USA

Poster #38
(p. 427)

The Hyperextension Varus Bicondylar Tibial Plateau Fracture

Reza Firoozabadi, MD, MA[1]*; Jason S. Schneidkraut, MD*[2]*;*
Daphne M. Beingessner, MD, FRCS(C)[1]*; Robert P. Dunbar, MD*[1]*;*
David P. Barei, MD, FRCS(C)[1]*;*
[1]*Harborview Medical Center, Seattle, Washington, USA;*
[2]*Elite Orthopaedics and Sports Medicine, Wayne, New Jersey, USA*

See pages 99 - 147 for financial disclosure information.

Poster #39
(p. 428)

Does Age Affect Functional Recovery Following Surgical Management of Tibial Plateau Fractures?

Arthur Manoli III, BS[1] Christina Capriccioso, BSE[1]; Sanjit R. Konda, MD[1,2];
Kenneth A. Egol, MD[1,2];
[1]NYU Hospital for Joint Diseases, New York, New York, USA;
[2]Jamaica Medical Center, Jamaica, New York, USA

Poster #40
(p. 429)

Spinal Anesthesia Improves Early Functional Scores and Pain Levels Following Surgical Treatment of Tibial Plateau Fractures

Arthur Manoli III, BS[1]; Germaine Cuff, PhD[1]; Arthur Atchabahian, MD[1];
Roy I. Davidovitch, MD[1]; ***Kenneth A. Egol, MD[1,2]***;
[1]NYU Hospital for Joint Diseases; New York, New York, USA;
[2]Jamaica Hospital Medical Center, Jamaica, New York, USA

HIP and FEMUR

Poster #41
(p. 430)

An Anatomical Study of the Greater Trochanter Starting Point for Intramedullary Nailing

Kathleen Farhang, BS[1]; Ronak Desai, MD[1]; John H. Wilber, MD[1];
Daniel R. Cooperman, MD[2]; ***Raymond W. Liu, MD[1]***;
[1]Case Western Reserve University, Cleveland, Ohio, USA;
[2]Yale University, New Haven, Connecticut, USA

Poster #42
(p. 431)

"Length-Stable" Fully Threaded Screw Fixation of Femoral Neck Fractures: Does it Work?

Adam Sassoon, MD; *Casey deDeugd, BS; Joshua Langford, MD;*
Kenneth Koval, MD; George Haidukewych, MD;
Orlando Regional Medical Center, Orlando, Florida, USA

Poster #43
(p. 432)

Tangential Bicortical Locked Fixation Techniques Give Improved Stability for Fixation of Vancouver B1 Periprosthetic Femur Fractures

Gregory S. Lewis, PhD[1]; Michele Bramer, MD[2]; Cyrus Caroom, MD[3];
Hwa Bok Wee, PhD[1]; Darin Jurgensmeier, MD[1]; Shane Rothermel, BS[1];
Samuel McArthur, MD[1]; ***J. Spence Reid, MD[1]***;
[1]Penn State University College of Medicine, Hershey, Pennsylvania, USA;
[2]West Virginia University College of Medicine, Morgantown, West Virginia, USA;
[3]Texas Tech University College of Medicine, Lubbock, Texas, USA

Poster #44
(p. 434)

ΔExtramedullary Versus Intramedullary Implants for Intertrochanteric Hip Fractures: 30-Day Outcomes Among 4432 Cases from the ACS-NSQIP Database

Daniel D. Bohl, MPH; *Bryce A. Basques, BS; Nicholas S. Golinvaux, BA;*
Christopher P. Miller, MD; Michael R. Baumgaertner, MD; Jonathan N. Grauer, MD;
Yale School of Medicine, New Haven, Connecticut, USA

Δ OTA Grant

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Poster #45
(p. 435)

Garden 1 and 2 Femoral Neck Fractures Collapse More Than Expected After CRPP

Paul Tornetta III, MD[1]*; Michael Kain, MD*[2]*; Andrew Marcantonio, MD*[2]*;*
Patrick Cronin[1]*;*
[1]*Boston University Medical Center, Boston, Massachusetts, USA;*
[2]*Lahey Medical Center, Burlington, Massachusetts, USA*

Poster #46
(p. 437)

Dynamic Locked Screws Versus Conventional Locked Screws in Comminuted Distal Femur Fractures: A Matched Cohort Study

Steven M. Cherney, MD*; Michael J. Gardner, MD; Amanda Spraggs-Hughes, MA;*
William M. Ricci, MD; Christopher M. McAndrew, MD;
Orthopaedic Trauma Service, Washington University School of Medicine,
St Louis, Missouri, USA

Poster #47
(p. 439)

Symptomatic Atypical Femoral Fractures Are Related to Underlying Hip Geometry

David P. Taormina, MS[1]*; Alejandro I. Marcano, MD*[1]*; Raj Karia, MPH*[1]*;*
Kenneth A. Egol, MD[1,2]*;* ***Nirmal C. Tejwani, MD***[1]*;*
[1]*NYU Hospital for Joint Diseases, New York, New York, USA;*
[2]*Jamaica Hospital Medical Center, Jamaica, New York, USA*

Poster #48
(p. 441)

Dynamic Stress Fluoroscopy (DSF) for Evaluation of the Femoral Neck After Intramedullary Nails: Faster, Cheaper, and Equally Effective as Intraoperative AP Pelvis Radiograph

David M. Joyce, MD*; Jason M. Evans, MD; Hassan R. Mir, MD, MBA;*
Vanderbilt University, Nashville, Tennessee, USA

Poster #49
(p. 442)

The Effect of Antegrade Femoral Nailing on Femoral Head Perfusion: A Quantitative MRI and Cadaveric Dissection Study Comparing Piriformis and Trochanteric Entry Points

Patrick C. Schottel, MD*; Richard M. Hinds, MD; Lionel E. Lazaro, MD;*
Craig E. Klinger; Amelia Ni; David L. Helfet, MD; Dean G. Lorich, MD;
Hospital for Special Surgery, New York, New York, USA

Poster #50
(p. 443)

Geographic Variations in Orthopaedic Trauma Billing and Reimbursements for Pelvis, Acetabular, and Hip Fractures in the Medicare Population

Catherine M. Bulka, MPH; Rachel V. Thakore, BS; Melinda Buntin, PhD;
William T. Obremskey, MD, MPH, MMHC; Jesse M. Ehrenfeld, MD, MPH;
David Joyce, MD; ***Manish K. Sethi, MD****;*
Vanderbilt University, Nashville Tennessee, USA

Poster #51
(p. 445)

Trends in Femoral Neck Fracture Management From 1998 to 2010

Julius Bishop, MD; ***Arthur Yang, MS****; Alex Sox-Harris, PhD;*
Stanford University, Stanford, California, USA

Poster #52
(p. 447)

Final Frontal Plane Alignment of United Subtrochanteric Femur Fractures Is Not Affected by Antegrade Medullary Nail Start Point

Geoffrey S. Marecek, MD*; Clifford Hou, MD; Julie Agel, MA, ATC;*
David P. Barei, MD;
Harborview Medical Center, Seattle, Washington, USA

See pages 99 - 147 for financial disclosure information.

Poster #53
(p. 449)

NIS and NSQIP Give Different Results in Hip Fracture Studies
Daniel D. Bohl, MPH; *Bryce A. Basques, BS; Nicholas S. Golinvaux, BA; Michael R. Baumgaertner, MD; Jonathan N. Grauer, MD; Yale School of Medicine, New Haven, Connecticut, USA*

Poster #54
(p. 450)

Minimizing Leg-Length Discrepancy After Intramedullary Nailing of Comminuted Femoral Shaft Fractures: A Quality Improvement Initiative Using the Scout CT Scanogram
Rahul Vaidya, MD[1]; *Bryant W. Oliphant, MD*[1]; *Frederick E. Tonnos, DO*[2]; *Daniel Hoard, MD*[1]; *Blake Miller, DO*[2]; *Paul J. Dougherty, MD*[1]; *Anil Sethi, MD*[1]; *Detroit Medical Center/Wayne State University, Detroit, Michigan, USA; Detroit Medical Center/Michigan State University, Detroit, Michigan, USA*

Poster #55
(p. 451)

Reverse Oblique Intertrochanteric Femoral Fractures (AO/OTA 31-A3) Treated with the Cephalomedullary Nail
Kaan S. Irgit, MD[1]; ***Raveesh D. Richard, MD***[1]; *Thomas R. Bowen, MD*[1]; *Michael Beebe, MD*[2]; *Erik Kubiak, MD*[2]; *Daniel S. Horwitz, MD*[1]; [1]*Geisinger Medical Center, Danville, Pennsylvania, USA;* [–2]*University of Utah, Salt Lake City, Utah, USA*

Poster #56
(p. 452)

Risk for Postoperative Complications Following Hemiarthroplasty for Femoral Neck Fracture in Patients on Warfarin at the Time of Admission
Kristin McPhillips, MD, MPH; *Hemil Maniar, MD; Jove Graham, PhD; Daniel Horwitz, MD; Geisinger Hospital, Danville, Pennsylvania, USA*

Poster #57
(p. 454)

Postoperative Complications of Dynamic Hip Screw Versus Cephalomedullary Nail for Treatment of Intertrochanteric Hip Fractures
Jimmy Jiang, MD; *Min Lu, MD; Hue Luu, MD; Douglas Dirschl, MD; University of Chicago, Chicago, Illinois, USA*

Poster #58
(p. 456)

Less Invasive Stabilization System (LISS) Plating Versus Locking Condylar Plates (LCPs) in Open and Closed Distal Femoral Fractures
Southeastern Fracture Consortium; ***William T. Obremskey, MD, MPH***[2]***;*** [1]*Chapel Hill, North Carolina, USA;* [2]*Vanderbilt University, Nashville, Tennessee, USA*

Poster #59
(p. 457)

Quantitative Contribution of Progressively More Extensile Posterior Surgical Approaches to the Acetabulum
Colin Crickard, MD; *Luke Harmer, MD, MPH; Erica Andrews; Katie Sample; Stephen H. Sims, MD; Joseph R. Hsu, MD; Carolinas Medical Center, Charlotte, North Carolina, USA*

Poster #60
(p. 459)

Failures in High-Energy Intertrochanteric (IT) Femur Fractures
Michael H. Amini, MD[1]; *John Feldman, MD*[1]; ***John C. Weinlein, MD***[1,2]***;*** [1]*University of Tennessee-Campbell Clinic, Memphis, Tennessee, USA;* [2]*Regional One Health, Memphis, Tennessee, USA*

POSTERS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

GERIATRIC

Poster #61
(p. 460)

ORIF Versus Arthroplasty of Geriatric Acetabular Fractures: Results of a Randomized Controlled Feasibility Study
Ted Manson, MD; *Robert V. O'Toole, MD;*
R Adams Cowley Shock Trauma Center, Baltimore, Maryland, USA

Poster #62
(p. 461)

Risk Factors for Discharge to Rehab Among Hip Fracture Patients
Rachel V. Thakore, BS; Cesar S. Molina, MD;
William T. Obremskey, MD, MPH, MMHC; ***Manish K. Sethi, MD****;*
Vanderbilt University, Nashville, Tennessee, USA

Poster #63
(p. 463)

Predictors of Delay for Time to Surgery in Geriatric Hip Fractures: Results and Outcomes
D. D. Berglund, BA; J. H. Flaherty, MD; T. K. Malmstrom, PhD,
J. Tracy Watson, MD*;*
Departments of Orthopaedic Surgery and Geriatric Medicine, St. Louis University School of Medicine, St. Louis, Missouri, USA

Poster #64
(p. 465)

Predictors of Cement-Related Perioperative Death in Patients Undergoing Hip Hemiarthroplasty Surgery
Ali Shah, MRCS*; Fahad S. Hossain, MRCS; Frank Howell, FRCS;*
Department of Trauma and Orthopaedics, North East Lincolnshire and Goole Hospitals, NHS Foundation Trust, United Kingdom

Poster #65
(p. 466)

Adherence to Preoperative Cardiac Clearance Guidelines in Hip Fracture Patients
Andrea Stitgen, MD; Kim Poludnianyk, DO; Elizabeth Dulaney-Cripe, MD;
Ronald Markert, PhD; ***Michael Prayson, MD****;*
Wright State University, Dayton, Ohio, USA

Poster #66
(p. 467)

Femoral Anatomy Changes With Age Predisposing to Distal Anterior Malpositioning of Intramedullary Implants
Damien M. Tucker, MBChB, MRCS[1]*; T. Surup, Dip Eng*[2]*; Andreas Petersik, PhD*[2]*;*
M. Acharya, MD[1]*; T. Chesser, MD*[1]*; M. Kelly, MD*[1]*;*
[1]*North Bristol NHS Trust, Bristol, United Kingdom*
[2]*Stryker R&D Virtual Engineering, Kiel, Germany*

Poster #67
(p. 469)

A Multicenter Retrospective Study of the Treatment of 253 Geriatric Acetabular Fractures: Should We Be Performing More Arthroplasty?
Ted Manson, MD[1]*; Lisa Reider, MS*[2]*; Paul Tornetta, MD*[3]*; Steven Sims, MD*[4]*;*
Robert O'Toole, MD[1]*; the METRC Investigators;*
[1]*R Adams Cowley Shock Trauma Center, Baltimore, Maryland, USA;*
[2]*Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA;*
[3]*Boston University Medical Center, Boston, Massachusetts, USA;*
[4]*Carolinas Medical Center, Charlotte, North Carolina, USA*

See pages 99 - 147 for financial disclosure information.

Poster #68
(p. 471)

Predictors of Failure for Cephalomedullary Nailing of Proximal Femoral Fractures
***Aidin Kashigar, MD, BASc**; Alex Vincent; Matthew J. Gunton, MD, BSc; David Backstein, MD, MEd, FRCSC; Oleg Safir, MD, FRCSC; Paul R.T. Kuzyk, MD, BSc(Eng), MASc, FRCSC; Mount Sinai Hospital, Toronto, Ontario, Canada*

Poster #69
(p. 472)

Complications and Outcomes of Primary Total Hip Arthroplasty in Displaced Neck of Femur Fractures
*Jillian Rutherford-Davies, FRCS (Tr&Orth); Aatif Mahmood, MRCS; **Gunasekaran Kumar, FRCS (Tr&Orth)**; Royal Liverpool University Hospital, Liverpool, United Kingdom*

Poster #70
(p. 474)

The Effects of Cephalomedullary Nail and Sliding Hip Screw on Perioperative Morbidity in Cases Being Converted to Total Hip Arthroplasty
*Andrew J. Marcantonio, DO; K. J. Bramlett, PA; Richard Iorio, MD; John F. Tilzey, MD; Lawrence M. Specht, MD; **Michael S. Kain, MD**; Lahey Hospital and Medical Center, Burlington, Massachusetts, USA*

Poster #71
(p. 475)

Revision Surgery in Stable Femoral Neck Fractures Treated with Percutaneous Screw Fixation in Elderly Patients
***Michael S. Kain, MD**; Richard Iorio, MD; Andrew J. Marcantonio, DO; Lahey Hospital and Medical Center, Burlington, Massachusetts, USA*

PELVIS and ACETABULUM

Poster #72
(p. 476)

Biomechanical Comparison of Quadrilateral Surface Buttress Plates to Traditional Forms of Fixation for Transverse Acetabular Fractures
***Brian J. Kistler, MD**; Ian Smithson, MD; Seth Cooper, MD; Jacob Cox, MD; Scott Marberry, MD; Aniruddh Nayak, MS; Brandon Santoni, PhD; H. Claude Sagi, MD; Orthopaedic Trauma Service, Florida Orthopaedic Institute, Tampa, Florida, USA; Foundation for Orthopaedic Research & Education, Tampa, Florida, USA; University of South Florida, Tampa, Florida, USA*

Poster #73
(p. 478)

Outcomes of Trochanteric Osteotomies for Acetabular Fracture Surgery
***Andrew Dubina**; Niluka Wickramaratne, BSE; Robert V. O'Toole, MD; Theodore T. Manson, MD; R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA*

Poster #74
(p. 479)

13-Year Experience in External Fixation of the Pelvis: Complications, Reduction, and Removal
*Phillip M. Mitchell, MD; Chad M. Corrigan, MD; Neelam A. Patel, BA; Arnold J. Silverberg, BS; Rachel Thakore, BA; William T. Obremskey, MD, MPH; Jason M. Evans, MD; Jesse M. Ehrenfeld MD, MPH; **Manish K. Sethi, MD**; Vanderbilt University, Nashville, Tennessee, USA*

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Poster #75
(p. 481)

Precision of Computer-Navigated Versus Fluoroscopic Guided Fixation of Percutaneous Iliosacral Screws

Jan F.M. Verbeek, BSc[1]; Erik Hermans, MD[2]; Arie B. van Vugt, MD, PhD[2];
Jan Paul M Frölke, MD, PhD[1];
[1]Radboud University Medical Center, Nijmegen, The Netherlands;
[2] Medical Spectrum Twente, Enschede, The Netherlands

Poster #76
(p. 482)

The Effect of Initial Reduction and Method of Reduction on Final Alignment in Type 3 Posterior Pelvic Ring Injuries

Paul Tornetta III, MD[1]; *Adam Lindsay, MD[1]; John Kurylo, MD[1];*
David Templeman, MD[2];
[1]Boston University Medical Center, Boston, Massachusetts, USA;
[2]Hennepin County Medical Center, Minneapolis, Minnesota, USA

Poster #77
(p. 484)

The Prevalence of Sacroiliac Joint Degeneration in Asymptomatic Adults: A Review of 500 CT Scans

Jonathan-James T. Eno, MD; *Christopher R. Boone, MD; Michael J. Bellino, MD;*
Julius A. Bishop, MD;
Stanford University, Stanford, California, USA

Poster #78
(p. 485)

Does Surgical Stabilization of Pelvic Ring Fractures Positively Impact Patients' Pain, Narcotic Requirement, and Mobilization?

Jennifer Hagen, MD[1]; Renan Castillo, PhD[2]; Andrew Dubina[1]; Greg Gaski, MD[3];
Robert O'Toole, MD[1]; ***Theodore Manson, MD[1]***;
[1]R Adams Cowley Shock Trauma Center, Department of Orthopaedics,
University of Maryland School of Medicine, Baltimore, Maryland, USA;
[2]Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA;
[3]Indiana University Health System, Indianapolis, Indiana, USA

Poster #79
(p. 486)

Does Application of a Pelvic Binder Affect the Sensitivity of Computed Tomography for Detecting Pelvic Ring Injuries?

John Swartz, DO; ***Rahul Vaidya, MD***; *Paul Dougherty, MD; Fred Tonnos, MD;*
Bryant Oliphant, MD;
Detroit Medical Center, Detroit, Michigan, USA

Poster #80
(p. 488)

Comparison of Circumferential Pelvic Sheeting Versus Commercially Available Pelvic Binders on Unstable Pelvic Injuries: A Biomechanical Cadaveric Study

Mark L. Prasarn, MD[1]; *Joshua L. Gary, MD[1]; MaryBeth Horodyski, PhD[2];*
Glenn R. Rechtine, MD[3];
[1]University of Texas, Houston, Texas, USA;
[2]University of Florida, Gainesville, Florida, USA;
[3]University of Rochester, Rochester, New York, USA

Poster #81
(p. 489)

Surgical Approach Algorithm for Transverse + Posterior Wall Fractures

Yelena Bogdan, MD; Shashank Dwivedi, MS; ***Paul Tornetta III, MD***;
Boston University Medical Center, Boston, Massachusetts, USA

See pages 99 - 147 for financial disclosure information.

Poster #82
(p. 491)

The Safety and Efficacy of Pelvic External Fixation as a Definitive Mode of Stabilization of the Anterior Pelvic Ring
*Hassaan Q. Sheikh; **Theodoros Tosounidis**; Nikolaos Kanakaris; Peter V. Giannoudis, MD;*
Academic Unit of Trauma and Orthopaedics, Leeds General Infirmary, Leeds, United Kingdom

Poster #83
(p. 493)

Biomechanical Analysis of Mechanically Unstable Pelvic Fractures: Retrograde Superior Pubic Ramus Screw Versus Anterior External Fixation
***Justin A. Krajca, MD**; Hyunchul Kim, MS; Jason W. Nascone, MD; Theodore T. Manson, MD; Christina L. Boulton, MD; Adam H. Hsieh, PhD; Robert V. O'Toole, MD;*
R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA

SPINE

Poster #84
(p. 495)

Is It Safe to Use Kinetic Bed Therapy During ICU Management of the Trauma Patient With an Unstable Cervical Spine Injury?
***Mark L. Prasarn, MD**[1]; Caleb Behrend, MD[2]; MaryBeth Horodyski, PhD[3]; Glenn R. Rechtine, MD[2];*
[1]University of Texas, Houston, Texas, USA;
[2]University of Rochester, Rochester, New York, USA;
[3]University of Florida, Gainesville, Florida, USA

Poster #85
(p. 496)

ASIA Impairment Scale Predicts the Need for Tracheostomy After Cervical Spine Injury
*Benjamin R. Childs, BS; Timothy A. Moore, MD; John J. Como, MD, MPH; **Heather A. Vallier, MD**;*
MetroHealth Medical Center, Cleveland, Ohio, USA

Poster #86
(p. 497)

•Biomechanical Comparison of Thoracolumbar Burst Fracture Stability with Traditional and Integrated Expandable Corpectomy Spacers: The Effect of Footprint Size, Supplemental Fixation, and Fracture Screws
*Ripul R. Panchal, DO[1]; **Erika Matheis, MS**[2]; Manasa Gudipally, MS[2]; Kanaan Salloum, BS[2]; Mir Hussain, BS[2]; Kee D. Kim, MD[1]; Brandon Bucklen, PhD[2];*
[1]Department of Neurological Surgery, University of California, Davis, Sacramento, California, USA;
[2]Globus Medical, Audubon, Pennsylvania, USA

Poster #87
(p. 499)

Do Attending Physicians Know Evidence-Based Guidelines for Cervical Spine Clearance in Blunt Trauma Patients?
***Elizabeth Inkellis, MD**; Alexander Theologis, MD; R. Trigg McClellan, MD; Murat Pekmezci, MD;*
University of California San Francisco, San Francisco, California, USA

• The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Poster #88
(p. 500)

Comparison of Methods of Halo Vest Application: A Biomechanical Study

Mark L. Prasarn, MD[1]*; Caleb J. Behrend, MD*[2]*; MaryBeth Horodyski, PhD*[3]*;*
Rex A. Marco, MD[1]*; Glenn R. Rechtine, MD*[2]*;*
[1]*University of Texas, Houston, Texas, USA;*
[2]*University of Rochester, Rochester, New York, USA;*
[3]*University of Florida, Gainesville, Florida, USA*

Poster #89
(p. 502)

Atlantoaxial Instability in Acute Odontoid Fractures Is Associated with Nonunion and Mortality

Nathan Evaniew, MD*; Blake Yarascavitch, MD; Kim Madden, BSc;*
Michelle Ghert, MD, FRCSC; Brian Drew, MD, FRCSC;
Mohit Bhandari, MD, PhD, FRCSC; Desmond Kwok, MD, FRCSC;
McMaster University, Hamilton, Ontario, Canada

Poster #90
(p. 504)

Incidence of Thoracolumbar Spine Injuries Is Increasing in the United States

Andrea Doud, MD*; Ashley Weaver, PhD; Jennifer Talton, MS; Ryan Barnard, MS;*
J. Wayne Meredith, MD; Joel Stitzel, PhD; Preston Miller III, MD;
Anna N. Miller, MD;
Wake Forest University School of Medicine, Winston-Salem, North Carolina, USA

UPPER EXTREMITY

Poster #91
(p. 506)

Midshaft Clavicle Fracture Fixation: Comparison of Pin Versus Plate

Barry C. Davis, MD*; George K. Bal, MD; E. Barry McDonough, MD;*
West Virginia University, Morgantown, West Virginia, USA

Poster #92
(p. 507)

Initial Varus Displacement of Proximal Humerus Fractures Results in Similar Function But Higher Complication Rates

Christina Capriccioso, BSE[1]*; Arthur Manoli III, BS*[1]*; Joseph D. Zuckerman, MD*[1]*;*
Kenneth A. Egol, MD[1,2]*;*
[1]*NYU Hospital for Joint Diseases, New York, New York, USA;*
[2]*Jamaica Medical Center, Jamaica, New York, USA*

Poster #93
(p. 509)

Olecranon Fractures: Factors Influencing Reoperation

Mark C. Snoddy, MD; Maximilian F. Lang, BS; Phillip M. Mitchell, MD;
W. Jeffrey Grantham, MD; Benjamin S. Hooe, BS; Harrison F. Kay, BS;
Ritwik Bhatia, BA; Rachel Thakore, BS; Jason M. Evans, MD;
William T. Obremskey, MD, MPH, MMHC; ***Manish K. Sethi, MD****;*
Vanderbilt University, Nashville, Tennessee, USA

Poster #94
(p. 511)

Factors Predicting Satisfactory Functional Outcomes in Patients Following Humeral Shaft Fractures

Edward Shields, MD*; Leigh Sundem, BS; Sean Childs, BS; Michael Maceroli, MD;*
Catherine Humphrey, MD; John Ketz, MD; Gillian Soles, MD;
John T. Gorczyca, MD;
University of Rochester, Rochester, New York, USA

See pages 99 - 147 for financial disclosure information.

Poster #95
(p. 513)

Functional Recovery of Complex Elbow Dislocations Treated with a Hinged External Elbow Fixator: Results of a Multicenter Prospective Study

*Gijs I.T. Iordens, MD[1]; **Dennis Den Hartog, MD, PhD[1]**;*
Esther M.M. Van Lieshout, MSc, PhD[1]; Wim Tuinebreijer, MD, PhD[1];
Jeroen de Haan, MD, PhD[2]; Peter Patka, MD, PhD[1];
Michael H.J. Verhofstad, MD, PhD[1]; Niels W.L. Schep, MD, PhD[3];
on behalf of the Dutch Elbow Collaborative;
[1]Erasmus MC, University Medical Center Rotterdam, Trauma Research Unit Department of Surgery, Rotterdam, The Netherlands;
[2]Westfriesgasthuis, Department of Surgery, Hoorn, The Netherlands;
[3]AMC, Trauma Unit Department of Surgery, Amsterdam, The Netherlands

Poster #96
(p. 514)

Initial Malalignment of Humeral Shaft Fractures Predicts Failure of Bracing: Results of a Treatment Protocol

Alexander Crespo, BS[1]; Deirdre Regan, BA[1]; Sanjit Konda, MD[1,2];
***Kenneth Egol, MD[1,2]**;*
[1]NYU Hospital for Joint Diseases, New York, New York, USA;
[2]Jamaica Medical Center, Jamaica, New York, USA

WRIST and HAND

Poster #97
(p. 516)

Unstable Distal Radius Fracture: Reduce Prior to Surgery?

***Teun Teunis, MD**; Frans J. Mulder, BSc; Sjoerd P.F.T. Nota, MD;*
David Ring, MD, PhD;
Massachusetts General Hospital–Harvard Medical School, Boston, Massachusetts, USA

Poster #98
(p. 517)

Does Malunion in Multiple Planes Predict Worse Functional Outcomes in Distal Radius Fractures?

Alejandro I. Marcano, MD[1]; Mathew Cantlon, MD[1]; James Lee[1];
***Kenneth A. Egol, MD[1,2]**;*
[1]NYU Hospital for Joint Diseases, New York, New York, USA
[2]Jamaica Medical Center, Jamaica, New York, USA

Poster #99
(p. 518)

Ulnar Styloid Fracture in Association with Distal Radius Fracture Portends Poorer Outcome

Omri Ayalon, MD[1]; Alejandro I. Marcano, MD[1]; Nader Paksima, DO[1];
***Kenneth Egol, MD[1,2]**;*
[1]NYU Hospital for Joint Diseases, New York, New York, USA
[2]Jamaica Medical Center, Jamaica, New York, USA

Poster #100
(p. 519)

Do Distal Radius Fractures Shift After External Fixation?

***Paul Tornetta III, MD**; Andrew Jawa, MD; Regina Meis, MD;*
Joey LaMartina II, MD;
Boston University Medical Center, Boston, Massachusetts, USA

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

2014 ANNUAL MEETING SCIENTIFIC POSTERS

Poster #101
(p. 521)

Lost Work Productivity in Patients With Distal Radius Fractures
Gerard Slobogean, MD, MPH, FRCSC; *Peter O'Brien, MD, FRCSC; Henry Broekhuyse, MD, FRCSC; Kelly Lefaivre, MD, MSc, FRCSC; Department of Orthopaedics, University of British Columbia, Vancouver, British Columbia, Canada*

Poster #102
(p. 522)

Decreasing Incidence and Changing Treatment of Distal Radius Fractures Among Elderly Adults
Benjamin D. Streufert, BS; *Jonathan A. Godin, MD, MBA; Robin N. Kamal, MD; Sendhilnathan Ramilingam, BS; R. Andrew Henderson, MD, MSc; Richard C. Mather III, MD; David S. Ruch, MD; Duke University Medical Center, Durham, North Carolina, USA*

Poster #103
(p. 524)

Variation in Treatment Recommendations for Fracture of the Distal Radius: Actual Radiographs Versus Radiographic Measurements
Valentin Neuhaus, MD; *Arjan G. Bot, MD; Thierry G. Guitton, MD; David C. Ring, MD, PhD; Massachusetts General Hospital, Boston, Massachusetts, USA*

Poster #104
(p. 525)

Influence of Surgeon, Patient, and Radiographic Factors on Distal Radius Fracture Treatment
Valentin Neuhaus, MD; *Arjan G. Bot, MD; Thierry G. Guitton, MD; David C. Ring, MD, PhD; Massachusetts General Hospital, Boston, Massachusetts, USA*

Poster #105
(p. 526)

Unstable Metacarpal Fractures Treated with Intramedullary Nail Fixation
Ather Mirza, MD; Justin Mirza; Brian Lee; Shawn Adhya; ***Christopher Healy****; St. Catherine of Siena Medical Center and North Shore Surgi-Center, Smithtown, New York, USA*

PEDIATRIC

Poster #106
(p. 527)

Detection of Pediatric Traumatic Knee Arthrotomy Using the Saline Load Test
Justin Haller, MD; *James Beckmann, MD; Ashley Kapron, PhD; Stephen Aoki, MD; University of Utah Department of Orthopaedics, Salt Lake City, Utah, USA*

Poster #107
(p. 528)

Does Skeletal Maturity Affect Pediatric Pelvic Injury Patterns, Associated Injuries, and Treatment Intervention?
Christiane G. Kruppa, MD[1,2]; ***Debra L. Sietsema, PhD[3,4]****; Justin D. Khoriaty, BS[4]; Marcel Dudda, MD[1]; Clifford B. Jones, MD[3,4];*
[1]Department of Surgery, BG-University Hospital Bergmannsheil, Bochum, Germany;
[2]Grand Rapids Medical Education Partners, Grand Rapids, Michigan, USA;
[3]Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA;
[4]Michigan State University, Grand Rapids, Michigan, USA

See pages 99 - 147 for financial disclosure information.

Poster #108
(p. 529)

Complications After Operatively Treated Both-Bone Forearm Fractures with ESIN in Childhood and Adolescence: A Two Center Study

Marcel Dudda, MD[1]*; Pamela Bunge, MD; Clifford B. Jones, MD*[2,3]*;*
Thomas A. Schildhauer, MD[1]*; Christiane Kruppa, MD*[1,4]*;*
[1]*Department of Surgery, University Hospital Bergmannsheil, Ruhr, University of Bochum, Bochum, Germany;*
[2]*Michigan State University/CHM, Grand Rapids, Michigan, USA;*
[3]*Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA;*
[4]*Grand Rapids Medical Education Partners, Grand Rapids, Michigan, USA*

Poster #109
(p. 530)

Fractures of the Acetabulum in Childhood and Adolescence

Christiane G. Kruppa, MD[1,2]*;* ***Debra L. Sietsema, PhD***[3,4]*; Justin D. Khoriaty, BS*[3]*;*
Marcel Dudda, MD[1]*; Clifford B. Jones, MD*[3,4]*;*
[1]*Department of Surgery, BG-University Hospital Bergmannsheil, Bochum, Germany;*
[2]*Grand Rapids Medical Education Partners, Grand Rapids, Michigan, USA;*
[3]*Michigan State University, Grand Rapids, Michigan, USA;*
[4]*Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA*

Poster #110
(p. 531)

Sacral Fractures in Pediatric Patients

Christiane G. Kruppa, MD[1,2]*;* ***Debra L. Sietsema, PhD***[3,4]*; Justin D. Khoriaty, BS*[3]*;*
Marcel Dudda, MD[1]*; Clifford B. Jones, MD*[3,4]*;*
[1]*Department of Surgery, BG-University Hospital Bergmannsheil, Bochum, Germany;*
[2]*Grand Rapids Medical Education Partners, Grand Rapids, Michigan, USA;*
[3]*Michigan State University, Grand Rapids, Michigan, USA;*
[4]*Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA*

POLYTRAUMA

Poster #111
(p. 533)

Is "Delayed" Early Total Care Dangerous When Nailing Femur Fractures?

Daphne Beingessner, MD; David P. Barei, MD; ***Jonah Hebert-Davies, MD****;*
Harborview Medical Center, Seattle Washington, USA

Poster #112
(p. 534)

A Day Late and a Fracture Missed: Delayed Diagnosis of Orthopaedic Injuries in Severely Injured Trauma Patients

Ronald T. Auer, MD*; Shane J. Kibbe, MD; John T. Riehl, MD;*
University of Louisville, Louisville, Kentucky, USA

Poster #113
(p. 535)

Definition of the Borderline Condition in Multiple Trauma Patients: Role of Conventional Parameters

Frank Hildebrand, MD[1,2]*; Rolf Lefering, PhD*[3]*; Richard Sellei, MD*[1]*;*
Hagen Andruszkow, MD[1,2]*; Boris A. Zelle, MD*[4]*; Hans-Christoph Pape, MD, FACS*[1]*;*
[1]*Department of Orthopaedic Trauma at Aachen University, Aachen, Germany;*
[2]*Harald Tscherne Research Laboratory for Orthopaedic Trauma at Aachen University, Aachen, Germany;*
[3]*Institute for Research in Operative Medicine (IFOM), Cologne, Germany;*
[4]*The University of Texas Health Science Center, San Antonio, Texas, USA*

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Poster #114
(p. 536)

Tissue Damage Volume Predicts Systemic Inflammation in Multiply Injured Patients with Fractures

Travis L. Frantz, MS; Greg E. Gaski, MD; Scott Steenburg, MD; Timothy Pohlman, MD; ***Todd O. McKinley, MD****;*
Indiana University School of Medicine, Methodist Hospital, Indianapolis, Indiana, USA

Poster #115
(p. 538)

Early Appropriate Care of Orthopaedic Injuries in Elderly Multiple-Trauma Patients

Michael S. Reich, MD; Andrea J. Dolenc, BS; Timothy A. Moore, MD; ***Heather A. Vallier, MD****;*
MetroHealth Medical Center, Cleveland, Ohio, USA

Poster #116
(p. 540)

Fracture Healing Complications in Patients Presenting with High-Energy Trauma Fractures and Bone Health Intervention

Debra L. Sietsema, PhD[1,2]*; Michael D. Koets, BS*[3]*; Clifford B. Jones, MD*[1,2]*;*
[1]*Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA;*
[2]*Michigan State University, Grand Rapids, Michigan, USA;*
[3]*Wayne State University School of Medicine, Detroit, Michigan, USA*

Poster #117
(p. 542)

Are the Fractures We Treat Becoming More Complex? Trends in Orthopaedic Fracture and Injury Severity—A Level-I Trauma Center Experience

Neil Tarabadkar, MD*; Timothy Alton, MD; Jacob Gorbaty, BA; Lisa Taitsman, MD; Sean Nork, MD; Conor Kleweno, MD;*
University of Washington, Harborview Medical Center, Seattle, Washington, USA

Poster #118
(p. 544)

Thromboelastography Demonstrates Less Hyperfibrinolysis in Multiply Injured Trauma Patients with Pelvic Fractures.

Christiaan N. Mamczak, DO[1,2]*; Bryan Boyer, MD*[1,2]*; Scott Thomas, MD*[2,3]*; Braxton Fritz, BS*[4]*; Ed Evans, BA, CCP*[2]*; Benjamin Speicher, BA*[2]*; Mark Walsh, MD*[2,4]*;*
[1]*Beacon Orthopaedic Trauma Surgery, South Bend, Indiana, USA;*
[2]*Memorial Hospital of South Bend, South Bend, Indiana, USA;*
[3]*General & Vascular Surgery PC, South Bend, Indiana, USA;*
[4]*Indiana University School of Medicine, South Bend, Indiana, USA*

Poster #119
(p. 546)

Phonomyography as a Noninvasive Continuous Monitoring Technique to Diagnose Acute Compartment Syndrome

Adriana P. Martinez Gomez, MD*; Thomas Hemmerling, MD, DEAA, PhD; Neil Saran, MD, MSc, FRCSC; Marylene Paquet, DMV, MSc, D'ACVP; Gregory K. Berry, MDCM, FRCSC;*
McGill University, Montreal General Hospital, Orthopaedic Surgery Department, Montreal, Quebec, Canada

See pages 99 - 147 for financial disclosure information.

POST TRAUMATIC RECONSTRUCTION

Poster #120 (p. 547)
Infection After Internal Fixation: Alternatives in Treatment
Salvatore Frangiamore, MD; Ajinkya Rane, BS; ***Heather A. Vallier, MD****;*
MetroHealth Medical Center, Cleveland, Ohio, USA

Poster #121 (p. 549)
Treatment of Complex Posttraumatic Wounds Without Free Flap Coverage: Are Stem Cells the Orthopaedic Surgeon's New Free Flap?
Bruce A. Kraemer, MD; Scott Geiger, MD; ***J. Tracy Watson, MD****;*
Departments of Orthopaedic and Plastic Surgery, St. Louis University School of Medicine, St. Louis, Missouri, USA

Poster #122
WITHDRAWN

Poster #123 (p. 551)
Manipulation Under Anesthesia: A Safe and Effective Treatment for Posttraumatic Arthrofibrosis of the Knee
Adam A. Sassoon, MD*; Obinna O. Adigweme, MD; Joshua Langford, MD;*
Kenneth J. Koval, MD; George J. Haidukewych, MD;
Orlando Regional Medical Center, Orlando, Florida, USA

Poster #124 (p. 552)
•Safety of Osseointegrated Prosthesis for Transfemoral Amputees
Munjed Al Muderis, MB ChB, FRACS, FAOrthA[1]*; Guy Raz, MD*[1]*;*
Michael Edwards[2]*; Henk van de Meent, MD, PhD*[2]*;* ***Jan Paul Frölke, MD, PhD***[2]*;*
[1]*School of Medicine, University of Notre Dame Australia,*
Sydney, New South Wales, Australia;
[2]*Radboud University Nijmegen Medical Center, Nijmegen, The Netherlands*

Poster #125 (p. 554)
The Treatment of Atrophic, Recalcitrant Long-Bone Nonunion with Human Recombinant Bone Morphogenetic Protein-7 (rhBMP-7): A Retrospective Cohort Review
Zachary Morison, MSc*; Milena Vicente, RN; Emil H. Schemitsch, MD, FRCS(C);*
Michael D. McKee, MD, FRCS(C);
St. Michael's Hospital, University of Toronto, Toronto, Ontario, Canada

Poster #126 (p. 555)
Osseointegrated Prosthetic Limb for Amputees: Over 10 Years' Experience with More Than 100 Cases
Guy Raz, MD*; Aditya Khemka, MD;*
Munjed Al Muderis, MB ChB, FRACS, FAOrthA;
School of Medicine, University of Notre Dame Australia,
Sydney, New South Wales, Australia

GENERAL INTEREST

Poster #127 (p. 556)
Function After Traumatic Amputation of the Lower Extremity: What Are the Predictors of Better Outcome?
Douglas A. Smith, DO; Meredith Grogan; ***Heather A. Vallier, MD****;*
MetroHealth Medical Center, Cleveland, Ohio, USA

POSTERS

• The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Poster #128
(p. 557)

First Clinical Use of a Novel Plasma-Based Biomaterial to Augment the Healing of Open Tibia Fractures
Brian Bernstein, MD; *Sithombo Maqungo, MD; Marc Nortje, MD; David North, MD;*
University of Cape Town, Cape Town, South Africa

Poster #129
(p. 558)

Depression in Orthopaedic Trauma Patients: A Prospective Cohort
Stephen Becher, MD; *Michele Smith, PhD; Bruce Ziran, MD;*
Atlanta Medical Center, Atlanta, Georgia, USA

Poster #130
(p. 559)

Evaluation of Appropriate Chemical and Mechanical Prophylaxis for Deep Vein Thrombosis and Pulmonary Emboli in Orthopaedic Trauma Patients
Christopher M. Domes, MD, ATC; *Anneliese M. Schleyer, MD; Daphne M. Beingessner, MD;*
Harborview Medical Center, Seattle, Washington, USA

Poster #131
(p. 560)

Timing, Incidence, and Risk Factors Associated with Unplanned Postoperative Hospital Readmissions in the Orthopaedic Trauma Patient Population
Rishin J. Kadakia, MD; *Harrison F. Kay, BSc; Jesse Ehrenfeld, MD, MPH; Sunil Kripalani, MD, MSc; Kamran Idrees, MD; Amanda M. McDougald Scott, MS; Kristin R. Archer, PhD, DPT; Hassan R. Mir, MD, MBA;*
Vanderbilt University Medical Center, Nashville, Tennessee, USA

Poster #132
(p. 561)

Is the Digital Divide in Orthopaedic Trauma Patients a Myth? A Prospective Cohort Study of the Usage of a Custom Internet Site
Paul E. Matuszewski, MD[1]; *Samir Mehta, MD*[2]; *Andrew N. Pollak, MD*[1]; *Robert V. O'Toole, MD*[1];
[1]*R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA;*
[2]*Hospital of the University of Pennsylvania, Department of Orthopaedics, Philadelphia, Pennsylvania, USA*

Poster #133
(p. 563)

Surgical Apgar Score (SAS) is Associated with Postoperative Complications in the Orthopaedic Trauma Patient Population
Rishin J. Kadakia, MD; *Harrison F. Kay, BSc; Jesse Ehrenfeld, MD, MPH; Sunil Kripalani, MD, MSc; Kamran Idrees, MD; Amanda M. McDougald Scott, MS; Kristin R. Archer, PhD, DPT; Hassan R. Mir, MD, MBA;*
Vanderbilt University Medical Center, Nashville, Tennessee, USA

Poster #134
(p. 564)

The Value of a Dedicated Saturday Orthopaedic Trauma OR
Robert P. Runner, MD; Thomas J. Moore Jr, MD; ***William M. Reisman, MD***;
Grady Memorial Hospital, Emory University Orthopaedic and Fracture Care, Atlanta, Georgia, USA

Poster #135
(p. 565)

The ASA Score as a Predictive Tool for Perioperative Transfusion in Trauma
Dagoberto Estevez-Ordonez, BS; Rachel V. Thakore, BS; Vasanth Sathiyakumar, BA; Rivka C. Ihejirika, BS; Anna E. Garcia, BSPH; Gerald Onuoha II, BS; Jesse M. Ehrenfeld, MD, MPH; Young M. Lee, BS; William T. Obremskey, MD, MPH; ***Manish K. Sethi, MD***;
Vanderbilt University, Nashville, Tennessee, USA

See pages 99 - 147 for financial disclosure information.

Δ OTA Grant

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Poster #144
(p. 578)

Decisional Balance and Smoking: Are Orthopaedic Trauma Patients More Willing to Quit?

Paul E. Matuszewski, MD; *Christina L. Boulton, MD; Robert V. O'Toole, MD;*
R Adams Cowley Shock Trauma Center, Department of Orthopaedics,
University of Maryland School of Medicine, Baltimore, Maryland, USA

Poster #145
(p. 579)

The Electronic Medical Record: Does It Accurately Reflect the Trauma Patient?

Wesley Winn, BS; Heidi Israel, PhD; ***Lisa K. Canada, MD****;*
Saint Louis University, St. Louis, Missouri, USA

Poster #146
(p. 581)

Decreasing the Occurrence of Intraoperative Technical Errors Through Periodic Simple Show, Tell, and Learn Method

Ely L. Steinberg, MD*; Eyal Amar, MD; Assaf Albagli, MD; Ehud Rath, MD;*
Moshe Salai, MD;
Department of Orthopaedic Surgery, Tel-Aviv Sourasky Medical Center,
Sackler Faculty of Medicine, Tel-Aviv University, Tel-Aviv, Israel

Poster #147
(p. 582)

Implant Choice, Spending, and Postoperative Complications: Exploring the Variability in an Orthopaedic Trauma Group

Thomas J. An, BA; Vasanth Sathiyakumar, BA; Harrison F. Kay, BS;
Michael Gerasimopoulos, MBA; Young M. Lee, BS; Rachel V. Thakore, BS;
William T. Obremskey, MD, MPH, MMHC; ***Manish K. Sethi, MD****;*
Vanderbilt University, Nashville, Tennessee, USA

Poster #148
(p. 584)

Health-Care Reimbursement Models and Orthopaedic Trauma: Will There Be Change in Management?

Rivka C. Ihejirika, BS; Vasanth Sathiyakumar, BA; A. Alex Jahangir, MD, MMHC;
William T. Obremskey, MD, MPH, MMHC; Hassan R. Mir, MD, MBA;
Daniel J. Stinner, MD; Rachel V. Thakore, BS; ***Manish K. Sethi, MD****;*
Vanderbilt University, Nashville, Tennessee, USA

Poster #149
(p. 586)

Thromboelastography Predictive of Death in Trauma Patients

Ian Kane, BS[1,2]*; Alvin Ong, MD*[2]*; Fabio R. Orozco, MD*[2]*; Zachary D. Post, MD*[2]*;*
Luke S. Austin, MD[2]*; Kris E. Radcliff, MD*[2]*;*
[1]*New York Medical College, Valhalla, New York, USA*
[2]*Rothman Institute of Orthopedics at Jefferson University Hospital,*
Philadelphia, Pennsylvania, USA

Poster #150
(p. 587)

Is It Ever Too Hot or Too Cold for Trauma?

Gregg M. Ebersole, MD; Melissa Meister, BS; ***Lisa K. Cannada, MD****;*
J. Tracy Watson, MD;
Saint Louis University Hospital, St. Louis, Missouri, USA

Poster #151
(p. 589)

Implementing Recovery Resources in Trauma Care: Impact and Implications

Sarah B. Hendrickson, Med; Mary A. Breslin, BA; ***Heather A. Vallier, MD****;*
Department of Orthopaedic Surgery, MetroHealth Medical Center,
Cleveland, Ohio, USA

See pages 99 - 147 for financial disclosure information.

Poster #152
(p. 590)

Early Complications and Outcomes in Combat Injury-Related Invasive Fungal Infections: A Case-Control Analysis

LT Louis Lewandowski, MD[1,2]; *Amy C. Weintrob, MD*[1,3]; *David R. Tribble, MD*[3]; *CDR Carlos J. Rodriguez, DO*[1,2]; *CPT Joseph Petfield, MD*[4]; *COL Bradley A. Lloyd, DO*[4,5]; *COL Clinton K. Murray, MD*[4]; *MAJ Daniel Stinner, MD*[4]; *Deepak Aggarwal, MSE, MSPH*[3]; *Faraz Shaikh, MS*[3]; *LTC Benjamin K. Potter, MD*[1,2]; *Infectious Disease Clinical Research Program Trauma Infectious Disease Outcomes Study Group*
[1]*Department of Orthopaedics, Walter Reed National Military Medical Center, America Bethesda, Maryland, USA;*
[2]*Department of Surgery, Uniformed Services University of the Health Sciences, Bethesda, Maryland, USA;*
[3]*Infectious Disease Clinical Research Program, Uniformed Services University of the Health Sciences, Bethesda, Maryland, USA;*
[4]*San Antonio Military Medical Center, Fort Sam Houston, Texas, USA;*
[5]*Landstuhl Regional Medical Center, Landstuhl, Germany*

Poster #153
(p. 591)

The Relationship Between Preinjury Functional Status and 12-Month Functional Outcomes Varies by Fracture Site

Deirdre Regan, BA[1]; *Arthur Manoli III, BS*[1]; ***Kenneth Egol, MD***[1,2];
[1]*NYU Hospital for Joint Diseases, New York, New York, USA;*
[2]*Jamaica Medical Center, Jamaica, New York, USA*

(p. 593)

BEST TRAUMA RELATED POSTER – 2014 ORS MEETING

Comparing Weight Bearing and Patient Satisfaction Between the Ertl Transtibial Amputation and the Traditional Below Knee Amputation

Anthony W. Feher, MD; *Kreigh A. Kamman, BA; Melissa A. Kacena, PhD; Janos P. Ertl, MD*
Department of Orthopaedic Surgery, Indiana University School of Medicine, Indianapolis, Indiana, USA

POSTERS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

DISCLOSURE LISTING – ALPHABETICAL

Abraham, Christine M	*(n)*	Paper #125
Acharya, Mehool R	*(n)*	Poster #66
Achor, Timothy S	*(3B-Synthes)*	Papers #62, 82; Poster #6
Adhya, Shawn	*(n)*	Poster #105
Adigweme, Obinna	*(n)*	Poster #123
Agarwal, Animesh	*(3B-Smith & Nephew, KCI; 8-Journal of Orthopaedic Trauma; 9-AAOS, Orthopaedic Research Society, Orthopaedic Trauma Association)*	Mini Symposia Faculty
Agel, Julie	*(9-American Orthopaedic Society for Sports Medicine; Orthopaedic Trauma Association)*	Mini Symposia Moderator; Papers #68, 76; Posters #52, 138
Aggarwal, Deepak	*(3A, 4-Emergent Biosolutions; 4-Cardinal Health; Carefusion; 8-Medical Journal)*	Poster #152
Ahn, Jaimo	*(2-Synthes; 3B-Merck; Synthes; 3C-Skelegen; 8-Fronteirs in Surgery; Journal of Orthopaedic Trauma; 9-AAOS; American Orthopaedic Association; American Physician Scientists Association; Foundation for Orthopaedic Trauma; NBME; Orthopaedic Research Society; Orthopaedic Trauma Association)*	Mini Symposia Moderator; Symposium Faculty; Paper #30; Poster #142
Aitken, Stuart	*(n)*	Paper #41
Al Muderis, Munjed	*(n)*	Posters #124, 126
Albagli, Assaf	*(n)*	Poster #146
Alt, Volker	*(n)*	BSFF Symposium Faculty
Althausen, Peter L	*(4-The Orthopedic Implant Company; 8-Journal of Orthopaedic Trauma; 9-Orthopaedic Trauma Association)*	Symposium Faculty; Mini Symposia Faculty
Altman, Daniel T	*(2-AO North America)*	Paper #105; Poster #18
Altman, Gregory T	*(n)*	Paper #105; Poster #18
Alton, Timothy Bruce	*(n)*	Poster #117
Amar, Eyal	*(n)*	Poster #146
Amini, Michael Haessam	*(n)*	Poster #60

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

An, Thomas J	*(4,5-Merck; 5-Johnson & Johnson)*	Poster #147
Anari, Jason Brett	*(n)*	Poster #136
Anderson, Duane R.	*(n)*	Poster #24
Andrews, Erica Brecht	*(n)*	Poster #59
Andruszkow, Hagen	*(n)*	Poster #113
Angerame, Marc	*(n)*	Paper #107
Aoki, Stephen K.	*(3B-Pivot Medical; 5-Biomet; Musculoskeletal Transplant Foundation; Arthrex, Inc)*	Poster #106
Appleton, Paul T	*(2-Synthes)*	Paper #51
Archdeacon, Michael T.	*(1,3B-Stryker; 7-SLACK Incorporated; 8-Journal of the American Academy of Orthopaedic Surgeons; 9-Ohio Orthopaedic Society; Orthopaedic Trauma Association)*	Lab Leader; Papers #70, 115
Archer, Kristin	*(n)*	Papers #109, 125; Posters #131, 133
Atchabahian, Arthur	*7 (McGraw-Hill)*	Poster #40
Auer, Ronald	*(n)* *(n)*	Paper #112; Poster #112
Austin, Luke Stanford	*(3B-Tornier; 5-Zimmer)*	Poster #149
Ayalon, Omri	*(n)*	Poster #97
Backstein, David	*(2,3B-Avenir Medical; 2-Wright Medical Technology, Inc.; 3B- Microport Orthopaedics; 2,3B,5-Zimmer; 8-Journal of Arthroplasty)*	Poster #68
Bader, Magdalena J	*(n)*	Poster #29
Bahney, Chelsea S	*(5-Musculoskeletal Transplant Foundation; 8-European Cell and Matrix Journal)*	Paper #10
Bailey, Karsyn N	*(n)*	Paper #27
Bakr, Omar	*(n)*	Paper #120
Bal, George K	*(2,3C-DePuy, A Johnson & Johnson Company; 2-Biomet; 9-American Orthopaedic Society for Sports Medicine)*	Poster #91
Balbachevsky, Daniel	*(n)*	Guest Nation

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Barbosa, Paulo ..... *(3C-Synthes;* ..... Guest Nation
8-Current Opinion in Orthopaedics;
9-Brazilian Orthopedic Trauma Society-Vice President 2013;
Rio de Janeiro Orthopedic Society - President 2012)

Barei, David ..... *(2,3B,5-Synthes;* ..... Lab Faculty;
5-Zimmer; ..... Papers #76, 115;
9-AO/ASIF) ..... Posters #38, 52, 111

Barnard, Ryan ..... *(n)* ..... Poster #90

Barnett, Joey Victor ..... *(n)* ..... Paper #9

Bartl, Christoph ..... *(9-European Federation of National*
Associations of Orthopedics and Traumatology) ... Paper #59

Barwise, John A ..... *(n)* ..... Paper #125

Basmajian, Hrayr G. ..... *(n)* ..... Moderator;
..... Paper #75

Basques, Bryce A ..... *(n)* ..... Posters #1, 44, 53

Baumgaertner, Michael R. ..... *(9-AO Trauma: International* ..... Poster Tour Guide;
Board North America representative, ... Posters #44, 53
AONA President)

Baumgartner, Rita ..... *(n)* ..... Paper #120

Becher, Stephen John ..... *(n)* ..... Poster #129

Beckmann, James ..... *(n)* ..... Poster #104

Beebe, Michael J. ..... *(n)* ..... Paper #121;
..... Poster #55

Behrend, Caleb J ..... *(n)* ..... Posters #84, 88

Beingessner, Daphne Michelle . *(3B,5-Synthes)* ..... Paper #76;
..... Posters #38, 111, 130

Belin, Eric ..... *(n)* ..... Paper #73

Belkin, Nicole Stephanie ..... *(n)* ..... Paper #30

Bellino, Michael ..... *(n)* ..... Poster #77

Belmont, Barry ..... *(8-Journal of Electrical Bioimpedance)* ..... Paper #2

Benirschke, Stephen K ..... *(n)* ..... Poster #138

Benvenuti, Michael Andrew ... *(4-Abbott, AbbVie, Bristol-Myers* ..... Paper #109;
Squibb, GlaxoSmithKline, ... Poster #19
Johnson & Johnson, Pfizer, Zimmer)

Bergin, Patrick F ..... *(2-Acumed, LLC, Synthes;* ..... Lab Faculty;
5-Synthes, Major Extremity ..... Paper #115
Trauma Research Consortium (METRC))

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Berglund, Derek	*(n)*	Poster #63
Berkes, Marschall B	*(n)*	Paper #104; Posters #11, 37
Bernstein, Brian Peter	*(2-Macromed; 5-Carmel; 9-AOTrauma; South African Orthopaedic Trauma Society)*	Poster #128
Bernstein, Derek	*(n)*	Paper #49
Berry, Gregory	*(n)*	Poster #119
Bethea, Synthia	*(n)*	Paper #11
Bhandari, Mohit	*(3B-Amgen Co, Eli Lilly, Stryker, Smith & Nephew, Zimmer; Stryker; Moximed; Bioventus; 5-Smith & Nephew, DePuy, A Johnson & Johnson Company, Eli Lily, Bioventus)*	BSFF Symposium Faculty, BSFF Moderator Papers #111, 117, 118; Posters #16, 89
Bhatia, Ritwik	*(n)*	Poster #93
Bihari, Aurelia	*(n)*	Paper #13
Birnbaum, Jacqueline Florence	*(4,6-Merck)*	Paper #104
Bishop, Julius A	*(1-Innomed; 2-Synthes; 5-Covidien)*	Paper #123; Posters #51, 77
Blachut, Piotr A	*(5,6-Synthes)*	Papers #40, 45
Black, Sheena R	*(n)*	Papers #63, 79
Blair, James Alan	*(n)*	Paper #46
Bliss, Ryan	*(n)*	Paper #88
Bogdan, Yelena	*(9-AAOS)*	Paper #71; Poster #81
Bohl, Daniel D	*(n)*	Paper #74; Posters #1, 44, 53
Bollinger, Alexander	*(n)*	Paper #56
Boone, Christopher	*(2-Synthes)*	Poster #77
Born, Christopher T	*(3B-Stryker, Illuminoss, DeRoyal; 3C,4-Biointraface; 4-Illuminoss; 5-Stryker; 9-American College of Surgeons, Orthopaedic Trauma Association, AAOS, Foundation for Orthopaedic Trauma)*	Poster #9
Borrelli, Joseph Jr	*(2,3B-Eli Lilly; 7-Injury–Elsevier, Springer; 8-Injury)*	BSFF Symposium Faculty; BSFF Moderator
Bosse, CAPT (ret) Michael J	*(3B-Diashy; 4-Orthopaedic Implant Company)*	Papers #11, 38, 107; Poster #143

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Bot, Arjan GJ	*(6-A part of the printing of my thesis was supported by grants from Anna Fonds te Leiden, Penders Voetzorg, Chipsoft, Reumafonds, Janssen-Cilag, Academisch Medisch Centrum, DePuy Synthes)*	Paper #99; Posters #103, 104
Bottlang, Michael	*(1,2,3B-Synthes; 1,2,3B,5-Zimmer; 3A-APEX Biomedical)*	BSFF Symposium Faculty; BSFF Moderator
Boudreau, John A	*(n)*	Paper #69
Boulton, Chris	*(n)*	Paper #58
Boulton, Christina L	*(3C-Advanced Orthopedic Systems (AOS))*	Paper #110; Posters #83, 144
Bowen, Thomas R	*(n)*	Paper #18; Poster #55
Boyer, Bryan A	*(4-OrthoPediatrics)*	Paper #67; Poster #118
Bramer, Michelle	*(n)*	Poster #43
Bramlett, Kasey	*(n)*	Poster #70
Brandao, Fernando	*(n)*	Paper #87
Breeze, Janis L	*(n)*	Paper #62
Brennan, Kindyle L	*(n)*	Paper #77
Brennan, Michael L	*(3B-Stryker)*	Paper #77
Breslin, Mary Alice	*(n)*	Mini Symposia Faculty; Poster #151
Brinker, Mark R	*(7-Wolters Kluwer Health - Lippincott Williams & Wilkins); 8-JOT Section Editor)*	Paper #49; Poster #6
Broderick, J Scott	*(2-AONA; 9-Orthopaedic Trauma Association, South Carolina Orthopaedic Association)*	Mini Symposia Moderator
Broekhuyse, Henry M.	*(2,5-Synthes; 9-AAOS, American Orthopaedic Association, AOA - CORD governing council, Canadian Orthopaedic Association)*	Papers #40, 45, 60, 100; Poster #101
Brooks, Amanda E.	*(3A,4,6-Elute Inc.)*	Poster #137
Brown, William Roy	*(n)*	Paper #14
Browner, Bruce D	*(8-Wolters Kluwer Health - Lippincott Williams & Wilkins; 9-American College of Surgeons)*	Symposium Faculty
Bruckner, Thomas	*(n)*	Paper #59

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Bucklen, Brandon	*(3A,4-Globus Medical)*	Paper #73; Poster #86
Buckley, Andrew Richard	*(n)*	Paper #25
Bulka, Catherine	*(n)*	Poster #50
Bunge, Pamela	*(n)*	Poster #108
Buntin, Melinda B	*(8-Health Services Research; Healthcare: The Journal of Delivery Science and Innovation)*	Poster #50
Burgess, Andrew R	*(2,3B,4-Stryker)*	Border Memorial Lecturer
Burgkart, Rainer H	*(3A,3B-Stryker)*	Poster #20
Burgos, Eduardo J	*(n)*	Papers #24, 52, 122
Burn, Matthew	*(3A-UCB)*	Paper #82
Busse, Jason Walter	*(5-Smith & Nephew)*	Paper #111
Butler, Paul	*(n)*	Paper #56
Cage, Jason M	*(n)*	Paper #79
Cameron, Kenneth L.	*(n)*	Poster #31
Cannada, Lisa K	*(2,5-Smith & Nephew; 3B,5-Zimmer; 8-Orthopedics Today; 9-AAOS, Orthopaedic Trauma Association)*	BSFF Symposium; Symposium Faculty; Case Presentation Moderator; Paper #103; Posters #145, 150
Cantlon, Matthew	*(n)*	Poster #98
Cantwell, Matthew	*(3A-Invibio Biomaterial Solutions)*	Paper #4
Capriccioso, Christina	*(n)*	Paper #94; Posters #39, 92
Carolinas Trauma Network Research Group	*(n)*	Paper #53
Caroom, Cyrus Theodore	*(n)*	Poster #43
Cass, Joseph Ralph	*(n)*	Paper #31
Cassidy, Dale	*(4-Pfizer; Bristol-Myers Squibb; GlaxoSmithKline)*	Poster #9
Castillo, Renan C	*(n)*	Papers #85, 110; Poster #78
Caswell, Kathleen A	*(n)*	OTA Executive Director
Cates, Justin	*(n)*	Paper #9
Cepinskas, Gediminas	*(n)*	Paper #13
Chan, Daniel Steven	*(3B-Biomet; Synthes)*	Paper #106; Poster #27
Chauhan, Aakash	*(n)*	Paper #105
Cherney, Steven Matthew	*(n)*	Posters #8, 46

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Chesser, Tim	*(3B,5-Stryker; 8-Injury; 9-British Orthopaedic Association)*	Paper #96; Poster #66
Childs, Benjamin Randolph	*(4-Edwards Life Sciences)*	Poster #85
Childs, Sean	*(n)*	Poster #94
Chin, Paul Carl	*(n)*	Paper #63
Chubinskaya, Susanna G.	*(5-CartiHeal, Mesoblast, Merrimackpharma; 9-Orthopaedic Research Society, OsteoArthritis Research Society International, International Cartilage Repair Society)*	BSFF Symposium Faculty, BSFF Moderator
Clement, Nicholas D	*(n)*	Papers #41, 89, 90
CMC-OC Ankle Fracture Research Group	*(n)*	Papers #38, 54
Coats, Timothy	*(n)*	Paper #22
Cole, Peter A.	*(2,3B,5-Synthes; 4-BoneFoams Inc, LLC; 5-Acumed, LLC; Stryker; Zimmer; 9-AO Foundation Board of Trustees)*	Paper #33
Collinge, Cory A	*(1-Biomet, Smith & Nephew, Advanced Orthopedic Solutions, Synthes; 3B-Biomet, Stryker, Smith & Nephew; 8-Journal of Orthopaedic Trauma; 9-Foundation for Orthopedic Trauma)*	Lab Faculty
Cook, Jay B	*(n)*	Paper #79
Cooper, Seth	*(n)*	Papers #29, 115; Poster #72
Cooperman, Daniel Roy	*(n)*	Poster #41
Corrigan, Chad M	*(n)*	Paper #66; Poster #74
Costa, Matthew L	*(5-X-Bolt; 8-Bone and Joint Journal)*	Paper #96
Cotton, Bryan A	*(n)*	Paper #62
Court-Brown, Charles M	*(7-Wolters Kluwer Health - Lippincott Williams & Wilkins)*	Papers #89, 90
Cox, Jacob	*(n)*	Paper #29; Poster #72
Crapo, James	*(n)*	Paper #15
Creevy, William R		Mini Symposia Faculty
Crespo, Alexander	*(n)*	Paper #101; Posters #25, 96
Crickard, Colin Victor	*(n)*	Posters #34, 59
Crist, Brett D	*(2-Medtronic; 3B-KCI; 4-Amedica Corporation, Orthopaedic Implant Company;*	Lab Faculty; Papers #50, 65, 114

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Crist, Brett D (cont'd) ..... *5-Medtronic, Sonoma, Synthes, Wound Care Technologies; 6-Smith & Nephew; 8-Journal of Orthopaedic Trauma, Journal of the American Academy of Orthopaedic Surgeons, Orthoinfo.org; 9-International Geriatric Fracture Society, Mid-Central States Orthopaedic Society, Orthopaedic Trauma Association)*

Cronin, Kevin J ..... *(n)* ..... Poster #27

Cronin, Patrick ..... *(n)* ..... Paper #117; Poster #45

Cross, William Wood ..... *(2-Synthes, AO North America;* ..... Lab Faculty; *3B-Zimmer, Zyga Tech Inc.;* ..... Paper #31 *8-Clinical Orthopaedics and Related Research, Journal of Orthopaedics and Traumatology)*

Crowder, Douglas ..... *(n)* ..... Paper #7

Cuff, Germaine ..... *(n)* ..... Poster #40

Cunningham, Brian ..... *(n)* ..... Paper #75

Dailey, Steven Kyle ..... *(n)* ..... Paper #70

Daniel, Joseph N ..... *(3B-Wright Medical Technology, Inc.)* ..... Poster #3

Dashe, Jesse ..... *(n)* ..... Paper #117

Davidovitch, Roy ..... *(3B-Mako Surgical; Stryker)* ..... Paper #126; ..... Posters #28, 33, 40

Davis, Barry C ..... *(n)* ..... Poster #91

Davis, Stephen ..... *(n)* ..... Poster #6

De Haan, Jeroen ..... *(n)* ..... Paper #91; Poster #95

Deakin, Daniel ..... *(n)* ..... Papers #40, 45

Deal, Dwight D ..... *(n)* ..... Paper #14

DeCoster, Thomas A. ..... *(3B-Toxicology Management* ..... Mini Symposia Faculty *Services; 4-Merck; 8-Orthopaedic Knowledge Online Journal)*

Dedeugd, Casey ..... *(n)* ..... Poster #42

Dehghan, Niloofar ..... *(3B-Acumed)* ..... Mini Symposia Faculty

Della Rocca, Gregory John ..... *(2,3B-Synthes; 3B-LifeNet Health,* ..... Papers #50, 65, 114 *Intellectual Ventures, Bioventus; 4-Amedica, The Orthopaedic Implant Company, MergeNet; 5-Wound Care Technologies, Eli Lilly, Sonoma Orthopaedics; 8-Geriatric Orthopaedic*

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Della Rocca, Gregory J (cont'd)	*Surgery and Rehabilitation, Journal of Bone and Joint Surgery – American, Journal of Orthopaedic Trauma, Journal of the American Academy of Orthopaedic Surgeons; 9-AAOS; Orthopaedic Trauma Association, American College of Surgeons)*	
Den hartog, Dennis	*(n)*	Paper #91; Poster #95
Desai, Ronak	*(n)*	Poster #41
Diaz, Larry (Hilario)	*(n)*	Lab Faculty
Dienstknecht, Thomas	*(n)*	Paper #23; Poster #29
DiGiovanni, Christopher W	*(1,2,3B,4-Extremity Medical, Inc.; 2,3B,4,5-Biomimetic; Wright Medical Technology, Inc.; 3B-BESPA; 6-Curamedix, Inc; Performance Orthotics, Inc; 7-Saunders/Mosby-Elsevier; Springer; Wolters Kluwer Health - Lippincott Williams & Wilkins; 8-(European) Journal of Foot and Ankle Surgery; Foot and Ankle International)*	Poster #9
Dijkgraaf, Marcel GW	*(3B-Echo Pharmaceuticals)*	Paper #86
Din, Shahab Ud	*(6-The hospital receives free of cost implants from SIGN Fracture Care (Surgical Implant Generation Network) and free plates from Acumed)*	Poster #24
Ding, David Y	*(n)*	Papers #32, 101
Dirschl, Douglas R	*(3B-Stryker; 9-American Orthopaedic Association, Orthopaedic Trauma Association)*	Poster #57
Dobberstein, Diane Vetrovec-	*(n)*	OTA Staff
Dolenc, Andrea	*(n)*	Poster #115
Domes, Christopher	*(n)*	Poster #130
Donegan, Derek J	*(3B-Synthes)*	Poster #142
Donohue, David	*(n)*	Paper #115
Doornberg, Job N	*(n)*	Poster #32
Doro, Christopher	*(n)*	Case Presentation Faculty
Doty, Daniel H	*(n)*	Paper #92
Doud, Andrea Nicole	*(n)*	Poster #90

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Dougherty, Paul J	*(8-Clinical Orthopaedics and Related Research)*	Posters #54, 79
Downes, Katheryne	*(n)*	Paper #46
Drew, Brian	*(n)*	Poster #89
Drobetz, Herwig	*(8-World Journal of Orthopaedics; 9-AO Australasia Member)*	Paper #98
Dubina, Andrew G	*(n)*	Papers #3, 85, 110; Posters #73, 78
Duckworth, Andrew David	*(7-Saunders/Mosby-Elsevier; 8-BMC Musculoskeletal Disorders)*	Lab Faculty; Papers #41, 89, 90
Dudda, Marcel	*(n)*	Paper #81; Posters #107, 108, 109, 110
Dulaney-Cripe, Elizabeth	*(n)*	Poster #65
Dunbar Jr, Robert P	*(6-Etex, Innovision; 8-Journal of Orthopaedics and Traumatology; OrthoInfo; 9-AAOS)*	Moderator; Symposium Faculty Poster #38
Dunwoody, James	*(4-Pfizer; Procter & Gamble)*	Paper #61
Dwivedi, Shashank Shekhar	*(n)*	Poster #81
Dziadosz, Daniel Richard	*(2-Biomet; Smith & Nephew; Synthes, AO North America)*	Lab Faculty; Poster #23
Ebersole, Gregg M	*(n)*	Poster #150
Ebrahimzadeh, Mohammad H	*(8-Archives of Bone and Joint Surgery)*	Paper #97
Edwards, Antoinette	*(n)*	Paper #22
Edwards, Michael JR	*(n)*	Poster #124
Eglseder, W Andrew	*(n)*	Paper #85
Egol, Kenneth A	*(1,3B-Exactech, Inc; 5-OMEGA; OREF; Synthes; 7-SLACK Incorporated; Wolters Kluwer Health -Lippincott Williams & Wilkins)*	BSFF Symposium Faculty; Papers #37, 94, 126; Posters #5, 16, 25, 28, 33, 39, 40, 47, 92, 96, 98, 99, 153
Ehrenfeld, Jesse	*(7-Springer, Lippincott, Oxford University Press)*	Posters #19, 50, 74, 131, 133, 135
Ellington, John Kent	*(2,3B-Arthrex, Inc, BME; 3B-Amniox, Conventusortho, Pacira, Zimmer; 5-Amniox)*	Paper #38
Ellington, Matthew David	*(n)*	Paper #77
Elster, Eric	*(n)*	Paper #21
Endres, Terrence J	*(2-AONA Speaker)*	Paper #56

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Eno, Jonathan-James	*(n)*	Poster #77
Ertl, Janos Paul	*(n)*	Poster #122
Estevez, Dagoberto	*(n)*	Poster #135
Etier, Brian	*(n)*	Poster #36
Evaniew, Nathan	*(n)*	Poster #89
Evans, Edward	*(n)*	Paper #67; Poster #118
Evans, Jason M	*(n)*	Paper #66; Posters #19, 48, 74, 93
Ewald, Timothy J	*(n)*	Paper #31
Fabricant, Peter David	*(n)*	Poster #11
Fanning, Paul Joseph	*(n)*	Papers #5, 8
Farhang, Kathleen	*(n)*	Poster #41
Feher, Anthony W	*(n)*	Poster #122
Feldman, John Joseph	*(n)*	Poster #60
Felix, Justin	*(n)*	Poster #31
Fening, Stephen	*(n)*	Paper #7
Ferguson, Chad	*(n)*	Paper #38
Finkemeier, Christopher	*(3C-Acumed, LLC)*	Lab Faculty
Firoozabadi, Reza	*(n)*	Papers #47, 68, 71, 95; Posters #38, 138
Fishler, Thomas	*(n)*	Paper #74
Flaherty, Joseph H	*(n)*	Poster #63
Flemister, Adolph Samuel	*(3C-Biomimetic; 9-American Orthopaedic Foot and Ankle Society, New York State Orthopaedic Society)*	Poster #7
Flinkkilä, Tapio	*(n)*	Paper #35
Flurin, Pierre-Henri	*(1,3-BExactech, Inc; 9-SOFCOT (French Society of Orthopaedic Surgery and Traumatology))*	Paper #94
Flynn, Jeffrey	*(n)*	Poster #22
Foltzer, Michael	*(n)*	Paper #18
Forsberg, Jonathan Agner	*(5-Biomet)*	Paper #21
Forte, Mary L	*(n)*	BSFF Symposium Faculty
Fourney, William Lawrence	*(n)*	Papers #19, 20
Fowler, Justin T	*(n)*	Paper #110
Francois, Elvis Lionel	*(n)*	Paper #109; Poster #19

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Frangiamore, Salvatore Joseph	*(n)*	Poster #120
Frantz, Travis L.	*(n)*	Poster #114
Fras, Andrew Robert	*(n)*	Paper #66
Frihagen, Frede	*(2-Amgen Co, Eli Lilly; 6-DePuy, A Johnson & Johnson Company)*	BSFF Symposium Faculty
Fritz, Braxton	*(n)*	Paper #67; Poster #118
Frolke, Jan Paul M	*(2,3B-Stryker; 7,8-Orthopedie Actueel)*	Posters #75, 124
Furman, Bridgette D	*(n)*	Paper #27
Galat, Daniel D	*(n)*	Poster #24
Galos, David	*(n)*	Papers #32, 101
Galpin, Matthew C	*(n)*	Papers #62, 82
Gao, Yubo	*(n)*	Paper #42
Garcia, Anna Elizabeth	*(n)*	Poster #135
Gardner, Michael J.	*(3B-BoneSupport AB, Pacira Pharmaceuticals, DGIMed, Stryker, RTI Biologics; 3B,5-Synthes; 7-Wolters Kluwer Health - Lippincott Williams & Wilkins; 9-Orthopaedic Trauma Association)*	Moderator; Case Presentation Faculty; Poster Tour Guide; Posters #8, 46
Garner, Matthew Robert	*(n)*	Paper #36, 39, 43, 104, 113; Posters #2, 11, 12, 37
Garrard, Eli	*(3A-Sanofi-Aventis)*	Paper #49
Gary, Joshua Layne	*(2-Smith & Nephew; 8-Journal of Bone and Joint Surgery - American; Wolters Kluwer Health - Lippincott Williams & Wilkins; 9-Orthopaedic Trauma Association)*	Papers #62, 82; Poster #80
Gaski, Greg E	*(n)*	Posters #78, 114
Gasser, Seth I.	*(n)*	BSFF Symposium Faculty
Gausden, Elizabeth	*(n)*	Poster #37
Gebhard, Florian	*(n)*	Paper #59
Gerasimopoulos, Michael	*(n)*	Poster #147
Gheen, William T.	*(n)*	Paper #79
Ghert, Michelle A	*(9-Musculoskeletal Tumor Society; Orthopaedic Research Society)*	Poster #89

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Giannoudis, Peter . . . . . *(1-Biomet; 2-Synthes,* . . . . . BSFF Symposium Faculty; *Medtronic Sofamor Danek,* . . . . . Poster Tour Guide; *Olympus Biotech; 3B-Synthes,* . . . . . Posters #14, 82 *Olympus Biotech; 3C-Amgen Co; 5-DePuy, A Johnson & Johnson Company; Synthes; Pfizer; 7-Injury Journal; 8-BMC Musculoskeletal Disorders, Injury, Journal Orthopaedic Trauma, European Journal of Trauma, Open Journal of Orthopaedics, Expert Opinion on Drug Safety; Springer; 9-Orthopaedic Trauma Association, British Trauma Society, British Orthopaedic Association; European Federation of National Associations of Orthopedics and Traumatology; Orthopaedic Trauma Association)*

Godin, Jonathan Alexander . . . . *(n)* . . . . . Poster #102

Golinvaux, Nicholas . . . . . *(n)* . . . . . Posters #1, 44, 53

Gorbaty, Jacob . . . . . *(n)* . . . . . Poster #117

Gorczyca, John T . . . . . *(8-The Journal of Orthopaedic* . . . . . Posters #7, 94 *Trauma; 9-AAOS CME Committee)*

Gould, Stephen . . . . . *(n)* . . . . . Paper #37

Goulet, James A . . . . . *(1-Zimmer;* . . . . . Mini Symposia Moderator; *9-American Orthopaedic Association,* . . . . . Poster #13 *Orthopaedic Trauma Association, Michigan Orthopaedic Society)*

Graham, Jove . . . . . *(n)* . . . . . Paper #18; . . . . . Poster #56

Grainger, David . . . . . *(3B-Synthes; 3C-Elute, Inc.,* . . . . . Poster #137 *Salt Lake City, UT USA; 4-Accelerate Diagnostics, CellSeed, Ltd, Elute, Inc., Endoshape, Jade Therapeutics; 8-Advanced Drug Delivery Reviews, Biomaterials; Eur. Cells Materials, J Biomaterials. Sci., Polymer Edition, Journal of Biomedical Materials Research, Journal of Controlled Release; 9-AO Foundation, Academic Council*

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Grainger, David (cont'd) ..... *Advisory Board, Switzerland, AO Foundation, Research Review Commission)*

Grantham, William J ..... *(3B-GlaxoSmithKline, Johnson & Johnson; 4-Pfizer)* ..... Poster #93

Grauer, Jonathan N ..... *(3B-Affinergy, Alphatec Spine, Bioventus, DePuy, A Johnson & Johnson Company, Hasrvard Clinical Research Institute, Stryker; 9-AAOS, Cervical Spine Research Society)* ..... Posters #1, 44, 53

Graves, Matt L ..... *(2,3B,5-Synthes; 5-Stryker; 8-Journal of Orthopaedic Trauma)* ..... Case Presentation; Lab Leader

Gray, Andrew Colin ..... *(n)* ..... Paper #96

Green, James ..... *(3A-Synthes)* ..... Paper #14

Greenberg, David Daniel ..... *(n)* ..... Paper #114

Grice, Elizabeth ..... *(2-Amway International; 3B-Steifel/GSK, L'Oreal, GOJO, Physical Optics Corp; 5-Janssen Pharmaceutical Companies; 9-Wound Healing Society Program Committee* ..... Poster #136

Grimaldi, Leandro ..... *(n)* ..... Paper #28

Gross, Jordan ..... *(n)* ..... Paper #72

Gruber, Helen Elizabeth ..... *(8-Biotechnic & Histochemistry; Spine)* ..... Paper #11

Gudipally, Manasa ..... *(3A,4-Globus Medical)* ..... Poster #86

Guilak, Farshid ..... *(3A,4-Cytex Therapeutics; 7,8-Osteoarthritis and Cartilage, Journal of Biomechanics; 9-Orthopaedic Research Society, Orthopaedic Research and Education Foundation)* ..... Paper #27

Guimarães, João Antonio Matheus ..... *(n)* ..... Guest Nation

Guitton, Thierry ..... *(n)* ..... Posters #103, 104

Gunton, Matthew ..... *(n)* ..... Poster #68

Gupta, Munish C ..... *(1,3B-DePuy, A Johnson & Johnson Company; 3B- Medtronic, Inc., Osteotech; 4-Johnson & Johnson, Pioneer, PFizer, Proctor and Gamble, Osteotech; 5-Medtronic; 9-FOSA Treasurer)* ..... Paper #17

Guy, Pierre ..... *(2,3B,5-Stryker; 4-Traumis Surgical Systems Inc.;* ..... Case Presentation Moderator; Mini Symposia Faculty;

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Guy, Pierre (cont'd)	*5-Synthes; DePuy, A Johnson & Johnson Company; 9-Canadian Orthopedic Foundation)*	Papers #40, 45, 60
Hagen, Jennifer Elizabeth	*(n)*	Poster #78
Haidukewych, George John	*(1,3B-Biomet; DePuy, A Johnson & Johnson Company; 3B-Synthes; 4-Orthopediatrics, Institute for Better Bone Health; 6-Synthes; 8-Journal of Orthopedic Trauma; 9-AAOS)*	Case Presentation Faculty; Posters #42, 123
Haines, Nikkole Marie	*(n)*	Paper #116
Hak, David J.	*(2-DePuy, A Johnson & Johnson Company; 3B-Invibio; Merck; 4-Emerge; 7-SLACK Incorporated; 8-Orthopedics; Journal of Orthopaedic Trauma, European Journal of Orthopaedic Surgery; 9-Orthopaedic Trauma Association, International Society for Fracture Repair)*	Moderator
Hake, Mark	*(n)*	Poster #13
Hall, Jeremy	*(2,5,6-Stryker; 2,3B,5,6-Zimmer; 5-Biomimetic; 5,6-Pfizer; Synthes; Smith & Nephew; Amgen Co)*	Papers #61, 84
Haller, Justin C.	*(n)*	Lab Faculty; Paper #26; Posters #35, 106
Hamam, Al Walid	*(n)*	Paper #34
Haman, Steven P	*(2,3B-Smith & Nephew; 8-SLACK Incorporated; 9-AAOS)*	Lab Faculty
Hamilton, Benjamin	*(n)*	Papers #68, 95; Poster #138
Hammacher, Eric R	*(n)*	Paper #86
Hankenson, Kurt D	*(3B-Invivotech; 4-Founder and co-owner of Skelegen; 8-JBMR editorial board, Connective Tissue research associated editor; 9-ORS board, ACLAM board)*	Paper #30
Hannigan, Geoff	*(n)*	Poster #136
Hansen, Erik Nathan	*(n)*	Paper #12
Harmer, Luke	*(n)*	Poster #59
Hart, Gavin Pollock	*(n)*	Poster #143

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Harvey, Edward J	*(5-Synthes; 7,8-Canadian Journal of Surgery; 8-Journal of Orthopaedic Trauma, Journal of Bone and Joint Surgery - American; 9-Canadian Orthopaedic Association, Orthopaedic Trauma Association)*	BSFF Symposium Faculty, BSFF Moderator
Harvin, William Hartman	*(1-Sigma Pharmaceutical Consulting Group)*	Paper #50
Haudenschild, Dominik R	*(8- Editorial Board of "Cartilage" (ICRS journal), published by SAGE Journals; 9-Orthopaedic Research Society)*	BSFF Symposium Faculty; Paper #6
Hauser, Carl J	*(n)*	Symposium Faculty
Hayda, COL (ret) Roman A	*(2-AONA; 3C-BioIntraface; 8-Clinical Orthopaedics and Related Research, Journal of Bone and Joint Surgery – American, Journal of Orthopaedic Trauma; 9-AAOS, Orthopaedic Trauma Association, METRC)*	BSFF Symposium Faculty; Poster #9
Haynes, Jacob	*(n)*	Poster #8
Healy, Christopher	*(n)*	Poster #105
Hebert, Carla	*(n)*	Paper #19
Hebert-Davies, Jonah	*(n)*	Poster #111
Heels-Ansdell, Diane	*(n)*	Paper #111
Helfet, David Leonard	*(3C-OHK, Healthpoint Capital, TriMedics; 4-OHK Medical Devices; FxDevices)*	Mini Symposia Faculty; Papers #36, 113; Posters #2, 49
Hemmerling, Thomas	*(6-ITAG Laboratory)*	Poster #119
Henderson, Robert Andrew	*(n)*	Poster #102
Hendrickson, Sarah	*(n)*	Poster #151
Henebry, Andrew Dixon	*(n)*	Poster #15
Henley, M Bradford	*(1-Renovis, Zimmer; 2-Stryker / Howmedica; Zimmer; 3B-Gerson Lehrman Group, Guidepoint Global, Health Services Asset Management LLC, Milliman Care Guidelines, Premera Blue Cross, Zimmer; 3C-Karen Zupko and Assts, Synergey Surgical (Renovis);*	Paper #95; Poster #138

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Henley, M Bradford (cont'd)	*4-Renovis (formerly Synergy Surgical Technologies); 7-Wolters Kluwer Health - Lippincott Williams & Wilkins; 9-AAOS, American Medical Association, Washington State Orthopaedic Society)*	
Henry, Patrick	*(n)*	Papers #61, 83
Herder, Lindsay	*(n)*	Paper #51
Hermans, Erik	*(n)*	Poster #75
Herzog, Greg Allen	*(n)*	Poster #30
Heydemann, John A	*(4-Merck)*	Paper #82
Hiesterman, Timothy	*(n)*	Paper #33
Higgins, Thomas F	*(4-Summit Medical Ventures; 9-Orthopaedic Trauma Association)*	Moderator; Case Presentation Faculty; Papers #26, 115, 119, 121; Posters #35, 141
Hildebrand, Frank	*(8-Wolters Kluwer Health - Lippincott Williams & Wilkins, shock (Journal))*	Paper #23; Poster #113
Hildebrand, Kevin A.	*(n)*	Paper #25
Hill, Austin	*(n)*	Mini Symposia Faculty
Hill, Brian W	*(n)*	Paper #103
Hiller, Paul M.	*(n)*	OTA Staff
Hinds, Richard M	*(n)*	Papers #36, 39; Posters #2, 49
Ho, Christine Ann	*(n)*	Mini Symposia Faculty; Paper #78
Hoard, Daniel Benjamin	*(n)*	Poster #54
Hodge, Mary Beth	*(n)*	Paper #62
Hodgins, Justin L.	*(n)*	Paper #61
Hodkinson, Brendan	*(n)*	Poster #136
Hoelscher, Gretchen	*(n)*	Paper #11
Holcombe, Sven	*(n)*	Poster #13
Holmes, James R	*(9-American Orthopaedic Foot and Ankle Society, Post-grad Education comm., American Orthopaedic Foot and Ankle Society)*	Paper #2
Holmes, Robert E	*(n)*	Paper #20

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Holt, David	*(n)*	Poster #35
Holte, Pamela Kay	*(n)*	Paper #31
Holzman, Michael	*(n)*	Paper #82
Hooe, Benjamin Scott	*(n)*	Poster #93
Hope, Donald N	*(n)*	Paper #21
Hopkins, Melanie L.	*(n)*	OTA Staff
Horan, Annamarie	*(n)*	Posters #136, 142
Horazdovsky, Ryan David	*(n)*	Paper #33
Horodyski, MaryBeth	*(5-Research funding; Exactech, Inc; 9-National Athletic Trainers' Association)*	Posters #80, 84, 88
Horst, Klemens	*(n)*	Poster #29
Horwitz, Daniel Scott	*(1,3B-Biomet; 3B-Cardinal Health; 5-Synthes; 8-Wolters Kluwer Health - Lippincott Williams & Wilkins; 9-AAOS, Foundation for Orthopaedic Trauma)*	Papers #18, 71; Posters #16, 55, 56
Hoshino, Christopher Max	*(n)*	Paper #73
Hossain, Fahad Siddique	*(n)*	Poster #64
Hotchkiss, William R	*(n)*	Poster #140
Hou, Clifford	*(n)*	Poster #52
Houle, Tim	*5 (Merck)*	Paper #14
Houwert, Marijn	*(n)*	Paper #86
Howard, Jeffrey T	*(n)*	Paper #63; Poster #140
Howell, Frank	*(n)*	Poster #64
Hsieh, Adam H	*(5-Synthes, Stryker, Regeneration Technologies, Inc.)*	Poster #83
Hsu, Joseph R.	*(2-Smith & Nephew; 9-Limb Lengthening Research Society)*	Mini Symposia Faculty; Poster #59
Huebner, Janet L	*(n)*	Paper #27
Hulsmans, Martijn	*(n)*	Paper #86
Humphrey, Catherine A	*(n)*	Poster #94
Hung, Man	*(n)*	Paper #119
Hussain, Mir	*(3A-Globus Medical)*	Paper #73; Poster #86
Hymes, Robert	*(3B-Stryker; 4-Johnson & Johnson)*	Poster #26
Idrees, Kamran	*(n)*	Posters #131, 133

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Ihejirika, Rivka Chinyere	*(n)*	Posters #135, 148
Ilyas, Asif M	*(3B-Integra Life Sciences; 7-Jaypee Medical Publishers; 8-Elsevier (Ortho Clinics))*	Paper #102
Infante, Anthony F	*(1,3B,4,5-Orthopaedic Synergy; 2-PriCara; 3B,4-Arthrosurface; 3C-Stryker)*	Paper #106
Ingram, Jane	*(n)*	Paper #11
Inkellis, Elizabeth	*(n)*	Poster #87
Iordens, GIT	*(n)*	Paper #91; Poster #95
Iorio, Richard	*(3B-Kyocera/IMDS; 8-Clinical Orthopaedics and Related Research, Journal of Arthroplasty, Journal of Bone and Joint Surgery – American, Journal of the American Academy of Orthopaedic Surgeons; 9-Hip Society, Knee Society, New England Orthopaedic Society)*	Posters #70, 71
Irgit, Kaan	*(n)*	Poster #55
Irvine, James	*(n)*	Paper #44
Israel, Heidi	*(n)*	Poster #145
Jackson, Kelly	*(3A,3C-Synthes)*	Paper #75
Jackson, Nancy M	*(n)*	Poster #22
Jaffe, David E	*(n)*	Papers #19, 20
Jahangir, A Alex	*(7-Springer; 9-Orthopaedic Trauma Association)*	Symposium Faculty; Poster #148
Jain, Sudheer	*(n)*	Papers #32, 101
Jawa, Andrew	*(n)*	Paper #118; Poster #100
Jazini, Ehsan	*(n)*	Paper #73
Jemison, D Marshall	*(5-Auxilium Pharmaceuticals, Inc.; 9-Tennessee Orthopaedic Society)*	Paper #92
Jenkins, Peter A	*(n)*	Paper #121
Jenkinson, Richard	*(5-Smith & Nephew; Zimmer; Synthes; Biomet)*	Paper #83
Jiang, Jimmy	*(n)*	Poster #57
Johal, Herman	*(n)*	Paper #25
Johansen, Antony	*(n)*	Paper #58

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Jones, Clifford B.	*(8-Journal of Bone and Joint Surgery - American; Journal of Orthopaedics and Traumatology; 9-AOA Own the Bone Board, Mid American Orthopaedic Association Membership Committee, OTA Membership Chairman, OTA Health Policy Committee, Michigan Orthopaedic Society PAC Secretary)*	Symposium Faculty; Case Presentation Faculty; Papers #71, 81; Posters #16, 107, 108, 109, 110, 116
Joyce, David	*(n)*	Posters #4, 48, 50
Jupiter, Daniel	*(n)*	Paper #77
Jurgensmeier, Darin	*(n)*	Poster #43
Kacena, Melissa	*(3B-Stryker; 8-Journal of Hand Surgery - American; 9-American Society for Bone and Mineral Research)*	Poster #122
Kachooei, Amir Reza	*(8-Archives of Bone and Joint Surgery)*	Paper #97
Kadakia, Rishin	*(n)*	Posters #131, 133
Kain, Michael S	*(9-New England Orthopaedic Society)*	Posters #45, 70, 71
Kalloub, Alaa	*(n)*	Poster #139
Kamal, Robin Neil	*(n)*	Poster #102
Kamman, Kreigh	*(n)*	Poster #122
Kanakaris, Nikolaos K	*(2-Biomet, DePuy, A Johnson & Johnson Company, Pfizer; 3B-Stryker, Biomet; 8-"Open Access Trauma" of Open Access Publishing London, "Hard Tissue" of Open Access Publishing London,"Case Reports in Orthopedics" of Hindawi Publishing Corporation)*	Poster #82
Kandemir, Utku	*(2-AO North America, Stryker; 5-Biomet, Stryker, Synthes)*	Case Presentation Moderator; Papers #12, 120
Kane, Ian W	*(n)*	Poster #149
Kane, Justin Michael	*(n)*	Poster #3
Kang, Dong Hyun	*(n)*	Poster #21
Kang, Heejae	*(n)*	Paper #12
Kapron, Ashley L.	*(n)*	Poster #106
Karam, Matthew D	*(n)*	Paper #42
Karek, Matthew	*(n)*	Poster #22
Karia, Raj	*(n)*	Poster #47

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Karunakar, Madhav A	*(8-Journal of Orthopaedic Trauma; 9-AAOS; Orthopaedic Trauma Association)*	Papers #11, 53, 54, 107, 116; Poster #34
Kashigar, Aidin	*(n)*	Poster #68
Kay, Andrew Brecher	*(n)*	Poster #3
Kay, Harrison F	*(n)*	Posters #93, 131, 133, 147
Kellam, James F	*(8-AO Foundation; 9-Canadian Orthopaedic Association, Orthopaedic Trauma Association, AO Foundation)*	Papers #11, 107
Kelly, Michael	*(2-Synthes)*	Posters #17, 66
Kempton, Laurence	*(n)*	Paper #116
Ketz, John P	*(5-Biomimetic)*	Posters #10, 94
Khazzam, Michael S	*(2-Arthrex, Inc)*	Paper #65
Khemka, Aditya	*(n)*	Poster #126
Khoriaty, Justin David	*(n)*	Paper #81; Posters #107, 109, 110
Kibbe, Shane	*(n)*	Poster #112
Kim, Hubert T	*(8-Knee)*	Paper #12
Kim, Hyunchul	*(n)*	Poster #83
Kim, Kee D	*(1-,3B-Globus Medical; 1-LDR; Spinal USA; 4-Molecular Matrix International)*	Poster #86
Kimmerling, Kelly Ann	*(n)*	Paper #27
Kistler, Brian	*(n)*	Poster #72
Klaus, Derek J	*(n)*	Paper #7
Kleweno, Conor P	*(n)*	Case Presentation Faculty; Poster #117
Klinge, Stephen	*(n)*	Poster #9
Klinger, Craig	*(n)*	Poster #49
Klocke, Noelle	*(3A,4-Globus Medical)*	Paper #73
Kobbe, Philipp	*(n)*	Paper #23
Koenig, Scott	*(4-Johnson & Johnson; 9-American Orthopaedic Foot and Ankle Society)*	Paper #118
Koets, Michael D	*(n)*	Poster #116

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Kojima, Kodi Edson	*(9-AO Trauma Education Commission; Brazilian Orthopaedic Trauma Society)*	Paper #87
Koleszar, Juliann C	*(n)*	Paper #127
Konda, Sanjit R	*(8-American Journal of Orthopedics)*	Papers #53, 54; Poster #5, 25, 28, 33, 39, 96
Kortekangas, Tero Heikki Juhana	*(n)*	Paper #35
Koshkina, Olexandra	*(n)*	Paper #62
Kottmeier, Stephen	*(n)*	Moderator; Poster #16
Koval, Kenneth J	*(1,2,3B-Biomet; 2-Stryker; 7-Wolters Kluwer Health - Lippincott Williams & Wilkins; 8-Journal of Orthopaedics and Traumatology; 9-AAOS; Orthopaedic Trauma Association)*	Posters #42, 123
Koval, Lidia	*(n)*	Paper #98
Kraemer, Bruce A.	*(3B-MatriStem- ACell)*	Poster #121
Krajca, Justin A	*(n)*	Poster #83
Kramer, Patricia	*(n)*	Poster #138
Kraus, Virginia Byers	*(3B-EMD Serono, Flexion Therapeutics, Merrimack; 5-Bioiberica, Endocyte; 8-Osteoarthritis and Cartilage; 9-OsteoArthritis Research Society International)*	Paper #27
Krause, Peter C	*(4-Medtronic)*	Paper #88
Kreder, Hans J	*(3B-Immediate family consultant for Synthes; 5-Synthes, Biomet, Zimmer; 7-Elsevier Publishing, AO North America; 9-Canadian Orthopaedic Association, AO Trustee)*	Paper #83
Krettek, Christian	*(1,2,6-Synthes; 8-Saunders/ Mosby-Elsevier; Springer)*	BSFF Symposium ; Case Presentation Faculty
Krieg, James C	*(1-SAM Medical, Synthes CMF; 3B-Synthes, Acumed, LLC; 4-Domain Surgical, Trice Medical Technologies; 8-Journal of the American Academy of Orthopaedic Surgeons)*	Symposium Faculty; Paper #47; Poster #3
Kripalani, Sunil	*(8-Journal of Hospital Medicine)*	Posters #131, 133

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Kruppa, Christiane Gertrud	*(n)*	Paper #81; Poster #107, 108, 109, 110
Kubiak, Erik	*(3B-DePuy, A Johnson & Johnson Company, DJ Orthopaedics, Tornier, Zimmer; 4-Connextions Medical, Inc., 5-Zimmer; 8-Journal of Orthopaedic Trauma; 9-Foundation for Orthopaedic Trauma)*	Case Presentation Moderator; Papers #26, 119, 121; Posters #35, 55, 141
Kumar, Gunasekaran	*(n)*	Poster #69
Kumaravel, Manickam	*(n)*	Paper #82
Kurylo, John	*(n)*	Paper #72; Poster #76
Kuzyk, Paul Robert	*(3B-Avenir Medical Inc.; 5-Stryker, Zimmer)*	Poster #68
Kwok, Desmond	*(n)*	Poster #89
Lack, William D	*(n)*	Paper #107
Lafferty, Paul Matthew	*(8-Clinical Orthopaedics and Related Research, Journal of Bone and Joint Surgery - American)*	Paper #33
Laflamme, George Yves	*(3B-Stryker)*	Paper #111
LaFrance, Russell	*(n)*	Poster #7
Lago, Michael	*(n)*	Poster #27
LaMartina, Joey	*(n)*	Poster #100
Lane, Joseph M	*(3B-Bone Therapeutics, Inc. Grafty's; 3B,4-CollPlant, 4-Dfine; 5-Merck; 9-Orthopaedic Research Society, Musculoskeletal Tumor Society, AAOS, Association of Bone and Joint Surgeons, AOA, ASBMR)*	BSFF Symposium Faculty; Mini Symposia Faculty
Lang, Gerald J	*(9-AAOS, Wisconsin Orthopedic Society)*	Symposium Faculty
Lang, Maximilian Frank	*(n)*	Poster #93
Langford, Joshua	*(2-Smith & Nephew; 3B-Stryker; 4-Core Orthopaedics; Institute for Better Bone Health, LLC)*	Lab Faculty; Posters #42, 123
Lanzi, Joseph T	*(4-Stryker; 5-Arthrex, Inc)*	Poster #31
Larouche, Jeremie	*(n)*	Papers #40, 60
Latta, Loren	*(3C-FxDevices, NuTek Orthopaedics, Sky Medical, MAKO Surgical, OrthoSensor, Miami Device Solutions; 5-Alphatec Spine, Medtronic Sofamor Danek,*	BSFF Symposium Faculty

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Latta, Loren (cont'd) ..... *Synthes; 7-Springer, Saunders/Mosby-Elsevier, ASOP; 8-Journal of Orthopaedic Trauma; 9-Assoc. for the Rational Treatment of Fractures)*

Lawendy, Abdel-Rahman ..... *(n)* ..... Papers #13, 34

Lazaro, Lionel E. ..... *(n)* ..... Poster #49

Leach, Kent ..... *(8-Springer)* ..... Paper #17

LeBrun, Christopher T ..... *(8-Journal of Bone and Joint Surgery - American; Journal of Orthopaedic Trauma; 9-Orthopaedic Trauma Association)* ..... Paper #110

Lecky, Fiona ..... *(n)* ..... Paper #22

Lee, Brian ..... *(n)* ..... Poster #105

Lee, James ..... *(n)* ..... Poster #98

Lee, John ..... *(n)* ..... Poster #13

Lee, Mark A ..... *(2-AONA; 2,3B-Zimmer; 2,3B,5-Synthes; 6-Synthes Fellowship Support; 9-Orthopaedic Trauma Association)* ..... Papers #6, 17

Lee, Young Min ..... *(n)* ..... Posters #135, 147

Lefaivre, Kelly Ann ..... *(5-Synthes, Zimmer)* ..... Papers #40, 45, 60, 100; ..... Poster #101

Lefering, Rolf ..... *(8-Springer* ..... Paper #23; *(Europ. J. Trauma Emerg. Med.))* ..... Poster #113

Leighton, Ross K ..... *(1,2-Zimmer; 2-Biomet; 2,3B-Etex; 2,5-Synthes; 2,6-DePuy, A Johnson & Johnson Company, Smith & Nephew, Stryker; 9-Canadian Orthopaedic Association, Orthopaedic Trauma Association)* ..... Symposium Faculty

Leinberry, Charles F ..... *(1,2,3B,4-Knee Creations; 1,2,4-Zimmer; 3C-SegWay Orthopedics; 9-American Society for Surgery of the Hand, AAOS, AOA)* ..... Paper #102

Lepojärvi, Sannamari ..... *(n)* ..... Paper #35

Leslie, Michael P ..... *(2-DePuy, A Johnson & Johnson Company; 7-Orthopedic Clinics of North America)* ..... Paper #74

Lewandowski, Louis ..... *(9-Society of Military Orthopaedic Surgeons)* ... Poster #152

Lewis, Gregory S ..... *(5-Synthes)* ..... Poster #43

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Lian, Jane B.	*(8-Bone; Calcified Tissue International)*	Paper #5, 8
Libuit, Kiley	*(n)*	Paper #120
Lindsay, Adam Douglas	*(n)*	Poster #76
Lindsay, Sarah Elizabeth	*(n)*	Paper #15
Liporace, Frank A	*(1,2,3B-Biomet; 2,3B-Synthes; Stryker; Medtronic; 3C-AO)*	Paper #115
Litrenta, Jody	*(n)*	Poster #16
Liu, Raymond W	*(6-Orthopediatrics: Royalties paid to my institution; 9-POSNA: OKO Committee)*	Poster #41
Liu, Xuhui	*(n)*	Paper #12
Lloyd, Bradley	*(n)*	Poster #152
Lopas, Luke A	*(n)*	Paper #30
Lorich, Dean G.	*(n)*	Paper #36, 39, 43, 104, 113; Poster #2, 11, 12, 37, 49
Lowe, Jason Allen	*(2,5,6-Synthes; 5-Stryker)*	Paper #1; Poster #36
Lu, Min	*(n)*	Poster #57
Ludwig, Meryl Rutkowski	*(n)*	Poster #26
Ludwig, Steven C	*(1,2,3B-DePuy, A Johnson & Johnson Company; 1,3B,4,5-Globus Medical; 2,3B- Synthes; 3B- K2Medical; 4-Alphatec Spine, ASIP, Spinicity, ISD; 7-Thieme, QMP; 8-Journal of Spinal Disorders and Techniques, The Spine Journal, Contemporary Spine Surgery; 9-Cervical Spine Research Society)*	Paper #73
Lundy, Douglas W	*(4-Livengood Engineering; 8-Clinical Orthopaedics and Related Research, Journal of Orthopaedic Trauma, Journal of the Southern Medical Association, Orthopedics; 9-AAOS; American Board of Orthopaedic Surgery, Inc., American College of Surgeons, Georgia Orthopaedic Society, Orthopaedic Trauma Association)*	Symposium Faculty; Mini Symposium Moderator; Poster #24
Luttrell, Kevin Wade	*(n)*	Paper #57

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Luu, Hue H	*(n)*	Poster #57
Lybrand, Kyle	*(n)*	Paper #72
Maceroli, Michael A	*(n)*	Posters #7, 10, 94
Mackenzie, Ellen J.	*(8-Injury; 9-National Trauma Institute)*	Mini Symposia Faculty
Madden, Kim	*(n)*	Poster #89
Mahmood, Aatif	*(n)*	Poster #69
Malekzadeh, A Stephen	*(5-Synthes)*	Poster #23
Malmstrom, Theodore K	*(n)*	Poster #63
Maltepe, Emin	*(n)*	Paper #10
Mamczak, Christiaan	*(2-AO North America; 9-Orthopaedic Trauma Association)*	Paper #67; Posters #15, 118
Mandell, Daniel	*(n)*	Paper #5
Maniar, Hemil Hasmukh	*(n)*	Paper #18; Poster #56
Manoli, Arthur	*(n)*	Papers #32, 37, 54; Poster #5, 25, 33, 39, 40, 92, 153
Manson, Theodore Thomas	*(8-Journal of Arthroplasty; 9-AAOS)*	Poster #61, 67, 73, 78, 83
Maqungo, Sithombo	*(n)*	Poster #128
Marberry, Scott	*(n)*	Paper #29
Marcano, Alejandro	*(n)*	Poster #47, 98, 99
Marcantonio, Andrew J	*(6-Synthes)*	Papers #62, 71; Posters #45, 70, 71
Marcucio, Ralph	*(5-Baxter)*	Paper #10
Marecek, Geoffrey	*(9-AAOS)*	Papers #47, 76; Poster #52
Markel, David C	*(1,2,3B,4,5-Stryker; 4-Novi Bone and Joint Center, Arbotetum Ventures; 8-Clinical Orthopaedics and Related Research, Journal of Arthroplasty, Journal of Bone and Joint Surgery – American, Osteoarthritis and Cartilage); 9-Michigan Orthopaedic Society, AAHKS, Mid America Ortho Assoc)*	Poster #22
Marmor, Meir Tibi	*(n)*	BSFF Symposium Faculty; Paper #120

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Marsh, John Lawrence	*(1-Biomet; 4-FxRedux; 7-Oxford Press; 9-American Board of Orthopaedic Surgery, Inc.; American Orthopaedic Association; Mid American Orthopadics; NBME; RRC-(chair, orthopaedic surgery))*	Paper #42
Martinez, Adriana Patricia	*(n)*	Poster #119
Masoudi, Aidin	*(n)*	Paper #28
Matheis, Erika	*(3A-Globus Medical)*	Poster #86
Mather, Richard C	*(3B-KNG Health Consulting; Pivot Medical; Smith & Nephew; Stryker; 4-for[MD]; 9-Arthroscopy Association of North America, American Academy of Orthopaedic Surgeons, North Carolina Orthopaedic Association)*	Poster #102
Mathews, John Abraham	*(n)*	Poster #17
Mattar, Rames	*(n)*	Paper #87
Matuszewski, Paul Edward	*(n)*	Posters #132, 144
Mauffrey, Cyril	*(5-Carbofix, Osteomed; 6-DePuy, A Johnson & Johnson Company; 7-Springer; 8-International Orthopaedics, Patient Safety in Surgery, The European Journal of Orthopaedic Surgery and Traumatology, Current Opinion in Orthopaedics; 9-La Societe Internationale de Chirurgie Orthopedique et de Traumatologie, Orthopaedic Trauma Association)*	Moderator
Mayberry, John C	*(2,3B,5-Acute Innovations LLC; 8-Journal of Orthopedic Trauma; 9-North Pacific Surgical Association)*	Mini Symposia Faculty
McAndrew, Christopher	*(2-Synthes; 7-Journal of Bone and Joint Surgery - American)*	Posters #8, 46
McArthur, Samuel	*(n)*	Poster #43
McClary, Kaylan	*(n)*	Paper #70
McClellan, Robert Trigg	*(3C-Advanced Biologics, LLC, Skeletal Kinetics, LLC; 4-Epix Orthopaedics, Inc., PayMD, PDP Holdings, LLC, Total Connect Spine, LLC; 5-Stryker; 9-Northern California Orthopaedic Society)*	Poster #87

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

McClure, Philip	*(n)*	Poster #9
McDaniel, Lee	*(n)*	Paper #30
McDonough, E Barry	*(n)*	Poster #91
McDougald Scott, Amanda M.	*(n)*	Posters #131, 133
McFadden, Molly	*(3B-Amgen Co)*	Paper #26; Poster #35
McGinnis, Kelly	*(n)*	Poster #136
McKee, Michael D	*(1-Stryker; 2,3B-Synthes; 2,3B,5-Zimmer; 3B-Acumed, LLC, Olympus Biotech; 5-Olympus Biotech, Wright Medical Technology, Inc.; 7-Wolters Kluwer Health - Lippincott Williams & Wilkins; 8-Journal of Orthopaedics and Traumatology; 9-American Shoulder and Elbow Surgeons, Orthopaedic Trauma Association, Canadian Orthopaedic Association)*	Moderator; Symposia Moderator; Mini Symposia Moderator; Presentation Faculty; Poster Tour Guide; Papers #61, 84; Poster #125
McKinley, Todd Owen	*(3B-Bioventus; 9-Orthopaedic Trauma Association)*	Symposium Moderator; Poster #114
McLemore, Ryan	*(4-Sonoran Biosciences; 5-Astellas Pharmaceuticals)*	Paper #75
McNamara, Andrew R	*(n)*	Paper #69
McPhillips, Kristin	*(n)*	Paper #18; Poster #56
McQueen, Margaret M	*(8-Wolters Kluwer Health - Lippincott Williams & Wilkins)*	Papers #89, 90
Mehta, Samir	*(2-Zimmer, AO North America; 2,3B,5-Smith & Nephew; 3B-Synthes; 5-Amgen Co, Medtronic; 7-Wolters Kluwer Health - Lippincott Williams & Wilkins; 8-Current Opinion in Orthopaedics; 9-Pennsylvania Orthopaedic Society)*	Symposium Moderator; Symposium Faculty; Posters #16, 132, 136, 142
Meijden, Olivier Van Der	*(n)*	Paper #86
Meis, Regina	*(3A,4-Takeda)*	Poster #100
Meister, Melissa	*(n)*	Poster #150
Mejia Oneto, Jose Manuel	*(n)*	Paper #17

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Mellema, Jos	*(n)*	Poster #32
Melton, Danielle	*(2-Ossur Americas, Inc; 3B-Medical Life Care Planning; 9-Amputee Coalition Medical Scientific Advisory Committee)*	BSFF Symposium Faculty
Meredith, J. Wayne	*(n)*	Poster #90
Meyer, Darlene A.	*(n)*	OTA Staff
Meyer, Todd R	*(3A,4-Bacterin International, Inc.)*	Paper #16
Meylaerts, Sven	*(n)*	Paper #86
Miclau III, Theodore	*(3B-Amgen Co, Merck; 3B,5-Baxter; 5-Stryker, Synthes; 9-AO, Orthopaedic Research Society, Orthopaedic Trauma Association, Osteosynthesis and Trauma Care Foundation)*	BSFF Moderator; Paper #10
Mignemi, Nicholas A	*(5-ISIS Pharmaceuticals, Inc.)*	Paper #9
Miller, Anna Noel	*(3B-Eli Lilly)*	Paper #14; Poster #90
Miller, Blake	*(n)*	Poster #54
Miller, Brian	*(2-Smith & Nephew)*	Paper #75
Miller, Christopher	*(n)*	Posters #1, 44
Miller, Eric T.	*(3C-Synthes)*	Paper #7
Miller, Mark C	*(5-Arthrex, Inc; 6-Integra Life Sciences)*	Poster #18
Miller, Preston	*(n)*	Poster #90
Mir, Hassan Riaz	*(3B-Smith & Nephew Educational Consultant; 8-Journal of Orthopaedic Trauma Associate Editor, OTA Newsletter Editor; 9-AAOS Council on Advocacy, AAOS Diversity Advisory Board, FOT Nominating and Membership Committees, OTA PR Committee)*	Symposium Moderator; Lab Faculty; Paper #66, 108; Posters #48, 131, 133, 148
Mirza, Amer J.	*(3B,3C-Acumed, LLC; 3C-Seattle Information Systems)*	Lab Faculty
Mirza, Ather	*(1,3A,4,5,7-A.M. Surgical, Inc.)*	Poster #105
Mirza, Justin	*(n)*	Poster #105
Mitchell, Phillip	*(n)*	Posters #74, 93

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Moed, Berton R . . . . . *(1-Biomet; 9-AO North America; AO Foundation)* . . . . . Paper #69

Mok, James Moon . . . . . *(n)* . . . . . Paper #12

Molenaars, Rik . . . . . *(n)* . . . . . Poster #32

Molina, Cesar Sebastian . . . . . *(n)* . . . . . Paper #24, 52, 55, 66, 122, 124; . . . . . Poster #62

Monazzam, Shafagh . . . . . *(n)* . . . . . Paper #1

Moojen, Dirk Jan . . . . . *(9-Dutch Orthopaedic Association; European Bone and Joint Infection Society)* . . . . . Paper #84

Moore, Sharon M. . . . . *(n)* . . . . . OTA Staff

Moore, Thomas J . . . . . *(3B-Smith & Nephew)* . . . . . Poster #134

Moore, Timothy A . . . . . *(n)* . . . . . Posters #85, 115

Mora, Arthur M . . . . . *(n)* . . . . . Paper #88

Moradi, Ali . . . . . *(8-Archives of Bone and Joint Surgery)* . . . . . Paper #97

Moran, Christopher G . . . . . *(2-Smith & Nephew, DePuy-Synthes; 8-International Editorial Board, Injury; 9-British Orthopaedic Association)* . . . . . Mini Symposia Moderator; . . . . . Papers #22, 58

Morgan, Jordan . . . . . *(n)* . . . . . Paper #51

Morison, Zachary . . . . . *(n)* . . . . . Paper #84; . . . . . Poster #125

Morshed, Saam . . . . . *(3B-Microbion Corporation; 5-Stryker; Synthes)* . . . BSFF Symposium Faculty; . . . . . Paper #120

Mulder, Frans J . . . . . *(n)* . . . . . Poster #97

Munz, John Wesley . . . . . *(n)* . . . . . Papers #62, 82

Murray, Clint . . . . . *(n)* . . . . . Poster #152

Murtha, Yvonne M . . . . . *(9-AAOS)* . . . . . Papers #50, 65, 114

Murthy, Kalyani . . . . . *(n)* . . . . . Paper #62

Mutyaba, Patricia Lorraine . . . . *(n)* . . . . . Paper #30

Nana, Arvind D . . . . . *(3C-Advanced Orthopaedic Solutions; 9-AAOS, AAOS, American Orthopaedic Association, International Geriatric Fracture Society, Musculoskeletal Infection Society, Orthopaedic Trauma Association)* . . . . . Paper #57

Nascone, Jason W . . . . . *(1,2-Synthes; 2,3B-Smith & Nephew; 3B-IMDS; 8-Journal of Orthopaedic Trauma;* . . Case Presentation Moderator; . . . . . Lab Faculty; . . . . . Paper #110;

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Nascone, Jason W (cont'd) ..... *9-AONA; Orthopaedic Trauma Association)* .... Poster #83

Nauth, Aaron ..... *(5-Capital Sports Entertainment;* .... Symposium Faculty; *Synthes, Stryker;* .....Mini Symposia Faculty; *Sonoma Orthopaedics)* .....BSFF Symposium Faculty, ... BSFF Moderator; Paper #84

Nayak, Aniruddh ..... *(n)*..... Paper #29; ..... Poster #72

Nazarian, Ara ..... *(n)*.....Paper #28

Ndasi, Henry ..... *(n)*..... Lab Faculty

Neal, Meredith Richard ..... *(n)*..... Poster #15

Nelson, Elisha M ..... *(n)*.....Paper #1

Nestorovski, Doug ..... *(n)*..... Poster #142

Neuhaus, Valentin ..... *(6-Gottfried und Julia Bangerter* ..... Posters #103, 104 *-Rhyner-Stiftung Foundation)*

Nguyen, Joseph ..... *(n)*.....Paper #43

Nguyen, Thao ..... *(n)*.....Papers #19, 20

Ni, Amelia ..... *(n)*..... Paper #104; .....Posters #11, 49

Niels, Schep WL ..... *(2-Synthes)*.....Paper #91

Nies, Matthew Stephen ..... *(n)*.....Paper #56

Niinimäki, Jaakko ..... *(n)*.....Paper #35

Nork, Sean E ..... *(2,3B,5-AONA, Synthes; 3B-Amgen; 5- OTA)*. . Poster #117

North, David ..... *(n)*..... Poster #128

Nortje, Marc ..... *(5-DePuy, A Johnson & Johnson Company)* .... Poster #128

Nota, Sjoerd ..... *(n)*..... Poster #97

Nowotarski, Peter J ..... *(2,5-Synthes; 3B-Synthes Financial* .....Paper #92 *support for the orthopedic trauma fellowship)*

Nwosu, Samuel ..... *(n)*.....Paper #109

Nyman, Jeffry ..... *(6-Active Life, Inc., Genzyme;* .....Paper #9 *8-Bone; 9-American Society for Bone and Mineral Research)*

O'Brien, Peter Joseph ..... *(2,3B,5-Zimmer; 5-DePuy,* ..... Papers #40, 45, 60, 100; *A Johnson & Johnson Company,* ..... Poster #101 *Synthes; 8-Journal of Orthopaedic Trauma; 9-AO Board of Trustees)*

O'Connor, Daniel P ..... *(3B-Nimbic Systems, Inc.;* .....Paper #49 *7-SLACK Incorporated)*

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

O'Donnell, Courtney Michelle . *(n)* . . . . . Poster #138

O'Mara, Timothy J. . . . . *(2-AO North America;* . . . . . Lab Faculty
4-Orthopaedic Implant Company;
8-Journal of Orthopaedic Trauma; 9-AAOS)

O'Toole, Robert V . . . . . *(3B-iMDS, Smith & Nephew;* . . . . . .Moderator;
5-Synthes, Stryker; . . . . . Symposium Faculty;
9-Orthopaedic Trauma . . . . . Case Presentation Faculty;
Association) . . . . . Papers #3, 73, 85, 110;
. . . . . Posters #16, 61, 67, 73, 78, 83, 132, 144

Obremskey, William T . . . . . *(9-Orthopaedic Trauma* . . . . . .Mini Symposia Faculty;
Association; Southeastern . . . . . Case Presentation Faculty;
Fracture Consortium) . . . . . Papers #9, 24, 52, 55, 108, 109,
. . . . . 122, 124, 125;
. . . . . Posters #4, 19, 50, 58, 62, 74,
. . . . . .93, 135, 147, 148

Ode, Gabriella . . . . . *(n)* . . . . . .Paper #11

Oh, Jin-cheol . . . . . *(n)* . . . . . Poster #21

Ohtonen, Pasi . . . . . *(n)* . . . . . .Paper #35

Oliphant, Bryant W. . . . . *(2-Synthes)* . . . . . Posters #54, 79

Olson, Steven A . . . . . *(5-Synthes;* . . . . . Symposium Moderator;
9-Orthopaedic Trauma Association, ...Paper #27
Southeastern Fracture Consortium)

Ong, Alvin C . . . . . *(3B-Stryker, Smith & Nephew,* . . . . . Poster #149
Medtronics; 5-Zimmer;
8-Journal of Arthroplasty,
Journal of Orthopedic Surgery and Research)

Onuoha, Gerald Obinna. . . . . *(n)* . . . . . Poster #135

Orozco, Fabio . . . . . *(3B-Stryker, Medtronics; 5-Zimmer;* . . . . . Poster #149
Stryker; 8-Journal of Arthroplasty)

Ortega, Gilbert R . . . . . *(2,3B-Smith & Nephew)* . . . . . .Moderator;
. . . . . .Paper #75

Ostrum, Robert F. . . . . *(7-SLACK Incorporated;* . . . . . Case Presentation Faculty;
8-Journal of Orthopaedic Trauma, ... Poster #16
American Journal of Orthopaedics)

Owens, Brett D . . . . . *(3B-Mitek, Musculoskeletal* . . . . . Poster #31
Transplant Foundation;
7-SLACK Incorporated; 8-American
Journal of Sports Medicine,
Orthopedics, Orthopedics Today;

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Owens, Brett D (cont'd)	*9-American Orthopaedic Society for Sports Medicine)*	
Pakarinen, Harri	*(n)*	Paper #35
Paksima, Nader	*(2,3B-Stryker; 3B-IMDS; 4-SBI; 8-bulletin of the Hospital for Joint Diseases)*	Poster #99
Pala, Navneet	*(n)*	Paper #62
Palmer, Michael	*(n)*	Poster #18
Palmisano, Andrew	*(n)*	Paper #2
Panchal, Ripul Rajen	*(3B-Mizuho OSI; 5-Globus Medical; 8-Journal of Neuroinfectious Diseases, Neurological Disorder; 9-American College of Osteopathic Surgeons, North American Spine Society)*	Poster #86
Panteli, Michalis	*(n)*	Poster #14
Pape, Hans-Christoph	*(3B-Zimmer; 7-Journal of Orthopaedic Research, Wolters Kluwer Health - Lippincott Williams & Wilkins, Springer; 8-J Orthop Trauma, Injury, Open Access Emergency Medicine)*	Symposium Faculty; Paper #23; Posters #29, 113
Papp, Steven R	*(5-KCI; Synthes)*	Moderator
Paquet, Marylene	*(n)*	Poster #119
Parisien, Robert L	*(n)*	Paper #117
Park, Sam Si-Hyeong	*(n)*	Paper #83
Patel, Neelam	*(n)*	Poster #74
Paterson, Michael	*(n)*	Paper #83
Patka, Peter	*(n)*	Paper #91; Poster #95
Patsalos-Fox, Bianka Naomi	*(n)*	Paper #126
Patterson, Joseph	*(n)*	Paper #74
Paulus, Jessica Katharine	*(n)*	Paper #62
Payton, Alivia	*(n)*	OTA Staff
Pedowitz, David Isadore	*(2,3B,5-Integra Life Sciences; 3B-Tornier)*	Poster #3
Pekmezci, Murat	*(2-DePuy, A Johnson & Johnson Company; 5-Stryker)*	Poster #87
Pellegrini, Vincent D	*(1,3B-DePuy, A Johnson & Johnson Company; 9-ACGME RRC in Orthopaedic Surgery, American Orthopaedic Association, Association of*	Papers #19, 20

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Pellegrini, Vincent D (cont'd)	*American Medical Colleges, Board of Directors, Council of Faculty and Academic Societies, AAMC - Chair-Elect and Administrative Board, Health Volunteers Overseas/Orthopaedics Overseas, Board of Directors, Hip Society)*	
Pensy, Raymond A	*(n)*	Paper #85
Perdue, Aaron M	*(n)*	Paper #108
Perez, Edward A	*(2-Smith & Nephew, Zimmer; 3B-Biomet; Cardinal Health; 4-Bristol-Myers Squibb; Pfizer; Stryker; 7-Saunders/Mosby-Elsevier; 9-Orthopaedic Trauma Association)*	Lab Leader
Petersik, Andreas	*(3A-Stryker)*	Posters #20, 66
Petfield, Joseph Laurence	*(9-AAOS)*	Poster #152
Peticca, Kathryn Diana	*(n)*	Paper #105
Phisitkul, Phinit	*(3B-Arthrex, Inc; Smith & Nephew; 4-MTP Solutions; 9-American Orthopaedic Foot and Ankle Society)*	Paper #42
Pike, Jeffrey	*(n)*	Papers #60, 100
Pitta, Michael	*(n)*	Poster #26
Pittman, Jason Lasseter	*(n)*	Paper #118
Podeszwa, David A.	*(9-Pediatric Orthopaedic Society of North America, AAOS)*	Mini Symposia Moderator
Pohlman, Timothy	*(n)*	Poster #114
Polfer, Elizabeth	*(n)*	Paper #21
Polga, David J	*(2-Synthes)*	Paper #108
Pollak, Andrew N	*(1-Zimmer; 5-Smith & Nephew; 7-AAOS; 9-National Trauma Institute)*	Poster #132
Poludnianyk, Kim Nicole.	*(n)*	Poster #65
Post, Zachary D	*(3B-Johnson & Johnson, Smith & Nephew; 5-DePuy, A Johnson & Johnson Company)*	Poster #149
Potter, Benjamin Kyle	*(8-Associate Editor (SOMOS), Journal of Surgical Orthopaedic Advances, Datatrace Publishing; 9-Society of Military Orthopaedic Surgeons; AAOS (BOS - SOMOS - research))*	Paper #21; Poster #152
Pountos, Ippokrates	*(n)*	Poster #14

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Prasarn, Mark Lawrence	*(2-DePuy, A Johnson & Johnson Company, Eli Lilly)*	Paper #62; Posters #80, 84, 88
Prayson, Michael J.	*(2-AO Faculty; 2,3B-Bioventus); 8-Journal of Orthopaedic Trauma, Journal of Trauma, Acta Orthopaedica; 9-Orthopaedic Trauma Association, Accreditation Council for Graduate Medical Education, Wright State Physicians, Inc.)*	Poster #65
Procter, Philip	*(3B-Medmix Switzerland, Skulle OY Finland, AddBio AB Sweden, Stryker GmBH Germany)*	Symposium Moderator
Pugh, Kevin J	*(2,3B-Smith & Nephew, Medtronic; 2,3C-Synthes; 3B-Integra; 3C-AO North America; 8-Journal of Orthopaedic Trauma)*	Mini Symposia Moderator
Quinnan, Stephen M.	*(3B-DePuy, A Johnson & Johnson Company, Smith & Nephew, Orthofix, Inc.)*	Moderator
Radcliff, Kristen E	*(1,3B,6-Globus Medical; 3B,5,6-DePuy, A Johnson & Johnson Company; Medtronic; 4-Mergenet Medical; 5-Paradigm Spine; 6-Stryker; Synthes; Relievant; 7-Lippincott; 9-ACSR)*	Poster #149
Radwan, Zayde	*(n)*	Paper #62
Raikin, Steven M	*(3B-Biomet)*	Poster #3
Ramalingam, Sendhilnathan	*(n)*	Poster #102
Ramsey, Lolita	*(n)*	Posters #23, 26
Rane, Ajinkya	*(n)*	Poster #120
Rangan, Amar	*(2,3B,6-DePuy, A Johnson & Johnson Company); 3B,6-JRI Limited, UK; 8-Journal of Arthroscopy and Joint Surgery; Shoulder & Elbow (Wiley); 9-British Elbow and Shoulder Society, British Orthopaedic Association)*	Paper #96
Raskett, Christopher	*(n)*	Papers #5, 8
Rath, Ehud	*(3B-Johnson & Johnson)*	Poster #146
Raz, Guy	*(n)*	Posters #124, 126

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Rechtine, Glenn R	*(8-orthopaedic knowledge online journal, The Spine Journal, Journal of Spinal Cord Medicine; 9-Cervical Spine Research Society)*	Posters #80, 84, 88
Refaat, Motasem I	*(n)*	Paper #6
Regan, Deirdre	*(n)*	Paper #37; Posters #5, 96, 153
Regan, Elizabeth Anne	*(4-Conceptus)*	Paper #15
Rehman, Saqib	*(2-Synthes; 3B-Eli Lilly, Guidepoint Global); 7-Jaypee Medical Publishing; 8-Orthopedic Clinics of North America; 9-Pennsylvania Orthopaedic Society-Board of Directors, Orthopaedic Trauma Association-Committee member)*	Lab Faculty
Reich, Michael	*(n)*	Poster #115
Reid, J Spence	*(2,3B-Smith & Nephew; 3B,5-Synthes; 5-Zimmer; 8-Clinical Orthopaedics and Related Research, Journal of Orthopaedics and Traumatology; 9-Limb Lengthening Research Society)*	Poster #43
Reider, Lisa	*(n)*	Poster #67
Reilly, Mark C	*(2,3B-Stryker)*	Case Presentation Faculty; Mini Symposia Faculty
Reisman, William Michael	*(n)*	Poster #134
Ren, Dennis	*(n)*	Paper #120
Reyes, Bryan	*(n)*	Paper #78
Rhee, Juong G	*(n)*	Paper #20
Rhorer, Anthony S	*(2,3B-ITS; 2,3B,5-Smith & Nephew; 8-Journal of Orthopaedics and Traumatology)*	Paper #75
Riaz, Hassan	*(n)*	Lab Faculty
Ricci, William M	*(1,3B-Wright Medical Technology, Inc.; 3B-Biomet; Stryker; 1,3B,5-Smith & Nephew; 7-Journal of Bone and Joint Surgery – American, Wolters Kluwer Health - Lippincott Williams & Wilkins; 8-Journal of Orthopaedic Trauma, Wolters Kluwer Health - Lippincott Williams & Wilkins;*	Lab Faculty; Posters #8, 16, 46

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Ricci, William M (cont'd)	*9-Orthopaedic Trauma Association, American Orthopaedic Association)*	
Riccio, Anthony Ian	*(n)*	Mini Symposia Faculty; Paper #79
Richard, Raveesh	*(n)*	Poster #55
Richards, Justin E	*(n)*	Paper #125
Riehl, John	*(2,3B-Arthrex, Inc)*	Paper #112; Posters #112, 139
Ring, David C	*(1-Biomet; Medartis; Skeletal Dynamics; Wright Medical Technology, Inc.; 3B-Acumed, LLC; Biomet; 4-Illuminos; 8-Clinical Orthopaedics and Related Research; Journal of Hand Surgery - American; Journal of Orthopaedic Trauma; Journal of Shoulder and Elbow Surgery; 9-American Shoulder and Elbow Surgeons; American Society for Surgery of the Hand)*	Lab Leader; Paper #99; Posters #97, 103, 104
Ristiniemi, Jukka	*(n)*	Paper #35
Rizkala, Amir Remond	*(n)*	Paper #33
Roberts, Craig S	*(7-Skeletal Trauma royalties from Elsevier; External. Fixation royalties from Elsevier; 8-Injury-Deputy Editor, Journal of Orthopaedic Trauma-Editorial Board)*	Symposium Faculty; Mini Symposia Moderator
Robertson, Astor	*(n)*	Papers #19, 20
Robinson, Juan De Dios	*(n)*	Paper #71
Rocha, Tito	*(n)*	Guest Nation
Rodriguez, Carlos Jose	*(n)*	Poster #152
Rodriguez, Edward	*(1-Zimmer; 3B-MXO; 4-MXO Orthopedics; 5-Synthes)*	Papers #28, 51
Rogers, John	*(n)*	Poster #31
Rollins, Mark	*(n)*	Paper #12
Romeo, Michelle	*(n)*	Paper #115
Rosenbaum, Samuel	*(n)*	Poster #13
Rosenwasser, Melvin P	*(1-Biomet; 3B-Stryker; 4-CoNexions, Radicle Orthopedics; 8-American Journal of Orthopedics;*	Lab Faculty

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Rosenwasser, Melvin P (cont'd)	*9-Foundation for Orthopedic Trauma, Osteosynthesis and Trauma Care Foundation)*	
Rothberg, David	*(n)*	Papers #26, 119, 121; Poster #141
Rothermel, Shane	*(n)*	Poster #43
Routt, Milton L "Chip"	*(n)*	Moderator; Lab Faculty; Mini Symposia Faculty; BSFF Symposium Faculty; Paper #47
Royzen, Maksim	*(n)*	Paper #17
Rozak, Michael Robert	*(n)*	Paper #3
Ruch, David Simms	*(1-Zimmer; 1,2-Acumed, LLC; 5-Synthes; 9-American Society for Surgery of the Hand)*	Poster #102
Rudloff, Matthew I	*(7-Saunders/Mosby-Elsevier)*	Lab Faculty
Ruland, Robert Thomas	*(n)*	Poster #15
Runner, Robert	*(n)*	Poster #134
Russell, George V., Jr.	*(2-AONA - Honorarium for two courses per year; 2,3B-Acumed, LLC - Consulting fees; 4-Zimmer; 5-Synthes, Research Support, Salarysupport for research manager; METRC, research support.; 9-AAOS - BOC Committee Member, Orthopaedic Trauma Association - Research Committee Member, AAOS)*	Symposium Faculty
Russell, Robert D.	*(n)*	Poster #140
Russell, Thomas (Toney) A	*(1-Smith & Nephew; 3A-Innovision, Inc; 3B-Zimmer; 4-Innovision; 4,6-ETEX; 6-PBC Ltd., Skeletal Kinetics; 7-Wolters Kluwer Health - Lippincott Williams & Wilkins)*	Symposium Faculty
Rutherford-Davies, Jill	*(n)*	Poster #69
Sadat, Ali	*(n)*	Paper #10
Safadi, Fayez	*(n)*	Paper #7
Safir, Oleg	*(3B-Intellijoint)*	Poster #68
Sagi, Henry Claude	*(1,2,3B,5-Stryker; 2-AO/Synthes; 2,3B,5-Smith & Nephew; 3B,5-Synthes; 8-Journal of Orthopaedic Trauma;*	Case Presentation Faculty; Papers #106, 115; Posters #27, 30, 72

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Sagi, Henry Claude (cont'd) . . . *9-AAOS, Orthopaedic Trauma Association, Foundation for Orthopaedic Trauma)*

Salai, Moshe . . . . . *(n)* . . . . . Poster #146

Salloum, Kanaan . . . . . *(3A-Globus Medical)* . . . . . Poster #86

Saltzman, Charles L . . . . . *(1,3B-Tornier; 1,2,3B-Zimmer;* . . . . . .Paper #119
3B-Smith & Nephew, Wright Medical Technology, Inc.; 7-Saunders/Mosby-Elsevier; 8-Clinical Orthopaedics and Related Research); 9-American Board of Orthopaedic Surgery, Inc., Association of Bone and Joint Surgeons)

Sample, Katie . . . . . *(n)* . . . . . Poster #59

Sanders, David . . . . . *(3B,5-Smith & Nephew; 5-Synthes;* . . . . . .Moderator;
8-Wolters Kluwer Health - . . . . . Papers #13, 34, 71, 111
Lippincott Williams & Wilkins; 9-Orthopaedic Trauma Association)

Sanders, Roy . . . . . *(1,3B-CONMED Linvatec; Biomet;* . . . . . Lab Leader;
Smith & Nephew; Stryker; . . . . . Papers #29, 46, 106;
5-Health and Human Services; . . . . . Posters #10, 27
National Institutes of Health (NIAMS & NICHD); Medtronic; Smith & Nephew; Stryker, METRC (DOD), OTA; 7,8-Journal of Orthopaedic Trauma)

Sanders, Thomas . . . . . *(n)* . . . . . Poster #23

Santoni, Brandon Gerad. . . . . *(3B-Musculoskeletal Transplant* . . . . . Paper #29;
Foundation; 5-Arthrex, Inc; Stryker). . . . . Poster #72

Santoyo, Jose Raul. . . . . *(n)* . . . . . Poster #140

Sapienza, Anthony . . . . . *(n)* . . . . . .Paper #101

Saran, Neil . . . . . *(5-DePuy, A Johnson & Johnson Company)* . . . . Poster #119

Sassoon, Adam . . . . . *(n)* . . . . . Posters #42, 123

Sathiyakumar, Vasanth . . . . . *(n)* . . . . . Paper #108;
. . . . . Posters #4, 19, 135, 147, 148

Savola, Olli . . . . . *(n)* . . . . . .Paper #35

Schallenberger, Mark . . . . . *(3A,4-Bacterin International, Inc.)* . . . . . .Paper #16

Schemitsch, Emil H. . . . . *(1,3B,6-Stryker;* . . . . . Symposium Faculty;
3B-Acumed, LLC, Amgen Co, . BSFF Symposium Faculty;
Wright Medical Technology, Inc., ...BSFF Moderator;
Kuros, Celgene, Sanofi-Aventis; . . .Mini Symposia Faculty;
3B,5,6-Smith & Nephew; . . . . . .Papers #71, 84, 111;
6-Canadian Institutes of . . . . . Posters #16, 125

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Schemitsch, Emil H (cont'd) . . . *Health Research (CIHR), OMEGA, Zimmer; Synthes; 7-Saunders/Mosby-Elsevier; 8-Journal of Orthopaedic Trauma; 9-Orthopaedic Trauma Association, Canadian Orthopaedic Association, Osteosynthesis and Trauma Care Foundation)*

Schemitsch, Laura . . . . . *(1,3B-Stryker; 3B,5-Smith & Nephew; 3B-Amgen Co; Wright Medical Technology, Inc.; 6-Canadian Institutes of Health Research (CIHR), OMEGA, Synthes, Zimmer, Osteosynthesis and Trauma Care Foundation; 7-Saunders/Mosby-Elsevier; 8-Journal of Orthopaedic Trauma; 9-Canadian Orthopaedic Association, Osteosynthesis and Trauma Care Foundation)* . . . . . Paper #61

Schep, Niels . . . . . *(n)* . . . . . Poster #95

Schessler, Matthew Joseph. . . . . *(n)* . . . . . Poster #18

Schildhauer, Thomas A. . . . . *(2,3B-Smith & Nephew; Zimmer; 8-Journal of Orthopaedic Trauma)* . . . . . Poster #108

Schlepp, Calvin Lee . . . . . *(n)* . . . . . Paper #68

Schleyer, Anneliese M. . . . . *(n)* . . . . . Poster #130

Schmidt, Andrew H . . . . . *(3B-Acumed, LLC, Bone Support AB, Medtronic, St. Jude Medical; 3C-Twin Star Medical; 3C,4-Conventus Orthopaedics; 4-Epien, Epix VAN, International Spine and Orthopaedic Instititute; 4,5-Twin Star Medical; 7-Thieme, Inc.; 8-Journal of Orthopaedic Trauma, Journal of Knee Surgery; 9-Orthopaedic Trauma Association)* . . . . . Lab Faculty

Schneider, Prism . . . . . *(n)* . . . . . Papers #25, 62; . . . . . Poster #6

Schneidkraut, Jason S . . . . . *(n)* . . . . . Poster #38

Schoenecker, Jonathan G . . . . . *(5-ISIS Pharmaceuticals)* . . . . . Paper #9

Schottel, Patrick Christopher. . . *(n)* . . . . . Papers #36, 113; . . . . . Posters #2, 11, 49

Schulman, Jeff Eric . . . . . *(3B-Stryker; 5-Synthes)* . . . . . Poster #26

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Schwartz, Herbert S	*(6-Musculoskeletal Transplant Foundation; 9-American Board of Orthopaedic Surgery, Inc.)*	Paper #9
Schwartzbach, Cary C	*(n)*	Poster #23
Sciadini, Marcus F	*(2,3B,4-Stryker)*	Papers #110, 116
Scolaro, John Alan	*(n)*	Paper #47
Scott, Ethan	*(n)*	Paper #7
Sellei, Richard Martin	*(n)*	Paper #23; Poster #113
Sems, Stephen A	*(1,3B-Biomet)*	Paper #31
Sen, Milan Kumar	*(2,3B,5-Stryker; 5-Synthes)*	Case Presentation Faculty; Poster #6
Serrano, Rafa	*(n)*	Poster #30
Serrano-Riera, Rafael	*(n)*	Papers #46, 106
Sethi, Anil	*(n)*	Poster #54
Sethi, Manish Kumar	*(n)*	Symposium Faculty; Papers #24, 52, 55, 108, 109 122 124; Posters #4, 19, 50, 60, 74, 93, 135, 147, 148
Seymour, Rachel	*(n)*	Papers #38, 53, 54, 107, 116; Posters #34, 143
Shaffer, Andre D	*(n)*	Poster #11
Shah, Anjan R.	*(3B-Stabilize)*	Lab Faculty
Shah, Muhammad Ali	*(n)*	Poster #64
Shahab, Faseeh	*(6-The hospital receives free of cost implants from SIGN Fracture Care (Surgical Implant Generation Network) and free plates from Acumed)*	Poster #24
Shaikh, Faraz	*(n)*	Poster #152
Shakir, Irshad A	*(n)*	Paper #103
Sheikh, Hassaan Qaiser	*(n)*	Poster #82
Shields, Edward J	*(n)*	Posters #10, 94
Shih, Albert	*(n)*	Paper #2
Shulman, Brandon	*(n)*	Paper #126
Siebler, Justin Cain	*(n)*	Paper #115
Siegel, Judith (Jodi)	*(7-Wolters Kluwer Health - Lippincott Williams & Wilkins)*	Case Presentation Faculty
Sietsema, Debra	*(2,3B-Eli Lilly; 9-American Orthopaedic Association,*	Mini Symposia Faculty; Paper #81;

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Sietsema, Debra (cont'd)	*National Osteoporosis Foundation, Orthopaedic Trauma Association)*	Posters #107, 109, 110, 116
Silva, Jorge Dos Santos	*(n)*	Paper #87
Silverberg, Arnold	*(n)*	Paper #108; Poster #74
Sims, Stephen H	*(n)*	Paper #107; Posters #59, 67
Sinclair, Kristofer D	*(3A,4,5-Elute, Inc.)*	Poster #137
Singh, Nathan	*(n)*	Paper #120
Siuta, Michael	*(3A-Merck)*	Paper #109; Poster #19
Sivasubramaniam, Priya Gomathi	*(n)*	Paper #66
Slipak, Alan	*(n)*	Paper #105; Poster #18
Slobogean, Gerard P	*(8-Journal of Orthopaedic Trauma)*	BSFF Symposium Faculty, BSFF Moderator; Mini Symposia Faculty; Papers #45, 60; Poster #101
Smith, Anne Katherine	*(n)*	Paper #109; Poster #19
Smith, Douglas Alexander	*(n)*	Poster #127
Smith, Michele	*(n)*	Poster #129
Smith, R Malcolm	*(2-Synthes; 8-Injury)*	Mini Symposia Faculty
Smithson, Ian	*(n)*	Paper #29; Poster #72
Snoddy, Mark	*(n)*	Poster #93
Soles, Gillian	*(n)*	Poster #94
Song, Hyungkeun	*(n)*	Poster #21
Specht, Lawrence	*(n)*	Poster #70
Speicher, Benjamin	*(n)*	Paper #67; Poster #118
Spitler, Clay A	*(5-Synthes)*	Papers #68, 92
Spraggs-Hughes, Amanda	*(n)*	Posters #8, 46
Staeheli, John	*(4-Medtronic, Merck, Pfizer)*	Lab Faculty
Stahl, Daniel Lee	*(n)*	Paper #77
Stains, Joseph	*(8-Journal of Bone and Mineral Research)*	Papers #19, 20
Stannard, James P	*(2-DePuy Synthes (Honorarium Jan 2014 Meeting), RTI (Honorarium),*	Moderator; BSFF Symposium Faculty; Papers #50, 65, 114

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Stannard, James P (cont'd) ..... *Smith & Nephew; Sonoma; 3B-DePuy, A Johnson & Johnson Company, Smith & Nephew, Sonoma, Synthes; 5-Kinetic Concepts, Inc.; 7-Theime; 8-Journal of Knee Surgery; 9-Orthopaedic Trauma Association)*

Stanton, Michael ..... *(n)* ..... Poster #7

Starr, Adam Jennings ..... *(1-Starrframe, LLC; 2-Smith & Nephew;* ..... Paper #63
8-Journal of Orthopaedic Trauma) ..... Poster #140

Steenburg, Scott D ..... *(n)* ..... Poster #114

Steinberg, Ely Liviu ..... *(n)* ..... Poster #146

Stengel, Dirk ..... *(2,3B,5-Biomet; 2,5-DePuy,* ..... Paper #59
A Johnson & Johnson Company; 3B,5-Aesculap/B.Braun, Stryker; 5-GlaxoSmithKline, Lilly); 8-Springer; Journal of Bone and Joint Surgery – British, Journal of Trauma Management and Outcomes, Injury; 9-German Trauma Society (DGU), AO Trauma)

Stephens, Kyle R ..... *(n)* ..... Poster #24

Steverson, Barbara ..... *(n)* ..... Paper #106

Stinner, Daniel J ..... *(9-Orthopaedic Trauma Association)* ..... Paper #108;
..... Posters #148, 152

Stitgen, Andrea ..... *(n)* ..... Poster #65

Stitzel, Joel Douglas ..... *(n)* ..... Poster #90

Stockton, David John ..... *(n)* ..... Paper #45

Streufert, Benjamin David ..... *(n)* ..... Poster #102

Stuart, Ami ..... *(n)* ..... Paper #119;
..... Poster #141

Stump, David ..... *(n)* ..... Paper #14

Stutz, Christopher M ..... *(n)* ..... Paper #9

Suk, Michael ..... *(3B-Stryker;* ..... Symposium Moderator
3B,6-Synthes; 8-American Journal of Orthopedics, Military Medicine, Journal of Trauma Management and Outcomes; 9-AAOS, Orthopaedic Trauma Association, AO International)

Sullivan, Matthew Patrick ..... *(n)* ..... Poster #142

Summers, Hobie ..... *(3B-Olympus)* ..... Case Presentation Faculty

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Sundem, Leigh	*(n)*	Poster #94
Surup, Timm	*(3A-Stryker)*	Poster #66
Svoboda, Steven James	*(9-AAOS; American Orthopaedic Society for Sports Medicine; American Board of Orthopaedic Surgery, Inc.)*	Poster #31
Swanson, Eli	*(n)*	Paper #49
Swartz, John	*(n)*	Poster #79
Swiontkowski, Marc F	*(3B-Eli Lilly; 7-Saunders/Mosby-Elsevier, Wolters Kluwer Health - Lippincott Williams & Wilkins; 8-Journal of Bone and Joint Surgery – American, Journal of Bone and Joint Surgery - American; 9-American Orthopaedic Association, Mid America Orthopaedic Assoc)*	Mini Symposia Faculty
Tai, Bruce Li-Jung	*(n)*	Paper #2
Taitsman, Lisa	*(8-Journal of Orthopaedic Trauma; Geriatric Orthopaedic Surgery & Rehabilitation; 9-American Orthopaedic Association; Orthopaedic Trauma Association)*	Poster #117
Talton, Jennifer Wrenn	*(n)*	Poster #90
Tannous, Oliver O	*(n)*	Paper #73
Tantavisut, Saran	*(n)*	Paper #42
Taormina, David P	*(n)*	Papers #101, 126; Posters #28, 47
Tarabadkar, Neil Sanjiwan	*(n)*	Poster #117
Taylor, Aaron	*(n)*	Paper #10
Tejwani, Nirmal C	*(1-Biomet; 2,3B-Zimmer, Stryker; 9-AAOS; Orthopaedic Trauma Association; Federation of Orthopaedic Trauma)*	Lab Faculty; Papers #32, 101; Poster #47
Templeman, David C	*(1,3B-Zimmer; 3C-Orthofix, Inc.; 9-AAOS; American Board of Orthopaedic Surgery, Inc.)*	Case Presentation Faculty; Poster #76
Teunis, Teun	*(n)*	Paper #99; Poster #97
Thakore, Rachel V	*(n)*	Papers #24, 52, 55, 108, 109 122, 124; Posters #4, 19, 50, 62, 74, 93, 135, 147, 148
Theologis, Alexander	*(6-Medtronic)*	Poster #87

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Thomas, Scott Brewer	*(n)*	Paper #67; Poster #118
Thore, Clara R	*(n)*	Paper #14
Thornton, Emily R.	*(n)*	Paper #99
Tieszer, Christina	*(n)*	Paper #34
Tilzey, John F	*(n)*	Poster #70
Tonnos, Frederick E.	*(n)*	Posters #54, 79
Tormos, Kathryn	*(n)*	Paper #10
Tornetta III, Paul	*(1-Smith & Nephew; 7-Wolters Kluwer Health - Lippincott Williams & Wilkins; 8-Journal of Orthopaedic Trauma)*	Symposium Faculty; Case Presentation Moderator; Poster Tour Guide; Paper #68, 71, 72, 93, 111, 117, 118; Posters #16, 45, 67, 76, 81, 100
Tosounidis, Theodoros	*(n)*	Poster #82
Tribble, David	*(n)*	Poster #152
Tsismenakis, Antonios	*(n)*	Paper #93
Tucker, Christopher J	*(n)*	Poster #31
Tucker, Damien Michael.	*(n)*	Poster #66
Tuinebreijer, Wim Eduard	*(n)*	Paper #91; Poster #95
Vaidya, Rahul	*(1,2,3B,3C-Stryker; 2,3B,5,6-Synthes; 8-European Spine Journal)*	Lab Faculty; Posters #22, 54, 79
Vallier, Heather A	*(8-Journal of Orthopaedics and Traumatology; 9-Orthopaedic Trauma Association)*	Mini Symposia Moderator; Paper #127; Posters #85, 115, 120, 127, 151
Van Beeck, Eduard Ferdinand	*(n)*	Paper #91
Van de Meent, Hendrik	*(3A-Othopedic Technology Nijmegen)*	Poster #124
Van Lieshout, Esther MM	*(8-World Journal of Orthopedics (editor); 9-Osteosynthesis and Trauma Care Foundation (Scientific Coordinator Research Program)*	Paper #91; Poster #95
Van Vugt, Arie	*(3B-Stryker)*	Poster #75
Varecka, Thomas F	*(n)*	Lab Faculty
Varghese, Thomas K	*(5 Nestle Healthcare Institute, Life Science Discovery Fund*	Paper #76

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Vemulapalli, Krishna	*(n)*	Poster #6
Venugopal, Vivek	*(n)*	Papers #5, 8
Verbeek, Jan FM	*(n)*	Poster #75
Verhofstad, Michael	*(n)*	Paper #86, 91; Poster #95
Verleisdonk, Egbert JMM	*(n)*	Paper #86
Vicente, Milena	*(n)*	Paper #61; Poster #125
Vincent, Alexander Duart	*(n)*	Poster #68
Virkus, Walter W	*(2,3B-Smith & Nephew; Stryker; 3A-Novartis; 3B-Collplant; 4-Stryker; Johnson & Johnson; 7-SLACK Incorporated; 8-American Journal of Orthopedics, Journal of Bone and Joint Surgery – American, Clinical Orthopaedics and Related Research, Journal of Orthopaedics and Traumatology)*	Poster #20
Volgas, David A	*(5-Pfizer)*	Papers #50, 114
Von Oldenburg, Geert	*(3A,4-Stryker)*	Poster #20
Vorhies, John	*(n)*	Paper #123
Vosbikian, Michael M	*(n)*	Paper #102
Vrahas, Mark S	*(8-Clinical Orthopaedics and Related Research; 9-AO Foundation)*	Symposium Faculty; Case Presentation Faculty; Mini Symposia Faculty; Paper #51
Waddell, James P	*(3B,6-Smith & Nephew; Stryker; 7-Saunders/Mosby-Elsevier; 9-Association for the Rational Treatment of Fractures; Canadian Orthopaedic Foundation Board Chair)*	Paper #84
Wakeman, Robert	*(n)*	Paper #58
Walsh, Mark	*(2-CSL Behring)*	Paper #67; Poster #118
Walton, Blaine T	*(2-DePuy, A Johnson & Johnson Company)*	Paper #1
Wang, Stewart C	*(n)*	Poster #13
Ward, Jayne	*(n)*	Poster #17
Warner, Stephen James	*(n)*	Paper #39, 43, 113; Poster #12
Wasserstein, David	*(n)*	Paper #83
Watson, David Timothy	*(2-Smith & Nephew)*	Paper #106

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Watson, Derek D . . . . . *(n)* . . . . . Paper #102

Watson, J Tracy . . . . . *(1-Biomet; DePuy,* . . . . . BSFF Symposium Faculty;
A Johnson & Johnson Company; . . . . . BSFF Moderator;
1,3B-Smith & Nephew; . . . . . Mini Symposia Faculty;
2-Medtronic; 3B-Advanced . . . . . Poster Tour Guide;
Orthopaedic Solutions; Bioventus; . . . Posters #63, 121, 150
3C-Accelalox; Acumed, LLC;
Ellipse; 8-Ortho knowlege online;
9-Orthopaedic Trauma Association)

Weatherford, Brian M . . . . . *(n)* . . . . . Paper #85

Weaver, Ashley . . . . . *(n)* . . . . . Poster #90

Weaver, Michael John . . . . . *(2-Synthes)* . . . . . Paper #51

Webb, Lawrence Xavier . . . . . *(2-Musculoskeletal Transplant* . . . . . Paper #14
Foundation; 3B-Zimmer); 6-Synthes;
Smith & Nephew; Stryker; Kinetic Concepts,
Doctors Group; 9-Orthopaedic Trauma
Association, Southeastern Fracture
Consortium Foundation)

Weber, Chris David . . . . . *(n)* . . . . . Paper #23;
. . . . . Poster #29

Weber, Timothy G . . . . . *(n)* . . . . . Lab Faculty

Wee, Hwa Bok . . . . . *(n)* . . . . . Poster #43

Weinlein, John C . . . . . *(7-Saunders/Mosby-Elsevier)* . . . . . Lab Faculty;
. . . . . Poster #60

Weintrob, Amy . . . . . *(7-I receive royalties from Up To Date)* . . . . . Poster #152

Westerlind, Brian O. . . . . *(n)* . . . . . Paper #42

Westrick, Edward . . . . . *(n)* . . . . . Paper #95;
. . . . . Poster #18

Whaley, Rumeal . . . . . *(n)* . . . . . Poster #139

White, Timothy O . . . . . *(3B,5,6-Acumed, LLC;* . . . . . Paper #41
3C-Smith & Nephew)

Whiting, Paul S . . . . . *(n)* . . . . . Lab Faculty;
. . . . . Paper #55;
. . . . . Poster #24

Wickramaratne, Niluka . . . . . *(n)* . . . . . Poster #73

Wickramasinghe, Neil Ranjan . . *(n)* . . . . . Papers #89, 90

Widhalm, Harald Kurt . . . . . *(n)* . . . . . Paper #44

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

DISCLOSURE LISTING – ALPHABETICAL

Wijdicks, Frans-Jasper Gerardus	*(5-AO Foundation, Davos, Switzerland)*	Paper #86
Wilber, John Howard	*(9-Orthopaedic Trauma Association; AONA, AOFoundation)*	Poster #41
Willett, Keith	*(1-Zimmer)*	Papers #22, 58
Williams, Joel C	*(n)*	Paper #6
Wilson, Frederic	*(9-AAOS, SIGN)*	Lab Faculty
Wilson, Matthew Steven	*(n)*	Paper #53
Wimberly, Robert Lane	*(n)*	Mini Symposia Faculty; Paper #79
Winn, Wesley W	*(n)*	Poster #145
Wixted, John J	*(3B-DePuy, A Johnson & Johnson Company; 5-Merck)*	Mini Symposia Faculty; Papers #5, 8
Wolinsky, Philip R	*(2,3B-Zimmer; 3B-Biomet; 5-Synthes; 8-Journal of Orthopedic Trauma; 9-OTA, AAOS, AOA, ACS)*	Symposium Faculty; BSFF Symposium Faculty; BSFF Moderator; Paper #1
Won, Yougun	*(n)*	Poster #21
Woodford, Maralyn	*(n)*	Paper #22
Wright, Thomas W	*(1,5-Exactech, Inc; 5-Integra Lifesciences Corporation/ Ascension Orthopaedics, Skeletal Dynamics LLC; 7-Wolters Kluwer Health - Lippincott Williams & Wilkins; 8-Journal of Hand Surgery - American)*	Paper #9
Wu, Chia-Lung	*(n)*	Paper #27
Yamada, Andrew	*(n)*	Paper #45
Yang, Arthur	*(n)*	Poster #51
Yang, Kyu Hyun	*(1-Zimmer)*	Poster #21
Yarascavitch, Blake Arden	*(n)*	Poster #89
Yeoh, Jane	*(n)*	Paper #100
Yoon, Patrick	*(3B-Arthrex, Inc; Orthofix, Inc.; 5-Synthes)*	Lab Faculty
Yuasa, Masato	*(n)*	Paper #9
Zelle, Boris A	*(9-AAOS)*	Posters #29, 113
Zhang, Bosong	*(n)*	Paper #48
Zhao, Stephen	*(n)*	Papers #19, 20

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

Ziran, Bruce H . . . . . *(3B-Acumed, LLC, Synthes;* . . . . . Symposium Faculty;
4-Powers Medical Group, Symbod, ... Poster #129
Tekartis; 8-Clinical Orthopaedics and Related Research, Journal of Bone and Joint Surgery – American, Journal of Orthopaedics and Traumatology, Journal of Trauma, Patient Safety in Surgery; 9-AAOS, American Board of Orthopaedic Surgery, Inc., American College of Surgeons, Orthopaedic Trauma Association)

Zirkle Jr, Lewis G. . . . . *(3C-SIGN; 8-Orthoprenour;* . . . . . .Lab Leader
9-Orthopaedic Trauma Association-International Committee)

Zuckerman, Joseph D . . . . . *(1-Exactech, Inc; 4-AposTherapy, Inc.;* . . . . . Paper #94;
6-Orthonet; 7-SLACK Incorporated, ... Poster #92
Thieme, Inc., Wolters Kluwer Health - Lippincott Williams & Wilkins; 9-American Orthopaedic Association, Musculoskeletal Transplant Foundation)

Zura, Robert D . . . . . *(2-Arthrex, Inc;* . . . . . Symposium Faculty;
2,3B-Smith & Nephew, Bioventus; . . . . . Lab Faculty
3B-Arthrex, Inc., Cardinal Health; 5-Synthes; 6-Synthes fellowship)

Zurakowski, David . . . . . *(n)* . . . . . .Paper #51

Disclosure:
(n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 601 - 603.

BSFF SYMPOSIUM 1: BIOMECHANICAL CONCEPTS FOR FRACTURE FIXATION

Moderators: *Emil H. Schemitsch, MD*
Michael Bottlang, PhD

7:30 am **Radial Head and Coronoid Fractures: Biomechanical Evidence for Modern Approaches**
Aaron Nauth, MD

7:40 am **Unstable Sacral Fractures: Is Standard Iliosacral Screw Fixation Adequate?**
M.L. "Chip" Routt, MD

7:50 am **Periprosthetic Femur Fractures: 90/90 Fixation Versus a Single Locking Plate?**
Emil H. Schemitsch, MD

8:00 am **Distal Femur Fractures: Far Cortical Versus Conventional Locking Screws: Is There a New Gold Standard?**
Michael Bottlang, PhD

8:10 am **Syndesmosis Injuries: What Is the Ideal Fixation Construct?**
Kenneth A. Egol, MD

8:20 am Discussion

NOTES

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

How to Use Fluoroscopic Imaging to Prevent Intra-Articular Screw Perforation During Locked Plating of Proximal Humerus Fractures: A Cadaveric Study

Jason Allen Lowe, MD[1]*; Shafagh Monazzam, MD*[2]*; Blaine T. Walton, MD*[1]*;*
Elisha M. Nelson, ARRT[2]*; Philip R. Wolinsky, MD*[2]*;*
[1]*University of Alabama, Birmingham, Alabama, USA;*
[2]*University of California Davis, Sacramento, California, USA*

Purpose: Intra-articular screw perforation is a common complication after open reduction and internal fixation (ORIF) of proximal humerus fractures. The purpose of this study was to determine the sensitivity and specificity of intraoperative fluoroscopic images used to evaluate if the tip of a screw is completely located within the bone of the proximal humerus or if it is intra-articular. The authors hypothesized that: (1) a screw that is completely contained within bone would always image as if it is within bone, (2) intra-articular screws can falsely appear on imaging as if they are completely located within bone, and (3) specific fluoroscopic views can be used to reliably evaluate specific locations of the humeral head.

Methods: 22 proximal humeri in fresh-frozen cadavers were instrumented. The articular surface was divided into equal-sized three rows (superior, central, inferior) and three columns (anterior, middle, posterior) so screws could be placed in reproducible locations at the intersections of the rows and columns. The screws in the first 10 specimens were inserted so their tips were located 2mm beneath the articular surface. The next 12 specimens had screws placed so their tips protruded 2 mm past the articular surface into the glenohumeral joint. 27 different C-arm views were obtained of each specimen/screw configuration for a total of 1242 images.

Results: A screw that is located completely within bone always imaged as if it was completely within bone. There were 0 false positives and therefore specificity was 100%. The average sensitivity of the images of the intra-articular screws was 55%, and varied greatly depending on the specific image and the screw tip exit location (range, 0%-100%) (Table 1). The sensitivity for the inferior row of screws was the lowest (39.1%) and was particularly low for the posterior inferior screw exit location (20.7%).

Conclusion: Screws that are completely contained within bone will never image as if they are intra-articular. Unfortunately, screws that are intra-articular, particularly the posterior inferior screw, can image incorrectly and appear as if they are completely located within bone. We recommend the use of seven specific C-arm images (black highlighted boxes in Table 1) since these views had a sensitivity of 100% for 8 of the 9 screws positions and 97% for the posterior inferior screw and required the least C-arm manipulation. This specific fluoroscopic imaging technique could be used to decrease the chances of placing intra-articular screws during ORIF of proximal humerus fractures.

See pages 99 - 147 for financial disclosure information.

Table 1. Sensitivity of Each Screw Exit Location for Each of the 27 C-Arm Views

	Cephalic Cant									NeutralCant									Caudal Cant									
Rainbow Position	Roll Back			Neutral			Roll Over			Roll Back			Neutral			Roll Over			Roll Back			Neutral			Roll Over			
Screw Exit Point	Arm IR	Arm NR	Arm ER	Arm IR	Arm NR	Arm ER	Arm IR	Arm NR	Arm ER	Arm IR	Arm NR	Arm ER	Arm IR	Arm NR	Arm ER	Arm IR	Arm NR	Arm ER	Arm IR	Arm NR	Arm ER	Arm IR	Arm NR	Arm ER	Arm IR	Arm NR	Arm ER	Average
Anterior Superior	83	92	75	92	50	17	58	25	8	58	**100**	92	**100**	92	42	92	42	25	25	92	**100**	75	**100**	92	92	58	42	67.3
Anterior Central	25	67	**100**	75	**100**	67	**100**	42	0	0	58	**100**	50	**100**	83	**100**	67	8	0	50	83	58	**100**	67	**100**	67	33	63.0
Anterior Inferior	0	8	58	0	67	**100**	75	**100**	83	0	33	83	0	75	**100**	50	**100**	42	0	58	**100**	25	**100**	**100**	67	92	42	57.7
Middle Superior	75	92	92	75	67	58	50	42	25	**100**	**100**	**100**	**100**	**100**	**100**	**100**	92	50	42	42	67	42	75	92	67	**100**	**100**	75.6
Middle Central	67	42	83	92	**100**	92	**100**	92	42	8	8	75	17	92	**100**	75	**100**	67	0	0	50	0	33	92	33	92	83	60.5
Middle Inferior	0	0	17	0	25	75	33	92	92	0	0	17	0	25	92	17	83	**100**	0	8	50	0	42	**100**	8	83	92	38.9
Posterior Superior	83	92	92	83	92	92	83	**100**	92	**100**	50	50	92	75	75	75	83	92	50	17	0	42	17	33	33	58	83	67.9
Posterior Central	**100**	42	25	92	67	92	92	92	**100**	50	8	0	33	8	58	33	58	**100**	8	0	8	8	0	25	0	17	75	44.1
Posterior Inferior	75	0	0	17	0	25	0	58	83	17	0	8	0	0	25	8	25	75	25	0	8	0	0	8	0	17	83	20.7
Average	56	48	60	58	63	69	66	71	58	37	40	58	44	63	75	61	72	62	17	30	52	28	52	68	44	65	70	55.1

IR = internal rotation, NR = neutral rotation, ER = external rotation. All sensitivities are in percentage, views with 100% sensitivity are bolded, and recommended views are highlighted in black.

• The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Cortical Bone Drilling Induced Heat Production with Common Drill Devices

Andrew Palmisano, MD*; Bruce Li-Jung Tai, PhD; Barry Belmont, MS;*
James R. Holmes, MD; Albert Shih, PhD;
University of Michigan, Departments of Orthopaedic Surgery and Mechanical Engineering,
Ann Arbor, Michigan, USA

Purpose: This study was designed to compare the heat produced during cortical bone drilling for various sizes of three common drill devices—standard twist drills, Kirschner-wires (K-wires), and a comparable cannulated drill. Previous studies have shown a threshold for thermal osteonecrosis to be 47°C. Significant data exist regarding heat production of standard twist drills; however, there is a paucity of data regarding cannulated drills and K-wires, both of which are used in many different sizes for many different situations. It was hypothesized that peak temperature would increase with bit size, with standard drills producing the least amount of heat followed by cannulated drills and lastly K-wires.

Methods: Three standard drill bits (2.0, 2.5, and 3.5 mm), three K-wires (1.25, 1.6, and 2.0 mm), and one cannulated drill bit (2.7 mm) were employed for comparison. Drill bits were driven by a Stryker hand drill secured on a servo-controlled linear actuator to provide a constant advancing speed of 1 mm/sec. The advancing speed was chosen after motion-testing a senior and resident surgeon. Bone samples were prepared from non-embalmed human tibia and moisturized at 37±1°C prior to drilling. To measure temperature, two thermocouples were embedded 2 mm into the cortical bone at distances of 0.5 mm and 1.5 mm from the drill hole margin. At least eight tests were performed for each drilling tool based on an initial power analysis.

Results: The peak temperature was extracted from each trial for comparison (Figures 1a and 1b). Standard twist drill data exhibited a positive trend between bit size and heat production. The bit size effect was shown to be less significant in K-wire drilling with no statistical difference between the sizes tested ($P > 0.05$). Comparing across different tools (Figure 1c), it can be seen that K-wires result in significantly ($P = 0.008$ at 0.5 mm) higher peak temperatures than standard twist drills of the same size ($\Delta T = 48.7 \pm 4.5$°C vs. $\Delta T = 35.1 \pm 9.3$°C). Figure 1d shows that a 2.7-mm cannulated drill produced more than double the temperature rise of a 2.5-mm twist drill ($\Delta T = 66.8 \pm 10.8$°C vs. $\Delta T = 33.1 \pm 8.4$°C).

Conclusion: Standard twist drills were found to be the most effective drilling devices, producing the smallest temperature rise among all bit types. For K-wires, all sizes reached substantial temperatures to cause instant thermal osteonecrosis. With an insignificant change in heat produced as K-wire size was increased, it was concluded that thermal effects should not be a reason for choosing K-wire size and that the largest size needed can be used. The cannulated drill showed significantly higher temperatures when compared with similar sized standard drills, reaching maximal temperatures comparable to those of a K-wire. This should be considered when choosing to use a standard versus cannulated drill.

See pages 99 - 147 for financial disclosure information.

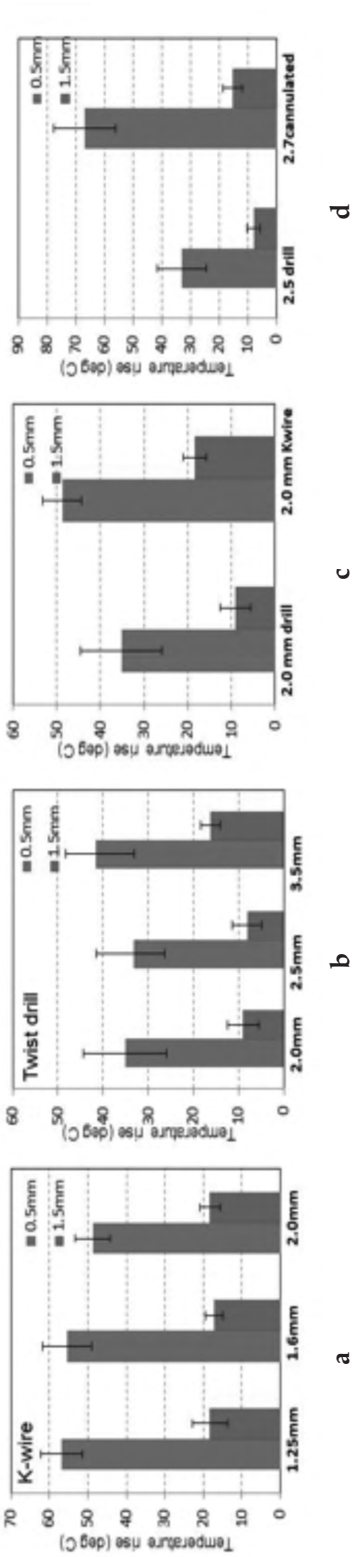


Figure 1. Experimental data with initial temperatures offset to zero.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Can Views of the Proximal Femur Be Reliably Used to Predict Malrotation After Femoral Nailing? A Cadaveric Validation Study

***Andrew G. Dubina**; Michael R. Rozak, BA, BS; Robert V. O'Toole, MD;*
R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA

Purpose: Malrotation after intramedullary nailing of femoral shaft fractures is a clinical problem that has been reported to occur in 15% to 40% of cases. One technique to evaluate rotation is to compare the amount of lesser trochanter that is visualized on standard AP hip film versus the amount visualized on the contralateral, uninjured side. Although this technique is commonly used, to our knowledge there are no data investigating its validity. The purpose of this study is to determine whether the amount of visualized lesser trochanter can be used as a surrogate for the degree of femoral rotation after fracture fixation. Our hypothesis is that this technique will be able to reliably detect clinically important differences in malrotation.

Methods: Twenty matched cadaveric femur pairs (n = 40) were obtained and mounted on a custom jig that allowed rotation along the axis of potential malrotation about a femoral nail. Sequential C-arm fluoroscopic images were taken of the proximal femur at 10° increments of internal and external rotation compared to a true AP of the hip as determined by knee position. The angle of rotation of the femur was measured with a computerized angular sensor affixed to the femoral shaft. The width of lesser trochanter visualized on each image was measured using standard PACS (picture archiving and communication system) clinical software and normalized to the maximum size observed to provide a percentage of trochanter observed for each image. The relationship between percentage of the lesser trochanter observed and angle of femoral rotation was analyzed using a trend line of the data.

Results: Rotation of the proximal femur demonstrates a consistent, linear relationship to the lesser trochanter ($r^2 = 0.87$). This linear relationship indicates that each 10% deviation in lesser trochanteric size corresponds to 7.7° of femoral rotation. The maximal size of the lesser trochanter was seen when the femur was externally rotated to an average of 34°, corresponding to the point when the intertrochanteric ridge begins to be visualized superior to the lesser trochanter. There was little variation in values between the left and right of each pair (paired *t*-test, $P > 0.1$) with the exception of one pair ($P = 0.02$), demonstrating that the contralateral hip is an excellent indicator of rotation.

Conclusion: To our knowledge, this is the first study to attempt to validate the common clinical practice of comparing the amount of lesser trochanter visualized on AP hip films to evaluate femoral rotation after intramedullary nailing. Our data demonstrate that the relationship between angular rotation of the femur and the size of the lesser trochanter is not only highly linear ($r^2 = 0.87$), but that the amount of change is quite sensitive to rotation. Previous authors have argued that clinically significant malrotation is thought to be somewhere in the 15° to 30° range, which corresponds to an easily measured change of 20% to 40% in size of the lesser trochanter. Clinicians can estimate the amount of malrotation using the relationship that roughly 8° of malrotation exists for every 10% difference in normalized size of the lesser trochanter.

See pages 99 - 147 for financial disclosure information.

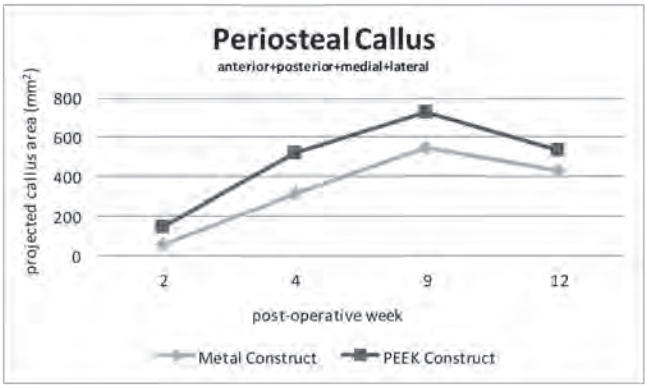
Polyether Ether Ketone (PEEK) Carbon Fiber Composites May Improve Healing of Fractures Stabilized with Intramedullary Nails

Jo Wilson, PhD; Matthew Cantwell;
Invibio Ltd, Thornton-Cleveleys, United Kingdom

Background/Purpose: Long bone diaphyseal fractures can be treated by using a number of methods. Intramedullary (IM) nailing represents a well-established approach for internal stabilization of bone fractures. Typical IM nail constructs consist of a metallic rod and placement of metallic screws at either end of the nail for stabilization. This study details the outcome of using a new material in the production of IM nail—PEEK-OPTIMA Ultra Reinforced, a carbon fiber–reinforced PEEK (polyetheretherketone) composite. The objective of this study is to compare bone healing of tibial osteotomy repaired with a PEEK carbon fiber composite IM nail to a traditional metallic construct in an established ovine fracture model. The study tested what effect lower modulus PEEK carbon fiber composite implants have on fracture healing in comparison with standard metallic constructs.

Methods: A 3-mm unilateral osteotomy defect was created in the left tibia of 10 sheep. Each animal was either assigned a PEEK or stainless steel (SS) nail for fracture stabilization. All animals were permitted immediate unrestricted weight bearing after surgery. Evaluation of bone remodeling was performed using CT, micro-CT (μCT), and portable radiography. The PEEK composite and SS IM nails were geometrically identical (10 mm in diameter and 187 mm in length). The material construction of the PEEK composite IM nail provided 59% lower stiffness in 4-point bending when compared to the SS nail. The healing process was monitored via radiography and CT at regular intervals. The animals were sacrificed at week 12; healed tibiae were analyzed by μCT.

Results: Bridging was observed on radiographs of all animals (5 of 5) implanted with the PEEK construct in contrast to the SS group (3 of 5). Callus formation of weekly radiographs was greater within the PEEK group, especially in the earlier time points: 158% ($P = 0.09$), 67% ($P = 0.08$), and 33% ($P = 0.10$) in weeks 2, 4, and 9, respectively. The callus formation in week 12 was 24% greater for the PEEK group when compared to the SS group ($P = 0.20$).



Conclusion: Improved healing in the form of complete bridging at an earlier time point and greater callus formation was seen in the PEEK nail group compared to the SS group. Potential reasons for the increased healing rate (bridging and callus) within the PEEK group are postulated to be enhanced dynamic loading and reduced stress shielding afforded by the lower modulus of the PEEK nail.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

BSFF SYMPOSIUM 2: BONE GRAFT SUBSTITUTION AND AUGMENTATION

Moderators: *Aaron Nauth, MD*
Peter V. Giannoudis, MD

9:35 am **Selecting the Right Bone Graft Substitute for Your Patient**
Aaron Nauth, MD

9:45 am **BMPs: Is There Still a Role in 2014?**
Peter V. Giannoudis, MD

9:55 am **Bone Marrow Aspirate and Autologous Stem Cells: Are They Effective?**
Joseph M. Lane, MD

10:05 am **Injectable Calcium Phosphates and Sulfates: When I Use Them and Which One I Use**
J. Tracy Watson, MD

10:15 am Discussion

NOTES

See pages 99 - 147 for financial disclosure information.

•Montelukast Sodium Enhances Fracture Repair: Is There a Dose Response?

Daniel Mandell, MD; ***John J. Wixted, MD****; Christopher Raskett, BS; Vivek Venugopal, BS; Jane B. Lian, PhD; Paul J. Fanning, PhD;*
University of Massachusetts Medical School, Worcester, Massachusetts, USA

Purpose: Previous studies have demonstrated that leukotrienes can act as negative regulators of chondrocyte activity, and that selective blockade through the use of leukotriene inhibitors can enhance chondrocyte activity and fracture repair. In this study, we sought to confirm these findings and determine if this effect was dose responsive. We hypothesized that the effect of cysteinyl leukotriene receptor blockade with montelukast sodium would demonstrate dose responsiveness and that increasing doses of the drug would demonstrate improved efficacy.

Methods: 451 animals were enrolled in an IACUC (Institutional Animal Care and Use Committee)-approved study. Animals underwent open retrograde nailing of the right femur followed by midshaft femoral guillotine fracture by standardized weight drop. Animals were divided into four treatment arms and received daily gavage with montelukast sodium at the following doses: control (carrier alone), 0.15 mg/kg once daily, 0.15 mg/kg twice daily, 1.5 mg/kg daily, and 1.5 mg/kg twice daily. Animals were sacrificed at day 7, 10, 14, and 21 post-fracture and underwent analysis by qtPCR (quantitative polymerase chain reaction) for gene expression, micro-CT, histology/immunohistochemistry, and mechanical testing.

Results: *Histomorphometry*: We performed histomorphometry on fracture callus sections from a total of 10 histological sections from each dose and time. We are able to demonstrate a clear, albeit small, effect of dose response from low to intermediate group, and a dramatic decline at the highest doses, suggesting potential inhibitory dose effect at the 1.5 mg/kg twice daily levels. *Mechanical Testing (day 21):* These data are largely consistent with our histomorphometry data showing larger callus size in the 1.5 mg/kg daily dosing, and this larger callus translated in this study to a more mechanically robust response by day 21. *Micro-CT:* For the overall bone volume and density, a tight contour around the entire ROI (region of interest) was utilized with no delineation between cortical or trabecular bone. Micro-CT data demonstrate an increased effect at 1.5 mg/kg daily dosing at specific time points, but no difference to control and a decline from 1.5 mg/kg daily was seen with 1.5 mg/kg twice daily dosing. *Gene Expression:* Aggrecan core protein expression levels and others are consistent with data demonstrating an increase to 1.5 mg/kg daily dosing and potential inhibitory dose effect at the highest levels.

Conclusion: Treatment of murine femoral fractures with oral montelukast sodium demonstrated increased callus size and gene expression profiles consistent with enhanced chondrogenesis at early time points, and this effect showed modest increases with escalating drug dosing. However, the highest dose appeared to exhibit potential inhibitory dose effect, with a drop off of nearly every parameter including mechanical testing, micro-CT parameters, and histomorphometry. This has important implications when considering the potential translation of leukotriene blockade for fracture treatments in humans.

• The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

ΔPossible Inhibitory Effect of Bone Marrow–Derived Mesenchymal Stem Cell Application on BMP-2–Mediated Bone Healing in a Critical Size Defect Model

Motasem I. Refaat, MD*; Joel C. Williams, MD; Dominik R. Haudenschild, PhD; Mark A. Lee, MD;*
University of California Davis, Sacramento, California, USA

Purpose: Healing of critical size defects (CSDs) remains a critical clinical challenge in fracture care. Bone morphogenetic proteins (BMPs) are commonly utilized in the setting of defect repair; however, large doses are required with associated costs and complications. Mesenchymal stem cells (MSCs) have been studied as an alternative to BMPs for bone defect repair. Composite constructs utilizing both BMPs plus osteogenic materials are commonly utilized. The purpose of this study was to investigate the relationship of MSCs and BMP response in a reproducible rodent CSD model. Our aim was to determine the efficacy of BMPs, MSCs, and combined application of BMPs plus MSCs deployed via an inert carrier in healing a validated critical size femoral defect model.

Methods: 6-mm diaphyseal CSDs were created in femora of skeletally mature male Fischer 344 rats and stabilized with a radiolucent PEEK (polyetheretherketone) plate and 6 angular stable bicortical titanium screws. MSCs were harvested from the intramedullary canal of a sacrificed Fischer 344 rat and expanded in MSC growth until confluent to 1×10^6 cells (4 passages). Rats were randomly assigned to four treatment groups: carrier alone (ICBM [insoluble collagenous bone matrix]), 2 μg BMP-2 with carrier (positive control), 1×10^6 MSCs with carrier, and 2 μg BMP-2 and 1×10^6 MSCs on carrier. Surveillance radiographs were obtained at 2-week intervals until the end of treatment and scored 0 (no bone formation), 1 (possible union), or 2 (union) by two blinded investigators. All animals were sacrificed at 8 weeks to examine bone formation using radiographs and micro-CT.

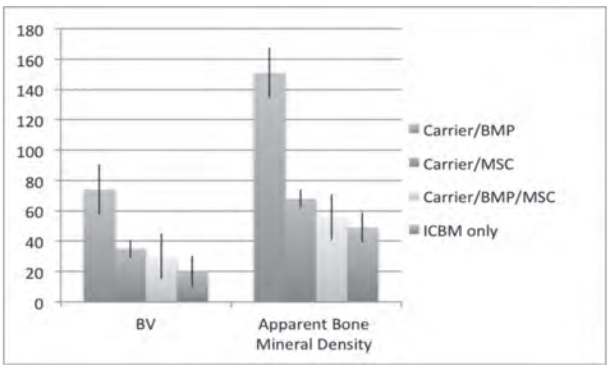
Results: All of the 2-μg group demonstrated 100% radiographic union by week 4 (D). None of the rats in the carrier (A) or the MSC group (B) fully united at the time of sacrifice. Rats in the MSC/BMP-2 group also failed to heal (C). Compared to BMP-2 or MSC alone, bone volume (BV) and bone mineral density were both decreased in the MSC/BMP-2 treatments (E). A qualitative analysis was preformed for all groups. Differences in mean values for all groups were tested using the analysis of variance (ANOVA). The analysis was significant for both BV ($P < 0.01$) and bone mineral density ($P < 0.01$) for all groups. Difference in mean values between the BMP-2 group and BMP/cells group were significant using a two-sided t-test, BV ($P = 0.014$) and for bone mineral density ($P < 0.01$).

Conclusion: BMP-2 delivered with an inert carrier in our mechanically stable rodent CSD model results in consistent, high-quality bone regenerate. The unmodified MSCs do not reliably heal the critical size defect. The addition of MSCs to the BMP-2 carrier construct demonstrated significantly reduced bone formation and failed to heal. The interplay between BMP-2 and unmodified MSCs merits further study.

Δ OTA Grant

See pages 99 - 147 for financial disclosure information.

Carrier (A) MSC (B) MSC/BMP (C) BMP (D)



(E)

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Effects of Reamer-Irrigator-Aspirator Wastewater on Bone Regeneration

Derek J. Klaus, MD[1]*; Douglas Crowder*[2]*; Ethan Scott, BS*[3]*, Steve Fening, PhD*[4]*;*
Fayez Safadi, PhD[3]*; Eric T. Miller, MD*[1]*;*
[1]*Department of Orthopaedic Surgery, Summa Health System, Akron, Ohio, USA;*
[2]*Department of Biomedical Engineering, University of Akron, Akron, Ohio, USA;*
[3]*Department of Anatomy and Neurobiology, Northeast Ohio Medical University, Rootstown, Ohio, USA;*
[4]*Austen BioInnovation Institute, Akron, Ohio, USA*

Background/Purpose: The reamer-irrigator-aspirator (RIA) device is capable of obtaining large quantities of autologous bone graft with significantly less donor site morbidity compared to iliac crest bone graft. The reamed femoral contents are aspirated and passed through a filter to separate the desired bone graft from the remaining wastewater (WW). The first aim of this study was to describe a method to concentrate osteogenic growth factors and viable mesenchymal stem cells (MSCs) from RIA WW. The second aim was to examine the effects of WW-derived growth factors on human MSCs in vitro as well as in a critical size defect (CSD) mouse calvarium model in vivo.

Methods: Twelve male patients scheduled for femoral RIA bone grafting procedures were enrolled. RIA WW and 50 cc of peripheral blood were collected. Peripheral blood was centrifuged to obtain platelet rich plasma (PRP). MSCs were extracted from the WW and the remaining aspirate was concentrated. MSCs were incubated in the presence of PRP or concentrated WW to assess cell proliferation, survival, and mineralization in vitro. 5-mm CSDs were made in the calvaria of immunodefficient mice and packed with a collagen sponge alone or a collagen sponge soak-loaded with PRP or WW. Four weeks post-surgery, the calvaria were harvested and examined using micro-CT to determine percent bone ingrowth.

Results: MSCs extracted from RIA WW remain viable after processing and retain multipotency. Concentrated WW yields comparable concentrations of osteogenic growth factors when compared to PRP. Concentrated WW significantly improved MSC proliferation by 4 times and survival by 3 times when compared to MSCs treated with PRP in vitro (Figure 1). MSCs treated with WW showed a 500-fold increase in mineralization after 2 weeks when compared to PRP. Significantly higher rates of bone ingrowth were observed in CSDs treated with WW (26%) compared to PRP (20%), $P < 0.01$.

Conclusion: When compared to PRP, concentrated WW was shown to (1) accelerate MSC proliferation, survival, and mineralization in vitro by 4, 3, and 500-fold, respectively, and (2) accelerate osteogenesis in a mouse calvarium CSD model in vivo.

See pages 99 - 147 for financial disclosure information.

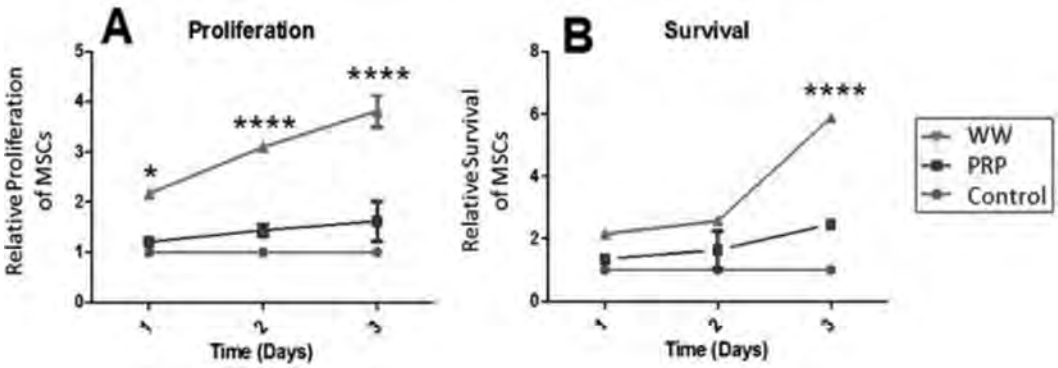


Figure 1. MSCs were incubated 1 to 3 days with normal growth media (Proliferation, **A**) or nutrient deplete media (Survival, B). For both assays, the media was either left untreated (control) or supplemented with WW or PRP. Significance was calculated between WW and PRP-treated groups. $^{*}P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$, $^{****}P < 0.0001$.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Is Impaired Fracture Healing in Cigarette Smokers Related to Carbon Monoxide Exposure?

John J. Wixted, MD; *Vivek Venugopal, BS; Christopher Raskett, BS; Jane B. Lian, PhD; Paul J. Fanning, PhD;*
University of Massachusetts Medical School, Worcester, Massachusetts, USA

Purpose: Smoking cigarettes delays fracture healing. Recent evidence has demonstrated that fracture repair can be enhanced by modifying hypoxia signaling during early stages of fracture repair. Additionally, carbon monoxide (CO) exposure in vitro has been shown to block hypoxic signaling through the hypoxic inducible factor (HIF) pathway. This led us to hypothesize that the deleterious effect of cigarettes on fracture healing could be due to CO exposure causing inhibition of physiologic hypoxia signaling via the HIF pathway.

Methods: A sealed environmental chamber was fitted with a CO delivery system so that low dose CO could be delivered cyclically, consistent with exposure seen in heavy smokers. Mice were initially treated with 200 ppm CO for 6 hours, alternating with 6 hours of room air, resulting in peak carboxyhemoglobin levels in the 14% to 20% range. After 2 weeks of accommodation, 240 animals underwent closed femoral fracture in an IACUC (Institutional Animal Care and Use Committee)–approved study. Animals were sacrificed at 7, 10, 14, and 21 days after treatment with cyclic CO or room air and fractures explanted for analysis with micro-CT, histology/immunohistochemistry, and qtPCR (quantitative polymerase chain reaction) for analysis of chondrogenesis, osteogenesis, and angiogenesis.

Results: Significant changes in fracture repair after cyclic CO exposure were readily apparent and occurred primarily at day 10 post-fracture. Micro-CT data demonstrated significant decreases in BV/TV (bone volume/trabecular volume) parameters ($P = 0.0012$) at day 10 after CO exposure, suggesting significant delays in healing. Furthermore, by day 14 the callus size in CO exposed animals was significantly larger than controls ($P = 0.0017$), suggesting delay in transition from chondrogenesis to osteogenesis. qtPCR data were consistent with findings of overall delay in healing by day 10. Expression profiles of angiogenesis genes (Hmox1, Jmjd6, Mmp9, Vegfa, Adora2b) and metabolism genes (Erol, Gys1, Hk2, Ldha, Pfkfb3, Pfkl) all showed more than twofold change from control with CO exposure. Markers of chondrogenesis (Sox9, Col2a1, Acan, Col10) were consistently below controls at all time points. Interestingly, osteogenic markers showed variable effects in Runx2, Col1, and Alk phos mRNA expression throughout the time course.

Conclusion: These data have particular relevance when considering pharmacologic treatments that may help overcome the inhibitory effect of cigarette smoke on healing fractures. Clear and consistent decreases in chondrogenesis and delays in fracture repair were seen with cyclic CO exposure at 200 ppm delivered at 6-hour intervals. This implicates CO as a negative regulator of fracture repair at concentrations consistent with that seen in human cigarette smokers. Altered mRNA expression of genes involved in angiogenesis, and decreases in HIF2a expression at early time points, further implicates HIF signaling in this delayed healing.

See pages 99 - 147 for financial disclosure information.

ΔThe Temporal and Spatial Development of Vascularity in a Healing Displaced Fracture

Nicholas A. Mignemi, BS[1]*; Masato Yuasa, MD*[2]*; Joey V. Barnett, PhD*[1]*;*
Justin M.M. Cates, MD, PhD[1]*; Jeffry S. Nyman, PhD*[1]*; William T. Obremskey, MD, MPH*[1]*;*
Atsushi Okawa, MD, PhD[2]*; Herbert S. Schwartz, MD*[1]*; Christopher M. Stutz, MD*[1]*;*
Jonathan G. Schoenecker, MD, PhD[1]*;*
[1]*Vanderbilt University, Nashville, Tennessee, USA;*
[2]*Tokyo Medical and Dental University, Tokyo, Japan*

Background/Purpose: Underlying vascular disease is an important pathophysiology shared among many comorbid conditions associated with poor fracture healing, such as diabetes, obesity, and age. Determining the temporal and spatial patterns of revascularization following fracture is essential for devising therapeutic strategies to augment this critical reparative process. Seminal studies conducted in the last century have investigated the pattern of vascularity in bone following fracture. The consensus model developed from these studies is of angiogenesis emanating from both the intact intramedullary and periosteal vasculature. Since the plethora of experimental fracture angiography in the early to mid-20th century there has been a paucity of reports describing the pattern of revascularization of a healing fracture. Consequently the classic model of revascularization of a displaced fracture has remained largely unchanged. Overcoming the limitations of animal fracture models performed in the above-described classical studies, we demonstrate for the first time the complete temporal and spatial pattern of revascularization in a displaced/stabilized fracture. These studies were designed specifically to (1) validate the classic model of fracture revascularization of a displaced/stabilized fracture, (2) assess the association between intramedullary and periosteal angiogenesis, and (3) elucidate the expression of vascular endothelial growth factor (VEGF)/VEGF-R (VEGF receptor) in relation to the classic model.

Methods: Midshaft femoral osteotomies (n = 52) were fixed with an intramedullary nail. Fracture healing was followed with radiographs, micro-CT, angiography, and histology at 7-42 days post fracture

Results: Representative data of vascularity during fracture repair are presented in Figure 1. Fractures with significant injury to the intramedullary vasculature revascularize initially through the development of a transperiosteal vascular network as a result of increased flow diverted centrifugally resulting from interruption of downstream medullary vascularity. In support of this observation, many enhanced vascular anastomoses developed between the medullary vasculature and the areas of periosteal vascular engorgement. Following the initial phases of fracture revascularization, there exists centrally an avascular cartilaginous matrix predominated by VEGF-A/VEGFR-1 negative cells surrounded by a richly vascular new bone matrix predominated by endothelial cells and osteoblasts expressing high levels of VEGF-A/VEGFR-1 peripherally. Histological data revealed hypertrophic VEGF-A producing chondrocytes in all areas of transition from avascular/soft tissue to vascular hard tissue callus. The chondrocytes continued to hypertrophy and release VEGF-A in a manner that directs the polarized bone formation together; the periosteal vasculature and bone

Δ OTA Grant

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

eventually unite. Following vascular union our results reveal that bone remodeling follows vascular remodeling in which intramedullary vascularity is re-established.

Conclusion: From these data, in conjunction with classic studies of fracture angiogenesis, we propose a novel model defining the process of bone revascularization. It is our hope that this new model of fracture revascularization of displaced/stabilized fractures will provide insight into the cause of impaired fracture healing, and potential means to restore bone healing.

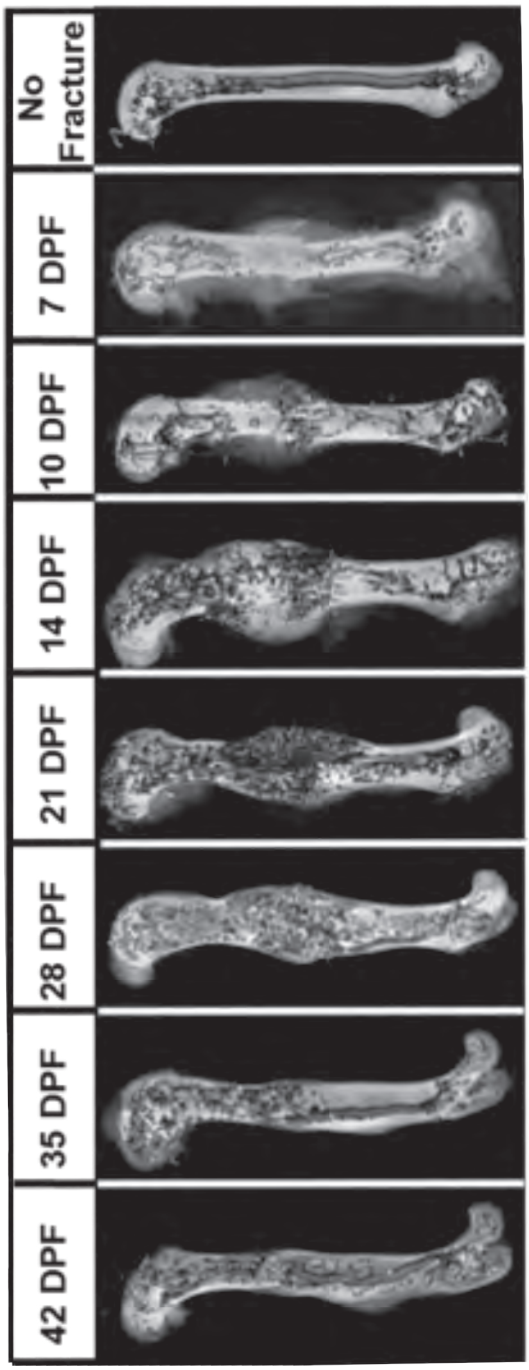


Figure 1.
Angiograph of femur facture from 0 to 42 days post fracture (DPF). Color denotes vessel size

See pages 99 - 147 for financial disclosure information.

ΔModulating the Vasculature at a Fracture Through the Therapeutic Application of Placental Stem Cells

Chelsea S. Bahney, PhD[1]*; Aaron J. Taylor, BS*[1]*; Ali Sadat, DDS*[1]*; Kathryn Tormos, PhD*[2]*;*
Theodore Miclau III, MD[1]*; Emin Maltepe, MD, MPH*[2]*; Ralph S. Marcucio, PhD*[1]*;*
[1]*Department of Orthopaedic Surgery, University of California, San Francisco,*
San Francisco, California, USA;
[2]*Department of Pediatrics, University of California, San Francisco,*
San Francisco, California, USA

Purpose: Blood supply to a fracture is a critical determinant of the rate and extent of healing. Therapies designed promote bone healing by stimulating angiogenesis have been proposed for a long time, yet to date no effective treatments are available. In this work, we capitalize on a transient process that modifies the vasculature during pregnancy to support the developing fetus. Placental progenitors, trophoblast stem cells (TSCs), promote vasculogenesis in response to fetal hypoxia by physically remodeling the maternal arterioles and secreting angiogenic factors to generate a high-volume, low-pressure fluid exchange. We hypothesize that the therapeutic application of TSCs will promote vascular remodeling and enhance fracture healing.

Methods: All murine studies were approved by the Institutional Animal Care and Use Committee. TSCs were isolated from the day E3.5 mouse blastocyst, transfected with eGFP (enhanced green fluorescent protein) and b-gal (beta-galactosidase) reporter constructs, expanded, and maintained in an undifferentiated state in vitro using published methodology. Nonstable fractures were created in the mid-diaphysis of immunocompromised mice (10-14 weeks, male, SCID Beige mice). Fractures were given and injection of 1 x 10^6 TSCs in 10 mL of PBS (phosphate-buffered saline), or PBS alone as a control. Fracture healing was evaluated by histology and quantitative stereology 5-28 days post injury. Immunohistochemistry was used to localize the cells following injections, and gene expression arrays were used to determine highly expressed genes from TSC that could benefit fracture repair.

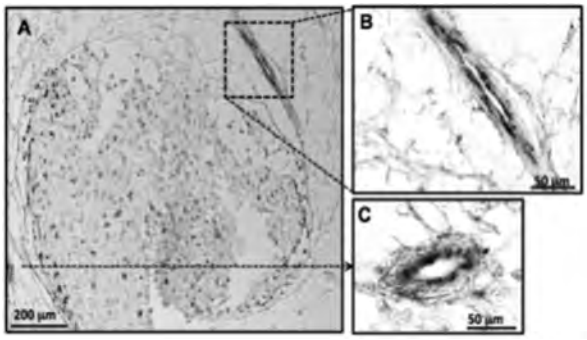


Figure 1. TSC Engraftment and endovascular invasion. (A) Bolus of β-gal labeled TSC located adjacent to fracture. (B-C) Insets of β-gal TSCs intercalated within vascular endothelium.

Results: Our data show that TSCs injected to nonstabilized murine fractures engraft into the vasculature (Fig. 1) and enhance the local blood supply (Fig. 2). Furthermore, injection of TSCs increased the volume of the cartilage callus 7 days post fracture, leading to more bone after 14 days of healing (Fig. 3)

Δ OTA Grant

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Conclusion: To our knowledge, this is the first study evaluating the therapeutic potential of TSCs. Our results have the potential to enhance clinical outcomes in skeletal trauma, where there is often poor vascular perfusion. Importantly, this work may also have a significant impact on the broader function that is often intimately tied to compromised vascularity.

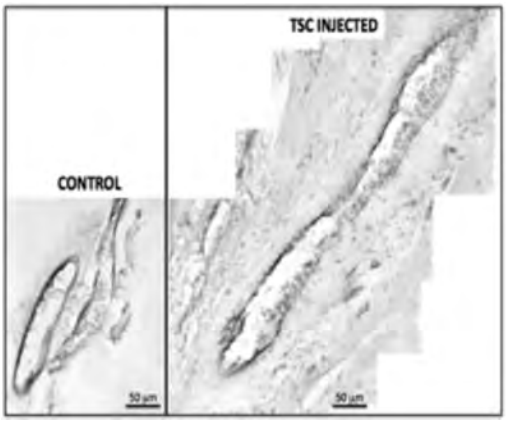


Figure 2. Comparison of average blood vessel diameter near fracture in control versus TSC injected animals shows vasodilation following TSC injection.

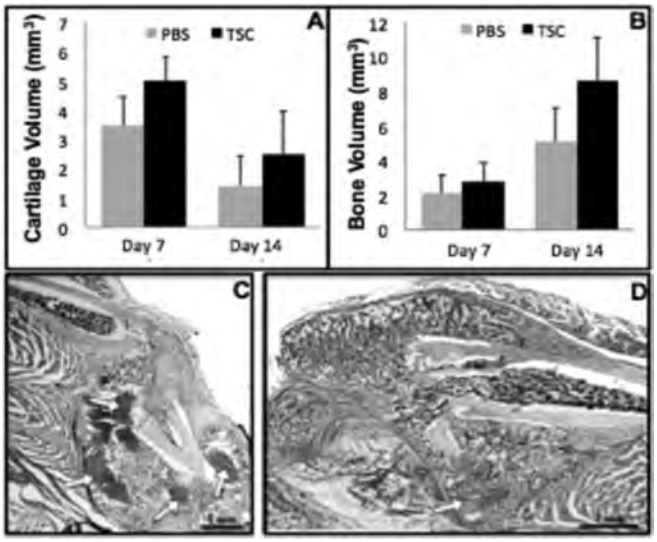


Figure 3. TSC treatment accelerates fracture repair. (A) Cartilage and (B) volume in fracture callus. Safranin-O staining of day 14 fracture (C) control, or (D) TSC treated fractures

See pages 99 - 147 for financial disclosure information.

Osteogenic, Stem Cell, and Molecular Characterization of the Human Biomembrane ("Induced Membrane") from Trauma Patients

Gabriella Ode, MD; *Gretchen Hoelscher, MS; Jane Ingram, BS; Synthia Bethea, BS; James Kellam, MD; Madhav Karunakar, MD; Michael J. Bosse, MD; Helen E. Gruber, PhD; Department of Orthopaedic Surgery, Carolinas HealthCare System, Charlotte, North Carolina, USA*

Purpose: The biomembrane (induced membrane) formed around polymethylmethacrylate (PMMA) spacers has great value as reflected in its clinical application in the Masquelet technique. Few studies, however, have evaluated cellular, molecular, or stem-cell features of the human biomembrane. The objective of this study is to evaluate and characterize the human biomembrane in terms of its osteogenic, stem cell, morphologic, and molecular characteristics. We hypothesize that a better understanding of its biologic properties will lead to development of methods that can optimize long-term functional outcomes for traumatic limb salvage/military amputee patients.

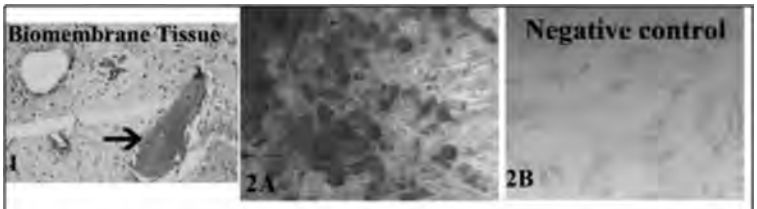


Table 1. Stem Cell Potency of Human Biomembrane Cells

	Osteogenic differentiation	Chondrogenic differentiation	Adipogenic differentiation
% (#/total)	70% (7/10)	90.9% (10/11)	90% (9/10)

Methods: Following IRB approval, biomembrane specimens were obtained from 12 surgeries (11 patients) with complex fractures (mean age 42.7 ± 13.2 years; 3 females, 8 males). Biomembranes from 8 tibias and 2 femurs were processed for routine morphology and molecular analysis or minced and utilized for monolayer cell culture to determination of the presence of stem cell populations. Cells were tested for their ability to differentiate into osteoblasts, chondroblasts and adipose cells using accepted differentiation criteria employing differentiation media (Lonza) and alizarin-red staining of calcified nodules formed by osteoblasts, micromass formation by chondroblasts, and adipocyte formation. The GCOS Affymetrix GeneChip Operating System was used to determine gene expression. Data were normalized and GeneSifterTM web-based software used to analyze microarray data. Statistical significance was determined using the Student *t*-test (two-tailed, unpaired, $P \leq 0.05$ as the significance level).

Results: Average duration of the PMMA spacer in vivo was 13.5 weeks (range, 6-21). Trabecular bone was present in 33.3% of the biomembrane specimens (Fig. 1, arrow). Biomembrane morphology showed high vascularity and collagen content; all specimens showed positive immunologic presence of bone morphogenetic protein 2 (BMP2) and RUNX2 in the biomembrane stroma. Differentiation of stem cells is shown in Table 1 and osteogenesis (alizarin-red staining of calcified nodules) in Figure 2A. Positive osteogenesis was found in cells from patients with PMMA present for 6-17 weeks (mean, 13.4 weeks). Molecular analyses compared 3 older (mean age, 56.7 years) versus 3 younger patients (mean age, 33.6 years). Biomembranes from older patients showed significant upregulation of aldehyde oxidase

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

1 (a producer of hydrogen peroxide/superoxide, $P = 0.03$) and type I collagen ($P = 0.008$), and significant downregulation of matrix metalloproteinase 13 ($P = 0.03$) and tenascin XB (an extracellular matrix protein, $P = 0.01$).

Conclusion: Stem cell differentiation data showed greater variability in pluripotency for osteogenic potential (70%) versus chondrogenic or adipogenic potentials (90.9 and 90%, respectively). Due to the importance and increased use of the Masquelet technique in complicated large bone defects, analysis of data such as these is valuable because it leads to improved understanding of the human biomembrane's osteogenic potential.

See pages 99 - 147 for financial disclosure information.

BSFF SYMPOSIUM 3: THE MANGLED EXTREMITY - FUNCTIONALITY THROUGH MECHANICS OR BIOLOGICS?

Moderators: *Edward J. Harvey, MD*
Lisa K. Cannada, MD

12:35 pm **Current Concepts for Infection Management in High MESS Legs**
Philip Wolinsky, MD

12:45 pm **Heterotopic Ossification in Trauma and Amputations**
Roman Hayda, MD

12:55 pm **New Concepts in Residual Limb Management and Rehabilitation**
Lisa K. Cannada, MD

1:05 pm **The Peg Leg or the Six Million Dollar Man- Where Are We?**
Danielle Melton, MD

1:15 pm Discussion

NOTES

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Pharmacological Treatment of Compartment Syndrome with Phenylephrine and Dobutamine Was Similar to Fasciotomy

Xuhui Liu, MD; James M. Mok, MD; Heejae Kang, BS; Julie Jin, BS; Alexandar Boehme, BS; Erik N. Hansen, MD; Mark Rollins, MD; Hubert T. Kim, MD; ***Utku Kandemir, MD****;*
Department of Orthopaedic Surgery, University of California San Francisco, San Francisco, California, USA

Purpose: Current treatment for acute extremity symptomatic acute compartment syndrome (CS) is fasciotomy. However, surgical treatment has associated morbidity and may delay the recovery of the patients. The goal of this study is to investigate the feasibility of a novel nonsurgical treatment strategy for acute CS that increases oxygen delivery to the affected extremity by increasing blood pressure in a dog CS model. We hypothesize that pharmacological treatment will raise the blood pressure, improve limb perfusion, and increase tissue oxygenation, thus rescuing muscle from CS.

Methods: CS was induced in the anterolateral compartment on bilateral legs in the animals. Intramuscular tissue oxygenation, compartment pressure, and blood pressure were recorded every 30 seconds. Pharmacological treatment was initiated 1 hour after CS was induced. Infusion of intravenous phenylephrine was titrated as needed to increase the diastolic blood pressure 30 mm Hg above the baseline (creating DP = 0 mm Hg). Intravenous dobutamine was initiated 2 hours later to maintain blood pressure. Six to seven hours after treatment, fasciotomy was performed on one leg of the animals and the skin was closed 1 hour later. In a separate nontreatment control group, CS of equivalent magnitude was induced in 6 animals in which no intervention (pharmacological nor fasciotomy) was performed. Animals were euthanized 2 weeks postoperatively at which point muscle biopsies were performed. Tissue viability was assessed by MTT (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide) assay as previously described. This is a validated technique in which the normalized tissue viability index is expressed as a percentage of control (quadriceps muscle).

Results: After induction of CS, pharmacological treatment significantly increased PmO2 in the anterior compartment muscle. The average PmO2 in the treatment group was 18.8 ± 4.3 mm Hg (mean ± standard error [SE]). In contrast, PmO2 in the non-treated group dropped to 0 mm Hg soon after the CS was induced. Fasciotomy increased the PmO2 from 18.8 ± 6.7 mm Hg to 35.7 ± 15 mm Hg. Two weeks after surgery, the muscle viability index in pharmacological treated, pharmacological treated plus fasciotomy, and non-treated groups was 128 ± 15%, 94.3 ± 8.3%, and 41.8 ± 17% (mean ± SE), respectively. There was no significant difference in viability index between the pharmacological treated and pharmacological -treated plus fasciotomy groups ($P = 0.09$). However, both groups had significantly higher tissue viability compared to the non-treated group ($P < 0.01$).

Conclusion: Our results showed that nonsurgical pharmacological treatment can significantly increase muscle oxygen and viability and may represent an alternative, less morbid treatment for acute CS than fasciotomy. Phenylephrine is often used for for trauma patients in the perioperative setting to maintain blood pressure and could serve as initial therapy in patients with possible CS. However, in our study, the effect of phenylephrine decreased over time, and a second line drug (dobutamine) was needed after the first few hours. Keep-

See pages 99 - 147 for financial disclosure information.

ing the blood pressure at a high level using solely pharmacological agents (phenylephrine/dobutamine combination) yielded similar results as fasciotomy for the treatment of acute CS.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

ΔCarbon Monoxide Releasing Molecule-3 (CORM-3) Diminishes the Oxidative Stress and Leukocyte Migration Across Human Endothelium in an In Vitro Model of Compartment Syndrome

Aurelia Bihari, MS*; Gediminis Cepinskas, DVM, PhD; David Sanders, MD;*
Abdel-Rahman Lawendy, FRCS;
London Health Sciences Centre, London, Ontario, Canada

Purpose: Acute limb compartment syndrome (CS), a potentially devastating complication of musculoskeletal trauma, results in muscle necrosis and cell death. Oxidative stress due to ischemia and inflammation both appear to contribute to the microvascular dysfunction and parenchymal injury. Recently, carbon monoxide (CO), liberated from the carbon monoxide releasing molecule-3 (CORM-3), has been shown to protect microvascular perfusion and reduce inflammation in a rat model of CS. The purpose of this study was to replicate the CS conditions in vitro, allowing the study of the mechanism(s) of CO protection on the human microvasculature. The ultimate goal is the development of a rational pharmacologic adjunctive treatment for CS, which would reduce the morbidity and disability in patients.

Methods: Human vascular endothelial cells (HUVEC), grown to confluency, were stimulated for 3 hours with either a cytokine/chemokine cocktail representing the serum levels of inflammatory mediators detected in our experimental model of CS ("CS cocktail"), containing tumor necrosis factor alpha (TNF-a), interleukin (IL)-1b, and GRO (1 ng/mL, 100 pg/mL, and 1 ng/mL, respectively), or human serum (40%) isolated from CS patients. Levels of intracellular oxidative stress, measured by the production of reactive oxygen species (ROS) were assessed by oxidation of dihydrorhodamine 123 (DHR-123). Leukocyte migration (transwell inserts) was assessed by quantifying the number of ^{51}Cr-labeled polymorphonuclear cells (PMNs) moving across the HUVEC monolayer in response to the CS cocktail or CS serum stimulation. All experiments were performed in the presence of CORM-3 (100 mM), or its inactive form iCORM-3.

Results: Stimulation of HUVEC with CS cocktail induced a significant increase in the production of ROS, expressed as fluorescence intensity (FI) per mg protein (1118.6 ± 255.6 in CS cocktail versus 600.8 ± 29.2 in control, $P \leq 0.01$), and increased PMN migration across HUVEC (35.1 ± 4.9% in CS cocktail vs. 10.0 ± 2.0% in control, $P \leq 0.05$). CORM-3 treatment completely prevented CS cocktail-induced ROS production (468.3 ± 37.8 vs. 1169.1±155.8 in iCORM-3 group, $P \leq 0.01$), and PMN migration (12.0 ± 1.5% vs. 35.0 ± .9% in iCORM-3 group, $P < 0.05$). In parallel, experiments employing human CS serum stimulation demonstrated that CORM-3 was also very effective in blocking the CS serum-induced ROS production (644.8 ± 114.5 vs. 1059.6 ± 56.3 in iCORM-3 group, $P \leq 0.01$).

Conclusion: Treatment of human vascular endothelial cells with CORM-3 was able to interfere with the intracellular ROS production, and suppressed leukocyte migration across the endothelial barrier. The data indicate that CORM-3 offers potent antioxidant and anti-inflammatory effects, and thus may have a potential therapeutic application to patients at risk of developing CS.

Δ OTA Grant
See pages 99 - 147 for financial disclosure information.

Use of the Reamer/Irrigator/Aspirator During Intramedullary Nailing Decreases Carotid and Cranial Embolic Events

Anna N. Miller, MD[1]*; Dwight D. Deal, BS*[1]*; James Green, BS*[2]*; Tim T. Houle, PhD*[1]*;*
William R. Brown, PhD[1]*; Clara R. Thore, PhD*[1]*; David Stump, PhD*[1]*; Lawrence X. Webb, MD*[3]*;*
[1]*Wake Forest School of Medicine, Winston-Salem, North Carolina, USA;*
[2]*DePuy Synthes, West Chester, Pennsylvania, USA;*
[3]*Mercer University School of Medicine, Macon, Georgia, USA*

Purpose: Reaming for and placement of intramedullary nails results in bone marrow and fat extravasating into the circulatory system. This may lead to fat emboli syndrome, multiple organ failure, and adult respiratory distress syndrome. Studies show varying results of increased intramedullary pressure and embolic phenomenon with reamed or unreamed nailing. The Reamer/Irrigator/Aspirator (RIA; DePuy Synthes, West Chester, PA) device has been shown to decrease intramedullary pressure during reaming. We hypothesized RIA would reduce the number of micro emboli (ME) detected in the carotid artery and brain compared with both reamed and unreamed nailing.

Methods: A large canine model was used. Each animal underwent either unreamed nailing (UR), reamed nailing (R), or RIA-reamed nailing (RIA) of bilateral femora. During reaming and nailing, the number and size of ME transiting the carotid were recorded by an ultrasonic embolus detector (EDAC; Luna Innovations, Roanoke, VA). The animals remained anesthetized 4 hours, then the brain was harvested for immunostaining (HSP70; hypoxia-inducible factor [HIF]-1α) and measurement of micro-infarction volumes.

Results: Carotid ME were only detected during the reaming and nailing portions of each procedure. The total ME load passing through the carotid was 0.05 cc (UR), 0.04 cc (R), and 0.01 cc (RIA) (not statistically significant). The number and size of ME of the UR and R group were similar. However, the RIA group had significantly smaller numbers of larger emboli, >200 microns; $P = 0.03$. Pathologic examination of the brain confirmed the presence of particulate emboli (photo center), as well as upregulation of stress-related-proteins, HSP70 and HIF-1α, detected in all groups.

Conclusion: Further study is required to determine the mechanisms by which ME pass into the arterial system during reaming. RIA decreased ME compared with traditional reamed and unreamed nailing, suggesting intramedullary pressure and heat are important variables. These results may help explain subtle neurobehavioral symptoms commonly seen in patients undergoing intramedullary nailing procedures.

Funding: Provided by NIH R01NS020618-28.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

•Superoxide Dismutase Mimetic Disrupts Bacterial Biofilms in an Infected Fracture Model

*Sarah E. Lindsay[1,2]; James D. Crapo, MD[1]; **Elizabeth A. Regan, MD, PhD**[1];*
National Jewish Health, Denver, Colorado, USA;
Stanford University, Palo Alto, California, USA

Background/Purpose: Implant-associated infections affect more than 50,000 orthopaedic cases a year. *Staphylococcus aureus* is one of the most common pathogens and its ability to persist locally and resist antibiotics is related to its ability to form and maintain biofilm structures. Fixation devices and total joint components provide a surface for bacterial adherence and foster bacterial growth within a 3-dimensional extracellular structure that is phenotypically different from its planktonic (single cell) counterpart. Biofilm associated infections become chronic and difficult to diagnose, leading to fracture nonunions and premature failures of total joints. Reports that bacteria actively modulate their redox environment in a biofilm by downregulating superoxide dismutase (SOD) suggested a novel treatment for biofilms. We postulated that a potent SOD mimetic would interfere with either the establishment or maintenance of the biofilm structure and might improve clinical outcomes. We tested the compound (MnTE-2-PyP) in an in vitro model and a murine infected fracture model with and without antibiotics.

Methods: *In Vitro:* A biofilm-forming subtype of *S. aureus* (ATCC 29213) was used. Biofilm assessment was done using crystal violet assay for extracellular polymeric structure (EPS); *S. aureus* was diluted and plated on sterile 96-well PVC plates. Cultures were grown over 24 hours, treated with drug (30 μM) or PBS (phosphate-buffered saline) at baseline or after 12 hours of growth. Absorbance was read at OD595 using a microplate reader. *Animal Model*: Procedures were approved by the Institutional Animal Care and Use Committee at National Jewish Health. Male C57BL6 mice (20-25 grams) were used. A midshaft femur fracture was created through a lateral incision and then treated with intramedullary fixation using an 8-mm section of 23-gauge needle. 10^3 bacteria in 5 μl volume were placed at the fracture site and the soft-tissue envelope was restored with 6-0 Vicryl and skin glue. There were four treatment groups and five mice per group: (1) no drug treatment, (2) SOD mimetic alone (MnTE-2-PyP), (3) cephalexin 250 mg/mL administered in drinking water, and (4) MnTE-2-PyP and cephalexin. The animals were allowed unrestricted activity for 2 weeks. Femurs were harvested at the end of 2 weeks. Bone was dissected free of surrounding muscle, weighed, homogenized, sonicated, then plated for quantitative cultures.

Results: Mn TE-2-PyP disrupted established biofilms (after 12 hours of growth) in vitro at both 15 and 30 μM concentrations. Neither dose prevented the formation of the initial biofilm structure. In the infected fracture model, mice regained full weight bearing within 24 hours when fixation was adequate. Treatment with cephalexin alone reduced the bacterial counts at 2 weeks by 75% compared to no drug treatment, but there were residual bacteria cultured in all of the animals. In the MnTE-2-PyP with cephalexin group, bacterial cultures were zero in all animals at 2 weeks ($P < 0.0001$)

Conclusions: An SOD mimetic drug in combination with standard antibiotic treatment is more effective than antibiotics alone for treating a biofilm associated bone and implant

See pages 99 - 147 for financial disclosure information.

infection. In vitro work suggests that the drug interferes with maintenance of the biofilm EPS structure, which may allow improved antibiotic penetrance as well as improved immune cell activity.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

•Rifampin and Minocycline-Containing Coating for Orthopaedic Implants with Potent In Vivo Activity

Mark Schallenberger, MS*; Todd R. Meyer, PhD;*
Bacterin International, Belgrade, Montana, USA

Purpose: Microbial contamination of implanted devices remains a significant complication in orthopedic medicine. While antimicrobial surface technologies have revolutionized a variety of medical devices, an efficacious antimicrobial coating for orthopaedic devices has remained elusive. To address this challenge we have developed a strongly adherent, biocompatible rifampin- and minocycline-containing coating for orthopaedic implants. Herein, we evaluate the efficacy of coated external fixation pins through several in vitro assays and in an animal model of pin-track infection.

Methods: The in vitro performance of coated Kirschner wires (K-wires) was evaluated by performing repeat zone of inhibition (ZOI) studies and measuring antimicrobial elution kinetics. For the in vivo evaluation of the technology, K-wires with and without the antimicrobial-containing coating were implanted bilaterally into the tibial metaphysis of New Zealand White rabbits. The surrounding soft tissue was surgically closed and the K-wire skin interface was inoculated with a suspension of 1×10^7 colony forming units (cfu) of *Staphylococcus aureus*. After 7 days, the animals (n = 8) were euthanized and the severity of infection was evaluated through the enumeration of adherent cfu on the surface of the K-wires. Additionally, pin loosening and local inflammation was evaluated semi-quantitatively. The size of the K-wires and location of placement were chosen to mimic the human clinical use of 5.0-mm half pins. No systemic antibiotics were administered in order to represent a worst-case scenario for microbial virulence.

Results: In vitro testing demonstrated that the antimicrobial-containing coating produced sizeable plate-to-plate ZOIs for 42 days and continuously released the antimicrobial agents in quantities above pathogenic MICs (minimum inhibitory concentrations) for at least 70 days. The coating completely inhibited biofilm formation on the surface of the K-wires in vivo (limit of detection = 3.7×10^1 cfu/cm^2), while the non-coated K-wires were colonized with $3.0 \times 10^6 \pm 1.5 \times 10^5$ cfu/cm^2, a 4.9 log reduction ($P < 0.0001$). Clinical microbiology confirmed that the bacteria recovered on the control implants were the strain of *S. aureus* employed in the testing. The coated K-wires also maintained significantly higher anchoring strength ($P = 0.017$) and displayed significantly reduced local tissue inflammation ($P = 0.001$) compared to the controls. Furthermore, animals implanted with coated devices lost significantly less weight during the study (4.9% vs. 12.9%, $P = 0.007$) and were significantly less likely to develop a fever (6.3% vs. 43.8% of study days, $P = 0.017$) than animals implanted with control devices.

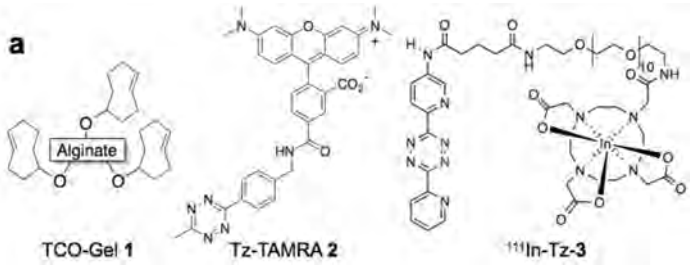
Conclusion: As microbial contamination of implants continues to present serious complications in orthopaedic medicine, new technologies are urgently needed to address this challenge. The described rifampin- and minocycline-containing coating has demonstrated excellent in vitro and in vivo activity. These results, coupled with the previously reported biocompatibility and strong coating adhesion, makes this technology an exciting prospect for clinical development.

See pages 99 - 147 for financial disclosure information.

ΔIn Vivo Chemistry and Implantable Biomaterial for Targeting Therapeutics

José M. Mejía Oneto, MD, PhD[1]*; Munish C. Gupta, MD*[1]*; Kent Leach, PhD*[1]*;*
Mark A. Lee, MD[1]*; Maksim Royzen, PhD*[2]*;*
[1]*University of California, Davis Medical Center, Sacramento, California, USA;*
[2]*University at Albany, State University of New York, Albany, New York, USA*

Purpose: This study is designed to evaluate a novel drug delivery system aimed to optimize local drug concentrations of systemic medications. Prior studies have shown that through in vivo chemistry a systemic molecular payload containing tetrazine (Tz) can be localized to an area previously tagged with an antibody modified with trans-cyclooctenes molecules (TCO). To explore the potential of this method for the treatment of focal orthopaedic infections, we set out to quantify the size of the molecular payload that can be delivered and to establish that a molecular payload could be delivered in vivo to TCO covalently bonded to an alginate gel.

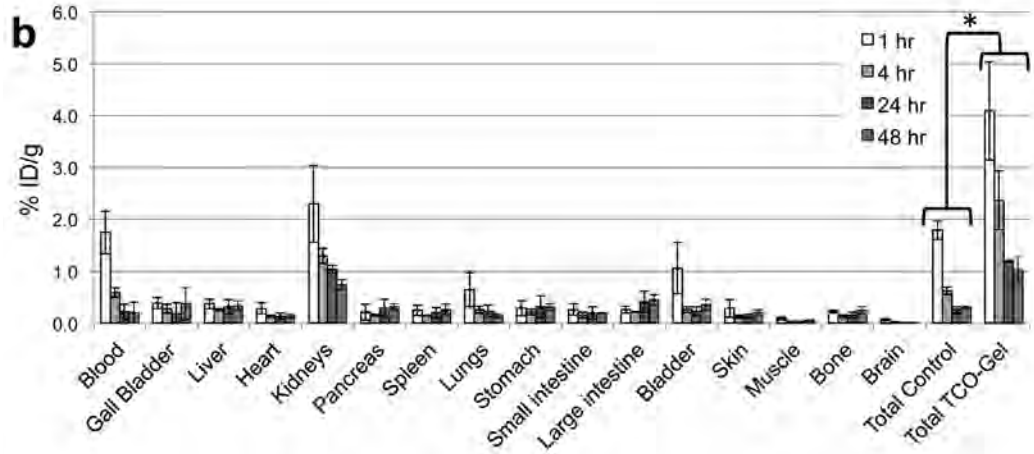


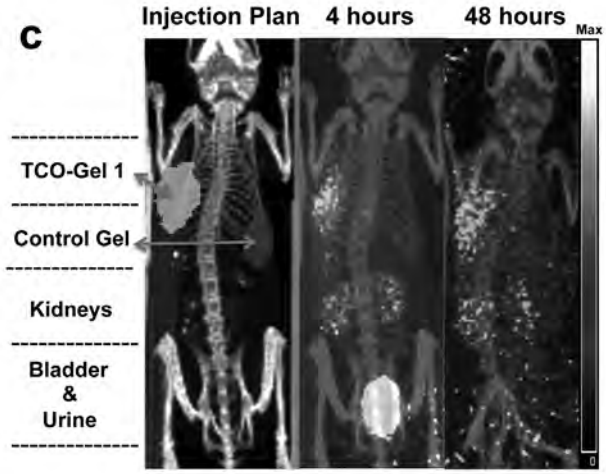
Methods: Investigators synthesized the desired molecules through organic chemistry: a modified alginate (TCO-Gel **1**), a fluorescent probe (Tz-TAMRA **2**), and a radioactive probe (^{111}In-Tz-**3**) (Figure a). To quantify the maximum amount of a molecular payload that can be delivered to the biomaterial, TCO-Gel **1** was exposed to fluorescent Tz-TAMRA **2** (ex. [excitation] 555 nm, em. [emission] 580 nm), and then the supernatant was removed. Fluorescence images of the supernatant were taken and fluorescence outputs were quantified digitally. Control alginate was treated identically and compared. After Institutional Animal Care and Use Committee approval, in vivo biodistribution studies were carried out by injecting either control or TCO-Gel **1** subcutaneously at each flank area of BALB/c mice. 3 to 4 hours later the subject received a tail vein injection of ^{111}In-Tz-**3** in normal saline (mean dose 1.63 MBq). Mice (n = 3) were euthanized at 1, 4, 24, and 48 hours. Organs, bodily fluids of interest, and gels were harvested and washed. Radioactivity was measured using a gamma counter, corrected for isotope decay and presented as percent injected dose per gram (%ID/g). A similar approach was used for in vivo imaging studies, except with a larger dose of ^{111}In-Tz-**2** (38.8 MBq). At 4 and 48 hours, the mouse was anesthetized and imaged with a SPECT (single photon emission computed tomography)/CT imaging station.

Results: Our in vitro studies revealed that a molecular payload of 29.9 nmoles can be delivered per mL of 2.0% (w/v) alginate solution in ddH_2O containing Dulbecco's PBS (phosphate-buffered saline) and calcium sulfate ions as cross-linkers. Our in vivo studies revealed that we can deliver more than 4% ID/g to the subcutaneous space of a murine model at 1 hour compared to < 0.3% ID/g delivered to musculoskeletal areas. The radioactivity level is maintained above 1% ID/g at the TCO-Gel **1** even after 48 hours. The difference between the groups is statistically significant at all time points (Figures b and c).

Δ OTA Grant

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.





Conclusions: We present a simple and modular method to modify a biomaterial with small molecules after in vivo implantation. This approach enables a hydrogel to enhance the spatial location of systemic small molecules through in vivo delivery by an order of magnitude. Further studies are required to assess this methodology with therapeutics molecules that are relevant to orthopaedic challenges.

See pages 99 - 147 for financial disclosure information.

Sonication Has the Potential to Improve Culture Yield in Patients with Clinical Infection

Hemil Hasmukh Maniar, MD*; Kristin McPhillips, MD, MPH; Jove Graham, PhD; Michael Foltzer, MD; Thomas R. Bowen, MD; Daniel S. Horwitz, MD; Geisinger Medical Center, Danville, Pennsylvania, USA*

Purpose: The number of patients with orthopaedic infections is rising with increased number of surgeries performed. Most infections involving orthopaedic implants result in the formation of a biofilm on the implant; organisms living in the biofilm are difficult to collect for laboratory analysis because they are adhered to the implant. Sonication dislodges bacteria from metal surfaces using low-frequency ultrasound, allowing for better culture yield. While arthroplasty explants are routinely sonicated, the sonication results of trauma explants are not known.

Methods: In an IRB-accepted retrospective review, all patients who had surgical explantation of an orthopaedic trauma device (plates, screws, nails) from August 2010 to July 2013 were included in the study. External fixators and other implants that intentionally extended through the skin were excluded. A detailed review of the electronic medical record was performed to note the indication for explantation as well as preoperative clinical and laboratory features to diagnose infection. Postoperative results of tissue culture and sonicate fluid were studied. Infected patients without routine cultures were excluded. Patients with intraoperative features of infection were also considered "infected." Clinical evidence of infection was considered the "gold standard."

Results: A total of 146 orthopaedic trauma-related devices (plates = 60, screws = 48, nails = 29,nail screws = 6, other = 3) explanted in the study period were sonicated. 32 of 146 (22%) were from clinically infected patients. 30 of these (94%) had a positive culture and 2 (6%) had a negative culture. In one clinically infected patient with a negative culture, sonication was able to detect presence of a specific organism in low yield. In another patient, with a positive culture, sonication was able to detect an additional organism. Overall, if explanted orthopaedic devices in patients with known clinical infection were to subjected to sonication only and not cultured, a positive microbiological yield with sonication would be 29/32 (91%) (including counts less than 20 colony forming units) as opposed to 30/32 (94%), a difference not statistically significant (Table 1). Sonication had a high sensitivity 29/32 (91%; 95% confidence interval [CI]: 75%-98%) but low specificity 72/114 (63%; 95% CI: 54%-72%) for clinical infection (Table 2). Some patients without infection did not get routine cultures; however, among those who were cultured, sensitivity and specificity of culture to detect infection were 94% and 88%, respectively

Sonication	Culture		Total
	Positive	Negative	
Positive	28	1	29
Negative	2	1	3
Total	30	2	32

Table 1. Culture Versus Sonication Results in Clinically Infected Patients (N = 32)

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Sonication	Clinical Infection		Total
	Positive	Negative	
Positive	29	42	71
Negative	3	72	75
Trauma	32	114	146

Table 2. Clinical Infection Versus Sonication Results in All Patients (N = 146)

Conclusion: In clinically suspected cases with infection, combined sonication and culture appears to increase the ability to detect biofilm forming organisms. Appropriate antibiotic therapy specific to those organisms can then be initiated. Further studies with larger sample size would be beneficial.

See pages 99 - 147 for financial disclosure information.

Pulsatile Lavage of Open Musculoskeletal Wounds Causes Muscle Necrosis and Dystrophic Calcification

Astor Devon Robertson, MBBS[1]*; Stephen Zhao, BS*[1]*; Thao Nguyen, MD*[1]*; David E. Jaffe, MD*[1]*; Carla Hebert, BS*[1]*; William Lawrence Fourney, PhD*[2]*; Joseph Stains, PhD*[1]*;*
Vincent D. Pellegrini Jr, MD[3]*;*
[1]*University of Maryland School of Medicine, Baltimore, Maryland, USA;*
[2]*University of Maryland, College Park, Maryland, USA;*
[3]*Medical University of South Carolina, Charleston, South Carolina*

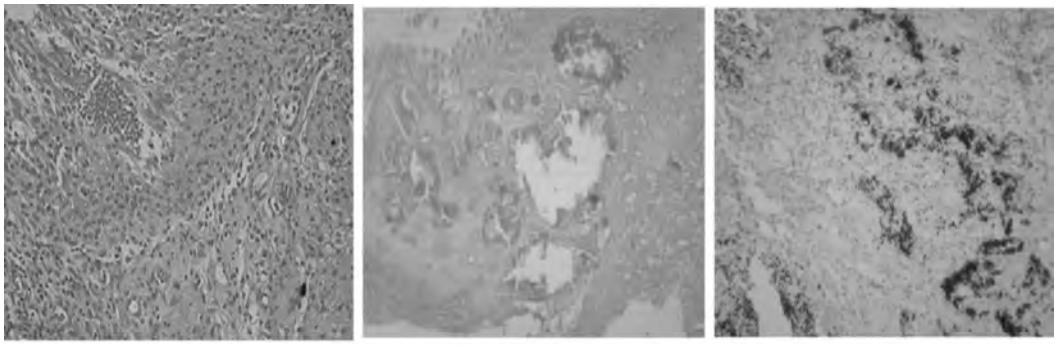
Purpose: Adequate wound irrigation of open musculoskeletal injuries is unanimously regarded as indispensable in the prevention of infection by decreasing bacterial load and other contaminants. While the removal versus the further seeding of debris into host tissue has been the subject of numerous studies, the detrimental effects of irrigation on muscle tissue has hardly been reported. This study aims to assess the relative damage to host muscle by pulsatile versus bulb syringe irrigation.

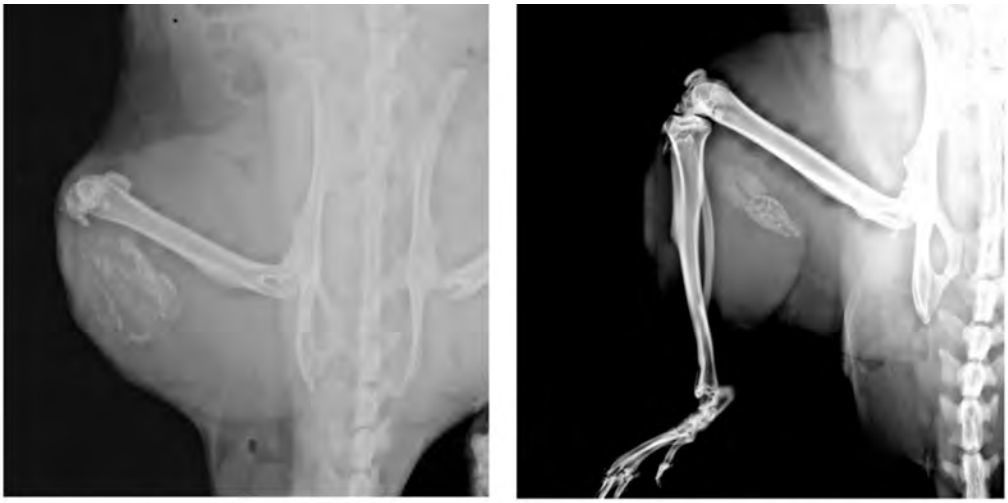
Methods: 24 Sprague-Dawley rats underwent hindlimb blast amputation via a column of propelled water following detonation of a submerged explosive. All wounds were irrigated with a 40:1 saline to chlorhexidine solution and had primary closure. There were three treatment groups (each n = 12): Group 1 underwent debridement above the zone of injury (ZOI) with through-knee amputation and 250 mL bulb syringe irrigation; Group 2 underwent both pulsatile lavage and through-knee amputation and irrigated with 1 L of solution using pulsatile lavage (Dental Pik) at 15-20 psi. In Group 3, an additional 6 animals were not subjected to the blast procedure but underwent a 3-cm anterolateral left thigh incision down to muscle, and pulsatile lavage of the wound. The animals were followed with serial AP and lateral radiographs monitoring for the appearance and evolution of any soft-tissue radiopacities until euthanasia at 24 weeks. X-ray–guided excisional muscle biopsies on a few representatives from each group were done at 6 weeks and post euthanasia, and prepped for histologic analysis with hematoxylin and eosin (H&E), Alizarin Red, and Von Kossa stains. Both of the latter are special stains for calcium deposits.

Results: All animals treated with bulb syringe irrigation had a benign radiographic course, with no evidence of radiopaque lesions. On the contrary, all animals that were subject to pulsatile lavage at 20 psi developed radiopacities that first appeared at around 10 days postoperatively, increased in density up to around 16 weeks, then showed signs of gradual decrease thereafter. H&E, Alizarin Red, and Von Kossa staining all revealed evidence of tissue damage with an abundance of inflammatory cells, and calcium deposits.

Conclusion: Pulsatile lavage when used in trauma-related musculoskeletal injuries may cause additional insult to viable muscle tissue resulting in muscle necrosis, which can be complicated by dystrophic calcification as evident in our results. Bulb syringe irrigation, while not as effective in the removal of debris, appeared to be the safer irrigation option of the two.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.





Dystrophic calcification is apparent in blast amputation (left) and non-blast (right) limbs following pulsatile lavage.

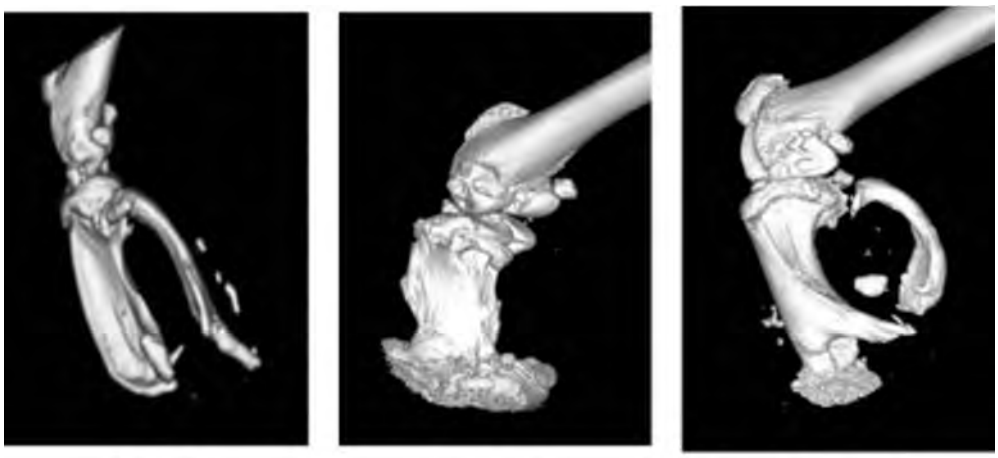
See pages 99 - 147 for financial disclosure information.

Failure of Indomethacin and Radiation to Prevent Blast-Induced Heterotopic Ossification in an Animal Model

Astor Devon Robertson, MBBS[1]; *Stephen Zhao, BS[1]; Thao Nguyen, MD[1]; Robert E. Holmes, MD[2]; David E. Jaffe, MD[1]; Juong G. Rhee, PhD[1]; William Lawrence Fourney, PhD[3]; Joseph Stains, PhD[1]; Vincent D. Pellegrini Jr, MD[2];*
[1]University of Maryland School of Medicine, Baltimore, Maryland, USA;
[2]Medical University of South Carolina, Charleston, South Carolina, USA;
[3]University of Maryland, College Park, Maryland, USA

Purpose: Heterotopic ossification (HO) in the residual limb has been a common morbidity in soldiers who survive extremity amputation via blast mechanisms during recent war conflicts. While several Level I clinical studies have demonstrated the efficacy of prophylactic regimens using either nonsteroidal anti-inflammatory drugs (NSAIDs) or low-dose external beam irradiation (XRT) to prevent HO formation following total hip arthroplasty and surgical treatment of acetabular fractures, the HO prophylactic potential of any of these treatment modalities in the setting of trauma or trauma related amputation has never been assessed. This study was aimed at investigating the effectiveness of the NSAID indomethacin and irradiation, in the prevention of HO formation following extremity blast amputation in a rat model.

Methods: 36 Sprague-Dawley rats were subjected to blast amputation of a hindlimb via a column of propelled water following detonation of a submerged explosive. There were 12 controls, 12 animals received an oral suspension of indomethacin at a dose of 3 mg/kg for 10 days starting on operative day, while another 12 received a single dose 8 Gy of irradiation to the amputated stump on the third postoperative day. All wounds were treated with bulb syringe irrigation, minimal debridement of skin edges, and primary closure of fascia and skin. Serial radiographs were done until euthanasia at 24 weeks, at which time HO severity was quantified as (0) absent, (1) mild, (2) moderate, or (3) severe, and HO type qualified as contiguous with the residual stump or as distinct bony islands, by independent graders.



Control Irradiation Indomethacin

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Results: One animal in the irradiation group died 2 weeks postoperatively and was not replaced. One animal in the control and indomethacin groups, and 2 animals in the irradiation group developed persistent granuloma-like lesions on their residual stumps. These animals all had radiographic evidence of HO. The mean HO severity was 1.5, 1.14, and 1.97 in the control, indomethacin, and irradiation groups, respectively. The qualitative means of HO type were 1.5, 1.47, and 2.12 in the control, indomethacin, and irradiation groups, respectively. Kruskal-Wallis one-way analysis of variance revealed no significant difference in HO severity or type between both treatment groups and control.

Conclusion: While indomethacin and XRT used prophylactically have shown efficacy in the prevention of HO in non-blast extremity injuries, these interventions when administered in a similar fashion seem not to effect any change in the development of HO in the setting of blast-injured extremities with resultant amputation. This revelation may be indicative of the provocation of inciting stimuli so overwhelming that conventional interventions are ineffective. The effect of NSAIDs administered pre-blast, earlier XRT post-blast, or both treatment modalities combined immediately after blast injury warrants further study.

See pages 99 - 147 for financial disclosure information.

The Surgeon's Catch-22: A Prospective Study on Inflammation, Wound Failure, and Heterotopic Ossification in Combat Wounds

Donald N. Hope, MD*; Jonathan A. Forsberg, MD; Benjamin K. Potter, MD;*
Elizabeth M. Polfer, MD; Eric A. Elster, MD, FACS;
Walter Reed National Military Medical Center, Bethesda, Maryland, USA;
Naval Medical Research Center, Silver Spring, Maryland, USA

Background/Purpose: After a decade of war, we have observed an increase in both combat-related injury survival, as well as a paradoxical increase in injury severity, mainly due to the effects of blasts. These severe injuries leave a devastating impact on each patient's immune system, resulting in massive upregulation of the systemic inflammatory response. In this setting, the timing of wound closure is made based mainly on subjective determinations and the surgeon's anecdotal experience. However, closing a wound either too early or too late can be problematic. By examining the inflammatory mediators, preliminary data suggest that it may be possible to correlate complications such wound failure and heterotopic ossification (HO) with distinct systemic and local inflammatory profiles. We asked whether systemic or local markers of inflammation could be used as an objective means to estimate the likelihood of wound failure and/or HO in patients sustaining combat-related injuries.

Methods: 200 combat-wounded active duty servicemembers who sustained high-energy extremity injuries were prospectively enrolled between 2007 and 2013. In addition to injury-specific and demographic data, we quantified 24 cytokines and chemokines in the serum and wound effluent during each debridement. Correlations were investigated between these markers and wound failure or HO.

Results: The relationships between inflammatory proteins and wound-specific outcomes varied throughout the debridement process. For patients who formed HO, serum interleukin (IL)-3 ($P = 0.002$), serum IL-12p70 ($P = 0.0013$), effluent IL-3 ($P = 0.02$), and effluent IL-13 ($P = 0.006$) were independently associated with HO formation. Both serum ProCT ($P = 0.03$) and effluent IL-6 ($P = 0.02$) correlated with wound failure.

Conclusion: We identified correlates of wound-specific complications such as wound failure and HO by characterizing the patient's systemic and local inflammatory response. Models designed to codify these interactions and estimate the likelihood of complications such as wound failure and HO must accommodate nonlinear relationships that vary over time.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

BSFF SYMPOSIUM 4: BIGGER DATA - BIGGER PROBLEMS?

Moderators: *Mohit Bhandari, MD, PhD, FRCSC*
Gerard P. Slobogean, MD, MPH, FRCSC

3:45 pm **What is Big Data?**
Gerard P. Slobogean, MD, MPH, FRCSC

4:00 pm **NHS Database- What It Can and Cannot Do**
Peter V. Giannoudis, MD

4:10 pm **Scandinavian Data-Ongoing Challenges and Successes**
Frede Frihagen, MD, PhD

4:20 pm **Designing Studies That Utilize Large Databases: The Basics**
Mary L. Forte, PhD

4:30 pm **The Future of Large Scale Databases: Will They Replace the Clinical Trial?**
Saam Morshed, MD, PhD

4:40 pm Discussion

NOTES

See pages 99 - 147 for financial disclosure information.

INORMUS Invited Paper - Trauma Worldwide Data Set
Mohit Bhandari, MD, PhD, FRCSC

NOTES

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Changing the System: Improving Outcome From Major Trauma by Developing a National System of Regional Major Trauma Networks

Christopher G. Moran, MD, FRCS(Ed)[1]*; Maralyn Woodford*[2]*; Fiona Lecky, FRCS, MSc, PhD*[2]*; Antoinette Edwards, BA*[2]*; Timothy Coats, MBBS, FRCS, MD*[2]*; Keith Willett, MD, FRCS*[3]*;*
[1]*NHS England, Nottingham University Hospital, Nottingham, United Kingdom;*
[2]*Trauma Audit and Research Network, University of Manchester, Manchester, United Kingdom;*
[3]*NHS England, Oxford, United Kingdom*

Background/Purpose: International evidence suggests that trauma care improves with organized trauma systems. In England, trauma care for the entire population (58.5 million) was reorganized in 2012 with the development of Trauma Networks. All hospitals in the country were designated as either Major Trauma Center (MTC; Level-1: n = 26) or Trauma Units (TU; Level-2), or Local Emergency Hospitals (LEH; Level-3). Prehospital care was also reorganized so that patients identified with major trauma were taken directly to the MTC if within 45 minutes travel time from accident. Other patients are taken to the nearest TU for resuscitation and expert triage before secondary transfer to the MTC. All Level-3 centres are bypassed. This paper reviews the early results.

Methods: From April 2008 until April 2014, data on 118,801 patients with an ISS >8 was prospectively collected by the national Trauma Audit and Research Network (TARN). The probability of survival was calculated using a model including ISS, age, blood pressure on arrival at hospital, and Glasgow Coma Scale (GCS). The odds ratio of survival (+95% confidence interval) was then calculated for each year and normalized to the year 2008-2009.

Results: From 2008 until 2011 there was a no significant change in the odds of surviving major trauma in England. However, following introduction of the Major Trauma Networks there was a significant ($P < 0.008$) 19% increase in the odds of survival during the first year of the new system and a further 17% increase in the odds of survival during the second year as the system matures so that the odds of survival for the population is now 1.36 compared to 2008. Process measures within the trauma system have shown significant increases in reception by an attending-led trauma team, more rapid intubation and CT scan, and increased use of tranexamic acid and massive transfusion protocols (all $P < 0.001$).

Conclusion: We believe this is the first attempt at an organized change in the system for major trauma care on a national level and covering a population of over 50 million. We have observed a significant improvement in the care process together with a significant improvement in the odds of surviving. This demonstrates that improvements seen in smaller state or regional trauma systems can be translated into a national trauma system with similar improvements for the whole population.

See pages 99 - 147 for financial disclosure information.

Increased Systemic Complications in Open Femoral Shaft Fractures Are Associated with the Degree of Soft-Tissue Injury Rather Than New Injury Severity Score (NISS) Values: A Nationwide Database Analysis

Christian D. Weber, MD[1]*; Rolf Lefering, PhD*[2]*; Thomas Dienstknecht, MD*[1]*;*
Philipp Kobbe, MD, PhD[1]*; Richard M. Sellei, MD*[1]*; Frank Hildebrand, MD, PhD*[1]*;*
Hans-Christoph Pape, MD, PhD, FACS[1]*; Trauma Registry of the German Trauma Society;*
[1]*RWTH Aachen University Medical Center, Department of Orthopedic Trauma,*
Aachen, Germany;
[2]*Institute for Research in Operative Medicine (IFOM), University of Witten/Herdecke,*
Cologne-Merheim Medical Center, Cologne, Germany

Background/Purpose: In blunt high-energy trauma, the degree of soft-tissue injuries associated with femoral shaft fractures may vary. The objective of this study was to assess the impact of open versus closed soft-tissue injuries associated with femoral shaft fractures on major systemic complications and mortality after trauma.

Methods: In this prospective cohort study from a population-based trauma database, patients with femoral shaft fracture (AO/OTA-32) were divided into the following groups: closed femoral shaft fracture (CFSF) and open femoral shaft fracture (OFSF). Open soft-tissue injuries were classified according to the Tscherne classification. Data of demographic, injury, therapy, and outcome characteristics (eg, multiple organ failure [MOF], sepsis, mortality, length of stay [LOS]) were collected and analyzed using SPSS.

Results: Data from 32.582 trauma victims were documented in a nationwide trauma registry between January 1, 2002 and December 31, 2013. Among 5761 trauma patients (NISS 30 ± 14 points), 4423 belonged to the CFSF group (77%) and 1338 belonged to the OFSF group (23%). Open fractures were separated into I° (334, 28.1%), II° (526, 44.3%), III° (309, 26%), and IV° (19, 1.6%). OFSF are associated with an increased risk for hemorrhagic shock (HS), higher resuscitation requirements, and increased in-hospital and intensive care LOS, but not with increased injury severity according to NISS, sepsis, or mortality. The prevalence of MOF, sepsis and mortality increased with the degree of open soft-tissue injury.

Conclusion: Open femur fractures were not associated with higher injury severity scores (NISS), but with an increased risk for HS, higher resuscitation requirements, MOF, and increased length of stay (LOS). The incidence of sepsis and mortality increased with the degree of open soft-tissue injury. The treatment of OFSF seems to be more complex and time-consuming, but the risk for major clinical complications (eg, sepsis, mortality) seems to be comparable for both groups.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Anatomic Region and the Risk of Adverse Events in Orthopaedic Trauma: An Analysis of 19,000 Patients

Cesar S. Molina, MD; Rachel V. Thakore, BS; Eduardo J. Burgos, MD; William T. Obremskey, MD, MPH, MMHC; ***Manish K. Sethi, MD****; Vanderbilt University, Nashville, Tennessee, USA*

Purpose: Little data exist exploring adverse events in orthopaedic trauma surgery. As our health-care system creates potential reimbursement implications for perioperative complications through readmission penalties, etc, it is increasingly important to turn our attention to this issue. Through the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database, we sought to compare adverse events in orthopaedic trauma procedures by anatomic region (upper extremity [UE], hip and pelvis [HP], and lower extremity [LE]) and to evaluate the impact of anatomic region on the overall rate of complications.

Methods: The ACS-NSQIP prospective database was used to identify a total of 91 CPT codes representing 19,028 orthopaedic trauma patients from 2005-2011. These patients were then divided into three anatomic regions: UE (n = 4925), HP (n = 5273), and LE (n = 8830). Perioperative minor and major complications were recorded and include wound dehiscence, superficial surgical site infection, pneumonia, urinary tract infection, death, deep wound infection, myocardial infarction, deep venous thrombosis, pulmonary embolism, peripheral nerve injury, sepsis, and septic shock. A comparison in perioperative complications between the three groups was performed using c^2 analysis. We used a multivariate analysis that controls for age, medical comorbidities, American Society of Anesthesiologists (ASA) status, operative time, baseline functional status, and anatomic region to evaluate risk factors for complications.

Results: A total of 19,028 orthopaedic trauma cases were divided into three anatomic regions: 25.9% (n = 4925) UE, 27.7% (n = 5273) HP, and 46.4% (n = 8830) LE. Table 1 shows the difference in age, ASA scores, and complication rates between the three groups. Statistically significant differences were identified when comparing demographics between HP and UE patients; these include the number of patients in each group over 65 years of age (85% vs. 32.2%), ASA >2 (78.9% vs. 32.4%), and diabetes (17.9% vs. 11.1%) (P = 0.01). No other variables were significantly different among the groups. After controlling for several important individual patient factors, hip and pelvis patients are nearly four times more likely to develop any perioperative complication than upper extremity patients (odds ratio [OR]: 3.79, 95% confidence interval [CI]: 3.01-4.79, P = 0.01). Also, patients in the LE group are three times more likely to develop any complication versus UE patients (OR: 2.82, 95% CI: 2.30-3.46, P = 0.01). The table shows the differences in patient age and ASA status as well as presents the overall complication rates:

See pages 99 - 147 for financial disclosure information.

Table 1. Patient Demographics/Characteristics and Rates of Complications*			
Anatomic Region	Mean Age*	Mean ASA Score*	Complication Rate*
Upper extremity (n = 4925)	55.4 ± 19.2	2.16 ± 0.77	3.0% (148)
Hip/pelvis (n = 5273)	79.3 ± 14.0	2.95 ± 0.67	19.0% (1002)
Lower extremity (n = 8830)	70.2 ± 19.3	2.77 ± 0.77	14.2% (1251)

*$P < 0.005$

Conclusion: There is an alarming difference in complication rates among anatomic regions in orthopaedic trauma patients. Even after controlling for several variables, patients undergoing procedures to the LE are almost three times more likely to develop a complication than patients in the UE group. Those undergoing procedures to the HP are almost four times more likely to develop a complication than patients in the UE group. While some of these results are explained by age and ASA status, further studies are required to explain the impact that anatomic region has on the overall complication rate.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

BSFF SYMPOSIUM 5: ADVANCES IN ARTICULAR CARTILAGE INJURY AND TREATMENT - WHERE WE ARE AND WHERE WE'RE GOING

Moderators: *Joseph Borrelli Jr, MD*
Susanna Chubinskaya, PhD

7:30 am **Cartilage's Response to Injury**
Dominik Haudenschild, PhD

7:40 am **Current/Futures Chondroprotective Products**
Susanna Chubinskaya, PhD

7:50 am **Chondroplasty/Microfracture/Cells for Treatment of Cartilage Injuries**
Seth Gasser, MD

8:00 am **OsteoChondral Allografts in 2014**
James Stannard, MD

8:10 am **Joint Preservation: Treatment of Intra-articular Malunions**
Christian Krettek, MD, FRACS

8:20 am Discussion

NOTES

See pages 99 - 147 for financial disclosure information.

ΔThe Dose-Response Effect of the Mast Cell Stabilizer, Ketotifen Fumarate, on Post-Traumatic Joint Contractures

***Prism Schneider, MD, PhD, FRCSC**; Herman Johal, MD, MPH; Andrew R. Buckley; Kevin A. Hildebrand, MD, FRCSC;*
University of Calgary, Calgary, Alberta, Canada

Purpose: Posttraumatic joint contracture (PTJC) is a debilitating complication following an acute fracture or intra-articular injury, which can lead to loss of motion at the affected joint. Prior research has shown that, in a rabbit model, treatment with ketotifen can significantly reduce the severity of joint contracture; however, the doses used previously were 0.5 mg/kg or 1.0 mg/kg twice daily, and there was no dose-response relationship shown over this narrow range. Prior to clinical testing in humans, knowledge of the dose-response relationship is required and an optimal dose range needs to be identified where contracture reduction is maximized while side effects are avoided. We hypothesize that there will be a linear dose-response effect of ketotifen on posttraumatic contractures and joint capsule properties, using an in vivo rabbit model.

Methods: After obtaining IRB approval, an in vivo model of PTJC of the knee was created, using a combination of intra-articular injury and internal immobilization in skeletally mature New Zealand White rabbits. Five groups of animals were studied (n = 10 per group): a nonoperative control group, a group with the operatively created PTJC and no pharmacological treatment (operative contracture group), and three groups with the operatively created PTJC treated with a mast cell stabilizer, ketotifen fumarate, at doses of 0.01 mg/kg, 0.1 mg/kg, and 5.0 mg/kg ketotifen twice daily (the 0.01-mg/kg, 0.1-mg/kg, and 5.0-mg/kg ketotifen groups). After 8 weeks of immobilization, flexion contractures were measured using a custom rabbit-knee-gripping device, attached to a hydraulic materials testing machine (MTS, Eden Prairie, MN) and the posterior aspect of the joint capsule was harvested for immunohistochemical quantification of myofibroblast and mast cell numbers.

Results: Flexion contractures developed in the operative contracture group and the severity of the contractures exhibited a dose-response reduction in all three of the groups treated with 0.01 mg/kg, 0.1 mg/kg, and 5.0 mg/kg of ketotifen, respectively; however this effect was greatest between the 0.01-mg/kg and 0.1-mg/kg doses. The joint capsule myofibroblast and mast cell numbers in the operative contracture group were significantly increased compared with the values in the control group ($P < 0.001$), and the myofibroblast and mast cell numbers in the 0.1-mg/kg and 5.0-mg/kg ketotifen groups were significantly reduced compared with the values in the operative contracture group ($P < 0.001$). There were 2 implant failures, 1 deep infection resulting in death, and 2 pre-experimental deaths during the acclimatization period.

Conclusion: The use of a mast cell stabilizer, ketotifen fumerate, reduces the biomechanical and cellular manifestations of joint capsule fibrosis in a rabbit model of posttraumatic joint contracture and a dose-response relationship was identified. Reduction in biomechanical and cellular contracture properties began at the 0.1-mg/kg dose, which is lower than previously studied doses. This study suggests that an inflammatory pathway, mediated by mast cell

Δ OTA Grant

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

activation, is involved in the induction of joint capsule fibrosis after traumatic injury. The range of doses used in this study includes both human-equivalent dosing and the currently used therapeutic dose for the treatment of asthma in humans.

See pages 99 - 147 for financial disclosure information.

ΔPresence and Degree of Matrix Metalloproteinases and Aggrecan Breakdown Products in the Setting of Acute Intra-Articular Fracture

Justin Haller, MD*; Molly McFadden, PhD; David L. Rothberg, MD; Erik Kubiak, MD; Thomas F. Higgins, MD;*
University of Utah Department of Orthopaedics, Salt Lake City, Utah, USA

Background/Purpose: Matrix metalloproteinases (MMPs) are a group of enzymes that play a role in tissue remodeling and have the ability to degrade articular cartilage. Aggrecan is a proteoglycan found in the extracellular matrix of cartilage. Proteolytic cleavage of aggrecan leads to aggrecan fragments that may be associated with cartilage degradation. Prior studies have demonstrated an association between the degree of inflammatory osteoarthritis and the presence of MMPs and presence of aggrecan breakdown products, suggesting a causative role in those diseases. The presence or absence of these compounds in the acute setting of articular fracture has not been established. Previous study of inflammatory cytokines demonstrated a local response, but did not examine these compounds. This study is designed to evaluate the presence of MMPs and aggrecan breakdown products following intra-articular tibial plateau fracture.

Methods: After IRB approval, investigators prospectively aspirated synovial fluid from the injured and uninjured knees of 45 patients between the ages of 18 and 60 years with tibial plateau fractures. Patients with open fracture, history of autoimmune disease, preexisting arthritis, or presentation greater than 24 hours from injury were excluded. The 20 patients who required spanning external fixator followed by definitive fixation were aspirated at both surgeries. The concentrations of MMP-1, -2, -3, -7, -9, -10, -12, and -13 were quantified using multiplex assays. Additionally, aggrecanase-cleaved aggrecan fragments were quantified using a sandwich ELISA (enzyme-linked immunosorbent assay) with an α-ARGS monoclonal antibody. Repeated-measures analysis of variance was used to test for differences on the log-transformed variables.

Results: We enrolled 45 patients (14 females, 31 males), with an average age of 42 years (range, 20-60). There were 24 low-energy (OTA 41B or Schatzker 1-3, all OTA 41B) tibial plateau injuries and 21 high-energy (Schatzker 4-6) tibial plateau injuries. Of the high-energy fractures, 6 were OTA 41B3 and 15 were OTA 41C. There were significantly higher concentrations of MMP-1 ($P < 0.001$), MMP-3 ($P < 0.001$), MMP-9 ($P < 0.001$), MMP-10 ($P < 0.001$), MMP-13 ($P = 0.001$), and aggrecan breakdown ($P = 0.021$) in injured knees as compared to uninjured knees. Only MMP-9 ($P = 0.05$) was found to be significantly greater in high-energy as compared to low-energy injuries. Interestingly, aggrecan breakdown ($P = 0.007$) was significantly greater in low-energy as compared to high-energy injuries. MMP-1 ($P < 0.001$), MMP-3 ($P = 0.026$), MMP-12 ($P < 0.001$), and aggrecan breakdown ($P < 0.001$) were significantly greater at the time of the second procedure at an average of 9.5 days (range, 3-21 days) from initial surgery. Conversely, the concentration of MMP-9 was significantly less at the time of the second surgery ($P = 0.005$). Both MMP-10 and MMP-7 remained elevated at the second time point, but this trend was not statistically significant. While MMP-13 was not significantly elevated in the injured compared to uninjured knee at the time of initial injury, MMP-13 was significantly elevated at the second procedure ($P < 0.001$).

Δ OTA Grant

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Conclusion: There is a significant increase in aggrecan breakdown and presence of MMPs in the acutely injured knee compared to the control knee, demonstrating the response after joint trauma to be local. In contrast to other inflammatory mediators examined, only MMP-9 was acutely elevated in high-energy as compared to low-energy injuries, suggesting that this proteinase may be associated with greater acute joint destruction. Perhaps most importantly, most of the MMPs and amount of aggrecan breakdown continued to be elevated a mean of 10 days after injury, demonstrating that the cartilage is subjected to continued interaction with matrix degenerating proteases over a week after injury. Given these data, these factors merit further investigation for a potential role in the ultimate development of posttraumatic arthritis.

See pages 99 - 147 for financial disclosure information.

Pre-Injury Depletion of Macrophages Results in Increased Acute Joint Inflammation Following Articular Fracture

Karsyn N. Bailey; Bridgette D. Furman, BS; Kelly A. Kimmerling, MS; Chia-Lung Wu, PhD; Janet L. Huebner; Virginia B. Kraus, PhD; Farshid Guilak, PhD; ***Steven A. Olson, MD;***
Duke University Medical Center, Durham, North Carolina, USA

Background/Purpose: Posttraumatic arthritis (PTA) is an accelerated form of arthritis that occurs following joint injury. Following articular fracture, C57BL/6 mice showed significant signs of PTA, whereas MRL/MpJ mice, a superhealer mouse strain, exhibited less severe joint degeneration. In order to elucidate the link between macrophages and PTA, a transgenic mouse strain that allows for the specific depletion of macrophages was used in this study. The Macrophage Fas-Induced Apoptosis (MAFIA) mouse strain expresses the inducible Fas-suicide gene, which facilitates apoptosis of macrophages following the administration of AP20187. We hypothesized that locally depleting synovial macrophages in the MAFIA mice would reduce joint synovitis following articular fracture. The objective was to characterize the role of macrophages in acute joint inflammation and synovitis following articular fracture.

Methods: Male MAFIA mice (Jackson Laboratories) were obtained at 6 weeks of age and then aged to skeletal maturity at 16 weeks, at which point the left hindlimb was subjected to a moderate articular fracture as previously reported. Macrophages were locally depleted at 2 days prior to fracture, immediately following fracture, or 2 days post fracture. The AP20187 (n = 6 per time point), which induces macrophage apoptosis in the MAFIA mice, or the carrier solution (n = 3 per time point) were delivered via a single 6-μL intra-articular injection. The mice were sacrificed 7 days post fracture, the limbs were harvested, and serum and synovial fluid were collected and stored at –80° for future analysis. All hindlimbs were formalin fixed and scanned with micro-CT (SkyScan 1176, Bruker BioSpin). The limbs were then processed and paraffin embedded using standard techniques. Histological sections of the joint were stained using hematoxylin and eosin, and synovitis was quantified using a modified synovitis grading scheme for mouse tissue. A multifactorial analysis of variance was used to assess synovitis by group and time, with limb as a repeated measure.

Results: Articular fractures were successfully created in all mice. For synovial inflammation, fracture in the experimental limb led to increased total synovitis scores compared to contralateral control limbs in all groups ($P < 0.05$) Additionally, with predepletion (Day –2), mice that received AP20187 had significantly higher joint synovitis in fractured limbs compared to carrier solution ($P = 0.05$). At the other two time points, where depletion occurred on the day of fracture (Day 0) or 2 days post fracture (Day 2), there was no significant difference in the level of synovitis between AP20187 and the carrier solution. Mice that received a local injection of AP20187 prior to fracture (Day –2) exhibited severe joint inflammation characterized by synovial infiltration with increased cellular density.

Conclusion: The observed changes at all points evaluated did not support our hypothesis; macrophage depletion did not reduce acute joint inflammation following articular fracture. Conversely, when depleted 2 days prior to fracture, joint inflammation increased following articular fracture. The massive influx of inflammatory cells was observed mostly in mac-

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

rophage-depleted joints, suggesting that macrophages could be a modulator for recruiting inflammatory cells following injury. Although inflammation has degenerative effects on cartilage, our data suggest that macrophages are important for regulating synovial inflammation and bone maintenance after joint injury. This finding is significant for understanding the role of macrophages in inflammation and joint injury. Our data suggest that macrophages are important to maintain a controlled inflammatory response to joint injury.

Funding Sources: Arthritis Foundation Grant 5244, National Institutes of Health, Department of Defense.

See pages 99 - 147 for financial disclosure information.

BSFF SYMPOSIUM 6: OSTEOPOROSIS- ARE WE CLOSER TO GOLD STANDARDS?

Moderator: *Theodore Miclau III, MD*

9:25 am **Fracture Models: Diaphyseal and Metaphyseal Healing**
Volker Alt, MD

9:35 am **Mechanical Testing: Selection of a Model**
Loren Latta, PhD

9:45 am **Medical Management**
Joseph Lane, MD

9:55 am **Atypical Femur Fractures – New Information**
Kenneth A. Egol, MD

10:05 am **Augmentation of Fixation: Selection of an Optimal Material**
Meri Tibi Marmor, MD

10:15 am Discussion

NOTES

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Is There a Future for Femoroplasty in Hip Fracture Prevention? Introducing Anisotropy Restoring Femoroplasty

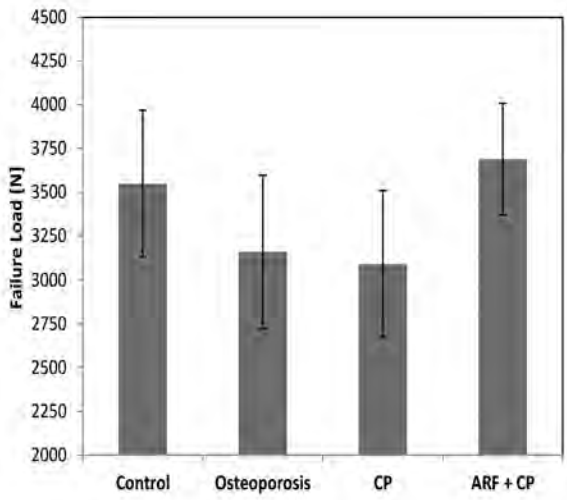
Edward K. Rodriguez, MD, PhD; *Leandro Grimaldi, MD; Aidin Masoudi, MD; Ara Nazarian, PhD;*
Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA

Background/Purpose: There are presently no standard of care interventional procedures aimed at preventing hip fracture occurrence in geriatric patients. Prior work on femoroplasty has focused on attempts to increase fracture resistance of the osteoporotic proximal femur by insertion of polymethylmethacrylate (PMMA), or other polymeric isotropic fillers. Results thus far have been inconsistent and no method has been adopted clinically. We introduce Anisotropy Restoring Femoroplasty (ARF), a technique that aims to mimic proximal femur anisotropy as defined by trabecular architecture. ARF combines linear structural elements with calcium phosphate (CP) filler to result in increased overall fracture resistance and improved stiffness matching.

Methods: A proof of concept pilot study was performed in which a minimally invasive intraosseous ARF device prototype was designed and tested in a cadaveric porcine proximal femur model to test whether ARF is a viable option for hip fracture prevention. Four groups of 6 porcine proximal femurs each—(1) normal control, (2) detrabeculated and partially decalcified (simulated osteoporotic), (3) simulated osteoporotic with CP isotropic femoroplasty, and (4) simulated osteoporotic with ARF device plus CP—were instrumented and tested to failure to quantify maximum load tolerance and construct stiffness.

Results: Insertion of the ARF device plus CP restores load to failure and stiffness of the proximal simulated osteoportic pig femur model to nearly normal values when tested to failure. The simulated osteoporotic group and the CP femoroplasty reinforced group (without ARF) exhibited similar failure load and stiffness, both significantly below the control group and the simulated osteoporotic group reinforced with the ARF device plus CP ($P < 0.05$ for both cases).

Conclusion: In this proof of concept pilot study, Anisotropy Restoring Femoroplasty results in increased fracture prevention potential when compared with traditional isotropic femoroplasty. A future minimally invasive procedure that effectively improves fracture resistance in osteoporotic proximal femur could result in a significant reduction of mortality, morbidity, and cost associated with geriatric hip fracture care.



See pages 99 - 147 for financial disclosure information.

Comparison of Femoral Head Rotation and Varus Collapse Between a Single and Integrated Dual Screw Intertrochanteric Hip Fracture Fixation Device Using a Chair Rise Biomechanical Model

Aniruddh Nayak, MS[1]*; Ian Smithson, MD*[2]*; Seth Cooper, MD*[2]*; Jacob Cox, MD*[1]*;*
Scott Marberry, MD[1]*; Brandon G. Santoni, PhD*[1,2]*; Roy Sanders, MD*[3]*;*
[1]*Foundation for Orthopaedic Research & Education, Tampa, Florida, USA;*
[2]*Department of Orthopaedics & Sports Medicine, University of South Florida, Tampa, Florida, USA;*
[3]*Orthopaedic Trauma Service, Florida Orthopaedic Institute, Tampa, Florida, USA*

Purpose: This study was conducted to compare the efficacy of two intertrochanteric fracture fixation devices in preventing femoral head rotation and varus collapse using a cadaveric biomechanical model. We hypothesized that an integrated dual screw construct would confer greater stability than a single screw construct.

Methods: 11 matched pairs of cadaveric osteopenic female hemipelves (T-scores: –1.5 ± 0.5; age: 72.8 ± 5.8 years) were used. The hip joint and capsule were retained during soft-tissue dissection. An unstable intertrochanteric fracture without calcar support (OTA 31-A2) was created in each specimen using a customized jig prior to reduction and fixation with either a single screw (Gamma3, Stryker Orthopaedics, Mahwah, NJ) or integrated dual screw fixation device (InterTAN, Smith & Nephew, Memphis, TN) under fluoroscopic guidance (Fig. 1, inset). Specimens were secured in fiberglass resin and coupled to a custom biomechanical testing apparatus (Fig. 1) and subjected to 3 months of chair rise simulation using a combination of controlled pelvis rotation (±45°) and corresponding axial loading at 2:1 body weight (BW) ratio for 13.5 K cycles while allowing any passive internal-external femoral shaft rotation. Optoelectronic triads quantified varus collapse and rotation about the neck axis temporally throughout cycling. If specimens survived 3 months of simulated chair rise loading (13.5 K cycles at 2 × BW), an additional 2 K cycles of loading was performed in 0.25 × BW/250 cycle increments to a maximum of 4 × BW or until failure.

Results: Femoral head rotation with the integrated dual-screw fixation construct was significantly less than the single screw construct after 3 months of simulated chair rise (3.2° vs. 24.5°, $P = 0.016$, see Fig. 2). Maximum femoral head rotation at the end of 4 × BW loading or until failure was significantly less (7×) for the integrated dual screw than the single screw construct (5.5° vs. 35.4°, $P = 0.006$). Varus collapse was significantly less with the integrated dual screw construct when compared to the single screw construct over the entire cyclic loading protocol (5.4° vs. 8.4° $P = 0.021$, see Fig. 3).

Conclusion: An integrated dual screw construct confers significantly greater resistance to multiplanar femoral head rotation and varus collapse over 3 months of simulated chair rise. This laboratory study provides biomechanical evidence that an integrated dual screw fixation device may be favorable and provide more predictable fixation than single screw fixation for the treatment of unstable, extracapsular intertrochanteric fractures in the elderly patient population with compromised bone quality.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

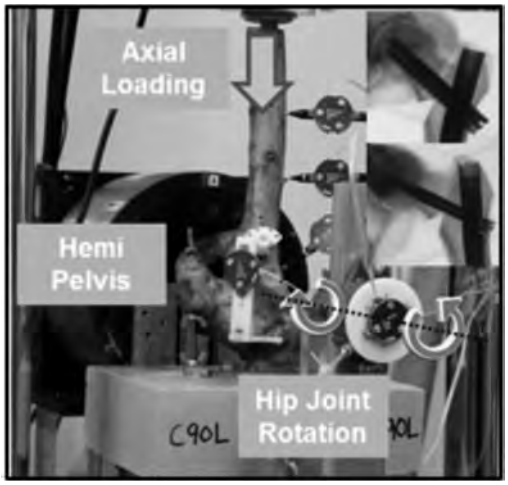


Fig. 1. Chair rise biomechanical test setup.

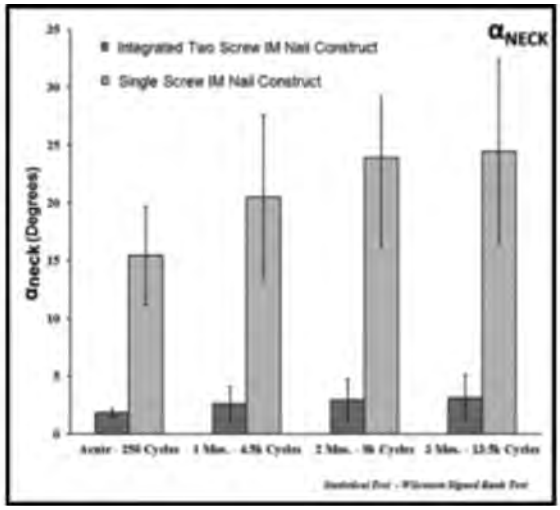


Fig. 2: Rotation about the neck axis (α_{neck}) over 13.5 K loading cycles.

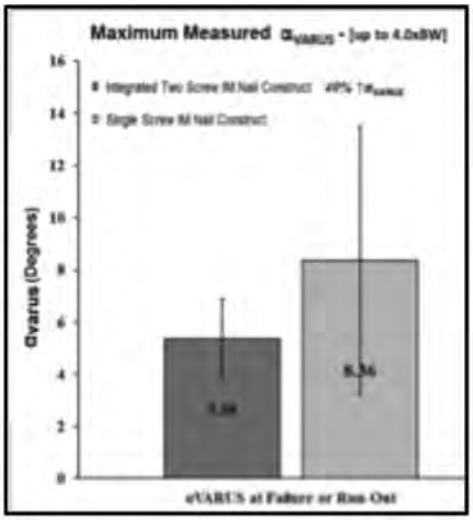


Fig. 3. Varus collapse ($\alpha_{varus)}$ measured over entire duration of cyclic loading.

See pages 99 - 147 for financial disclosure information.

Traumatic Fracture Healing in Geriatric Mice Shows Decreased Callus Formation with Associated Deficiencies in Cell Cycle and Immune Cell Function

Luke A. Lopas, BS*; Nicole S. Belkin, MD; Patricia L. Mutyaba, BS; Lee McDaniel, MS; Kurt D. Hankenson, DVM, MS, PhD; Jaimo Ahn, MD, PhD;*
University of Pennsylvania, Philadelphia, Pennsylvania, USA

Purpose: Geriatric fragility fractures often display reduced healing, which leads to substantial morbidity, mortality, and cost to the patient as well as cost to society. An improved understanding of the fundamental biological deficiencies of geriatric fracture healing will provide mechanistic insight into this disordered healing and provide rationally selected therapeutic targets. The purpose of this study was to develop a truly geriatric fracture model based on chronological age.

Methods: Traumatic, prestabilized, transverse, 3-point-bend tibia fractures were created in 5-month-old (m/o) mature young adults and 25-m/o geriatric C57BL/6 mice from the National Institute of Aging (NIA) colonies. Fracture calluses were harvested at 0, 5, 10, 15, 20, 25, 30, and 40 days post fracture (dpf) for analysis with micro-CT (vivaCT 40), histomorphometry (Safranin-O, Masson's Trichrome), immunohistochemistry (IHC; anti-Proliferating Cellular Nuclear Antigen [PCNA]), quantitative real-time polymerase chain reaction (qPCR), and microarray. Microarray data was uploaded into DAVID bioinformatics for gene set enrichment analysis (GSEA) and Cell Type Enrichment Analysis for Microarray Data (CTen) to evaluate cell populations.

Results: Geriatric mice produce a significantly reduced healing response. As early as 10 dpf, geriatric mice produced less cartilage and total callus. This blunted response in conjunction with delays in endochondral ossification led to diminished bone and callus formation throughout fracture healing (Figs. 1A and B). Despite the reduced total cartilage and bone produced by geriatric mice, the ratio of cartilage and bone relative to total callus produced was not significantly altered (Fig. 1C). Reflective of this, the relative expression of chondrogenic and osteogenic genes was similar. Staining for PCNA revealed decreased proliferation in mesenchymal stem cells in 25-m/o mice. Global gene expression analysis revealed differences in aged and young healing profiles most strikingly related to cell cycle and immune function. Cell cycle genes are highly upregulated in young mice at 0, 5, and 10 dpf, but upregulated in geriatric mice at 20 dpf.

Conclusion: Overall, the fracture-healing template appears to be intact in geriatric mice, much as it is in geriatric humans, but callus expansion is significantly hindered with additional temporal delay. Gene expression based analyses of cell populations demonstrate a reduced proliferative capacity of progenitor cells, which also highlighted differences in genes related to the cell cycle and immune response. Further exploration of the difference in progenitor and fracture callus cell populations and the healing environmental milieu is warranted to identify therapeutically targetable deficiencies in geriatric fracture healing.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

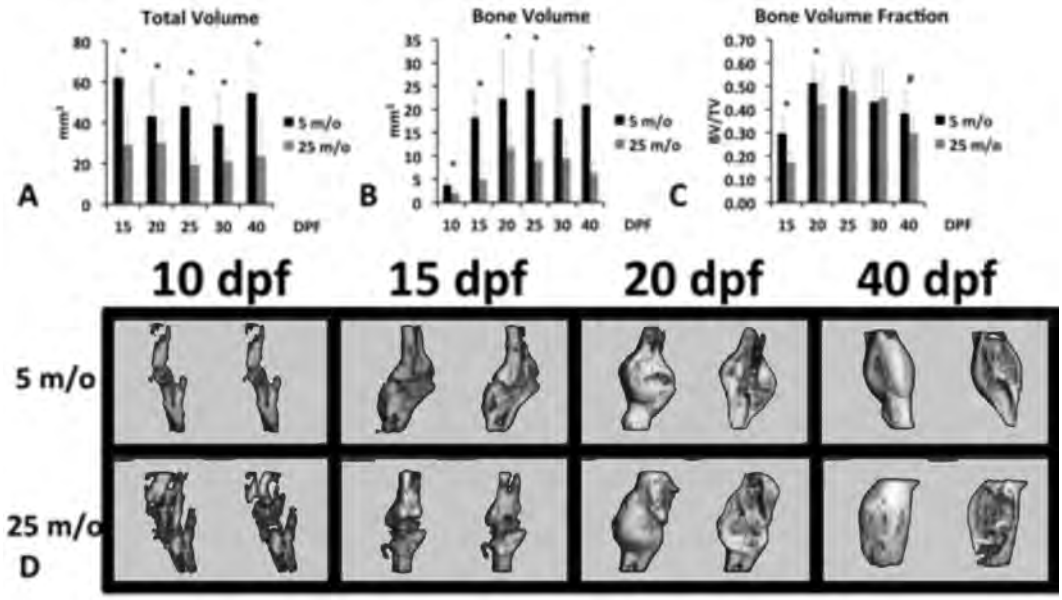


Fig 1. Micro-CT measurements of (A) total volume, (B) bone volume, and (C) bone volume fraction. (D) Representative whole callus and midcoronal plane images.

See pages 99 - 147 for financial disclosure information.

ORTHOPAEDIC TRAUMA ASSOCIATION

30th Anniversary Annual Meeting

October 15-18, 2014

Tampa Convention Center
Tampa, Florida, USA

Final Program

Program Chair
Thomas F. Higgins, MD

Program Co-Chair
Robert V. O'Toole, MD

President
Ross K. Leighton, MD

Local Hosts
Roy Sanders, MD &
H. Claude Sagi, MD

TAMPA 2014

See pages 99 - 147 for financial disclosure information.

SYMPOSIUM I: CONTEMPORARY DEBATES IN ORTHOPAEDIC TRAUMA

Moderator: *Michael Suk, MD, JD*

Faculty: *Bruce D. Browner, MD*
Lisa K. Cannada, MD
A. Alex Jahangir, MD
Clifford B. Jones, MD
Gerald J. Lang, MD
Douglas W. Lundy, MD
Samir Mehta, MD
Philip R. Wolinsky, MD

1:20 pm **OTA Health Policy Chairman Update**
Michael Suk, MD

Proposition 1:
"The US Should Adopt a Standardize Approach to Hip Fracture Care"

1:30 pm *Faculty*
2:00 pm Open Microphone

Proposition 2:
"Implementation of the Accountable Care Act is Good for Orthopedic Trauma"

2:10 pm *Faculty*
2:40 pm Open Microphone

NOTES

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Does Ankle Aspiration for Acute Ankle Fractures Result in Pain Relief? A Prospective Randomized Double-Blinded Placebo-Controlled Trial

Timothy J. Ewald, MD, BS, MSc; Pamela K. Holte, CNP; Joseph R. Cass, MD; William W. Cross III, MD; ***S. Andrew Sems, MD****;*
Mayo Clinic, Rochester, Minnesota, USA

Purpose: Aspiration of fracture hemarthrosis has been previously recommended as a method of pain control following certain intraarticular fractures. This study is designed to determine if aspiration of the fracture hemarthrosis in the setting of an acute ankle fracture results in pain relief and diminished need for narcotic pain medications.

Methods: After IRB approval, the investigators randomized 109 patients with an ankle fracture (OTA classification 44) who presented within 24 hours of injury to undergo either an ankle aspiration to remove the hemarthrosis, or to receive a sham procedure where the needle was advanced to the level of the subcutaneous tissue above the capsule, but no fluid was removed. Both the patient and the investigators were blinded. No differences were seen between these study groups. Patients recorded their Numeric Rating Scale (NRS) pain scores and narcotic usage (oral morphine equivalents [OMEs]) for the first 72 hours or until a surgical procedure occurred, whichever was first. Secondary outcomes included limb volumes (as measured by the technique of fluid displacement), 6-month Olerud-Molander (OM) and SMFA (Short Musculoskeletal Function Assessment) scores, and complications.

Results: A total of 109 subjects (37 males, 72 females) were enrolled with an average age of 52 years. 56 patients were randomized to aspiration, removing an average of 5 mL of hemarthrosis. 53 patients were randomized to and received the sham procedure (control). There were 9 OTA 44A, 78 OTA 44B, and 22 OTA 44C, occurring in even distribution between the aspiration and sham procedure groups. The NRS pain score between emergency department arrival and dismissal improved 2.9 in the aspiration group and 2.5 in the sham group ($P = 0.4$). The highest pain scores in the first 24 hours after injury were 7.3 in the aspiration group and 7.4 in the sham group ($P = 0.88$); hours 24-48 maximum scores were 5.7 in each group ($P = 0.97$); hours 48-72 maximum scores were 4.6 and 5.2 ($P = 0.33$). Pain medicine usage in the first 72 hours following injury showed a total of 89 mg OMEs in the aspiration group and 103 mg OMEs in the sham group ($P = 0.43$). Volumetric measurements at initial follow-up showed that the aspiration group had an average limb volume of 2296 mL on the injured side and 2032 mL on the uninjured side (13% difference), while the control group had volumes of 2248 mL on the injured side and 2012 mL on the uninjured side (12% difference, $P = 0.6$ between groups). OM scores at 6 months were 71.7 in the aspiration group and 78.4 in the sham group ($P = 0.67$). SMFA dysfunction index at 6 months was 15 in the aspiration group and 10.8 in the sham group ($P = 0.12$); bother index was 16.7 in the aspiration group and 10.7 in the sham group ($P = 0.09$). Two post-ORIF (open reduction and internal fixation) infections were seen in the aspiration group and none in the sham group ($P = 0.5$). There were no significant differences in any outcome measure between the aspiration group and the sham group.

Conclusion: Aspiration of acute ankle fractures did not result in decreased NRS pain scores or opioid usage following aspiration. No differences in secondary outcomes, including limb volume, 6-month SMFA and OM scores, or complications were seen. Aspiration of acute ankle fractures does not provide measurable clinical benefit.

See pages 99 - 147 for financial disclosure information.

Continuous Popliteal Sciatic Nerve Block for Ankle Fractures Reduces Postoperative Opioid Requirements and Rebound Pain: A Prospective Randomized Comparative Trial

David Ding, MD; Arthur Manoli III, BS; David Galos, MD; Sudheer Jain, MD;
Nirmal C. Tejwani, MD, FRCS;
NYU Langone Medical Center Hospital for Joint Diseases, New York, New York, USA

Purpose: Peripheral nerve blocks have been well studied in the literature with generally good results for controlling postoperative pain following orthopaedic surgery. However, patients often experience "rebound pain" occurring 12 to 24 hours postoperatively that is subjectively worse than in patients treated without regional blocks. The purpose of this study is to determine whether a continuous infusion of anesthetic will reduce rebound pain and the need for narcotic analgesia after operatively treated ankle fractures.

Methods: After IRB approval, 50 patients undergoing operative fixation of ankle fractures were randomized to receive either a popliteal sciatic nerve block as a single injection (SNB) or a continuous infusion via an On-Q pump. Pain medication (fentanyl and oxycodone/acetaminophen) and visual analog scale (1-10) pain levels were tracked in the post-anesthesia care unit (PACU). Patients were discharged with 5/325 mg oxycodone/acetaminophen for postoperative pain control. Additionally, pain scores, the number of pain medications taken, and any side effects were assessed at scheduled time points by blinded data collectors at 8, 12, 24, 48, and 72 hours postoperatively.

Results: While the On-Q group received significantly less fentanyl in the PACU than the SNB group (21 mcg vs. 71 mcg, $P = 0.006$), there was no difference in the number of oxycodone/acetaminophen pills taken in the PACU or in pain levels at discharge. For all time points after discharge, mean postoperative pain scores and pain pills taken were lower in the On-Q group versus the SNB group. Differences in pain scores were significant at the 12-hour postoperative time point ($P < 0.001$) and differences in pain pills taken were significant at the 12 to 24-hour ($P = 0.002$) and 24 to 48-hour ($P = 0.03$) postoperative intervals. By 72 hours postoperatively, the On-Q group had taken an average of 14.3 pills versus 23.8 pills in the SNB group ($P = 0.01$).

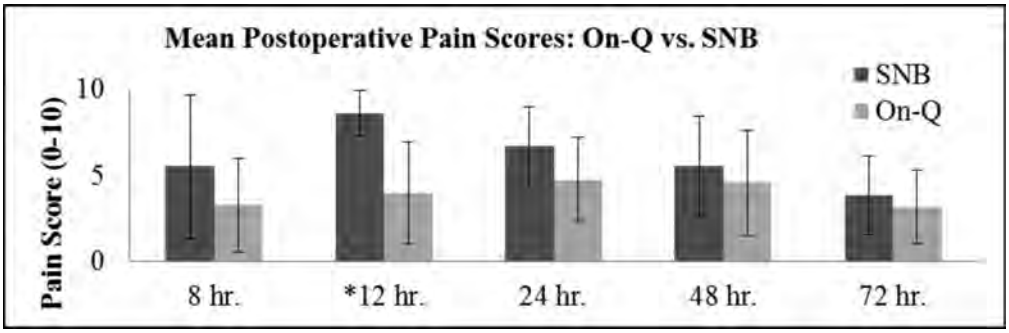


Figure 1. Average visual analog scale pain scores by hours postoperatively for SNB and On-Q groups with error bars representing ±1 standard deviation from the mean. Statistically significant differences ($P < 0.05$) are represented by an asterisk.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Conclusion: Use of continuously infused regional anesthetic for pain control in ankle fracture surgery significantly reduces "rebound pain" and the need for oral opioid analgesia compared to single-shot regional anesthetic after operatively treated ankle fractures over a 72-hour period.

See pages 99 - 147 for financial disclosure information.

Intraoperative O-Arm Evaluation on the Effect of Ankle Position on Accuracy of Syndesmotic Reduction

Paul M. Lafferty, MD; Timothy Hiesterman, MD; ***Amir R. Rizkala, MD****;*
Ryan D. Horazdovsky, MD, Peter A. Cole, MD;
University of Minnesota, St. Paul, Minnesota, USA

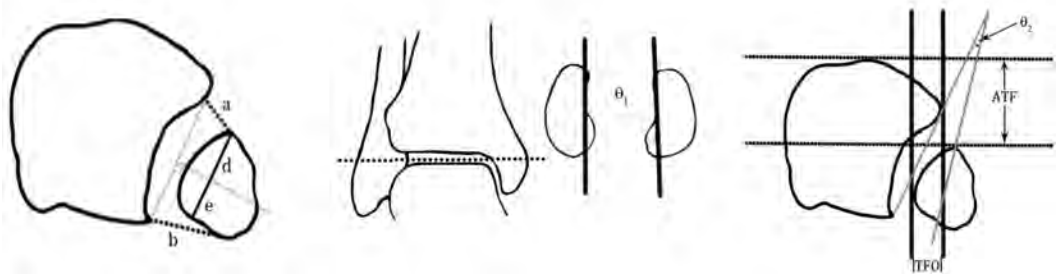
Purpose: This is a prospective study aimed at evaluating the effects of ankle position on the spatial relationships of the tibiofibular syndesmosis by utilizing intraoperative O-arm imaging. The differences in spatial relationships of the tibiofibular syndesmosis during intraoperative dorsiflexion and plantar flexion were observed by comparing each reduction with its contralateral, uninjured side (control). We hypothesize that dorsiflexion of the ankle will result in malreduction of the syndesmosis more frequently than plantar flexion due to the re-creation of the deforming force of external rotation, posterior translation, and proximal migration that occurs with dorsiflexion of the ankle.

Methods: 20 patients with obvious complete syndesmotic disruptions noted on static radiographs underwent O-arm scans after placement of a clamp across the syndesmosis but prior to definitive fixation. The clamp was placed at the level of the distal tibiofibular joint and at 0° with respect to the tibiofibular axis. O-arm images were then taken with the patient's ankle dorsiflexed to a neutral position and then in resting plantar flexion. The same procedure was repeated on the opposite, uninjured ankle for later comparison. All uninjured ankles had no history of previous injury. The same syndesmotic spatial measurements cited in Dikos et al and Nault et al were used for the measurement of all O-arm scans. Measurements from the injured side were then subtracted by the measurements taken in the same ankle position on the uninjured side. This difference was then compared to the difference in measurements when the ankle was placed in the other position. The significance of this comparison was then assessed.

Results: Out of the 14 different types of spatial measurements taken for each ankle position, a significant difference in measurement between ankle positions was found with 7 types of spatial measurements and ratios. These included tibiofibular overlap (TFO) ($P < 0.001$), anterior tibiofibular interval (ATF) ($P < 0.001$), q_1 ($P < 0.001$), q_2 ($P < 0.001$), a ($P = 0.04$), a:b ($P < 0.001$), and d:e ($P < 0.001$). While in dorsiflexion, ATF (mean = 2.4 mm), q_2 (mean = 7.3°),a (mean = 0.1 mm), a:b (mean = 0.1), and d:e (mean = 0.2) were measured to be most similar to their contralateral uninjured measurements when compared to plantar flexion. While in plantar flexion, TFO (mean = 0.5 mm) and q_1 (mean = 5.5°) were measured to be most similar when compared to dorsiflexion.

Conclusion: Seven out of the 14 measurements performed showed a significant difference in reduction depending on ankle position. Compared to the contralateral uninjured ankle, syndesmotic reduction was shown to be closest to anatomic alignment during dorsiflexion in 5 out of the 7 parameters measured. These finding could have implications with regards to the position of the ankle during placement of syndesmotic fixation.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.



See pages 99 - 147 for financial disclosure information.

A Prospective Study to Compare Open Reduction and Ligament Repair Versus Percutaneous Screw Fixation of the Tibia Fibular Syndesmosis

David Sanders, MD; A. Walid Hamam, MD; ***Christina Tieszer, CCRP****;*
Abdel-Rahman Lawendy, MD;
Western University/London Health Sciences Centre, London, Ontario, Canada

Background/Purpose: The outcome of high ankle fractures associated with syndesmotic disruption (Weber-C [OTA 44.C]) is determined by the quality of the reduction. Using fluoroscopic parameters (closed reduction) to gauge reduction has variable results. Open syndesmotic reduction can reduce malreduction rates from 40% to 15%. Current syndesmosis repair techniques include either open or closed reduction, combined with fixation between the distal tibia and fibula. In this study, we compare radiographic and functional outcomes between conventional closed reduction and screw fixation of the syndesmosis with open reduction of the syndesmosis, direct repair of the anterior inferior tibiofibular ligament (AiTFL) and screw fixation. The AiTFL is the first lateral ligamentous stabilizing structure compromised in rotational syndesmotic injury and is accessible for repair during open reduction. We hypothesize that restoration of the AiTFL combined with open reduction is more likely to provide an anatomic repair, and therefore a better outcome, compared to closed reduction and screw fixation.

Methods: 29 patients (19 male; average age, 37 years) with high ankle fractures and syndesmotic disruption were enrolled in this IRB-approved cohort study. Following fibular and/or malleolar fixation, a syndesmosis stress test was performed. Unstable ankles were treated with either an open or closed reduction and fixation of the syndesmosis. The anatomic repair technique (AR) involved direct reduction of the syndesmosis, repair of the AiTFL ligament using suture anchors, and placement of syndesmosis screws. The closed reduction technique (CR) included fluoroscopic assessment of reduction with the syndesmosis clamped, followed by placement of syndesmosis screws. 14 patients were treated by AR, 15 by CR. Rehabilitation was identical between the groups. Functional outcomes included the AOFAS (American Orthopaedic Foot & Ankle Society) Ankle-Hindfoot Score, Maryland Foot Score, and FAOS (Foot and Ankle Outcome Score). Radiographic reduction was measured from bilateral ankle CT scans performed 3 months following surgery; fibular translation and syndesmosis diastasis were compared between injured and noninjured ankles.

Results: *Radiographic:* The average difference in ankle translation and diastasis between injured and noninjured ankles was 0.47 ± 0.38 mm in the AR group (mean ± standard deviation), compared with 1.09 ± 0.69 mm in the CR group ($P < 0.03$). 73% of the CR group and 11% of the AR group had 1 mm or greater side-to-side difference. 11% of the CR group and none of the AR group had 2-mm incongruity or diastasis. *Functional:* The Maryland pain subscore showed a statistically significant ($P < 0.05$) improvement in the AR group compared to the CR group. Improved functional outcome scores were noted using the AR technique compared with the CR technique, but did not reach statistical significance. To date, 5 patients required removal of hardware for irritation (4 CR; 1 AR). One in the CR group had failed reduction requiring revision.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Conclusion: We have shown that an open anatomic repair of the syndesmosis results in better radiographic outcomes compared with percutaneous screw fixation. Pain at 6 months was significantly reduced in the AR group. Based on these results, 20 subjects per group would be required to demonstrate statistical significance in functional outcome scores. Efforts to achieve and maintain an anatomic syndesmosis reduction are important to improve patients' outcomes. Further study of the anatomic repair technique is warranted.

See pages 99 - 147 for financial disclosure information.

Syndesmotic Fixation in Supination–External Rotation Ankle Fractures: A Prospective Randomized Study at a Minimum of 4 Years of Follow-up

Tero Kortekangas, MD*; Harri Pakarinen, MD, PhD; Olli Savola, MD, PhD; Jaakko Niinimäki, MD, PhD; Sannamari Lepojärvi, MD; Pasi Ohtonen, MSc; Tapio Flinkkilä, MD, PhD; Jukka Ristiniemi, MD, PhD; Oulu University Hospital, Oulu, Finland*

Background/Purpose: This study compared midterm functional and radiologic results of syndesmotic transfixation versus no fixation in supination–external rotation (SER) ankle fractures with intraoperatively confirmed syndesmosis disruption. We hypothesized that early-stage good functional results would remain and unfixed syndesmosis disruption in SER IV ankle fractures would not lead to an increased incidence of osteoarthritis.

Methods: This was a prospective study of 140 operatively treated patients with Lauge-Hansen SER IV (Weber B) ankle fractures. After bony fixation, the 7.5-Nm standardized external rotation stress test for both ankles was performed under fluoroscopy. A positive stress examination was defined as a difference of >2 mm side-to-side in the tibiotalar or tibiofibular clear spaces on mortise radiographs. 116 patients had a stable syndesmosis compared to the uninjured side. The other 24 patients were randomized to either syndesmotic screw fixation (13 patients) or no syndesmotic fixation (11 patients). After a minimum of 4 years of follow-up (mean, 58 months), ankle function and pain (Olerud-Molander, 100-mm visual analog scale [VAS] for ankle function and pain) and quality of life (RAND-36) of all 24 patients was assessed. Ankle joint congruity and osteoarthritis were assessed using mortise and lateral projection plain weight-bearing radiographs and 3-T MRI scans.

Results: Improvement in Olerud-Molander score, VAS, and RAND-36 showed no significant difference between groups during the follow-up. In the syndesmotic transfixation group, improvements in all functional parameters and pain measurements were not significant, whereas in the no syndesmotic fixation group Olerud-Molander score improved from 84 to 93 ($P = 0.007$) and pain (VAS) score from 11 to 4 ($P = 0.038$) from 1 year to last follow-up. Radiographs or MRI showed no difference between groups at the follow-up visit.

Conclusion: Syndesmosis transfixation in SER (Weber B)-type fracture patterns had no influence on the functional results or radiological findings after a minimum of 4 years follow-up compared to no syndesmosis fixation.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Syndesmotic Malreduction Results in Poorer Clinical Outcomes in Supination and Pronation External Rotation IV Ankle Fractures

Richard M. Hinds, MD*; Patrick C. Schottel, MD; Matthew R. Garner, MD;*
David L. Helfet, MD; Dean G. Lorich, MD;
Hospital for Special Surgery; New York, New York, USA

Purpose: The purpose of this study was to compare the functional outcomes of postoperative supination and pronation external rotation (SER and PER) IV ankle fractures in patients with and without syndesmotic malreduction.

Methods: A prospectively created clinical registry of ankle fractures surgically treated from 2004 to 2010 was reviewed. Inclusion criteria included unilateral SER IV or PER IV ankle fractures (AO/OTA 44-B), patient age at time of surgery ≥18 years, preoperative ankle radiographs and MRI, postoperative bilateral ankle CT scans, and follow-up of 1 year including Foot and Ankle Outcome Score (FAOS). All patients with CT evidence of articular malreduction were excluded. 86 patients were ultimately included for analysis. Each ankle was assessed on axial CT scan for syndesmotic malreduction at a level approximately 1 cm proximal to the tibial plafond using a novel syndesmotic malreduction assessment method recently described by Davidovitch et al (Figure 1). Designation of syndesmotic malreduction was conferred if any one of the three measurements (anterior tibial incisura distance [AI], posterior tibial incisura distance [PI], or anterior translation distance [AT]) demonstrated a difference greater than 2 mm between the injured ankle and the uninjured ankle.

Results: 63 of the 86 patients (73%) demonstrated syndesmotic malreduction. These patients demonstrated a clinically significant reduction in the FAOS Sport subcategory (58 vs. 73; $P = 0.064$) compared to the 27% (23/86) with a reduced syndesmosis. No clinically or statistically significant differences were observed between patients with and without syndesmotic malreduction in the remaining FAOS subcategories. Demographic, medical comorbidity, injury severity, and postoperative complication comparison between the syndesmotic malreduction and reduction cohorts showed no statistically significant differences.

Conclusion: SER IV and PER IV ankle fractures with syndesmotic malreduction demonstrate poorer clinical outcomes than those without syndesmotic malreduction. However, the high syndesmotic malreduction rate and lack of a statistically significant difference between cohorts may represent an overestimation of malreduction utilizing this method. Regardless, we recommend exercising extreme care in performing open reduction and internal fixation of these ankle fractures to improve a surgeon-dependent variable influencing postoperative outcomes.

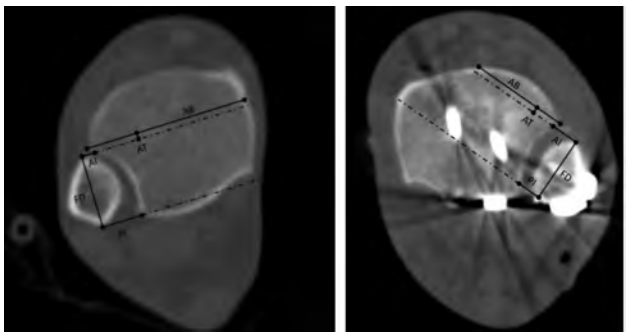


Figure 1. Syndesmotic malreduction assessment on axial CT utilizing a novel method.

See pages 99 - 147 for financial disclosure information.

ΔOutcomes a Decade After Surgery for Unstable Ankle Fracture: Functional Recovery Does Not Decay with Time

*Stephen Gould, MD, MPH[1]; Deirdre Regan, BA[1]; Arthur Manoli III, BS[1]; Kenneth J. Koval, MD[2]; Nirmal C. Tejwani, MD[1]; **Kenneth A. Egol, MD**[1,3];*
[1]NYU Hospital for Joint Diseases, New York, New York, USA;
[2]Orlando Regional Medical Center, Orlando, Florida, USA;
[3]Jamaica Medical Center, Jamaica, New York, USA

Purpose: Ankle fractures are among the most common injuries treated by orthopaedic surgeons; however, there is a dearth of evidence regarding long-term outcomes following surgery for an unstable ankle fracture. The purpose of this OTA-funded study is to examine long-term clinical and radiographic outcomes in a well-documented patient cohort.

Methods: Between January 2001 and January 2007, 500 patients who underwent surgical repair of an unstable ankle fracture (original cohort) were enrolled in a prospective database and followed out to 1 year. Trained interviewers recorded baseline characteristics at the time of injury, including patient demographics, American Society of Anesthesiologists (ASA) classification, and medical comorbidities. Short Musculoskeletal Function Assessment (SMFA) scores and American Orthopaedic Foot & Ankle Society (AOFAS) Ankle-Hindfoot Scale scores were obtained at standard follow-up intervals. Patients were contacted by mail and telephone for long-term follow-up, which included radiographs and functional assessment with the use of the SMFA and AOFAS Ankle-Hindfoot Scale. Radiographs were evaluated for the presence of posttraumatic arthritis of the ankle. Multiple linear regression was used to identify predictors of functional recovery, binary logistic regression was used to identify predictors of radiographic osteoarthritis, and paired-samples *t*-tests were used to compare long-term functional outcome scores to scores at 1 year.

Results: Overall, 75 patients out of the 148 patients contacted (51%) returned for evaluation (follow-up cohort). The average length of follow up was 10.5 years (range, 7-13 years), and the mean age at follow up was 57 years (range, 27-85). The follow-up cohort was significantly older at the time of injury when compared to the original cohort ($P = 0.043$; mean 47.3 years vs. 43.2 years). There was no significant difference in the number of males and females in the original cohort compared to the follow-up cohort ($P = 0.547$). Based on follow-up radiographs, 23.2% of patients had no osteoarthritis, 46.4% of patients had mild osteoarthritis, 26.1% of patients had moderate osteoarthritis, and 4.3% of patients had severe osteoarthritis. Overall, 13% of patients had removal of ankle hardware, and 1 patient underwent a tibiotalar fusion secondary to symptomatic posttraumatic arthrosis. 86.2% of patients had none-to-mild ankle pain, and 89.2% of patients had no limitation of daily activities. According to the AOFAS Ankle-Hindfoot Scale, 86% of patients had ≥80% long-term functional recovery and 58% had ≥90% long-term functional recovery. Overall, male sex was a predictor of having radiographic osteoarthritis ($P < 0.05$). There were no other significant predictors for any severity of radiographic osteoarthritis. Overall, there was no difference in total SMFA scores at an average of 11 years compared to scores 1 year postoperatively. ASA class 1 or 2 was found to be a significant predictor of functional

Δ OTA Grant

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

recovery based on long-term standardized total SMFA scores ($P < 0.05$). No other significant predictors of functional recovery were identified.

Conclusion: Over a decade after ankle fracture fixation, the majority of patients are doing well; despite the fact that 76% of patients have some form of radiographic arthritis, very few experience pain, and have few restrictions in function or daily activities. Patients' long-term functional outcomes are not significantly different than their outcomes at 1 year.

See pages 99 - 147 for financial disclosure information.

Functional Outcome After Ankle Fractures and Ankle Fracture-Dislocations: A Prospective Study

Chad Ferguson, MD[1]*; Michael Ruffolo, MD*[1]*; J. Kent Ellington, MD*[2]*; Rachel Seymour, PhD*[1]*; CAPT (ret) Michael J. Bosse, MD*[1]*; CMC-OC Ankle Fracture Research Group*[1,2]*;*
[1]*Carolinas Medical Center, Charlotte, North Carolina, USA;*
[2]*OrthoCarolina, Charlotte, North Carolina, USA*

Purpose: The literature on patient and injury-specific factors that contribute to functional recovery and long-term results of ankle fracture-dislocations are limited. Further study specific to ankle fracture-dislocations may provide insight into patient and injury-specific factors contributing to poor outcomes or cause surgeons to explore alternative surgical methods to achieve improved outcomes. The long-term clinical and radiographic outcomes for patients sustaining ankle fracture-dislocations are poorer than those without dislocation.

Methods: After IRB approval, 80 patients with bimalleolar or trimalleolar ankle fractures (OTA 44A, B, and C type fractures) were prospectively enrolled in a prospective observational study. The study population included 40 patients with non-dislocated ankle fractures (AF) and 40 with ankle fracture-dislocations (AFD) treated operatively with standard fracture fixation techniques. Injury characteristics, radiographs, demographics, and medical comorbidities were collected at the time of injury. Postoperatively, patient-reported outcome scores were assessed using FAAM (Foot and Ankle Ability Measure) and SMFA (Short Musculoskeletal Function Assessment) questionnaires. Additional outcomes related to patient recovery and complications of surgical care were also tabulated.

Results: Demographic and injury characteristics for the two groups are comparable. Data at 6 months are available for 71 patients. 33 (82.5%) AF patients and 38 (95.0%) AFD patients' outcomes were collected at the 6-month follow-up. Interim results for patient-centered outcome scores collected at 6 months show a mean FAAM score of 72.8 for AF compared to 68.2 for AFD cohort ($P = 0.497$). Combined SMFA scores for the AF cohort were 36.8 compared to 37.5 in the AFD cohort ($P = 0.847$). Based on these results, we report no significant short-term differences in patient-reported outcome scores between these groups. Additionally, at the 6-month follow-up, there are no differences in complications (deep venous thrombosis, pulmonary embolism, neurovascular), time to full weight bearing, or time to full range of motion based on clinical follow-up data.

Conclusion: The comparison of the outcomes between patients sustaining ankle fractures and fracture-dislocations provides additional information for clinicians treating these injuries. Conventionally, ankle fracture-dislocations are considered a higher energy injury with increased soft-tissue stripping and propensity for concomitant soft-tissue and cartilagenous injury, putting patients at risk for increased complications and longer recovery. However, the initial results of our prospective study have shown no difference in FAAM and SMFA scores, complication rates, or time to full recovery when comparing AF and AFD groups.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Correlation Between the Lauge-Hansen Classification and Ligament Injury in Ankle Fractures

Stephen Warner, MD, PhD*; Matthew R. Garner, MD; Richard M. Hinds, MD; Dean G. Lorich, MD;*
Hospital for Special Surgery, New York, New York, USA

Purpose: The Lauge-Hansen classification system was intended to predict mechanisms and ligament injuries based on ankle fracture radiographs. Previous work has suggested that this classification has limitations in its ability to associate ligament injuries with ankle fracture patterns. The purpose of this study was to better define the ability of the Lauge-Hansen classification to predict ligament injury in ankle fractures using MRI and intraoperative findings.

Methods: We reviewed a prospectively collected database of patients who underwent operative treatment for ankle fractures from 2007-2013. All patients had injury radiographs, which were assigned a Lauge-Hansen classification by senior orthopaedic residents using the morphology of the fibula fracture and constellation of other fractures. Included patients all had preoperative MRI, and one of two experienced musculoskeletal MR radiologists evaluated the MR images for the integrity of the syndesmotic, talofibular, and deltoid ligaments. Operative treatment was performed by one senior attending trauma surgeon, who recorded a Lauge-Hansen classification for each patient based on intraoperative findings. The basis for the intraoperative classification included direct visualization of fractures and ligaments and the stability of the tibiotalar joint during intraoperative rotational stress tests. Comparisons were made between the predicted injuries based on the radiographic Lauge-Hansen classifications and the preoperative MRI analyses and intraoperative findings.

Results: 300 patients were included in the study, with an average patient age of 47.8 years (range, 15-88). On the basis of the Lauge-Hansen system, 228 (76%) were classified as supination–external rotation (SER), 42 (14%) were pronation–external rotation (PER), 11 (4%) were supination adduction, 2 (1%) were pronation abduction (PAB), and 17 (6%) were not classifiable. Of the 283 fractures that were classified into Lauge-Hansen categories, 254 (90%) had MRI readings of ligamentous injuries and fracture patterns consistent with the Lauge-Hansen predictions based on the sequential rotational mechanism. Intraoperative findings also highly correlated with the Lauge-Hansen class of ankle fracture, with nearly complete agreement. Comparing MRI and intraoperative findings revealed 37 (13%) of ankle fractures had different classifications by MRI than what was found intraoperatively, with 18 of these being classified as SER intraoperatively but unclassifiable by MRI. The stage of injury within the SER and PER classes had 88% agreement between injuries seen on MRI and findings intraoperatively.

Conclusion: Previous studies have reported mixed results regarding the reliability of the Lauge-Hansen system to predict ligament injuries associated with ankle fractures; however, these studies used limited numbers of patients with varying methods of assessing ligament injuries. In our large cohort of patients, comparing injury radiographs, preoperative MRI, and intraoperative findings suggested that the Lauge-Hansen system is an accurate predictor of ligamentous injuries. The predictions based on the Lauge-Hansen system can be useful for fracture reduction maneuvers as well as fixation planning.

See pages 99 - 147 for financial disclosure information.

The Early and Medium-Term Results of Early Primary Open Reduction and Internal Fixation of AO43-B/C Tibial Pilon Fractures: A Prospective Cohort Study

Daniel Deakin, FRCS*; Pierre Guy, MD; Peter J. O'Brien, MD; Henry M. Broekhuyse, MD; Jeremie Larouche, MD; Piotr A. Blachut, MD; Kelly A. Lefaivre, MD;*
University of British Columbia, Vancouver, British Columbia, Canada

Purpose: Our hospital manages AO 43-B and C fractures with early open reduction and internal fixation (ORIF) whenever possible, rather than using staged management with delayed ORIF. Previous retrospective studies of early definitive ORIF for pilon fractures have reported complication rates that are comparable to delayed or staged ORIF. The purpose of this study was to report the results on the first assembled prospective cohort of pilon fracture cases aiming to (1) determine the early and late complication rates and (2) determine the medium-term functional and radiographic outcome of these fractures

Methods: 53 patients with 55 AO 43-B (n = 17) or 43-C (n = 38) distal tibial pilon fractures were prospectively enrolled. Patients were reviewed with radiographs and functional scores (Short Form-36 [SF-36], Foot and Ankle Outcome Scores [FAOS], and Short Musculoskeletal Function Assessment [SMFA]) at baseline, 6, 12, and 60 months postoperatively. Fracture reduction was graded using a strict intraoperative and radiographic method (modified Burwell). Osteoarthritis was graded at final follow-up (modified Resnick and Niwayama). Our outcome measures were (1) deep infection requiring reoperation; (2) ankle arthritis requiring reoperation; (3) functional scores at 6, 12, and 60 months; and (4) radiographic osteoarthritis at final follow-up.

Results: The mean age was 42 years (range, 19-70). Three patients (4 fractures) received external fixation in referring hospitals and were managed with delayed ORIF. Of the remaining 51 fractures, 57% underwent early definitive ORIF within 24 hours of injury, 79% by 48 hours, and 91% by 72 hours. *Infection:* The deep infection rate was 2/43 (4.7%) for closed fractures and 2/8 (25%) for open fractures treated with early definitive ORIF. Of the 3 patients (4 fractures) referred with a fixator, one patient sustained an open (IIIb) AO 43.C3 fracture with significant metaphyseal bone loss and underwent delayed definitive fixation with free flap 14 days after injury. This patient underwent a below-knee amputation 4 months following injury for deep infection. *Arthritis:* One patient (1/51) underwent ankle fusion following a deep infection. *Aseptic Nonunion:* Two patients had aseptic nonunion and underwent successful revision ORIF. *Radiographic Follow-up:* 50 patients had 1 year or greater radiographic follow-up. Using strict reduction assessment method, 34 had reduction graded as "anatomical" and 16 had reduction graded as "fair". Fair reductions were significantly more likely to develop moderate or severe arthritis than mild or no arthritis (c^2; $P = 0.009$). *Functional Scores:* Mean normalized SF-36 scores improved but remain abnormal at 5 years (statistically significant with difference >MCID [minimum clinically important difference). Osteoarthritis was associated with significantly worse FAOS scores at 12 months and five years (*t*-test; $P < 0.05$).

PAPER ABSTRACTS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Table 1: SF-36 Scores by Time for All Patients (50 Represents the Normal Population Score)

	Physical Component Score*	Mental Component Score*
Baseline (n = 55)	55.84 (53.74-57.92)	53.02 (50.14-55.90)
6 months (n = 49)	37.17 (34.08-40.27) ***P* < 0.0001**	51.04 (47.37-54.70)
12 months (n = 47)	44.59 (41.33-47.86) ***P* < 0.0001**	47.89 (44.45-51.31) ***P* < 0.005**
5 years (n = 20)	45.21 (40.93-49.49) ***P* < 0.0001**	49.56 (44.67-54.44)

*With 95% confidence interval.

Conclusion: This is the first prospective cohort study to report the medium-term functional outcome of distal tibial pilon fractures. The acute fixation of pilon fractures is safe and results in rates of complications that are comparable to those in published series of delayed or staged fixation. Anatomical articular reduction appears to be associated with better short and medium-term functional outcomes as well as less radiographic osteoarthritis. Patients with pilon fractures show significant long-term morbidity, although this effect appears to plateau with time, which could inform prognosis.

See pages 99 - 147 for financial disclosure information.

Type C Tibial Pilon Fractures: Rate and Risk Factors for Complications Following Early Operative Intervention

Andrew D. Duckworth; Nicholas D. Clement, MRCSEd; Stuart A. Aitken, MD;
Timothy O. White, MD, FRCS;
Edinburgh Orthopaedic Trauma Unit, Royal Infirmary of Edinburgh,
Edinburgh, United Kingdom

Purpose: The optimal treatment for tibial pilon fractures remains controversial, with advocates for both early fixation versus two-stage delayed fixation. It is acknowledged that further data are needed to document the outcome of these complex injuries. The aim of this study was to document the outcome following either early or delayed fixation for complex fractures of the tibial plafond.

Methods: We identified 112 skeletally mature patients from our trauma database over an 11-year period, which were managed acutely for a complex intra-articular fracture (type C) of the distal tibia. Demographic data, fracture classification, management, complications, and subsequent surgeries were recorded following retrospective clinical record review. A minimum follow-up of 3 months was used to detect any complications from surgery. Patients with incomplete data or inadequate follow-up were excluded. The primary outcome measure was the development of complications following the acute management of these injuries.

Results: There were 96 patients in the study cohort with a mean age of 42 years (range, 16-86) and 74% (n = 71) were male ($P < 0.001$). There were ≥1 comorbidities documented in 42 (43.8%) patients, with 40 (41.7%) smokers and 33 (34.4%) with a background of alcohol excess. High-energy injuries accounted for 79 (82.3%) of all fractures, with a fall from height (n = 66, 68.8%), motor vehicle collision (n = 8, 8.3%), and sports injuries (n = 7, 7.3%) most common. There were 22 (22.9%) patients with multiple injuries and 12 (12.5%) patients with an open fracture. The median time to definitive surgery was 2 days (range, 0-15). There were 71 (74%) patients who underwent primary open reduction and internal fixation (ORIF), 17 (17.7%) primary external fixation with delayed ORIF, 5 (5.2%) primary ORIF + external fixation, and 3 (3.1%) primary fusion. There were 33 complications recorded in 24 (25%) patients. There were 13 (13.5%) infections, with a deep wound infection in 7 (7.3%) patients and a superficial wound infection in 6 (6.3%). There were 9 (9.4%) patients who went onto a nonunion, of which 5 were infected nonunions. Other complications included a loss of reduction (n = 5, 5.2%), acute compartment syndrome (n = 1, 1%), and complex regional pain syndrome (n = 1, 1%). There were 34 (35.4%) patients who underwent ≥1 subsequent procedures, with 26 (27.1%) requiring removal of metalwork. The only risk factor identified for developing any complication was multiple comorbidities ($P = 0.033$). Risk factors for developing infection were multiple comorbidities ($P = 0.046$) and primary external fixation with delayed ORIF ($P = 0.035$), with an open fracture approaching significance ($P = 0.055$).

Conclusion: This is one of the largest series in the literature documenting the outcome following fixation for type C tibial pilon fractures. Despite the severity of these injuries, we

PAPER ABSTRACTS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

have demonstrated a satisfactory outcome using primary early fixation in the vast majority of cases. The primary risk factor we identified for developing a complication was multiple comorbidities, with primary external fixation with delayed ORIF also a risk factor for infection.

See pages 99 - 147 for financial disclosure information.

Percutaneous Reduction and Screw Fixation in Displaced Intra-Articular Fractures of the Calcaneus

Saran Tantavisut, MD*; J. Lawrence Marsh, MD; Phinit Phisitkul, MD;*
Matthew D. Karam, MD; Brian O. Westerlind, BA; Yubo Gao, PhD;
University of Iowa Hospitals and Clinics, Iowa City, Iowa, USA

Purpose: This study retrospectively reviewed patients with intra-articular calcaneal fractures who were treated with percutaneous reduction and fixation with screws alone and assessed their clinical outcomes and radiographs using a novel CT scoring system.

Methods: Between 2000 and 2011, 153 consecutive patients with 182 displaced intra-articular fractures of the calcaneus (Sanders type 2 in 17%, type 3 in 66%, and type 4 in 17%) were operatively reduced and fixed with screws alone using percutaneous techniques. During the study period, there were no patients treated with other operative techniques. All patients' records were assessed for early postoperative complications at 3 months from the injury and radiographs were measured for maintenance of reduction. Midterm clinical results for pain and late complications were assessed for patients seen at a minimum of 1 year after surgery (90 patients, 106 feet). This subgroup had a mean follow-up of 2.6 ± 1.7 years (range, 1-8.9 years). In patients who had both preoperative and postoperative CT scans (50 patients, 60 feet), the articular reduction was quantitatively analyzed by measuring the widest gap or step in the anterior talocalcaneal joint, posterior talocalcaneal joint, and calcaneocuboid joint in 3 scanning planes. Bohler angle, Gissane angle, talocalcaneal angle, calcaneal width, height, and length were measured by a nontreating surgeon on preoperative, immediate postoperative, and 3-month postoperative radiographs.

Results: At 3-month follow up, early complications were identified in 4 patients (2.6%). There were 2 superficial infections and 2 patients with screw irritation that required removal. The midterm complications in patients with a minimum 1-year follow-up were: screw irritation requiring removal in 10 feet (9.4%), subtalar osteoarthritis needed subtalar fusions in 6 feet (5.7%), 2 malunion (1.9%), 1 deep infection (0.9%), and 1 Achilles tendinopathy (0.9%). The clinical results in this subgroup were good-excellent in terms of pain, stiffness ,and function at 54.5%, 52.2%, and 60%, respectively. Comparing preoperative and immediate postoperative radiographs, there was significant improvement in Bohler angle ($P < 0.0001$), calcaneal facet height ($P < 0.0001$), and calcaneal width ($P < 0.0001$). On radiographs after healing the reduction was maintained for all parameters except Bohler angle, which was significantly decreased compared to immediate postoperative films ($P = 0.0002$). Comparing the CT composite score of preoperative and postoperative CT showed significant improvement in posterior talocalcaneal joint ($P < 0.0001$) and calcaneocuboid joint ($P = 0.0303$). Of the patients with either subtalar fusion or late-stage arthritis, there was significant correlation between both the pre-operative and postoperative CT composite scores ($P = 0.05$ and 0.03, respectively). The visual analog scale scores did not correlate with the preoperative CT scores ($P = 0.4$), although they showed a strong trend to correlate with postoperative scores ($P = 0.06$).

Conclusion: These radiographic measurements suggested that the shape of the calcaneus (height, width, and Bohler angle) could be significantly improved using percutaneous

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

techniques and screw fixation alone and the improvements were largely maintained (average 4.3 screws per foot). The complication rate was low compared to other reported techniques. The posterior facet reduction on postoperative CT was significantly improved from the preoperative status. However, residual articular displacement and settling of Bohler angle were present. The clinical significance of these residual displacements is uncertain.

See pages 99 - 147 for financial disclosure information.

Evaluation of Vitamin D Levels and Outcomes After Ankle Fracture Fixation

Stephen Warner, MD, PhD*; Matthew R. Garner, MD; Joseph Nguyen, MPH;*
Dean G. Lorich, MD;
Hospital for Special Surgery, New York, New York, USA

Purpose: Optimal vitamin D levels are critical for bone health and muscle function, and hypovitaminosis D is common in patients undergoing orthopaedic trauma surgery. While previous studies have shown that vitamin D levels correlate with functional outcome after hip fracture surgery, the significance of vitamin D levels on outcomes after surgery in other orthopaedic trauma patients is unknown. The purpose of this study was to determine if vitamin D levels correlated with outcomes in ankle fracture patients.

Methods: We reviewed a prospectively collected database of patients who underwent operative treatment for ankle fractures from 2003-2012. Preoperative serum 25-hydroxyvitamin D (25[OH]D) levels were measured, and the primary and secondary outcomes included Foot and Ankle Outcome Scores (FAOS) and ankle range of motion (ROM). Data wrtr also collected on patient comorbidities, articular malreductions, and wound complications. Included patients had at least 12 months of clinical outcome data.

Results: 98 patients operatively treated for ankle fractures met our inclusion criteria. Mean patient age was 55.8 years (range, 18-91), and length of follow-up for outcome scores averaged 21 months (range, 12-77 months). Of these 98 patients, 36 (37%) were deficient in vitamin D (<20 ng/mL) and 31 (32%) had vitamin D insufficiency (<30 ng/mL, ≥20 mg/mL). Patients with vitamin D deficiency were similar with regard to age, gender, and comorbidities compared to patients with vitamin D levels ≥20. Univariate analysis revealed that patients with vitamin D deficiency had significantly worse FAOS with regard to symptoms ($P = 0.031$) and worse average scores in the FAOS quality-of-life domain than patients with vitamin D levels ≥20. Multivariate regression analysis suggested that vitamin D deficiency was a factor in inferior FAOS with regard to symptoms, activities of daily living, and quality of life. Vitamin D levels were not significantly correlated with postoperative ROM, articular malreductions, or wound complications.

Conclusions: Several studies have demonstrated that patients with deficient vitamin D levels have increased fracture risks, yet the significance of vitamin D levels on postoperative outcomes is less known. In our group of patients with operatively treated ankle fractures, preoperative vitamin D deficiency correlated with inferior clinical outcomes at a minimum of 1-year follow-up. Our study suggests that deficient vitamin D levels may result in worse outcomes in orthopaedic trauma patients recovering from fracture fixation.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

PRESIDENT'S MESSAGE
Ross K. Leighton, MD
"The Orthopaedic Trauma Association - Enhancing the Care of the Patient - Past, Present, and Future"

NOTES

See pages 99 - 147 for financial disclosure information.

CASE PRESENTATIONS

Treatment of Pelvic Fractures
Moderator: *Paul Tornetta III, MD*
Faculty: *Robert V. O'Toole, MD; Robert Ostrum, MD; H. Claude Sagi, MD* and *Jodi Siegel, MD*

Distal Humerus Fractures: Tips and Tricks
Moderator: *Utku Kandemir, MD*
Faculty: *Michael J. Gardner, MD; Michael D. McKee, MD* and *Milan K. Sen, MD*

2 Minutes - 2 Slides: Tips and Tricks for Nailing and Plating Long Bone Fractures
Moderator: *Pierre Guy, MD*
Faculty: *Matt L. Graves, MD; Thomas F. Higgins, MD; Christian Krettek, MD, FRACS* and *David C. Templeman, MD*

NOTES

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

SKILLS LABS

(SL1) **SIGN Fracture Care International**
Lab Leader: *Lewis G. Zirkle Jr, MD*
Faculty: *Larry (Hilario) Diaz, MD; Justin C. Haller, MD; Henry Ndasi, MD; John Staeheli, MD; Paul S. Whiting, MD; Frederic Wilson, MD and Patrick Yoon, MD*

(SL2) **IM Fixation of Proximal Tibial Fractures**
Lab Leader: *Roy Sanders, MD*
Faculty: *Daniel R. Dziadosz, MD; Steven P. Haman, MD; Joshua Langford, MD; William M. Ricci, MD and Anjan R. Shah, MD*

NOTES

See pages 99 - 147 for financial disclosure information.

Prospective, Randomized Evaluation of Optimal Implant Position of Gamma3 and PFNA for the Treatment of AO/OTA 31-A2 Fractures: Is Central Positioning Always the Best?

James N. Irvine Jr, MD[1]*; Jennifer L. D'Auria, BS*[1]*; Constantin Dlaska, MD*[2]*;*
Julia Kottstorfer, MD[2]*; Harald Wolf, MD*[2]*; Stefan Hajdu, MD*[2]*; Harald K. Widhalm, MD*[2]*;*
[1]*University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA;*
[2]*Medical University of Vienna, Vienna, Austria*

Background/Purpose: Parker et al have reported on lag screw positioning during dynamic hip screw (DHS) implantation in the treatment of proximal femur fractures. They found significant differences in screw cut-out when positioned superior on the AP radiograph and posterior on the lateral. Our goal was to determine ideal positioning of prospectively randomized screw or helical blade placement during intramedullary nail fixation of AO/OTA 31-A2 fractures, in order to minimize the reoperation rate.

Methods: A prospective, randomized controlled study was initiated for the treatment of AO/OTA 31-A2 fractures with either a third-generation Gamma nail (Gamma3, Stryker) or proximal femoral nail antirotation (PFNA, Synthes). 200 patients from 2007 to 2010 with an average age of 81.1 years were randomized in a 1:1 ratio. Intraoperative AP and lateral radiographs were reviewed to calculate Parker's ratio and tip-apex-distance (TAD). Incidences of reoperation were categorized based on Parker's ratios and TAD, and logistic regression and receiver operator characteristic (ROC) curves were used for predictive modeling of reoperation. Significant values were set at $P < 0.05$.

Results: 177 patients (Gamma3: 91; PFNA: 86) met all study criteria. Both implants showed a predilection for a central position on the AP radiograph with 83/91 (91.2%) for Gamma3 and 81/86 (94.2%) for the PFNA group. In the Gamma3 group, there were significantly higher reoperation rates for Parker's ratio values less than 34 (inferior position) on the AP radiograph compared to values between 34 and 66 (central position; $P = 0.035$); this was not seen in the PFNA group. There was a significant association between implant type and reoperation, with Gamma3 having 11/91 (12.1%) reoperations and PFNA having 0/86 (0%) reoperations ($P = 0.001$). Predictive modeling of reoperation for Gamma3 was maximized when both TAD and Parker's ratios from AP radiography were incorporated into the model. With Parker's ratios subdivided into thirds (0-33, 34-66, 67-100), TAD categorized as <20 and ≥20 generated an ROC curve with area under the curve (AUC) of 0.700 ($P = 0.032$) while TAD categorized as ≤25 and >25 generated an ROC curve with AUC of 0.612 ($P = 0.226$). Although a higher risk for reoperation in the Gamma3 group was evident in cases with a lower-third Parker's ratio, these criteria were not predictive of cut-out. There were no significant differences between the Gamma3 and PFNA in terms of Parker's ratios and TAD.

Conclusion: For the Gamma3 device, central position on AP radiographs resulted in significantly fewer reoperations compared to an inferior position. ROC analysis indicates that the combination of Parker's ratio and TAD is a significant predictor of reoperation rate in Gamma3. It also indicates that TAD <20 mm is a better predictor of reoperation compared to 25 mm. The same criteria predicted reoperation, but not cut-out. If using a Gamma3

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

system it is important to achieve central positioning of the lag screw on the AP radiograph and TAD <20 mm to minimize the risk of reoperation. In this study the PFNA nail did not fail and was more tolerant of outliers of position.

Rates for reoperation and cut-out subdivided by Parker's ratio for Gamma3 and PFNA: Inferior positioning on AP radiography had a significantly higher reoperation rate. P values, odds ratios, and 95% confidence intervals (CIs) could not be calculated for PFNA because the absence of complications resulted in indistinguishable groups.

Rates for Reoperation and Cut-Out Subdivided by Implant Type and Parker's Ratio

Implant Type	X-Ray View	Outcome	Parker's Ratio			*P* Value*	Odds Ratio*	95% CI*
			<33	34-66	67-100			
Gamma3	AP	Reoperation n/total (%)	3/8 (37.5)	8/83 (9.6)	0/0 (0)	0.035	5.63	1.13-28.04
		Cut-out n/total (%)	1/8 (12.5)	4/83 (4.8)	0/0 (0)	0.382	2.82	0.28-28.14
	Lateral	Reoperation n/total (%)	0/1 (0)	11/85 (12.9)	0/5 (0)	0.536	0.395	0.02-7.52
		Cut-out n/total (%)	0/1 (0)	5/85 (5.9)	0/5 (0)	0.683	0.424	0.01-25.92
PFNA	AP	Reoperation n/total (%)	0/6 (0)	0/80 (0)	0/0 (0)	N/A	N/A	N/A
		Cut-out n/total (%)	0/6 (0)	0/80 (0)	0/0 (0)	N/A	N/A	N/A
	Lateral	Reoperation n/total (%)	0/0 (0)	0/81 (0)	0/5 (0)	N/A	N/A	N/A
		Cut-out n/total (%)	0/0 (0)	0/81 (0)	0/5 (0)	N/A	N/A	N/A

Gamma3 = third-generation Gamma nail, PFNA = proximal femoral nail antirotation, N/A = not available. *Calculated using binary logistic regression.

See pages 99 - 147 for financial disclosure information.

Incidence, Magnitude, and Predictors of Shortening in Young Femoral Neck Fractures

***Gerard P. Slobogean, MD, MPH, FRCSC**; David J. Stockton, MD; Andrew Yamada, BSc; Henry M. Broekhuyse, MD; PiotrA. Blachut, MD; Peter J. O'Brien, MD, FRCSC; Pierre Guy, MD; Kelly A. Lefaivre, MD;*
University of British Columbia, Vancouver, British Columbia, Canada

Purpose: Fracture shortening following internal fixation of nongeriatric femoral neck fractures remains poorly described. Recent evidence suggests femoral neck fracture shortening of >5 mm is associated with clinically significant decreases in functional outcome. The purpose of this study is to describe the incidence and magnitude of shortening following internal fixation of young adult femoral neck fractures. Secondary objectives are to identify variables associated with femoral neck shortening. We hypothesized that a small magnitude of fracture shortening would be common in this population, but severe shortening would be relatively rare.

Methods: Young femoral neck fracture patients (ages <60 years) from 2003-2013 were identified from our prospective trauma database. Only subjects treated with cannulated screws or a sliding hip screw (SHS) were included. Patient demographics and operative data were obtained from the prospective database and retrospectively from the chart when necessary. Femoral neck shortening was measured radiographically along the long axis of the neck. All measurements were adjusted for magnification. Univariate analysis was performed to identify potential predictors of shortening, followed by a multivariable regression model to independently adjust for significant variables.

Results: 65 patients with a median age of 51 years (interquartile range [IQR]: 43-56 years) were included. 71% were male and 33% of injuries were from high-energy mechanisms. 75% of the fractures were displaced. The distribution of the fractures within the Pauwel classification was 6% Type I, 58% Type II, and 36% Type III. A closed reduction was performed in 85% of the cases. The median amount of radiographic femoral neck shortening was 6 mm (IQR: 0-12 mm) at a median of 222 days postfixation (IQR: 101-399 days). 54% of patients had ³5 mm of femoral neck shortening (22% between ³5 mm and <10 mm; 32% ³10 mm). Initially displaced fractures shortened more than undisplaced fractures (mean 8.1 mm vs. 2.2mm, $P < 0.001$), and fractures treated with a SHS + derotation screw shortened more than fractures fixed with cannulated screws alone (10.7 mm vs. 5.5 mm, $P = 0.03$). There was no association between fixation type used and fracture displacement, Pauwel angle, Pauwel classification, Garden classification, or level of fracture. Regression analysis confirmed the independent associations of initial fracture displacement and fixation type on femoral neck shortening ($P = 0.001$). When adjusting for initial fracture displacement, fractures treated with a SHS + derotation screw shortened an average of 2.3 mm more than fractures treated with screws alone ($P = 0.03$).

Conclusion: There was a 54% incidence of femoral neck shortening ³5 mm in our young femoral neck fracture population. Furthermore, 32% of the entire cohort experienced severe shortening >1 cm. Although the clinical significance of this shortening is unknown in our series, an association between ³5 mm of shortening and poor functional outcomes

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

appears to be emerging in the literature. Finally, irrespective of fracture displacement, fixation with a SHS + derotation screw was associated with more shortening than fixation with screws alone. This adds further controversy to the debate of the optimum fixation method for young femoral neck fractures.

See pages 99 - 147 for financial disclosure information.

Cephalomedullary Nail Fixation of Intertrochanteric Fractures: Are Two Proximal Screws Better than One?

***Rafael Serrano-Riera, MD**; James A. Blair, MD; Katherine Downes, PhD; Roy Sanders, MD; Orthopaedic Trauma Service, Florida Orthopaedic Institute, Tampa, Florida, USA*

Purpose: This study was conducted to analyze radiographic changes in intertrochanteric fracture alignment after treatment with either a one or a two (integrated)-screw cephalomedullary nail construct.

Methods: 1004 OTA 31-A, 31-B2.1 fractures (1002 patients) treated with either a single-screw cephalomedullary nail (Gamma 3, Stryker), or a two integrated screw cephalomedullary nail (InterTAN, Smith & Nephew) between February 1, 2005 and June 30, 2013 were identified at our institution and reviewed retrospectively. Patients younger than 50 years, follow-up (f/u) less than 3 months, a tip-apex distance >25 mm, inaccurate lag screw placement, pathologic fractures, and revisions were excluded. Fracture stability was based on the Evans classification. Radiographic review included: fracture pattern (stable vs. unstable), postoperative (postop) fracture reduction, differences in the neck shaft angle (NSA), and femoral neck shortening (FNS) at 3, 6, and 12 months postop. Measurements of implant size, NSA, and FNS were normalized using known lag screw dimensions that were digitally corrected for magnification. Rotational discrepancies between radiographs were controlled using a ratio of known to measured dimensions. NSA and FNS were compared at each time interval for all fractures, to measure changes occurring with each device. The Mann-Whitney *U* test was used for statistical analysis.

Results: 372 patients died and 219 were lost to f/u, leaving 413 patients (413 fractures) with more than 3 months f/u. Mean age was 76 years (range, 51-103 years). 67% were female. Of 413 fractures, 130 were treated with a single-screw device (79 stable, 51 unstable), and 283 with a two integrated screw device (155 stable, 128 unstable). At 6-month f/u, there were 64 fractures treated with the single-screw device (33 stable, 31 unstable) and 107 with the two integrated screw device (51 stable, 56 unstable). At 12-month f/u there were 54 fractures treated with the single-screw device (32 stable, 22 unstable) and 54 with the two integrated screw device (23 stable, 31 unstable). Table 1 illustrates the changes between postop and the 12-months f/u films.

Table 1	**NSA Changes at 12-Month f/u (degrees)**		**Shortening (FNS) at 12-Month f/u (mm)**	
	Single	**Two Integrated**	**Single**	**Two Integrated**
All Fractures	4.56	1.81*	5.10 (0-13.36)	2.36 (0-7.84)*
Stable	4.19	1.24*	4.91 (0-11.62)	2.35 (0-6.50)*
Unstable	5.08	2.24*	5.37 (0-13.36)	2.38 (0-7.84)*

*Differences statistically significant ($P < 0.001$)

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

The single-screw device resulted in 2.5 times greater varus collapse (NSA) and 2 times more femoral neck shortening over 1 year than the two integrated screw device, regardless of fracture stability ($P < 0.001$). NSA and FNS changes were greater for both devices in an unstable fracture pattern as compared to stable fractures, but significantly less movement occurred with the two integrated screw device.

Conclusion: A cephalomedullary nail with two integrated proximal screws appears to maintain initial fracture reduction and subsequent position over time (FNS), with less varus collapse (NSA) than a cephalomedullary nail with a single proximal screw. This was true for both stable and unstable fractures. These data indicate that the two integrated screw device resulted in fewer intertrochanteric malunions, which may be clinically important when considering long-term functional outcomes in patients with these fractures.

See pages 99 - 147 for financial disclosure information.

Management and Outcomes of Femoral Head Fractures

John A. Scolaro, MA, MD[1]*; Geoff Marecek, MD*[2]*; Reza Firoozabadi, MD*[3]*; James C. Krieg, MD*[4]*; Milton Lee (Chip) Routt, MD*[5]*;*
[1]*University of California, Irvine, Orange, California, USA;*
[2]*University of Southern California–Los Angeles, California, USA;*
[3]*Harborview Medical Center, University of Washington, Seattle, Washington, USA;*
[4]*Rothman Institute, Thomas Jefferson University, Philadelphia, Pennsylvania, USA;*
[5]*The University of Texas–Health Sciences Center at Houston, Houston, Texas, USA*

Purpose: The purpose of this study was to evaluate the incidence, treatment, and outcomes of femoral head fractures at a high-volume academic Level I trauma center. Previous studies have reported small series of patients with these injuries but information from larger study populations is lacking.

Methods: This study was approved by the IRB at our institution. A retrospective chart review of a prospectively collected trauma database was performed at a single regional Level I trauma center between January 1, 2000 and January 1, 2013. All AO/OTA 31C fractures of the femoral head were identified for review. All fractures were classified by the Pipkin system. Patients with clinical and radiographic follow-up greater than 6 months were included in our evaluation. Patients treated operatively and nonoperatively were included. For patients treated operatively, approach and fixation techniques were recorded. Follow-up patient radiographs were evaluated for failure of fixation (if performed), development of heterotopic ossification, and the development of osteonecrosis or posttraumatic degenerative joint disease at latest follow-up.

Results: We identified 164 fractures in 163 patients. 17 patients were excluded because of incomplete records or radiographs, leaving 147 fractures available for review. The overall distribution in classification was as follows: Pipkin I: 40 (27.2%), II: 62 (42.2%), III: 7 (4.8%), IV: 23 (15.6%); 15 (10.2%) fractures did not fit within the Pipkin classification system. 78 patients (53.4%) were treated with open reduction and internal fixation (ORIF), 37 (25.3%) with fragment excision, 28 (19.2%) patients were treated nonoperatively, and 3 (2%) with hemiarthroplasty. An anterior approach, rectus tenotomy and mini-fragment screws were used in the majority of patients treated with ORIF. 69 fractures in 68 patients had clinical and radiographic follow-up greater than 6 months (mean follow-up 12.4 months). 62 fractures (89.9%) proceeded to union without radiographic signs of failure. All patients were full weight bearing by 3 months. All Pipkin III fractures failed operative fixation. At last follow-up, 6 patients developed radiographic signs of osteonecrosis, and 7 patients went on to hip arthroplasty. Heterotopic ossification developed in 28 (40.6%) patients. Classification was Brooker I in the majority of patients (60.1%).

Conclusion: Fractures of the femoral head are rare injuries. Over a 13-year period, 147 fractures were treated at our institution. The majority of these fractures can be reliably treated with ORIF using mini-fragment screws through an anterior approach. If fragment fixation is not possible, excision can be performed. Pipkin III fractures represent severe injuries that may not be amenable to successful fixation strategies. Nonbridging heterotopic ossification is

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

common following operative intervention. Few patients progress to osteonecrosis or joint degeneration that requires later arthroplasty.

See pages 99 - 147 for financial disclosure information.

The Clinical Study of the Treatment of Femoral Shaft Nonunions After Nailing with Augmentation Plating Versus Exchange Nailing

Bosong Zhang, MD; *Yunbang Liang, MD; Xiaofeng Gong, MD; Manyi Wang, MD; Jishuitan Hospital, Beijing, China*

Purpose: The purpose of this study was to compare the results between augmentation plating versus exchange nailing for femoral shaft nonunion after nailing. We hypothesized that augmentation plating group would have a similar clinical results versus exchange nailing.

Methods: From May 2003 to June 2011, 104 cases of femoral shaft nonunions after nailing were treated. 83 patients were treated with augmentation plating leaving the nail in situ and autogenous bone grafting. 21 patients were treated with exchange nailing without autogenous bone grafting. The main outcome measures included operation time, volume of intraoperative blood loss, volume of intraoperative autogenous blood refused, volume of postoperative drainage, length of hospital stay, cost of hospitalization, and time to radiographic union. The t'-test was performed to compare results.

Results: There were no significant differences between the two groups in age, gender, volume of postoperative drainage, and length of hospital stay. There were significant differences in operation time, volume of intraoperative blood loss, volume of intraoperative autogenous blood reinfused, cost of hospitalization, and time to radiographic union (Table).

Conclusion: Augmentation plating leaving the nail in situ with autogenous bone grafting is a better option than exchange nailing for femoral shaft nonunions.

Table. Results of Augmentation Plating Compared With Exchange Nailing

	Augmentation Plating Group	Exchange Nailing Group	*P*
Operation time (min)	99.3 ± 27.8	176.5 ± 46.0	$t' = 7.359$, $P < 0.001$
Volume of blood loss (mL)	494.9 ± 281.3	1157 ± 815.7	$t' = 3.666$, $P = 0.001$
Volume of blood reinfused (mL)	344.6 ± 173.2	665 ± 306.1	$t' = 3.005$, $P = 0.014$
Volume of drainage (mL)	332.0 ± 220.7	315.0 ± 257.1	$t' = -0.305$, $P = 0.761$
Hospital time (day)	13.9 ± 6.1	17.0 ± 5.4	$t' = 1.778$, $P = 0.078$
Cost of hospital (RMB)	28862.5 ± 8547.1	40998.0 ± 14068.3	$t' = 4.083$, $P < 0.001$
Union time (month)	5.2 ± 2.8	8.5 ± 5.5	$t' = 3.175$, $P = 0.002$

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

The Results of a Systematic Approach to Exchange Nailing for the Treatment of Aseptic Femoral Nonunions

Eli A. Swanson, MD; Eli C. Garrard, MD; Derek T. Bernstein, MD; ***Daniel P. O'Connor, PhD****; Mark R. Brinker, MD;*
Fondren Orthopedic Group, Texas Orthopedic Hospital, Houston, Texas, USA

Purpose: This study evaluated the effectiveness of a systematic approach to exchange nailing for the treatment of aseptic femoral nonunions previously treated with an intramedullary nail.

Methods: 50 aseptic femoral nonunions in 49 patients who presented with an intramedullary nail in situ an average of 25 months after the initial fracture nailing were evaluated. Our systematic approach includes inserting an exchange nail at least 2 mm larger in diameter than the in situ nail, using a different manufacturer's nail to facilitate placement of interlocking screws in different locations or trajectories or both, static interlocking, correction of any metabolic and endocrine abnormalities, and secondary nail dynamization in cases showing slow progression toward healing. In addition, we do not utilize closed exchange nailing in patients with partial segmental defects of the femur comprising greater than 50% of the cross-sectional cortical contact surface area. The outcome measures were radiographic and clinical evidence of nonunion healing and time to union.

Results: All 50 femoral nonunions (100%) healed following this systematic approach to exchange nailing. The average time to achieve union was 7 months (range, 3-26 months). Fourteen (28%) nonunions healed but had undergone nail dynamization performed between 3 and 9 months following exchange nailing due to concerns about slow progression to healing on radiographs. In 6 patients who had either a subtrochanteric nonunion initially treated with a retrograde nail or a distal femur nonunion initially treated with an anterograde nail, an exchange nail in the opposite direction was utilized to achieve greater stability in the shorter segment. Time to bony union did not vary by patient age ($P = 0.464$), gender ($P = 0.754$), fracture pattern ($P = 0.579$), soft tissues at the time of original injury (closed vs. open) ($P = 0.777$), nonunion location ($P = 0.907$), nonunion type ($P = 0.656$), nonunion duration ($P = 0.852$), history of prior failed dynamization of the in situ nail at presentation ($P = 0.783$), and increase in nail diameter with exchange nailing ($P = 0.649$).

Conclusion: Utilization of our systematic approach of exchange nailing for treatment of aseptic femoral nonunions resulted in a 100% healing rate. The systematic approach includes careful patient selection, increasing nail diameter by at least 2 mm, selecting a different nail manufacturer for the exchange nail, static interlocking, dynamization after 3 months if necessary, and screening for and treating metabolic, endocrine, and other medical problems.

See pages 99 - 147 for financial disclosure information.

Working Length and Proximal Screw Constructs in Plate Osteosynthesis of Distal Femur Fractures

William H. Harvin, MD; Gregory J. Della Rocca, MD, PhD; Yvonne M. Murtha, MD; David A. Volgas, MD; James P. Stannard, MD; ***Brett D. Crist, MD****;*
University of Missouri, Columbia, Missouri, USA

Purpose: This work was undertaken to evaluate the working length, proximal screw density, and diaphyseal fixation mode and the correlation to fracture union after locking plate osteosynthesis of distal femoral fractures using bridge-plating technique.

Methods: In this retrospective medical record review, patients undergoing operative fixation of distal femur fractures with a distal femoral locking plate utilizing bridge-plating technique for the metadiaphyseal region were included. Primary variables included fracture union, secondary surgery for union, plate working length, and diaphyseal screw technique and configuration. Secondary variables included patient demographics, patient comorbidities (tobacco use and diabetes mellitus), injury mechanism, plate metallurgy, OTA fracture type, Gustilo type for open fractures, periprosthetic fracture, and coronal plane fracture alignment.

Results: 99 patients with distal femur fractures with a mean age 60 years (36 male and 63 female) met inclusion criteria. Mean follow-up was 576 days with 89% follow-up until declared union or 1 year and overall 63% 1-year follow-up. None of the clinical parameters (patient demographics, comorbidities, fracture type, mechanism of injury) were statistically significant indicators of union. Plate metallurgy (50 stainless steel and 49 titanium) was not a statistically significant indicator of union. The mean working length (distance between the first screw on either side of the fracture) was 90.5 mm and it was not statistically significant for fracture union. Screw density (number of screws proximal to fracture divided by length of plate proximal to fracture), number of proximal screws, and screw cortices were not significantly related to fracture union. Diaphyseal screw technique did show statistical significance (1 non-locking, 45 locking, 53 hybrid). Hybrid technique had a statistically significant higher chance of union when compared to locking ($P = 0.03$). All proximal locking screw constructs were 2.7 times more likely to lead to nonunion.

Conclusion: Stiffer plating constructs when using bridge-plating techniques in distal femur locking plates was associated with a 2.7× higher likelihood of nonunion. Surgeons should consider avoiding the use of all locking screws for diaphyseal fixation in distal femoral locking plates. However, other factors associated with more flexible fixation constructs such as increased working length, decreased proximal screw number, and decreased proximal screw density were not significantly associated with union in this study. Larger prospective studies are necessary to determine plate type, length, and screw construct to promote the ideal stress-strain environment for fracture healing in distal femur fractures.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Construct Characteristics Predisposing to Nonunion After Locked Lateral Plating of Distal Femur Fractures

Edward K. Rodriguez, MD, PhD[1,2]*; Lindsay M. Herder*[1,2]*; Jordan Morgan, BS*[2,3]*;*
David Zurakowski, PhD[2,4]*; Michael J. Weaver, MD*[2,3]*; Paul T. Appleton, MD*[1,2]*;*
Mark S. Vrahas, MD[2,5]*;*
[1]*Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA;*
[2]*Harvard Orthopedic Trauma Service, Boston, Massachusetts, USA;*
[3]*Brigham and Women's Hospital, Boston, Massachusetts, USA;*
[4]*Children's Hospital,, Boston, Massachusetts, USA;*
[5]*Massachusetts General Hospital, Boston, Massachusetts, USA*

Background/Purpose: Nonunion rates after lateral locked plating (LLP) of a distal femur fracture range from 0% to 21%. Previous studies have examined patient and injury parameters such as obesity, age, diabetes, fracture type, etc, as possible predictors of nonunion. We now seek to identify discrete construct characteristics related to construct stiffness that may be independent predictors of nonunion risk after LLP fixation of distal femur fractures.

Methods: This is a retrospective review of 271 distal femoral fractures treated with LLP at three Level I academic centers. Nonunion was defined as the occurrence of any secondary procedure to manage poor healing. Construct variables recorded were: (1) plate material, (2) plate length, (3) number of screws proximal to the fracture, (4) ratio of filled screw holes to total plate holes, (5) presence of a screw crossing the main fracture plane, and (6) an overall stiffness score (range, 0 [low stiffness] to 5 [high stiffness]) incorporating the above variables in an equally weighted manner. Stiffness score was calculated by awarding 1 point for each of the following: if the construct was stainless steel, if it had >4 screws proximally, if the plate was <10 holes in length, if the ratio of filled to unfilled holes was >0.65, and if a screw crossed the main fracture plane. Multivariable analysis was performed using logistic regression to control for confounding in order to identify independent risk factors for nonunion.

Results: The overall nonunion rate was 13.3% (n = 36). There was a significant association between plate material and nonunion with rates of 9.6% for titanium and 40.6% for stainless steel ($P < 0.001$). Fixation crossing the fracture was associated with a higher rate of nonunion but did not reach statistical significance ($P = 0.13$). No significant univariate differences with respect to number of proximal screws ($P = 0.34$), plate length ($P = 0.14$), or ratio of filled to total holes ($P = 0.56$) were observed between healed fractures and those with nonunion. Stiffness score did reach significance ($P = 0.025$) but likely reflects the overbearing effect of plate material. Results of the multivariate analysis confirm that the primary significant independent predictor of nonunion is use of stainless steel material showing an odds ratio >6 times higher for nonunion compared to titanium use (odds ratio = 6.4, 95% confidence interval: 2.8-14.7, $P < 0.001$).

Conclusion: When treating distal femur fractures with LLP, plate material has a highly significant and overbearing influence on the risk of nonunion independent of any other construct variable, including an overall stiffness score that weights suspect construct char-

See pages 99 - 147 for financial disclosure information.

acteristics equally. Material is a highly dominant predictor and a significant risk factor for nonunion. Comparison of construct characteristics as contributors to stiffness and nonunion risk are not useful unless all constructs compared are of similar material. A stiffness score that incorporates plate material as an equally weighted variable as other construct characteristics may overestimate the relevance of the other variables.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

MINI SYMPOSIA

OTA Trauma Registry Database
Moderators: *Julie Agel, ATC* and *Douglas W. Lundy, MD*

Circular Fixation: Applications for the Trauma Surgeon
Moderator: *Kevin J. Pugh, MD*
Faculty: *Animesh Agarwal, MD; Joseph R. Hsu, MD* and *J. Tracy Watson, MD*

Rib Fracture Fixation and the Surgical Management of Flail Chest Injuries: State of the Art
Moderator: *Michael D. McKee, MD*
Faculty: *Peter Althausen, MD; Niloofar Dehghan, MD; John C. Mayberry, MD; Aaron Nauth, MD; Emil H. Schemitsch, MD* and *Gerard P. Slobogean, MD*

NOTES

See pages 99 - 147 for financial disclosure information.

SKILLS LABS

(SL3) **ORIF Distal Tibia and Fibula Fractures**
Leader: *Matt L. Graves, MD*
Faculty: *David P. Barei, MD, FRCSC; Patrick F. Bergin, MD; Christopher Finkemeier, MD; Jason W. Nascone, MD* and *Timothy G. Weber, MD*

(SL4) **ORIF Distal Radius Fractures**
Leader: *David C. Ring, MD*
Faculty: *Cory A. Collinge, MD; Brett D. Crist, MD; Andrew D. Duckworth, MD; Saqib Rehman, MD; Melvin P. Rosenwasser, MD; Andrew H. Schmidt, MD* and *Thomas F. Varecka, MD*

NOTES

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Hip Fractures Are Risky Business: An Analysis of the NSQIP Data

*Rachel V. Thakore, BS; **Cesar S. Molina, MD**; Eduardo J. Burgos, MD; William T. Obremskey, MD, MPH, MMHC; Manish K. Sethi, MD; Vanderbilt University, Nashville, Tennessee, USA*

Purpose: The recent expansion of the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database provides an unparalleled opportunity to analyze the highest-risk orthopaedic surgeries. In this study, we begin by utilizing ACS-NSQIP data to compare the rate of 13 adverse events among the 30 most common orthopaedic procedures. We then use our findings to investigate risk factors and complication rates among the top five surgeries found to have the greatest rate of adverse events in orthopaedic surgery.

Methods: Using the ACS-NSQIP database, a prospective cohort of 101,862 orthopaedic patients from 2005-2011 were categorized by CPT codes. Demographics including age, sex, race, and comorbidities were recorded. The incidence of 13 adverse events was calculated. For the 5 procedures with the greatest rate of adverse events, the most common postoperative complications and risk factors for adverse events were identified. Statistical significant was set at $P < 0.05$.

Results: The top 5 orthopaedic procedures with the highest rate of adverse events were all hip fracture surgeries (n = 9460). Adverse events occurred in 15.9% to 27.4% of cases among these 5 procedures (Figure 1). These surgeries also accounted for 25.2% (2433/9640) of all adverse events in orthopaedics. Among the top 5 procedures, the most common adverse events were death (6.90%), urinary tract infection (UTI) (5.92%), and pneumonia (3.45%) (Table 1). Five significant risk factors were identified for adverse events following hip fracture repair, including age, history of CHF (congestive heart failure), esophageal varices, ASA (American Society of Anesthesiologists) class, and functional status (Table 2).

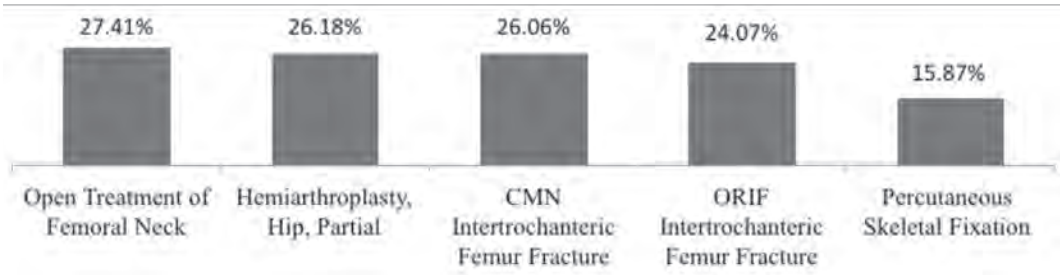


Figure 1. Orthopaedic procedures with the greatest rate of adverse events. CMN = cephalomedullary nailing, ORIF = open reduction and internal fixation.

Conclusion: This study, which is the first to use the expanded orthopaedic ACS-NSQIP database, demonstrates that over one-third of all adverse events in orthopaedics are due to hip fractures. Quality improvement programs targeted towards hip fracture patients, especially those with the risk factors identified above, can dramatically reduce adverse events in orthopaedic trauma.

See pages 99 - 147 for financial disclosure information.

Table 1. Top Five Complications Following Hip Fracture Repair	
Death	6.90% (n = 665)
Myocardial infarction	1.69% (n = 163)
Sepsis	2.02% (n = 195)
UTI	5.92% (n = 571)
Pneumonia	3.45% (n = 333)

Table 2. Risk Factors for Adverse Events Following Hip Fracture		
Risk Factors	Odds Ratio (95% Confidence Interval)	*P*
Age >65 years	1.37 (1.07-1.75)	0.013
History of CHF	1.85 (1.31-2.62)	0.0001
Esophageal varices	3.73 (1.20-11.6)	0.022
ASA class	1.26 (1.72-2.78)	0.0001
Functional status	2.33 (2.12-2.56)	0.0001

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Trauma Triage Scores Inadequately Assess Geriatric Patients

Matthew Wilson, MD[1]*; Sanjit R. Konda, MD*[2]*; Rachel Seymour, PhD*[1]*;*
Madhav A. Karunakar, MD[1]*; Carolinas Trauma Network Research Group*[1]*;*
[1]*Carolinas Medical Center, Charlotte, North Carolina, USA;*
[2]*NYU Hospital for Joint Diseases, New York, New York, USA*

Purpose: The objective of this study was to identify variables that predict mortality in geriatric trauma patients. We hypothesized that current trauma triage scores that were designed from younger, high-energy patient cohorts would not accurately predict the mortality risk for geriatric patients. Additionally we hypothesized traditional triage factors (age, vital signs, anatomic injuries) may require different weighting in the geriatric trauma population to account for differences in injury characteristics and physiology that occur with increasing age.

Methods: After obtaining IRB approval, we utilized the Trauma Registry to identify all geriatric trauma patients (age ≥55 years) who presented to our Level I trauma center from 2008-2011. Patients with a predicted probability of survival of 10%-75% based on the Trauma Score-Injury Severity Score (TRISS) were identified. This cohort with predicted intermediate mortality risk was selected because triage decision-making is less clear than with patients in the lower or upper bounds and, therefore, the sensitivity and specificity of the triage tool is more critical. A total of 247 patients met our inclusion criteria and had complete data. Ten patients were excluded for death in the emergency room. The remaining cohort of 237 patients was divided into survivors and nonsurvivors for analysis. The following triage variables that have been reported to have a role in predicting survival were analyzed: age, mechanism of injury, laboratory values, and vital signs upon arrival at the trauma center. The ISS and TRISS were calculated for both survivor and nonsurvivors.

Results: Of the 237 patients analyzed, 109 (46%) died during the index hospitalization (nonsurvivors) and 128 (54%) survived (survivors). There was no difference between survivors and nonsurvivors for gender (61% vs. 58% male; $P = 0.594$). The mean age for nonsurvivors was significantly higher than for survivors (74 years vs. 67 years; $P < 0.001$). 68% of nonsurvivors versus 43% of survivors ($P < 0.001$) suffered injuries as a result of a low energy mechanism (fall from standing height). GCS (Glasgow Coma Scale) was significantly lower for nonsurvivors compared to survivors (5.1 vs. 7.9; $P < 0.001$). The following parameters were significantly lower for nonsurvivors compared to survivors: temperature (96 vs. 97; $P < 0.01$), respiratory rate (10.7 vs. 13.8; $P < 0.05$), and HCT (hematocrit) (34.4 vs. 36.5; $P < 0.05$). Pulse rate, blood pressure, shock index (heart rate divided by systolic blood pressure), and base deficit on arrival were not significantly different. The TRISS was predictive of survival (TRISS 0.35 vs. 0.46; $P < 0.001$) while the ISS (a measure of injury severity) was significantly lower for nonsurvivors than survivors (ISS 23 vs. 26; $P <0 .001$).

Conclusion: In spite of its widespread adoption and use, the ISS is a poor predictor of mortality in an intermediate-risk geriatric trauma population as evidenced by lower triage scores for nonsurvivors when compared with survivors. Those patients in our cohort who survived had a higher probability of survival based on the TRISS, but the difference between groups was quite small, suggesting that the TRISS lacks the requisite specificity

See pages 99 - 147 for financial disclosure information.

to be used as an accurate prediction model in the geriatric patient. Older age, lower GCS, and a low-energy mechanism of injury are associated with a higher mortality rate in this geriatric population seen at an urban Level I trauma center. Given the inability of existing measures to adequately predict mortality in older adults, existing measures may be missing key variables that impact survival of traumatic injuries. This information sets the stage for the development of a triage tool specific to the geriatric trauma population with appropriately weighted risk factors.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Development and Validation of a Geriatric Trauma Triage Score

Sanjit R. Konda, MD[1]*; Rachel Seymour, PhD*[2]*; Arthur Manoli III, BS*[1]*;*
Madhav A. Karunakar, MD[2]*; Carolinas Trauma Network Research Group*[2]*;*
[1]*NYU Hospital for Joint Diseases, New York, New York, USA;*
[2]*Carolinas Medical Center, Charlotte, North Carolina, USA*

Purpose: Current injury severity indices (ISIs) (eg, Injury Severity Score [ISS], Trauma Score-Injury Severity Score [TRISS]) were developed in a high-energy, young adult population that translates poorly to the geriatric population. We sought to develop a novel, easy-to-use triage tool to identify inpatient mortality risk in geriatric trauma patients upon arrival in the emergency department.

Methods: The patient population consisted 2940 and 1605 low-energy and high-energy geriatric (≥55 years old) trauma patients (LE-GTPs and HE-GTPs, respectively) treated at a single Level I trauma center from 2008-2011 that were identified from Trauma Registry. Low-energy was defined as a ground-level fall and high-energy was defined as trauma resulting from a fall from height, motor vehicle or motorcycle accident, or pedestrian struck. In phase 1, we evaluated the ability of current ISIs to predict mortality for LE- and HE-GTPs using area under the receiver operating characteristic curve (AUROC). In phase 2, a backwards stepwise regression analysis (using <0.05 as the significance threshold) was used to create a novel low-energy and high-energy geriatric trauma triage score (LE-GTTS and HE-GTTS, respectively) using 4 core-host variables (age, preexisting conditions via the Charlson Co-morbidity Index (CCI), anatomic injuries via the Abbreviated Injury Scale (AIS), and physiologic status via vital signs). We compared the ability of the new scores versus current ISIs to detect inpatient mortality. In phase 3 we validated these scores using AUROC analysis with 37,474 LE-GTPs and 97,034 HE-GTPs from the National Trauma Databank (NTDB).

Results: LE-GTPs were 9.1 years older than HE-GTPs (75.8 ± 11.0 vs. 66.7 ± 9.2, $P < 0.01$). The overall mortality rate for LE-GTPs vs. HE-GTPs was 7.9% vs. 7.0% ($P < 0.01$) Phase 1: TRISS was found to be the most predictive existing ISI for both cohorts and was deemed to have moderate predictive capacity in the low-energy cohort and excellent predictive capacity in the high-energy cohort (LE-GTP AUROC: 0.82 vs. HE-GTP AUROC: 0.91; $P < 0.01$). Phase 2: The LE-GTTS was found to have the following variables included in the final model (data type, odds ratio): age (continuous, odds ratio [OR]: 1.05), CCI (ordinal, OR: 1.28), Glasgow Coma Scale (GCS) (ordinal, OR: 0.72), AIS-Head & Neck (ordinal, OR: 1.67), and AIS-Chest (ordinal, OR: 1.52). The predictive capacity of the LE-GTTS was significantly better than TRISS (AUROC 0.89 vs. 0.82, $P < 0.01$). The HE-GTTS was found to have the following variables included in the final model: age (continuous, OR: 1.12), GCS (ordinal, OR: 0.69), AIS-Head & Neck (ordinal, OR: 1.77), AIS-Chest (ordinal, OR: 1.51), and AIS-Extremity (ordinal, OR: 1.59). The predictive capacity of the HE-GTTS was significantly better than TRISS (AUROC 0.96 vs. 0.91, $P < 0.01$). Phase 3: In the NTDB, the LE-GTTS and HE-GTTS were both found to be significantly more predictive of mortality than TRISS (LE-GTTS AUROC: 0.82 vs. 0.79, $P <0.01$; HE-GTTS AUROC: 0.86 vs. 0.85, $P <0.01$).

Conclusion: The LE-GTTS and HE-GTTS are novel triage scores developed specifically for geriatric trauma patients. They are intended to triage patients to lower or higher levels of

See pages 99 - 147 for financial disclosure information.

care/monitoring from the emergency department setting. These scores have been validated in the NTDB and should therefore be valid to use prospectively in the clinical setting. Future work will focus on the development of clinical guidelines to improve triage decision-making.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Does Anesthesia Type Influence Risk of Perioperative Complications in Hip Fracture Surgery?

Rachel V. Thakore, BS; Cesar S. Molina, MD; ***Paul S. Whiting, MD****;*
William T. Obremskey, MD, MPH, MMHC; Manish K. Sethi, MD;
Vanderbilt University, Nashville Tennessee, USA

Purpose: Several recent studies have advocated the use of regional anesthesia (spinal and regional nerve blocks) over general anesthesia as a means of reducing the risk of perioperative complications associated with geriatric hip fracture surgery. However, conclusive evidence demonstrating clinically significant differences in complication rates between regional and general anesthesia in this patient population does not exist. We sought to explore further the impact of anesthesia type on perioperative complications in hip fracture surgery using the recently expanded American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database—a large, multicenter, prospective cohort of hip fracture patients.

Methods: Four CPT codes (27235, 27236, 27244, and 27245) representing the spectrum of hip fracture surgery were used to identify a prospective cohort of 7808 hip fracture patients from 2005-2011 in the ACS-NSQIP database. Only patients who were administered general anesthesia or regional anesthesia (spinal or nerve blocks) were included in the analysis (n = 7764). Perioperative complications were recorded and categorized as minor (wound dehiscence, superficial surgical site infection, pneumonia, and urinary tract infection) or major (death, deep wound infection, myocardial infarction, deep venous thrombosis, pulmonary embolism, peripheral nerve injury, sepsis and septic shock). Using a multivariate logistic regression analysis controlling for age, medical comorbidities, American Society of Anesthesiologists (ASA) status, operative time, and baseline functional status, perioperative complications were compared between patients receiving general anesthesia and patients receiving regional anesthesia. A χ^2 analysis was then used to compare complication rates between the two groups.

Results: 7764 patients with hip fractures were included in the final analysis**.** Rates of minor, major, and total complications by anesthesia type are displayed in Table 1. Patients undergoing surgical treatment for hip fractures who received regional anesthesia had a significantly higher risk of total complications (odds ratio [OR]: 1.05, $P = 0.025$) and minor complications (OR: 1.09, $P = 0.001$) compared with patients who were administered general anesthesia. There was no significant difference in risk of major complications between the two groups (OR: 0.99, $P = 0.720$) (Table).

See pages 99 - 147 for financial disclosure information.

Anesthesia Type	Minor Complication Rate	Major Complication Rate	Overall Complication Rate
General	9.0% (527/5840)	12.2% (714/5840)	17.9% (1,044/5840)
Regional nerve blocks	7.2% (8/111)	8.1% (9/111)	12.6% (14/111)
Spinal	11.6% (211/1813)	11.6% (211/1813)	19.6% (356/1813)
Total	9.6% (746/7764)	12.0% (934/7764)	18.2% (1414/7764)
OR, confidence interval (CI), *P* value	OR: 1.09, 95% CI: 1.035-1.150, ***P* = 0.001**	OR: 0.99, 95% CI: 0.940-1.043, *P* = 0.72	OR: 1.05, 95% CI: 1.006-1.094, ***P* = 0.025**

Conclusion: In this large prospective cohort of patients with hip fractures, regional anesthesia was associated with a small (OR = 1.05) but statistically significant increase in the risk of perioperative complications compared with general anesthesia. This increased risk is driven by a higher risk of minor complications in the regional anesthesia group (OR = 1.09). Considering the small odds ratios, the clinical significance of these findings remains unclear. Nonetheless, our results do not support the conclusions of several recent studies, which suggest decreased rates of perioperative complications with regional as compared to general anesthesia.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Efficacy of Scheduled Intravenous Acetaminophen Pain Management Protocol in Hip Fractures

Alexander J. Bollinger, MD[1,2]*; Paul D. Butler, MD*[1,2]*; Matthew S. Nies, MD*[2]*;*
Debra L. Sietsema, PhD[2,3]*; Clifford B. Jones, MD*[2,3]*; Terrence J. Endres, MD*[2,3]*;*
[1]*Grand Rapids Medical Education Partners, Grand Rapids, Michigan, USA;*
[2]*Michigan State University College of Human Medicine, Grand Rapids, Michigan, USA;*
[3]*Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA*

Purpose: Hip fractures are a common problem in the geriatric population, having wide-reaching effects including functional decline and economic impact on the health-care system. Prior studies have demonstrated both the safety of intravenous (IV) acetaminophen and its efficacy in decreasing perioperative narcotic consumption. The purpose of this study was to determine whether the implementation of a scheduled IV acetaminophen perioperative pain protocol during geriatric hip fracture treatment influenced length of hospital stay (LOS), pain level, narcotic use, physical therapy (PT) participation, and discharge disposition.

Methods: After IRB approval was obtained, a retrospective CPT code (27235, 27236, 27244, 27245) search was performed and the charts were reviewed of all patients 65 years or older admitted to the orthopaedic service at a Level I trauma center who underwent operative treatment for a hip fracture from June 1, 2011 through May 31, 2013. The patients were divided into two cohorts; the first (Group 1) consisted of patients treated before the initiation of a standardized IV acetaminophen pain control protocol, and the second (Group 2) consisted of those treated after the protocol was initiated. 365 consecutive fractures in 360 patients were identified. Pathologic fractures (8), periprosthetic fractures (8), concomitant injuries requiring operative intervention (8 fractures in 7 patients), and perioperative deaths (5) were excluded. This resulted in 332 patients with 336 intertrochanteric or femoral neck fractures (169 fractures in Group 1, 167 fractures in Group 2) with a mean age of 83 years (range, 65-101).

Results: There was no statistically significant difference in demographic data (age, gender, fracture classification, body mass index) or time from admission to the operating room between the two cohorts. Group 2 had a shorter mean LOS (4.4 vs. 3.8 days), lower mean visual analog scale (VAS) pain score (4.2 vs. 3.8), lower mean narcotic usage (41.3 vs. 28.3 mg "morphine equivalent"), lower rate of PT sessions missed (21.8% vs. 10.4%), and higher likelihood of discharge home instead of to a secondary care facility (7.1% vs. 19.2%) ($P \leq 0.001$, respectively). Separate multivariate regression analyses also demonstrated statistical significance for the utilization of IV acetaminophen as an independent predictor of decreased LOS, decreased VAS pain scores, lower narcotic usage, fewer missed PT sessions ($P < 0.001$, respectively), and increased rate of home discharge ($P = 0.008$).

Conclusion: The utilization of scheduled perioperative IV acetaminophen as part of a standardized pain management protocol for operative geriatric hip fractures is efficacious for shortening hospital length of stay, improving subjective and objective pain measures, missing fewer physical therapy sessions, and increasing home discharge rate.

See pages 99 - 147 for financial disclosure information.

The Effect of Preoperative Transthoracic Echocardiogram on Mortality and Surgical Timing in Elderly Hip Fracture Patients

Kevin Luttrell, MD[1]*; Arvind D. Nana, MD*[1,2]*;*
[1]*John Peter Smith Hospital Orthopaedic Surgery Residency Program, Fort Worth, Texas, USA;*
[2]*Harris Methodist Hospital, Fort Worth, Texas, USA*

Purpose: Heart disease is the most common cause of postoperative mortality in elderly hip fracture patients, and transthoracic echocardiogram (TTE) is often used to assess cardiac function prior to surgery. The purpose of our study was to evaluate the effect of preoperative TTE on mortality, postoperative complications, surgical timing, and length of stay in surgically treated hip fracture patients.

Methods: A retrospective chart review was performed on 694 consecutive hip fracture patients >60 years of age treated surgically at two local hospitals. Patients were identified by billing codes over a 30-month time period from July 1, 2009 to December 31, 2011. Hospital records were reviewed for age, sex, timing of admission, medical clearance, operation and discharge, admitting service, fracture and treatment type, medical comorbidities, American Society of Anesthesiologists (ASA) score, preoperative testing ordered (TTE), preoperative cardiac intervention, complications, and mortality. The Social Security Death Index was used for 30-day and 1-year mortality data when not available in the hospital records. Our primary outcome measure was in-hospital, 30-day, and 1-year mortality following hip fracture surgery in patients who receive preoperative TTE. Secondary outcome measures included complications (particularly cardiovascular) and time required for medical clearance and operative treatment.

Results: Preoperative echocardiogram was performed on 131 patients (18.9%). Patients admitted by the medicine service were 1.76 times more likely to receive preoperative TTE ($P < 0.01$). Patients were 2.28 times more likely to receive TTE if they had a history of coronary artery disease ($p < .001$), and 2.12 times more likely if they had a history of arrhythmia ($P < 0.001$). Five patients in the TTE group and one patient in the control group underwent cardiac catheterization prior to surgery, but none of these patients required angioplasty or stent placement. There was no difference in mortality between the TTE group and the control group in hospital (3.8% vs. 1.8%, $P = 0.176$), at 30 days (6.9% vs. 6.6%, $P = 0.90$), or at 1 year (20.6% vs. 20.1%, $P = 0.89$), respectively. There was no significant difference in major cardiac complications between groups. Average time from admission to operative treatment was 66.5 hours in the TTE group and 34.8 hours in the control group ($P < 0.001$). Average time from admission to medical clearance was 43.2 hours in the TTE group and 12.4 hours in the control group ($P < 0.001$). There was no difference in the time between medical clearance and operative treatment between the two groups (23.3 hours versus 22.4 hours, $P = 0.639$). The TTE group also had a significantly longer length of stay at 8.68 days compared to 6.44 days in the control group ($P < 0.001$).

Conclusion: Preoperative TTE did not help reduce mortality rates in elderly hip fracture patients in either short or long-term postoperative periods. In addition TTE delayed surgical treatment, resulted in no cardiac intervention, and increased length of stay. The American

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Heart Association (AHA) and the American College of Cardiology (ACC) have developed guidelines for perioperative assessment of patients in case of noncardiac surgery. TTE should not be used as a screening tool in hip fracture patients, but instead used to further evaluate active cardiac conditions.

See pages 99 - 147 for financial disclosure information.

Improving Care for Older Patients with Hip Fracture

Christopher G. Moran, MD, FRCS(Ed)[1]*; Chris Boulton, BA*[2]*; Antony Johansen*[2]*;*
Robert Wakeman[2]*; Keith Willett, MD, FRCS*[3]*;*
[1]*NHS England, Nottingham University Hospital, Nottingham, United Kingdom;*
[2]*National Hip Fracture Database, Royal College of Physicians, London, United Kingdom;*
[3]*NHS England, Oxford, United Kingdom*

Background/Purpose: Hip fracture is a common and increasing socioeconomic problem throughout the world. These patients present a challenge to the health-care system as they are elderly with multiple comorbidities, have high rehabilitation demands, and often require enhanced social care. Single variables within the patient pathway, such as a new implant, may make a difference to outcome but most research suggests that improvements in the entire pathway from admission through to surgery and rehabilitation are required to make the biggest impact on outcome. This pathway should include measures to reduce the risk of future falls and fragility fractures. In England, a best-practice pathway together with financial incentive and audit has been introduced to cover the entire population of the country.

Methods: The National Hip Fracture Database (NHFD) prospectively collects data for hip fracture admissions at all 186 hip fracture units in England. 6000 new patients are added to the database each month. It started in 2008 and currently holds records on 309,839 patients. The median age is 80 years and 71% are female. The best-practice pathway has evolved from 7 to 10 key standards: admissions protocol, joint orthopaedic and geriatric care, surgery within 36 hours, geriatric review within 72 hours, multidisciplinary rehabilitation, falls and osteoporosis assessments; pre- and postoperative cognitive assessment, and data submission to NHFD. Mortality data are linked to the National Office of Statistics allowing 100% follow-up for mortality. To qualify for the financial incentive, a patient must receive all 10 parts of the pathway.

Results: The best-practice pathway started in 2010 and in the first year 14,615 out of 53,443 patients (27%) received the complete pathway. The number of patients receiving the entire pathway has increased quarter by quarter so that during the year April 2012-2013, 30,627 of 56,226 patients (54.5%) received all 10 standards. A further 14,506 patients (25.8%) received 9 of 10 pathway measures, indicating that the hospitals have systems in place to deliver a good care pathway. The national 30-day mortality following hip fracture has fallen 15% from 9.2% in 2008 to 8.2% in 2013.

Conclusion: We have undertaken a project to improve hip fracture care for the entire population of a country. Using a combination of well-defined, evidenced-based practice standards that address the entire patient pathway, financial incentive and good clinical audit, there has been a significant improvement in the care pathway with an additional 30,000 patients receiving the 9 or 10 parts of the pathway within 3 years of starting the project. This has been reflected in a 15% reduction in the national 30-day mortality.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Surgery Versus Cast Immobilization for Displaced Intra-Articular Distal Radius Fractures in Elderly Patients: A Randomized Controlled Multicenter Trial

Christoph Bartl[1]*; Dirk Stengel, MD, PhD, MSc*[2]*; Thomas Bruckner, Dipl Math*[3]*;*
Florian Gebhard, MD, PhD[1]*; the ORCHID Study Group;*
[1]*Department of Orthopaedic Trauma Surgery, Ulm University, Ulm, Germany;*
[2]*Department of Orthopaedic Trauma Surgery and Clinical Research, Unfallkrankenhaus Berlin, Berlin, Germany;*
[3]*Department of Biostatistics, Heidelberg University, Heidelberg, Germany*

Purpose: The best treatment strategy for displaced intra-articular distal radial fractures in elderly patients with poor bone quality is still controversial. In this randomized controlled multicenter trial we investigated whether surgical management is more effective than cast immobilization in patients over 65 years.

Methods: Of 737 eligible individuals, 185 patients with an intra-articular distal radius fracture (AO/OTA C1, C2, C3) agreed to participate. 94 participants were assigned to surgical management with volar locking plate fixation and 91 to closed reduction and cast immobilization for 6 weeks. The primary outcome was the Short Form-36 physical component summary score (SF-36 PCS) 1 year after randomization. We also assessed other SF-36 domains, the Disabilities of the Arm, Shoulder and Hand (DASH) score, the EuroQol-5D (EQ-5D) visual analog scale (VAS) and utility index, wrist range of motion (ROM), and radiographic evaluation of the wrist 3 and 12 months after randomization.

Results: Both groups showed similar baseline characteristics concerning age, gender, fracture severity and activity status. 37 (41%) patients assigned to cast immobilization subsequently underwent surgery due to significant loss of reduction. After 1 year, surgery was not superior to cast treatment (SF-36 PCS mean difference 3.3, 95% confidence interval –0.2 to 6.8) in the intent-to-treat population. Also, no statistical or clinical benefit of surgery was apparent with regard to mean differences in DASH scores (–5.0, 95% confidence interval [CI] –11.0 to 1.0) and EQ-5D VAS scores (3.0, 95% CI –1.9 to 7.9). The surgical group showed a faster improvement in ROM of the wrist after 3 months ($P < 0.05$), but after 1 year there were no significant differences of wrist ROM in all planes between both groups. Surgical management achieved a significant better anatomic restoration of the distal radius in palmar tilt, ulnar variance, and radial height (each $P < 0.05$), but this finding was not associated with superior functional results. Outcome results were similar when analyzed according to the treatment actually received.

Conclusion: In elderly patients with a displaced intra-articular distal radius fracture, surgical fixation with volar locking plates was not superior to cast immobilization in terms of health-related quality of life and wrist function 1 year after the intervention. Cast immobilization remains the primary treatment option in this patient group, and second-line surgery in case of cast treatment failure does not compromise late outcome results.

See pages 99 - 147 for financial disclosure information.

Determinants of Functional Outcome in Distal Radius Fractures in High Functioning Elderly Patients

***Jeremie Larouche, MD, FRCSC**; Jeffrey Pike, MD; Gerard P. Slobogean, MD, MPH, FRCSC; Pierre Guy, MD; Henry M. Broekhuyse, MD; Peter J. O'Brien, MD, FRCSC; Kelly A. Lefaivre, MD;*
Division of Orthopaedic Trauma, Department of Orthopaedic Surgery, University of British Columbia, Vancouver, British Columbia, Canada

Background/Purpose: Despite numerous previous studies showing no difference between operative and nonoperative treatment of distal radius fractures in the elderly, the rate of operative fixation has increased fivefold over the last decade. We aimed to determine the influence of treatment and radiographic parameters on patient-reported functional outcomes over a 1-year period.

Methods: Patients with an acute distal radius fracture over the age of 55, and with a Canadian Study of Health and Aging (CSHA) Frailty score of 1 or 2 (high functioning, medically well) were recruited for this prospective study and treated as per the surgeon's protocol. Baseline patient characteristics were collected. Standard radiographs were obtained at the time of injury, treatment, and at 12-week follow-up. Patients provided baseline, as well as 12-week and 1-year functional outcome measures including the Patient-Rated Wrist Evaluation (PRWE), Disabilities of the Arm, Shoulder and Hand (DASH), and Short Form-36 (SF-36). Univariate analyses to evaluate the relationship between operative and nonoperative treatment, as well as various radiographic parameters, on functional outcome were performed. Linear regression analysis was carried out to determine the effect of specific radiographic parameters as well as surgical treatment on functional outcome when controlling for other important predictors.

Results: 129 patients were recruited for this study, 117 women and 12 men. The mean age of the cohort was 65.96 ± 0.67 years (range, 55-90). 70 patients underwent open reduction and internal fixation, and 59 were treated with manipulation and casting. There was no statistically significant difference in DASH score, SF-36 PCS (physical component summary) or PRWE at 52 weeks follow-up ($P = 0.963$, $P = 0.184$, $P = 0.645$). The operative group had higher PRWE pain scores (7.85 ± 1.08 vs. 6.95 ± 1.34) but this did not reach statistical significance. As expected, the operative group had a significantly worse composite radiographic score at the time of injury ($P = 0.0002$), but the two groups had very similar scores at the time of treatment ($P = 0.4303$). At 3 months postsurgery, the nonoperatively treated group had significantly worse radiographic scores ($P = 0.0006$). A univariate relationship existed between ulnar positive measurement of >2 mm and poorer DASH and SF-36 scores were seen ($P = 0.0349$, $P = 0.0385$); however, no such relationship existed for the other individual or composite radiographic parameters tested. Linear regression models controlling for operative versus nonoperative treatment, gender, age, and occurrence of a complication found a significant relationship between ulnar positivity >2 mm and change in DASH between baseline and 12 months (0.0466) as well as SF-36 PCS between 0 and 12 months (0.0383).

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Conclusion: In high-functioning elderly patients, surgical treatment produced a better radiographic result than cast treatment; however, the functional outcomes at 1 year are not statistically different. Univariate and regression analysis demonstrated a relationship between ulnar positive variance and poorer functional outcomes, but no such relationship was found for other radiographic parameters or a composite radiographic score.

See pages 99 - 147 for financial disclosure information.

A Comparison of Primary Total Elbow Arthroplasty Versus Secondary Total Elbow Arthroplasty (Following Failed Internal Fixation) for Distal Humeral Fractures of the Elderly

James M. Dunwoody MD, FRCSC; Justin L. Hodgins, MD; ***Milena R. Vicente, RN, CCRP****;*
Laura Schemitsch, BA; Patrick Henry, MD, FRCSC; Jeremy Hall, MD, FRCSC;
Michael D. McKee, MD, FRCSC;
St. Michael's Hospital and the University of Toronto, Toronto, Ontario, Canada

Purpose: The purpose of our study was to compare the outcome of distal humeral fractures treated with acute (primary) total elbow arthroplasty (TEA) to those treated with late (secondary) arthroplasty following failure of initial fracture fixation.

Methods: This was a single-center, retrospective, longitudinal cohort study of patients undergoing primary TEA or secondary TEA for distal humerus fracture at a single university-affiliated hospital from 1994 to 2011. Patients were initially identified through a prospectively gathered clinical database. Data captured included demographics, fracture classification, type of arthroplasty (primary or secondary), presence of complications, revision surgery, and signs of radiographic loosening. Charts were reviewed and patients were asked to return to clinic for a follow-up visit in order to capture functional outcomes. The primary outcome measure was the Disabilities of the Arm, Shoulder and Hand (DASH) score. Other outcome measures included operative parameters, Mayo Elbow Performance Score (MEPS), range of motion, ulnar nerve function, and grip strength.

Results: We identified 91 eligible patients who were treated with either primary or secondary TEA for a distal humerus fracture between 1994 and 2011. Nine patients declined participation, and 31 had died. A comprehensive chart review was performed on 82 patients with a mean follow-up of 6 years (the latest available chart data were included for patients who had died). 36 patients had a primary TEA, and 46 had a secondary TEA. In the primary group there were 7 male and 29 female patients with an average age of 77 years. In the secondary group there were 11 male and 35 female patients with an average age of 68 years. The difference in age was statistically significant ($P < 0.001$). The rate of revision was 8% (3/36) in the primary group and 20% (9/46) in the secondary group ($P = 0.12$). Two patients (6%) with a primary arthroplasty had a deep infection requiring irrigation and debridement compared to four patients (9%) in the secondary group ($P = 0.34$). 25% of patients in the primary group had postoperative neurologic symptoms in the limb compared to 22% in the secondary group ($P = 0.78$). The mean operative time was 101 minutes in the primary group and 103 minutes in the secondary group ($P = 0.89$). The mean DASH score at final follow-up was 33 in the primary group and 42 in the secondary group ($P = 0.46$). The mean MEPS at final follow-up was 85 in the primary group and 80 in the secondary group ($P = 0.45$).

Conclusion: To our knowledge, this is the largest reported comparison of primary versus secondary TEA for distal humeral fracture. There was no significant difference in functional outcome between the two groups. Our study suggests a trend that secondary TEA was associated with a higher incidence of revision compared to primary TEA, but this was

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

not statistically significant (possibly due to a small sample size or beta error). Our results support TEA for either primary fracture care or secondary reconstruction of distal humeral fractures in the elderly. Additionally, these data are useful in surgical decision-making regarding these difficult injuries.

See pages 99 - 147 for financial disclosure information.

GUEST NATION – BRAZIL

Best International Forum Paper:
What Is the Cell Composition and Characteristics of Fibrous Tissue Harvested from the Nonunion Site of Long Bone Atrophic Nonunions?
Richard Cuthbert, BSc; Ahmed Lotfy; Hiang Boon Tan, MBBS; Elena Jones, PhD; ***Peter Giannoudis, MD***

Guest Nation Presentation
Tito Rocha, MD
National Institute of Traumatology and Orthopaedics
Ministry of Health, Rio de Janeiro, Brazil

"Evolution of Trauma Care System in Brazil: Current Status"

NOTES

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

JOHN BORDER MEMORIAL LECTURE
"Long Term Careers in Orthopaedic Trauma: System Design and Career Development"

Andrew R. Burgess, MD
Professor, Vice Chair UT Health Medical School, Houston, Texas

NOTES

See pages 99 - 147 for financial disclosure information.

SYMPOSIUM II: DAMAGE CONTROL ORTHOPAEDICS – WHERE ARE WE AFTER A DECADE (CENTURY) OF DEBATE AND RESEARCH?

Moderators: *Todd O. McKinley, MD*
Steven A. Olson, MD

Faculty: *Carl J. Hauser, MD* *Hans Christoph Pape, MD*
Robert V. O'Toole, MD

12:41 pm **Historical Perspective - Early Total Care and Ortho Damage Control**
Steven A. Olson, MD

12:52 pm **Mitchondrial DAMPs and Inflammation After Trauma**
Carl J. Hauser, MD

1:03 pm **Basic & Clinical Science - Systemic Response to Injury and the Polytrauma Patient**
Hans Christoph Pape, MD

1:14 pm **Translating Basic Science to Clinical Science**
Todd O. McKinley, MD

1:25 pm **Future Directions and Opportunities in Damage Control**
Robert V. O'Toole, MD

NOTES

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Evaluation of the Relationship Between Fractures and Hyponatremia

Kalyani Murthy, MD, MS[1]; Navneet Pala, MD[1]; Olexandra Koshkina, MD, MS[1]; Janis Breeze, MPH[2]; Jessica Paulus, ScD[2]; Andrew Marcantonio, DO, MBA[1]; Mary Beth Hodge, MD[1];
[1]Lahey Health and Medical Center, Burlington, Massachusetts, USA;
[2]Tufts Clinical and Translational Science Institute, Tufts University, and Institute for Clinical Research and Health Policy Studies, Tufts Medical Center, Boston, Massachusetts, USA

Purpose: Hyponatremia is frequently present in the elderly population. Recent studies show an increased risk of fractures in patients with mild chronic hyponatremia. Hyponatremia upregulates osteoclast-mediated bone resorption. Our study evaluates the relationship between hyponatremia and risk of incident fracture while controlling for bone density, age, and sex.

Methods: A retrospective, matched case-controlled study was performed. Patients ≥45 years old with dual-energy x-ray absorptiometry (DEXA_ scans and serum sodium obtained within a year prior to event of interest (fracture/nonfracture complaint) were included**.** Cases were defined as patients with an incident fracture (vertebra, femur/hip, tibia/fibula, and forearm) between January 2005 and May 2013. The first fracture was used for cases with multiple fractures. Controls were defined as patients with a nonfracture complaint over the same time period, matched 2:1 with cases on age (within 2 years) and sex. Data on disease modifiers including medications and disease conditions that could influence sodium levels and osteoporosis risk were also obtained. Hyponatremia was defined as: absent (>137 mmol/L), low-normal (135-137 mmol/L), mild (130-134 mmol/L), or moderate-severe (<130 mmol/L). Bone density classification was defined as: osteopenia = T-score –1.0 to –2.5, and osteoporosis = T-score <–2.5; univariate and multivariate conditional logistic regression models were used to estimate risk of fracture with hyponatremia and bone density. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. ll statistical analysis was performed using SAS v9.3. All tests were two-sided with alpha = 0.05.

Results: We identified 457 cases and 914 controls. Mean age was 73 ± 10 years old and 89% females. Hyponatremia was more prevalent in cases compared to the controls. Univariate logistic regression models showed a significantly higher risk of fracture in hyponatremia ($P < 0.0001$) and osteoporosis/osteopenia ($P < 0.0001$). Vertebral fractures were associated with worsening hyponatremia, compared to nonvertebral fractures (χ^2, $P = 0.0002$). A similar pattern was observed in femur fractures when compared to other nonvertebral fractures (χ^2, $P = 0.04$). On multivariate analysis, controlling for presence of known disease modifiers, the risk was 3-fold higher in mild (OR 3.0; 95% CI: 2.2, 4.2), 4-fold higher in moderate (OR 4.4; 95% CI: 2.8, 7.0) and 11-fold higher in severe hyponatremia (OR 11.1; 95% CI: 4.1, 30.5). A reverse trend was seen among patients with forearm and tibia/fibula fractures who tended to be younger.

Conclusion: Our study shows an increased risk of fractures in patients with varying degrees of hyponatremia irrespective of radiologic bone density changes. In addition the risk of fracture appeared to increase with worsening hyponatremia while controlling for known disease modifiers. This highlights the importance of recognizing and managing hyponatremia and its associated morbidity including fractures.

See pages 99 - 147 for financial disclosure information.

Can Thrombelastography Predict Venous Thromboembolic Events in Patients with Severe Extremity Trauma?

Prism S. Schneider, MD, PhD[1]; Bryan A. Cotton, MD[2]; Matthew Galpin, RC[1]; Zayde Radwan, MD[1]; John W. Munz, MD[1]; Timothy S. Achor, MD[1]; Mark L. Prasarn, MD[1]; ***Joshua L. Gary, MD[1]****;*
[1]Department of Orthopaedic Surgery, University of Texas Health Science Center, Houston, Texas, USA;
[2]Department of Surgery and the Center for Translational Injury Research (CeTIR), University of Texas Health Science Center, Houston, Texas, USA

Background/Purpose: Despite increased bleeding risk during the acute trauma resuscitation, trauma-induced coagulopathy is associated with greater likelihood of hypercoagulability, and eventual venous thromboembolic events (VTEs). Rapid thrombelastography (r-TEG) is a whole-blood assay that identifies both hypo- and hypercoagulable states. Graphical r-TEG results are available within minutes, correlate with conventional coagulation laboratory values, and predict early transfusion requirements. In addition, an elevated maximal amplitude (mA) value on admission can identify general trauma patients with increased risk of VTE. We hypothesized that (1) the risk of VTE traditionally assigned to injury lies specifically in those who sustain major orthopaedic trauma, and (2) an elevated admission mA value could be used to identify patients with major orthopaedic injuries at risk for VTE during initial hospital admission.

Methods: This is a retrospective review of a prospectively collected database of 9090 consecutive trauma patients admitted to an urban Level I trauma center between September 2009 and February 2011. We then evaluated only those patients who met highest-level trauma activation criteria, were 18-85 years of age, and were direct scene transports. Patients with burn wounds greater than 20% total body surface area or who died within 30 minutes of arrival were excluded. Two groups were created, one whose extremity abbreviated injury severity (AIS) score was 2 or greater (ORTHO) and one whose extremity AIS score was <2 (non-ORTHO). VTEs were defined as those pulmonary emboli confirmed by CT angiography and those symptomatic deep vein thromboses confirmed by venous duplex. Univariate analyses were conducted followed by purposeful regression analysis.

Results: 1818 patients met the inclusion criteria (310 ORTHO, 1508 non-ORTHO). While there was no difference in median age (32 vs. 34), ORTHO patients were more likely to be female (29% vs. 21%), white (62% vs. 54%), and blunt trauma (89% vs. 73%); all $P < 0.05$. With the exception of median extremity AIS (3 vs. 0, $P < 0.001$), there were no differences in individual systems AIS scores. ORTHO patients had lower systolic blood pressure (115 vs. 130), higher pulse (107 vs. 95), and worse base deficit (–5 vs. –2) on arrival; all $P < 0.05$. Despite more hypocoagulable r-TEG values on arrival (alpha angle 71 vs. 73 and mA 62 vs. 64, both $P < 0.05$), ORTHO patients had higher rates of VTE (6.5% vs. 2.7%, p<0.001). Time to VTE was similar (5.5 days vs. 5.5 days). Stepwise regression generated four values to predict development of VTE (age, male gender, white race, and ORTHO). After controlling for these variables, admission mA of ³65 (odds ratio 3.66) and ³72 (odds ratio 6.70) were independent predictors of VTEs during hospitalization.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Conclusion: Admission r-TEG mA values can identify patients with major orthopaedic trauma injuries who present with an increased risk of in-hospital deep vein thrombosis and pulmonary embolism. Patients presenting with admission r-TEG mA value of ³65 are at a 3.6-fold increased risk (and those with mA ³72 at a 6.7-fold risk) for in-hospital VTE. Admission r-TEG values can help to identify patients at greatest risk for VTE and best target those who might benefit from an early, aggressive prophylaxis strategy.

See pages 99 - 147 for financial disclosure information.

Prediction of Pulmonary Embolism in Trauma Patients: A Risk Assessment Model Based Upon 38,000 Patients

Sheena R. Black, MD[1]*; Jeffrey T. Howard, MA*[2]*; Paul C. Chin, MD, PhD*[1]*; Adam J. Starr, MD*[1]*;*
[1]*Department of Orthopaedic Surgery, University of Texas Southwestern Medical Center, Dallas, Texas, USA;*
[2]*Department of Demography, University of Texas at San Antonio, San Antonio, Texas, USA*

Purpose: Pulmonary embolism (PE) is a rare but sometimes fatal complication of trauma. Many studies have identified risk factors and developed risk stratification models to identify patients at an increased risk of venous thromboembolism; however, they are often complex and difficult to use. The purpose of this research is to develop a risk assessment model, based upon a large sample of trauma patients, which can be easily and quickly used at the time of admission to predict PE.

Methods: Our institutional trauma registry was queried. The National Trauma Registry of the American College of Surgeons (NTRACS) registry system collects voluminous data on each patient registered. We targeted the following information: demographic and injury data, prehospital information, and data on treatments and events during hospitalization. Out of 49,604 patients admitted to our trauma center from 2000-2012, 11,007 (22%) were excluded due to incomplete data. This study used trauma registry data from the remaining 38,597 trauma patients. Of these patients, 239 (0.619%) developed a PE. A multivariate binary logistic regression model was developed to predict the likelihood of developing a PE during each patient's hospitalization. The logistic regression model was developed using a 50%, randomly selected development subsample, and then tested for accuracy of prediction using the remaining 50% validation sample. The two random subsamples did not differ with respect to any demographic, injury, prehospital, or hospital treatment variables examined.

Results: Results from this study suggest there are seven statistically significant predictors of PE, including age, obesity, injury resulting from motorcycle accident, arrival to hospital by helicopter or ambulance, pulse rate upon arrival in emergency room, admission to ICU, and location of injury (thorax, abdomen, and lower extremity). Comparison of predicted PE events to actual PE events resulted in high sensitivity (82%) and specificity (75%). The comparison of odds ratios in the model development and validation samples was nonsignificant ($P = 0.4032$), indicating that predictions from the model do not differ between the two samples.

Conclusion: Using this model, based on data available upon admission, we were able to correctly predict 88.9% of the pulmonary emboli within the top 35% of the model score distribution of our validation subsample. This knowledge will allow us to focus more stringent and earlier thromboprophylactic efforts on those patients at highest risk for PE. In the future, this model will be used to develop an application suitable for smart phone devices, to allow physicians easy and accurate identification of trauma patients at high risk for the development of PE.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Role of Acute Negative-Pressure Wound Therapy Over Primarily Closed Surgical Incisions in Hip, Pelvis, and Acetabular Fracture Surgery: A Prospective Randomized Trial

Brett D. Crist, MD, FACS*; Michael S. Khazzam, MD; Gregory J. Della Rocca, MD, PhD; Yvonne M. Murtha, MD; James P. Stannard, MD;*
University of Missouri, Columbia, Missouri, USA

Purpose: This trial was conducted to determine the effectiveness of using negative-pressure wound therapy (NPWT) over primarily closed surgical incisions used for open reduction and internal fixation (ORIF) of hip, pelvis, and acetabular fracture surgery in decreasing postoperative surgical wound drainage, infections, and hospital stay in a cost-effective manner when compared to standard gauze dressings.

Methods: After IRB approval, 115 patients who underwent an open surgical exposure for hip, pelvis, or acetabular fracture ORIF were prospectively randomized to either receiving standard gauze or negative-pressure dressing applied over the primarily closed incision sterilely in the operating room. NPWT was left on for 2 days or longer if drainage continued. Patients were followed for 12 months. Prospective data points collected include patient demographics, mechanism of injury, fracture type, surgical approach, type of surgical closure, associated injuries and procedures, Injury Severity Score, body mass index (BMI), depth of subcutaneous adipose tissue, condition of soft tissue associated with surgical approach, deep venous thrombosis prophylaxis, ICU stay, antibiotic use, hospital stay, dressing changes, length of wound VAC (vacuum-assisted closure) use, superficial and deep infection, skin maceration/wound breakdown, and drainage. The primary end point was deep infection.

Results: 55 patients were randomized to the NPWT group and 60 patients randomized to the standard dressing group. The NPWT group included 49 patients and the gauze group included 42 patients who completed the 12-month follow-up. The rate of deep infection in the NPWT group was 5/49 (10.2%) and 2/42 (4.8%) in the gauze group ($P = 0.44$). The odds ratio showed that NPWT patients were 2.3 times more likely to develop a deep infection. BMI was not associated with an increased risk of infection ($P = 0.54$). Patients with eventual infections spent a significantly longer time in the ICU ($P = 0.015$) and had a longer hospital stay ($P = <0.001$) during their initial admission. All infections occurred in acetabular fractures that involved the posterior wall or column requiring a Kocher-Langenbeck surgical approach.

Conclusion: In a randomized prospective trial, NPWT use over a primarily closed surgical incision potentially increases the risk of deep infection when compared to gauze dressings in this patient population. This is contrary to a previously published retrospective case series. All deep infections occurred in patients with acetabular fractures involving the posterior wall or column that were treated with a Kocher-Langenbeck surgical approach regardless of BMI.

See pages 99 - 147 for financial disclosure information.

Early Treatment of Associated Pattern Acetabular Fractures Via an Anterior Approach Does Not Increase Blood Loss or Need for Transfusion

Cesar S. Molina, MD*; Priya G. Sivasubramaniam, BA; Andrew R. Fras, MD; Chad M. Corrigan, MD; Hassan D. Mir, MD, MBA; Jason M. Evans, MD; Vanderbilt University, Nashville, Tennessee, USA*

Background/Purpose: Despite strong support for early total care in adequately resuscitated patients with long bone fractures, there remain limited data to suggest appropriate timing for surgical fixation of associated pattern acetabular fractures due to concern for excessive procedure-related blood loss. Fracture patterns involving displacement of acetabular columns are associated with considerable blood loss, particularly from exposed cancellous surfaces, which can be difficult to control intraoperatively. Delay to surgery has been hypothesized to limit this low-pressure bony bleeding. The purpose of this study is to determine relationship of the timing of surgery on blood loss and transfusion requirements for associated pattern acetabular fractures stabilized through an anterior surgical approach.

Methods: A retrospective review of our Level I trauma center records from 2006 to 2012 identified 130 patients with associated pattern acetabular fractures classified by the system of Letournel as: associated both-column (ABC), anterior column posterior hemi-transverse (ACPHT), or T-type fractures treated operatively via ilioinguinal or modified ilioinguinal approach. Data points collected include patient demographics (sex, age), body mass index (BMI), past medical history (PMH), and time from emergency department (ED) admission to surgery. Our outcome measures were estimated blood loss (EBL), preoperative and post-operative hematocrit levels, intraoperative red blood cell (RBC) unit transfusions, 1-week postoperative RBC unit transfusions as a function of the timing of surgery, and total RBC unit transfusions. χ^2 and Fisher's exact test were used for categorical and dichotomous variables. Outcome variables were analyzed with the unpaired *t*-test, Mann-Whitney U, Kruskal-Wallis, and Spearman correlation tests.

Results: No difference in EBL was observed for those patients undergoing surgery in less than 24 hours (n = 11), less than 48 hours (n=34), or less than 72 hours (n = 57) when compared to later ($P = 0.54$, 0.45, and 0.82, respectively). When analyzing time to surgery as a continuous variable, there was no correlation with: EBL (Spearman's rho = 0.013, $P = 0.89$), total RBC unit transfusion (Spearman's rho = 0.07, $P = 0.40$), postoperative hematocrit (Spearman's rho = 0.09, $P = 0.30$), and only a small correlation with intraoperative RBC unit transfusion (Spearman's rho = 0.19, $P = 0.02$). The average EBL was 1440 (±762) cc. The average intra-operative RBC transfusion was 2.8 (±2.4) units. The average total volume transfused RBC was 4.4 (±3.3) units. A post hoc power analysis demonstrated that our sample could detect a difference in EBL of 360 mL.

Conclusion: Our results indicate no relationship between estimated blood loss or total transfusion requirements and timing of operative intervention for associated pattern acetabular fractures treated via an anterior approach. Associated patterns may be treated without delay in patients otherwise able to tolerate the procedure without increasing the risk of excessive blood loss or increasing the utilization of RBC transfusion.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

The Value of Thromboelastography in Orthopaedic Trauma Pelvic Fracture Resuscitation

Christiaan N. Mamczak, DO[1,2]*; Bryan A. Boyer, MD*[1,2]*; Scott Thomas, MD*[2,3]*; Braxton Fritz, BS*[4]*; Edward Evans, BA, CCP*[2]*; Benjamin Speicher, BA*[2]*; Mark Walsh, MD*[2,4]*;*
[1]*Beacon Orthopaedic Trauma Surgery, South Bend, Indiana, USA;*
[2]*Memorial Hospital of South Bend, South Bend, Indiana, USA;*
[3]*General & Vascular Surgery PC, South Bend, Indiana, USA;*
[4]*Indiana University School of Medicine, South Bend, Indiana, USA*

Purpose: Thromboelastography (TEG) evaluates real-time hemostatic integrity by measuring the ability of whole blood samples to form a clot. Recent combat and civilian trauma research has demonstrated the value of TEG in directing blood component therapy (BCT) during hemostatic resuscitation. Despite the emerging use of TEG at trauma centers in the United States and Europe, its role in orthopaedic trauma remains largely unknown and unreported in the literature. We describe the use of TEG-guided resuscitation in patients presenting to a Level II trauma center with pelvic fractures, and the financial impact TEG had on directing individualized BCT.

Methods: This study retrospectively reviewed patients with acute pelvic fractures treated with standard fracture care and an index TEG to guide their initial resuscitation. Patients were excluded if they were not classified a trauma activation with a pelvic fracture, age <15 years, ISS <9, and/or if a TEG perfusionist was unavailable. Whole blood samples were drawn and analyzed via TEG for the following stages of clot formation: *initiation* (R measurement: reflective of INR/PTT [international normalized ratio/partial thromblastin time] status), *amplification* (α angle: fibrin and fibrinogen activity), *propagation* (maximum amplitude [MA]: strength of clot through fibrin/platelet contact), and *termination through fibrinolysis* of the clot (LY30 [percentage reduction in MA at 30 minutes]) (Figure 1). Based on prior studies, standard BCT resuscitation was defined as a 1:1:1 ratio of packed red blood cells (PRBCs) to fresh-frozen plasma (FFP) to platelets. We compared the standard BCT ratio to ratios of blood products directed from individualized patient resuscitative needs as defined by the TEG. A cost analysis was performed of the actual transfusion requirements compared to anticipated requirements using the 1:1:1 protocol.

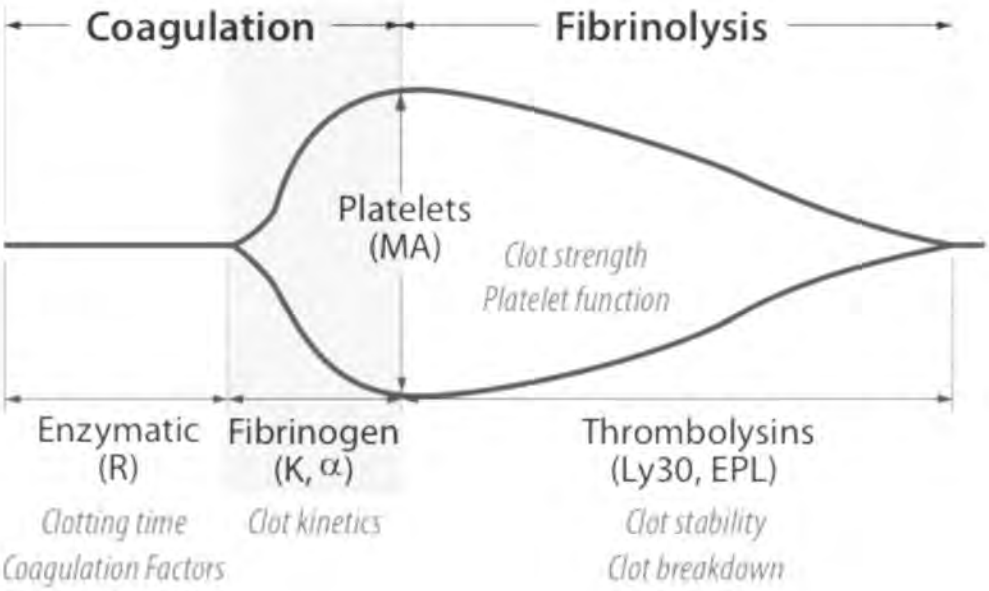
Results: From May 2010 to July 2013, 40 patients met criteria for review. The average age was 44.7 years. All types of pelvic and acetabular fractures were included. The average ISS was 30. In the first 24 hours, the cohort received 282 units of PRBCs, with 250 given in the first 6 hours. FFP requirements were a total of 112 units (105 given in the first 6 hours). 54 single-donor apheresis platelets (SDAP) were given, which translates into 324 units of platelets (42 SDAP given in the first 6 hours). Patients with TEG-guided resuscitation were transfused greater volumes of platelets and RBCs versus FFP ($P = 0.017$). Empirical standard BCT 1:1:1 protocols would have misused 42 units of PRBCs and 212 units of FFP. Given the average price of PRBCs and FFP our institution, TEG-guided resuscitation saved $71,086 in 40 patients.

Conclusion: TEG-guided BCT can individualize orthopaedic pelvic fracture resuscitation with cost effective transfusion requirements. When compared to the standard 1:1:1 BCT resuscitation protocol, TEG-resuscitated patients may be exposed to fewer units of component blood products that may otherwise not improve their resuscitation. The increased institutional costs and potential complications of unwarranted transfusions can have detrimental effects.

See pages 99 - 147 for financial disclosure information.

The routine use of TEG may reduce the costs of hemostatic resuscitation in multiply injured trauma patients with pelvic fractures.

Figure 1. Physiologic TEG tracing (reprinted with permission from Haemonetics).
EPL = estimated percent lysis.



- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Posterior Wall Acetabular Fractures and Stability

Reza Firoozabadi, MD, MA[1]*; Clay A. Spitler, MD*[1]*; Calvin L. Schlepp, MD*[1]*;*
Benjamin Hamilton, MS[2]*; Julie Agel, MA*[1]*; Paul Tornetta III, MD*[3]*;*
[1]*Harborview Medical Center/University of Washington, Seattle, Washington, USA;*
[2]*Case Western Reserve University, Cleveland, Ohio, USA;*
[3]*Boston University School of Medicine, Boston, Massachusetts, USA*

Purpose: The stability of the hip after posterior wall acetabular fractures is difficult to determine radiographically. Historically the percent of the posterior wall involvement was utilized to estimate stability based on cadaveric data. A history of dislocation may also aid in predicting instability. The purpose of this project was to determine if the radiographic parameters of femoral head coverage by the intact posterior wall, acetabular version, and location of fracture or a history of dislocation were determinates of hip stability based on intraoperative fluoroscopic examination after a posterior wall acetabular fracture.

Methods: A retrospective review of prospectively gathered data at a regional Level I trauma center was performed to identify patients who sustained a posterior wall acetabular fracture and underwent a fluoroscopic examination under anesthesia to determine instability. Patients were categorized as either stable or unstable and all comparisons compared these two groups. Measurements obtained using preoperative and postoperative CT scans included: ratio of remaining femoral head coverage at the fovea, cranial exit point of the fracture (mm from dome), roof edge angle, equatorial angle at fracture line, center edge angle, and percent wall involvement based on 3 published methods (Moed, Keith, Caulkin). A history of dislocation in the two groups was also recorded. A positive stress examination was any subluxation on any view of the hip in any position, including flexion, internal rotation, and posterior stress.

Results: 138 total patients underwent fluoroscopic stress examination of the hip under general anaesthesia of which 116 were stable and 22 unstable. Average age in stable group was 39 years old and 41 years in the unstable group. Mechanism of injury included 91 motor vehicle collisions, 6 pedestrian struck, 11 motorcycle collisions, 11 falls, and 19 other mechanisms. Table 1 displays the radiographic parameters studied.

Table 1. Radiographic Parameters

	Dislocations ($P = 0.49$)	Head Coverage at Rovea ($P = 0.7$)	Cranial Exit Point of Fracture ($P = 0.004$)	Roof Edge Angle ($P = 0.85$)	Equatorial Angle at Fracture Line ($P = 0.69$)	Center Edge Angle ($P = 0.97$)	Displaced wall size based on:		
							Moed ($P = 0.02$)	Keith ($P = 0.001$)	Caulkin ($P = 0.96$)
Unstable	15/22 (68%)	33%	5.0 mm	5.2°	13.1°	40.3°	26%	27%	25%
Stable	69/116(59%)	32.7%	9.5 mm	4.8°	12.4°	40.4°	21%	17%	25.3%

Conclusion: Determination of hip stability can be challenging in patients with posterior wall acetabular fractures. While displaced wall fragments over 50% are a reliable indicator of hip instability, radiographic assessment of stability in patients with smaller wall fragments is

See pages 99 - 147 for financial disclosure information.

less predictable. Our data suggest that the location of the exit point of the fracture in relation to the dome of the acetabulum may be a radiographic marker that can be utilized to aid physicians in determining stability. Additionally, the presence of a hip dislocation was not associated with instability.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Nonoperative Treatment of Posterior Wall Fractures of the Acetabulum After Dynamic Stress Examination Under Anesthesia: Revisited

Andrew McNamara, MD*; John Boudreau, MD; Berton R. Moed, MD;*
Saint Louis University, Saint Louis, Missouri, USA

Purpose: Performing an examination under general anesthesia using dynamic stress fluoroscopy (EUA) has been used as a tool to determine hip stability in the acute setting and has been recommended for all fractures with 50% or less of wall involvement. The purpose of this study was to provide additional radiographic and clinical follow-up data, mainly from a source other than the primary advocates of this method, to further evaluate patient outcomes.

Methods: 17 patients with an acute posterior wall fracture who underwent EUA and were found to be stable were treated nonoperatively. Posterior wall fragment size ranged from 6% to 42% with a mean of 24%. Five patients had an associated hip dislocation. Patient follow-up averaged 30 months (range, 6-64 months). Outcome evaluation included the modified Merle d'Aubigné clinical score (MMA) and the Short Musculoskeletal Function Assessment questionnaire (SMFA). Radiographic evaluation consisted of the three standard pelvic radiographs; posttraumatic arthritis was graded according to the criteria described by Matta.

Results: Radiographic evaluation showed all hips to be congruent joint with a normal joint space. 16 of the 17 patients had radiographic outcomes rated as "excellent"; one patient was rated "good" due to the presence of slightly increased sclerosis as compared to the normal side. The MMA could be obtained in 12 patients and the average score was very good, with only one having less than a good clinical outcome (fair). There was essentially no correlation between MMA and fracture size and there was no significant difference between those with or without history of hip dislocation. The patient's SMFA scores (from 11 patients, see table below) were not significantly different from the reported SMFA normals for all indices and categories (Z-test).

Conclusion: This study further supports the contention that hip joint stability after a posterior wall acetabular fracture determined by EUA is predictive of hip joint congruity, an excellent radiographic outcome, and a generally good-to-excellent early clinical outcome after nonoperative treatment. As functional outcome was shown to be not significantly different from normal, performing an EUA appears to be an effective means of determining candidates for nonoperative management of posterior wall fractures of the acetabulum. It should be considered an important evaluative tool for patients with these fractures.

See pages 99 - 147 for financial disclosure information.

Short Musculoskeletal Function Assessment Questionnaire Scores

Score	n	Min	Max	Mean	Std. Dev.
Dysfunction Index	11	.00	51.47	20.18	17.2
Daily activities	11	.00	52.50	18.63	20.0
Emotional status	11	.00	64.29	31.17	23.1
Arm/hand function	11	.00	28.13	7.38	11.2
Mobility	11	.00	69.44	24.74	23.1
Bother Index	11	2.08	81.25	25.56	27.8

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

CT Scan After Acetabulum Fracture ORIF: Is There Value?

Michael T. Archdeacon, MD, MSE; ***Steven K. Dailey, MD;*** *Kaylan N. McClary, BS;*
Department of Orthopaedic Surgery, University of Cincinnati, Cincinnati, Ohio, USA

Purpose: In acetabular fracture surgery, failure to obtain an adequate reduction, residual incarcerated osteochondral joint fragments, and intra-articular hardware may result in rapid posttraumatic arthritis. Surgeons utilize intraoperative fluoroscopy and plain radiographs to mitigate these complications; however, these modalities may not provide the same diagnostic accuracy as CT.The purpose of this study was to evaluate the efficacy of routine postoperative CT scan following open reduction and internal fixation (ORIF) of acetabular fractures. We hypothesized that postoperative CT scan following acetabular fracture fixation would identify surgically correctible factors not identified with intraoperative fluoroscopy or plain radiographs.

Methods: A total of 606 consecutive patients who underwent surgical fixation of 612 acetabular fractures were identified from a prospectively collected acetabular fracture database. All patients were evaluated with intraoperative fluoroscopy in addition to three standard plain radiographs (AP pelvis and two 45° oblique Judet views). Reduction and fixation were felt to be adequate and definitive prior to exiting the operative suite based on these imaging modalities. Routine postoperative CT scan of the pelvis was obtained in 563 (93%) of the patients following 569 operative cases. Medical records were reviewed to determine whether postoperative CT scan results prompted revision surgery.

Results: There were no significant differences between index and revision surgery groups with regard to age, gender, body mass index (BMI), fracture pattern, mechanism of injury, or surgical approach ($P > 0.05$). Evaluation of 563 post-operative CT scans of the pelvis resulted in revision acetabular surgery for 2.5% of patients (n = 14). There were six (1.1%) cases of intra-articular hardware not recognized on the intraoperative fluoroscopy or pelvic radiographs. Four (0.7%) patients had residual intra-articular osteochondral fragments deemed too large to leave in the hip joint. There were three (0.5%) cases of unacceptable malreduction, and one (0.2%) case of both malreduction and an intra-articular osteochondral fragment.

Conclusion: A small percentage (2.5%) of patients will benefit from a routine CT scan following acetabular fracture fixation.

See pages 99 - 147 for financial disclosure information.

Neurologic Injury in Operatively Treated Acetabular Fractures

Yelena Bogdan, MD[1]*; Paul Tornetta III, MD*[1]*; Clifford B. Jones, MD, FACS*[2]*;*
Emil H. Schemitsch, MD[3]*; Daniel S. Horwitz, MD*[4]*; David Sanders, MD*[5]*;*
Reza Firoozabadi, MD[6]*; Juan de Dios Robinson, MD*[7]*; Andrew Marcantonio, MD*[8]*;*
[1]*Boston University Medical Center, Boston, Massachusetts, USA;*
[2]*Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA;*
[3]*St Michael's Hospital, Toronto, Ontario, Canada;*
[4]*Geisinger Health System, Danville, Pennsylvania, USA;*
[5]*London Health Sciences Center, London, Ontario, Canada;*
[6]*Harborview Medical Center, Seattle, Washington, USA;*
[7]*Dalhousie University, Halifax, Nova Scotia, Canada;*
[8]*Lahey Clinic, Burlington, Massachusetts, USA*

Purpose: Neurologic injury after pelvic fractures is well studied, yet there is a paucity of data regarding the recovery of neural injury in acetabular fractures. Nerve injury in acetabular fractures is typically at the peripheral nerve level rather than at the nerve root and functional recovery may be quite different than in pelvic ring injuries. The purpose of this study is to evaluate a large series of operatively treated acetabular fractures with documented neurologic injury, both fracture-related and iatrogenic, and to track neurologic recovery and outcome.

Methods: All operatively treated acetabular fractures with documented neurologic injury from 8 trauma centers were reviewed in detail. To be included, patients had to be followed for at least 6 months or to neurologic recovery. We excluded patients with associated type 3 posterior pelvic ring injuries, nerve injury unrelated to the acetabular fracture (ie, laceration), spinal cord injury, and preexisting neurologic deficit. Data collected included demographics, injury characteristics, presence of dislocation, and surgical approach. Although these are not root injuries, we documented motor and sensory function by root to clearly document recovery. We tabulated L2-3, L4, L5 and S1 function preoperatively, at 3 months, at 6 months, and at final follow-up. Outcomes included partial or complete recovery, development of CRPS (chronic regional pain syndrome), brace use, and return to work. Motor and sensory injuries were documented separately as either complete (no function) or incomplete (weakness or paresthesias) at all time points.

Results: 137 patients (101 male, 36 female) with an average age of 42 years (range, 17-87) met criteria. Mechanisms of injury included motor vehicle collision (67%), fall from height (11%), motorcycle (9%), and other (13%). The most common fracture types were transverse + posterior wall (33%), posterior wall (23%), and both-column (23%). Median time from injury to surgery was 3 days (range, 0-92), and follow-up was 25 months. The Kocher-Langenbeck (KL) was used in 74%, the ilioinguinal/stoppa in 19%, and 7% were combined. The neurologic deficit was identified preoperatively in 57%, postoperatively with no preop exam (obtunded, etc) in 24%, and was iatrogenic in 19%. Surgical approach (KL versus others) did not have an effect on the development of iatrogenic palsy ($P = 0.8$). A total of 187 motor and/or sensory deficits were identified: 7 in L2/3 (1 complete, 6 incomplete), 18 in L4 (1 complete, 17 incomplete), 114 in L5 (32 complete, 82 incomplete), and 48 in S1 (12 complete, 36 incomplete). Full recovery occurred in 54 (29%), partial recovery in 69 (37%), and 64 (34%)

PAPER ABSTRACTS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

had no recovery (Table). Deficits in the sciatic distribution (L5, S1) were least likely to fully recover (26%) and 31% of those with complete injuries had no recovery. Importantly, 48% of iatrogenic injuries did not recover. Hip dislocation had no effect on neurologic recovery ($P = 0.4$). Of L5 deficits that had partial or complete recovery, 36% did so by 3 months and 52% by 6 months. 48 patients wore a brace at final followup, all for L5 dysfunction (48/106, 45%). CRPS developed in 19% (18/94 with data) and 60% (42 of 70 with data) returned to work. Complete versus incomplete injury did not affect development of CRPS ($P = 1$). Nerve recovery had no effect on return to work ($P = 0.8$).

Table.
Recovery by Functional Level (Both Complete and Incomplete Injuries Included)

Level	No Recovery	Partial Recovery	Full Recovery
L2/3 (n = 7)	2 (29%)	2 (29%)	3 (42%)
L4 (n = 18)	8 (45%)	2 (10%)	8 (45%)
L5 (n = 114)	33 (29%)	51 (45%)	30 (26%)
S1 (n = 48)	21 (43%)	14 (29%)	13 (27%)

Conclusion: Peripheral neurologic injury in operatively treated acetabular fractures is most common in the sciatic nerve distribution. Surgical approach does not influence development of iatrogenic palsy. L5 deficits (extensor hallucis longus, tibialis anterior, and deep peroneal sensation) were most commonly seen in this series and have only a 26% chance of full recovery.

See pages 99 - 147 for financial disclosure information.

Does Removal of the Symphyseal Cartilage in Symphyseal Dislocations Have Any Effect on Final Alignment and Hardware Failure?

*Paul Tornetta III, MD[1]; **Kyle Lybrand, MD**[1]; John Kurylo, MD[1]; Jordan Gross, BS[1]; David Templeman, MD[2];*
[1]Boston University Medical Center, Boston, Massachusetts, USA;
[2]Hennepin County Medical Center, Minneapolis, Minnesota, USA

Purpose: Multiple factors have been correlated with failure of symphyseal reductions including the use of short plates and the quality of the reduction. The symphyseal cartilage is typically left in place and compression across it is utilized to gain stability. We hypothesized that removal of the cartilage would allow for greater friction with compression creating a more stable construct. The purpose of this study is to compare the results of symphyseal fixation with and without symphyseal cartilage excision.

Methods: We retrospectively evaluated the records and all radiographs of patients at two trauma centers who had APC (anterior posterior compression)-2 or APC-3 injuries with symphyseal dislocation. Bilateral injuries, those with associated acetabular injuries, and those lost to follow-up were excluded. Operative indications were the same for both centers with iliosacral screws used only for type 3 injuries with complete widening and displacement of the posterior ring. Both centers used 6-hole plates through a rectus-sparing approach. One center routinely removed the symphyseal cartilage and the other did not. We compared the postoperative and final separation at the superior and middle of the symphysis, and the incidence of hardware loosening and plate breakage between patients who had their cartilage excised and those in whom it was retained. Multiple screw loosening ± breakage was considered as one event. Plate breakage with screw loosening was considered one event in the combined calculation.

Results: We reviewed 95 patients (88 male, 7 female) aged 19-76 years (mean 48), with ISS 4-51 (mean 15.6) who had 65 APC-2 and 30 APC-3 symphyseal injuries. Motor vehicle and pedestrian struck accounted for 67% of injuries. There was no difference in the demographics between the groups, although the initial displacement in those not "sheeted" was slightly greater in the retention group ($P < 0.05$). The symphyseal cartilage was removed in 50 patients and retained in 45. There was no difference in the reduction of type 2 and 3 injuries so the results are reported together. As expected, the symphyseal space after cartilage excision was less than if retained. This difference was maintained through union and was true for the AP and outlet views. The measurements are shown for the AP radiographs in Table 1. The incidence of screw loosening, plate breakage, and combined hardware problems was statistically lower in those in whom the cartilage was excised (Table 2).

Table 1: AP Radiographic Reduction and Final Position at Union (in mm)

	Initial Postop Reduction			Position at Union		
Location	Excision	Retention	*P* Value	Excision	Retention	*P* Value
Superior	2.0 ± 1.0	6.1 ± 2.4	<0.0001	3.6 ± 2.6	8.3 ± 4.3	<0.0001
Middle	2.5 ± 1.2	6.1 ± 2.8	<0.0001	4.1 ± 2.9	8.2 ± 4.0	<0.0001

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Table 2. Hardware Complications

	Excision (50)	Retention (45)	*P* Value
Screw loosening	9 (18%)	18 (40%)	0.04
Plate breakage	2 (4%)	8 (18%)	0.02
Combined	11 (22%)	22 (49%)	0.009

Conclusion: Hardware failure is common after symphyseal reconstruction. While multiple factors leading to possible failure and displacement have been examined, no data exist regarding excision of the symphyseal cartilage to gain better friction across the symphysis. We sought to evaluate the effect of symphyseal cartilage excision on final alignment and hardware complications. We found that excision led to closer apposition of the symphyseal bodies postoperatively and at final follow-up and that this correlated with substantially lower rates of loosening and plate breakage. Surgeons may elect to use this technique to avoid hardware failure and maintain closer apposition of the symphyseal bodies.

See pages 99 - 147 for financial disclosure information.

Biomechanical Analysis of Lumbopelvic Fixation Versus Posterior Sacroiliac and Anterior Pubic Symphysis Fixation in an Unstable Vertical Sacral Fracture Cadaveric Model

Ehsan Jazini, MD[1]*; Oliver O. Tannous, MD*[1]*; Eric Belin, MD*[1]*; Christopher M. Hoshino, MD*[1]*; Robert V. O'Toole, MD*[1]*; Noelle Klocke, MS*[2]*; Mir Hussain, MS*[2]*; Brandon Bucklen, PhD*[2]*; Steven C. Ludwig, MD*[1]*;*
[1]*University of Maryland Orthopaedics Associates/R Adams Cowley Shock Trauma, Baltimore, Maryland, USA;*
[2]*Globus Medical, Audubon, Pennsylvania, USA*

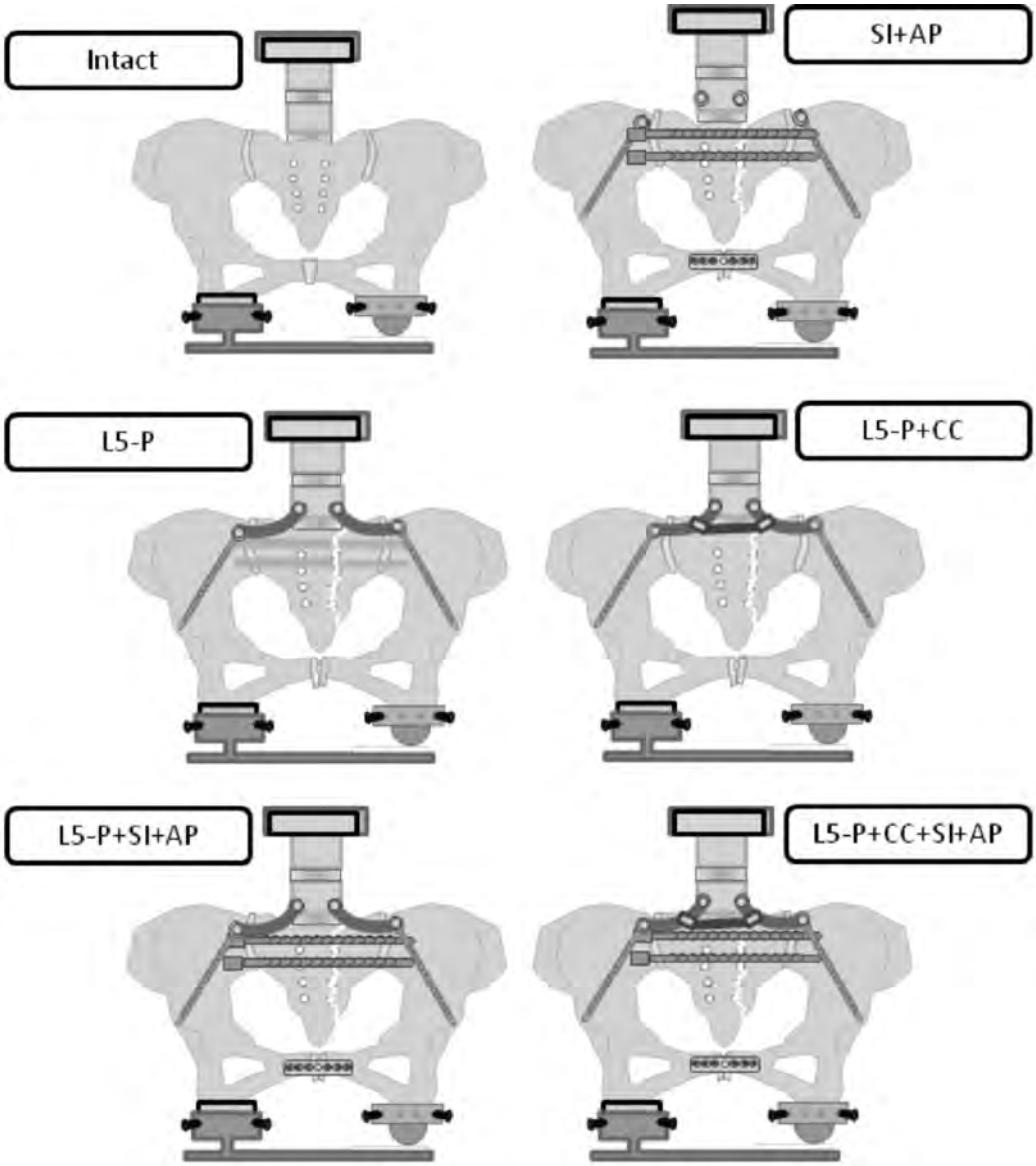
Purpose: Optimal fixation of unstable pelvic ring and sacral fractures is unknown. We hypothesized that a minimally invasive percutaneous lumbopelvic fixation (LPF) would have superior mechanical performance to traditional fixation for unstable pelvic ring fractures. This technique would be especially useful for reduction of blood loss, operative time, and infection in the setting of polytrauma.

Methods: We used seven L4-pelvic fresh-frozen nonosteoporotic cadaveric specimens. They were tested in a bilateral stance testing apparatus in a "floating hip" model. Specimens were tested in flexion-extension (FE), lateral bending (LB), and axial rotation (AR). Each specimen was tested intact. Then a vertical zone 2 fracture was created with a saw and the pubic symphysis was cut to simulate the unstable fracture pattern. Five constructs were tested (Figure 1): (1) LPF (bilateral L5-pelvis fixation using cannulated iliac screws), (2) LPF plus a cross-connector, (3) anterior symphyseal plate with transsacral screws at S1 and S2, (4) combination of LPF with plate and screw, and (5) combination with cross-slink (constructs 2 and 3). We defined our outcome measure of pelvic ring stability as the relative displacement between the iliac crests during maximum range of motion. The measurements were analyzed using one-way analysis of variance ($P < 0.05$).

Results: LPF allowed for significantly more motion in FE (1027%, $P < 0.03$) and AR (980%, $P < 0.02$) compared to all other constructs, and was only comparable to LPF with cross-connect in LB (947%, vs. with cross-connect 754%, $P = 0.901$; $P < 0.01$ for all other constructs in LB) for pelvic ring stability. Surprisingly, the combined lumbopelvic-SI (sacroiliac) fixation with (FE: 108%, LB: 188%, AR: 106%) or without (FE: 129%, LB: 205%, AR: 112%) a cross-link did not impart increased pelvic ring stability as compared to SI fixation with anterior plating (FE: 105%, LB: 154%, AR: 90%, $P = 1.00$ for all comparisons and modes of bending). Cross-links improve the mechanics of LPF, especially in flexion-extension and rotation.

Conclusion: In contrast to our hypothesis, LPF performed relatively poorly in this model and added little mechanical stiffness to the more commonly used pelvic fixation with an anterior plate and transsacral screws. Additionally, anterior plate and posterior screws outperformed LPF (without cross-connects) alone ($P < 0.05$). Use of the floating hip model realistically simulated pelvic instability. In light of this, it is possible that LPF does not provide as much mechanical rigidity to complex pelvis fractures as previously thought.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.



See pages 99 - 147 for financial disclosure information.

MINI SYMPOSIA

From the Operating Room to the Boardroom - Applying an MBA to Benefit Orthopaedic Traumatology
Moderator: *Hassan R. Mir, MD, MBA*
Faculty: *Peter L. Althausen, MD, MBA; M. Bradford Henley, MD, MBA; Douglas W. Lundy, MD, MBA; Craig S. Roberts, MD, MBA* and *George V. Russell, MD, MBA*

Biologic Solutions in the Management of Nonunions and Patients at Risk for Delayed Healing
Moderator: *Samir Mehta, MD*
Faculty: *Jaimo Ahn, MD, PhD; Robert P. Dunbar Jr, MD; James C. Krieg, MD* and *Robert D. Zura, MD*

History of Nailing
Moderator: *Philip Procter, PhD*
Faculty: *Thomas A. (Toney) Russell, MD*

NOTES

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Clinical Indications for CT Angiography in Lower Extremity Trauma

Joseph T. Patterson, MD*[1]*; Thomas Fishler, MD*[2]*; Daniel D. Bohl, MPH*[3]*;
Michael P. Leslie, DO[3]*;*
[1]*University of California, San Francisco, Department of Orthopaedic Surgery, San Francisco, California, USA;*
[2]*Harborview Medical Center, Seattle, Washington, USA;*
[3]*Yale University School of Medicine, Department of Orthopaedics and Rehabilitation, New Haven, Connecticut, USA*

Purpose: Computed tomographic angiography (CTA) is replacing conventional angiography as a rapid and accurate modality for diagnosis of suspected vascular injury in the traumatized lower extremity. We hypothesize that specific physical examination findings and injury patterns in lower extremity orthopaedic trauma patients are predictive of detection of a vascular injury by CTA. These findings may indicate or obviate ordering a CTA study in this context.

Methods: With IRB approval, investigators retrospectively reviewed physical examinations and injury patterns of 72 consecutive trauma patients at an academic Level I trauma center who underwent CTA of a lower extremity from 2006 through 2012. Outcomes included CTA detection of a vascular injury, additional imaging by duplex ultrasonography or angiography, operative or endovascular vascular intervention, and contrast-induced nephropathy (CIN).

Results: 40/72 (55.6%) diagnostic CTA studies demonstrated a vascular injury. 10/40 patients (25.0%) received specific vascular intervention. The positive predictive values (PPVs) of specific physical examination findings for predicting CTA detection of injury were dependent on the pattern of injury (table below). Normal physical examination led to observational management without incident, regardless of CTA findings. CTA was performed per published recommendations in 73.6% to 95.8% of cases, depending on criteria. CTA agreed with management in 95.8% of cases. CIN occurred in 4/72 cases (5.6%).

Conclusion: CTA is not indicated in lower extremity trauma when physical examination fails to demonstrate signs of vascular injury. Specific injuries and physical examination findings are predictive of CTA detection of vascular injury and may guide imaging and treatment decisions.

See pages 99 - 147 for financial disclosure information.

Table:
PPVs of Examination and Injury for Predicting CTA Detection of Lower Extremity Vascular Injury

CTA Positives/Exam Positives		Percent (%)	95% CI* (%)
All patients			
Any exam finding	22/53	41.5	28.1-55.9
Any soft exam finding	16/46	34.8	21.4-50.2
Diminished pulse	10/32	31.3	16.1-50.0
Asymmetry of color	8/11	72.3	39.0-94.0
Asymmetry of temperature	8/17	47.1	23.0-72.2
Any hard exam finding	15/23	65.2	42.7-83.6
Absent pulse	15/20	75.0	50.9-91.3
Only patients with low-risk injuries			
Any exam finding	4/20	20.0	5.7-43.7
Any soft exam finding	3/18	16.7	3.6-41.1
Any hard exam finding	4/10	40.0	12.2-73.8
Only patients with high-risk injuries			
Any exam finding	18/33	54.5	36.4-71.9
Any soft exam finding	13/28	46.4	27.5-66.1
Any hard exam finding	11/13	84.6	54.6-98.1

*95% CI = 95% confidence interval.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Immediate Weight Bearing as Tolerated Has Improved Outcomes Compared to Non-Weight Bearing After Surgical Stabilization of Midshaft Clavicle Fractures in Polytrauma Patients

Brian P. Cunningham, MD[1] *; Gilbert R. Ortega, MD*[2]*; Anthony S. Rhorer, MD*[1]*;*
Brian Miller, MD[1]*; Hrayr Basmajian, MD*[3]*; Ryan McLemore, PhD*[1]*; Kelly A. Jackson, NP-C*[4]
[1]*Banner Good Samaritan, Phoenix, Arizona, USA;*
[2]*Sonoran Orthopedic Trauma Surgeons, Scottsdale, Arizona, USA;*
[3]*Loma Linda University Medical Center, Loma Linda, California, USA;*
[4]*Scottsdale Healthcare, Scottsdale, Arizona, USA*

Background/Purpose: Midshaft clavicle fractures are common injuries and recent studies have demonstrated the clinical benefit of surgical management. Weight bearing (WB) status after open reduction and internal fixation (ORIF) has been primarily as non–weight bearing (NWB) in the literature; however, in the polytrauma patient population a clear benefit exists to early ambulation with the use of an assistive device. Previous reports have illustrated that crutch weight bearing following surgical stabilization of midshaft humerus fractures resulted in high union rates and low complications. The literature does not have any studies evaluating early crutch weight bearing following ORIF of midshaft clavicle fractures. Our hypothesis was that immediate postoperative weight bearing as tolerated (WBAT) for midshaft clavicle fracture would result in decrease length of stay and decreased complication rate in polytrauma patients compared to operative management with NWB.

Methods: After IRB approval a retrospective cohort study was conducted from August 2007 to November 2013. Inclusion criteria were skeletally mature patients with a midshaft clavicle fracture and a lower extremity injury that required non–weight bearing (long bone, periarticular, acetabular, or pelvic fracture). Exclusion criteria were open fracture, presentation with Glasgow Coma Scale below 8, and/or non–weight bearing upper extremity injury. 24 patients met the inclusion criteria; 9 patients underwent surgical stabilization with immediate weight bearing using crutches and 15 patients underwent surgical stabilization with no weight bearing, but could complete active and passive range of motion exercises. These two cohorts were compared using Mann-Whitney for statistical significance. We evaluated data regarding age, sex, mechanism of injury, and revised trauma score. We compared data collected on length of stay (LOS), maximum mobility level at discharge, and LOS postoperatively.

Results: The mean patient age was 41.4 years (range, 19-64) and 45.6 years (range, 22-63) in the WB and NWB groups, respectively. Revised trauma score was similar in both groups (11.2 WB vs. 11.3 NWB). The WB group had decreased LOS (11.7 vs. 17.4 days, $P = 0.056$). The WB group had a significant improvement in physical therapy score (4.3 vs 2.8, $P = 0.005$), and subsequently discharged faster postoperatively than the NWB group (6.9 vs 12.9 days, $P = 0.015$). The WB group also had a decreased rate of deep venous thrombosis (DVT) compared to the NWB group (0 vs. 2). There was no statistical difference in the union rates between groups.

Conclusion: This study demonstrates that immediate postoperative crutch weight bearing provides improved participation in physical therapy, decreased LOS, and potentially deceased

See pages 99 - 147 for financial disclosure information.

rate of DVT. Our data suggest also that early operative intervention for midshaft clavicle fractures with WBAT protocol produced the shortest LOS in a population of polytrauma patients. We plan to continue studying the effect of early WBAT after ORIF of midshaft clavicle fractures and the effect on quality of life and patient-centric outcomes measures.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Management of Clavicle Fractures in Patients with Thoracic Trauma

Geoffrey S. Marecek, MD[1]*; David P. Barei, MD*[2]*; Julie Agel, MA, ATC*[2]*;*
Thomas K. Varghese, MD, MA, FACS[2]*; Daphne M. Beingessner, MD*[2]*;*
[1]*University of Southern California, Los Angeles, California, USA;*
[2]*Harborview Medical Center, Seattle, Washington, USA*

Purpose: Clavicle fractures are associated with significant thoracic trauma. Fracture reduction and stabilization may improve proximal chest wall morphology and comfort and be secondary indicators for surgical intervention. We hypothesized that operative fixation of clavicle fractures may be beneficial for patients with thoracic chest trauma.

Methods: We reviewed a prospectively recorded trauma database for all patients with clavicle fractures (OTA 05, 06, 07) from April 2005 to June 2010. We identified 1074 patients with clavicle fractures. Minors and those with missing data were excluded. We recorded age, chest Abbreviated Injury Score (AIS), length of ICU stay, and other demographic information. ICU admission was made at the discretion of the general trauma team and the orthopaedic trauma staff in consultation with the ICU team made the decision for surgery. The primary indication for clavicular open reduction and internal fixation (ORIF) was the magnitude of fracture displacement, and fellowship-trained orthopaedic trauma surgeons performed all surgeries. The operative tactic and implant selection were made at the discretion of the treating surgeon. Postoperatively patients were placed into a sling and, when possible, patients began range of motion exercises on postoperative day 1.

Results: Mean chest AIS was 3.56 ± 0.71 (mean ± standard deviation). 763 patients had a chest AIS ≥2. Of these, 75 patients had operative treatment of their clavicle fracture (9.8%). 49 of these patients required an ICU stay (65.3%) with a mean length of stay (LOS) of 4.5 days (range, 1-24). Of the 688 patients who had nonoperative treatment of their clavicle fracture, 493 patients required an ICU stay (72%) with a mean LOS of 7.8 days (range, 1-98). ICU stay was significantly shorter in patients with operatively treated fractures ($P < 0.001$). We further stratified those patients who had minimum ICU stay of 2 days. Of these 359 patients, 340 were treated nonoperatively during the initial hospital course with a mean ICU stay of 10.7 days. 13 patients had operative fixation of the clavicle while in the ICU with a mean LOS of 8.8 days. This difference was significant ($P < 0.001$)

Conclusion: Polytraumatized patients with clavicle fractures commonly have significant thoracic trauma. Operative stabilization of the fractured clavicle is associated with shorter ICU stays. Further research is needed to better identify those patients who may benefit from operative fixation of the clavicle.

See pages 99 - 147 for financial disclosure information.

The Association of Ipsilateral Rib Fracture(s) with Displacement of Midshaft Clavicle Fractures

Matthew Ellington, MD*; Daniel Jupiter, PhD; Kindyle L. Brennan, PhD;*
Michael L. Brennan, MD; Daniel L. Stahl, MD;
Scott and White Memorial Hospital, Temple, Texas, USA

Background/Purpose: Recent evidence suggests that operative fixation of displaced midshaft clavicle fractures (OTA 15-B) significantly decreases nonunion rates as well as improves functional results compared to nonoperative management. Close radiographic follow-up in trauma patients with high-energy clavicle fractures is also recommended due to a high prevalence of subsequent displacement. To our knowledge, there is currently no evidence to indicate which clavicle fractures are more likely to displace in the weeks following the trauma. The purpose of this study is to determine if the presence of ipsilateral rib fracture(s) affects the rate of a clavicle fracture being unstable (>100% displacement). We hypothesized that the presence of ipsilateral rib fracture(s) would lead to an increased rate of unstable midshaft clavicle fractures when compared to those without ipsilateral rib fracture(s).

Methods: A retrospective review from 2002-2013 was performed at a single Level I trauma center evaluating 243 midshaft clavicle fractures. These fractures were then subdivided into those with ipsilateral rib fracture(s) (CIR; n = 149), and those without ipsilateral rib fracture(s) (CnIR; n = 94). The amount of displacement was measured on the initial injury radiograph as well as subsequent follow-up radiographs taken during the first 2 weeks after injury. Fractures were subsequently classified as "stable" (<100% displacement) or "unstable" (>100% displacement). Ipsilateral rib fracture(s) were also assessed and recorded based on which number rib was fractured as well as the total number of ribs that were fractured.

Results: 116 (78%) of the midshaft clavicle fractures with ipsilateral rib fracture(s) (CIR) and 51 (54%) of the midshaft clavicle fractures without ipsilateral rib fracture(s) (CnIR) were found to be unstable ($P = 0.0047$). 72% of the CIR group, compared to only 40% of the CnIR group, progressed from stable to unstable clavicle fractures ($P < 0.001$). Each additional rib fracture was found to increase the odds of final displacement greater than 100% by a factor of 1.24 (95% confidence interval [CI], 1.11-1.38). The odds ratio for progression to an unstable clavicle fracture was found to be 4.08 ($P = 0.000194$) when ribs 1-4 were fractured and not significant for rib fractures 5-8 or 9-12.

Conclusion: The presence of concomitant ipsilateral rib fracture(s) significantly increases the rate of unstable midshaft clavicle fractures. Additionally, a fracture involving the upper one-third of the ribs (ie, ribs 1-4) will significantly increase the rate of the clavicle fracture being unstable. Also, there is a trend for clavicle fractures with associated ipsilateral rib fracture(s) to demonstrate an increased amount of displacement on follow-up radiographs compared to those without ipsilateral rib fracture(s).

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Is There a Higher Risk of Infection with Delayed Treatment of Pediatric Seymour Fractures?

Bryan A. Reyes, MD*; Christine A. Ho, MD;*
Children's Medical Center-Texas Scottish Rite Hospital for Children, Dallas, Texas, USA

Purpose: The purpose of this study is to describe treatment methods and complication rates of all Seymour fractures (open Salter-Harris I/II fractures of the distal phalanx of the hand with associated nailbed laceration; OTA 78) treated at or referred to a pediatric Level I trauma center over a 10-year time period. We hypothesized that delayed or inappropriately treated Seymour fractures would be associated with higher infectious complication rates.

Methods: All patients treated in the orthopaedic pediatric hand clinic at our institution with an ICD-9 diagnosis of 816.02 or 816.12 (closed or open fracture of distal phalanx or phalanges of hand, respectively) between August 2002 and December 2012 were identified. All charts and radiographs were retrospectively reviewed. 47 patients treated for 48 Seymour fractures were identified. Patients were divided into groups based on timing and quality of treatment. "Appropriate" treatment was defined as irrigation and debridement, fracture reduction, nailbed repair, and antibiotics. "Partial" treatment was defined as any type of incomplete treatment. "Acute" treatment was defined as management within 48 hours of the injury, and "delayed" as presenting for treatment past 48 hours from time of injury. Statistical comparisons were performed using Fisher's exact test.

Results: Average patient age was 8.7 years (range, 1-15 years), with 35 males and 12 females. Most common mechanism of injury was sports (32%, 15/47), followed by closed in door/window (30%, 14/47). 57% (27/47) were treated in an acute, appropriate manner; 15% (7/47) received acute, partial treatment; and 28% (13/47) received delayed treatment. One patient initially treated at an outside hospital had inadequate documentation to determine appropriateness of treatment but had no complications. There were 9 complications: 3 superficial infections, 5 osteomyelitis, and 1 malunion. With respect to infectious complications, only 1 (superficial infection) occurred in the acutely, appropriately treated group (infection rate 3.7%, 1/27); 1 (osteomyelitis) occurred in the acutely, partially treated group (14%, 1/7); and 6 (2 superficial, 4 osteomyelitis) occurred in the delayed treatment group (46%, 6/13). Differences in infection rates among the treatment groups were statistically significant ($P < 0.003$ including all infections; $P < 0.007$ including osteomyelitis only).

Conclusion: Timing and quality of treatment of Seymour fractures significantly influences infectious complication rates, as patients with delayed treatment had a 12-fold risk of infection compared to those treated early and appropriately. This study, the largest reported cohort of Seymour fractures, highlights the importance of timely, appropriate treatment of this outwardly benign fracture to reduce the risk of infection.

See pages 99 - 147 for financial disclosure information.

All Lateral Versus Medial and Lateral Flexible Intramedullary Nails for the Treatment of Pediatric Femoral Shaft Fractures

J. Matthew Cage, DO; Sheena R. Black, MD; Robert L. Wimberly, MD; Jay B. Cook, MD; W. Taylor Gheen, BA; ***Anthony I. Riccio, MD****;*
Childrens Medical Center/Texas Scottish Rite Hospital for Children, Dallas, Texas, USA

Purpose: Multiple techniques for flexible intramedullary fixation of pediatric femur fractures have been described. To our knowledge, no study comparing medial and lateral entry versus all lateral entry retrograde nailing has been reported. The purpose of this study is to compare surgical outcomes, radiographic outcomes, and rates of complications between these techniques.

Methods: An IRB-approved, retrospective review of patients treated by retrograde, dual flexible intramedullary fixation of femur fractures was performed at a Level I pediatric trauma center from 2005-2012. Demographics, blood loss, and operative time were collected from the medical and surgical record. We assessed radiographs for fracture pattern and canal fill as well as shortening, and angulation at the time of osseous union. Rates of symptomatic hardware and hardware removal were noted. Data was compared between patients treated with all lateral entry nailing and those treated with medial and lateral entry nailing using the Student *t*-test and correlation statistics.

Results: 282 children with femoral shaft fractures were treated with retrograde flexible intramedullary fixation using Ender's stainless steel nails (Richards). 109 were treated with two lateral entry nails and 173 were treated with one medial and one lateral entry nail according to surgeon preference. There were no statistical differences in gender, weight, body mass index, blood loss, or fracture pattern between the two groups. The average total anesthesia time was 31 minutes shorter in the all lateral group (P <0.0001). There was no difference between the techniques in shortening or coronal angulation at union, regardless of fracture pattern. In comminuted fractures, the all lateral group demonstrated less sagittal angulation (0.6° vs 3.3°, P = 0.0162). In the all lateral group, there was a strong correlation between fill of the canal and reduced shortening at union. No statistical differences were found in the presence or degree of varus alignment, procurvatum, or recurvatum between the two constructs. However, all femurs that healed with greater than 10° of valgus were instrumented with the all lateral technique (P = 0.015). There were no differences between the groups in the rate of symptomatic hardware removal or surgical complications.

Conclusion: Final fracture alignment, surgical complications, and rates of symptomatic hardware are clinically comparable between pediatric femur fractures treated with all lateral entry flexible nailing and those treated with medial and lateral flexible nailing. The all lateral technique is potentially a faster procedure, although when using this construct, specific attention should be paid to percentage of canal fill of the nail and ensuring that the fracture is not reduced in a valgus position.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

WITHDRAWN

See pages 99 - 147 for financial disclosure information.

Pediatric Pelvic Ring Injuries: How Benign Are They?

Christiane G. Kruppa, MD[1,2]*; Justin D. Khoriaty, BS*[3]*; Debra L. Sietsema, PhD*[3,4]*;*
Marcel Dudda, MD[1]*; Clifford B. Jones, MD, FACS*[3,4]*;*
[1]*Department of Surgery, BG-University Hospital Bergmannsheil, Bochum, Germany;*
[2]*Grand Rapids Medical Education Partners, Grand Rapids, Michigan, USA;*
[3]*Michigan State University, Grand Rapids, Michigan, USA;*
[4]*Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA*

Purpose: Pediatric pelvic ring fractures are rare, with scant outcomes in the literature. The etiology is usually high-energy trauma with associated major injuries that require multidisciplinary trauma team intervention. Historically, conservative treatment was mainly performed, but has changed to more operative treatment of unstable fractures. Leg-length discrepancy (LLD) and pain are reported. The purpose of this study was to determine clinical and radiographic outcome following pediatric pelvic ring injuries.

Methods: Between 2002 and 2011, 33 pediatric pelvic ring fractures were retrospectively analyzed. Fractures were classified according to AO/OTA classification as 2 A2, 3 B1, 16 B2, 10 B3, and 2 C2 fractures. Mechanism of injury, associated injuries, transfusion requirement, Glasgow Coma Scale (GCS), Injury Severity Score (ISS), and length of hospital stay were recorded. Treatment of the pelvis injury, infection, and nonunion rates were determined. Deformity, low back/sacroiliac (SI) joint pain, LLD, and hip range of motion were evaluated on final follow-up.

Results: Age averaged 12.6 years (range, 4-16). 91% (30) injuries were caused by traffic accidents. GCS averaged 13.6 (range, 3-15) and ISS averaged 26 (range, 4-66). Length of hospital stay averaged 6 days (range, 1-39). 10 (30%) children required blood transfusion. 30 (91%) children had associated injuries, of whom 11 (33%) required surgery. Two (6%) required interventional embolization for intrapelvic bleeding. Clinically unstable fractures were treated operatively in 16 children and conservatively in clinically stable fractures in 17 children. Follow-up averaged 25.6 months (range, 6-84). One superficial wound infection and in one case repeat debridement for Morel Lavallée lesion was documented. No nonunion was recorded. 20 (74%) children had a sacral or ischial height difference of 5-10 mm on follow-up (outlet). 18 (67%) children had a sacral or iliac height difference of 5-10 mm (inlet). 67% complex, unstable fractures had a permanent ischial height difference >5 mm versus 42% less complex, stable fractures. Unstable, operatively treated fractures had a higher permanent pelvic asymmetry (12.3 mm vs. 6.6 mm) ($P = 0.15$) and ring width difference (6.9 mm vs. 3.9 mm) as compared to stable, nonoperatively treated fractures. All children returned to full, unrestricted activity. 13 children (39%) had low back or SI joint pain on their final follow up, which was significantly higher in the operatively treated group ($P = 0.008$), and in children with 5-10 mm sacral height difference (inlet) compared to children with 0-4 mm ($P = 0.034$). 3 (9%) children had an LLD of 5-15 mm. One child had persistent neurological symptoms. One (3%) demonstrated rotational limitation on final follow-up.

Conclusion: The majority of pediatric pelvic ring fractures are caused by traffic accidents, with associated major injuries. Radiographic deformity persisted without remodeling. De-

PAPER ABSTRACTS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

formity occurs more commonly with complex unstable ring injuries, which may plastically deform the ring, are mostly operatively treated, and have continued associated low back or SI joint pain, but no limitations.

See pages 99 - 147 for financial disclosure information.

Iliosacral Screw Pathways in the Pediatric Population: Are There Safe Bony Corridors?

Joshua L. Gary, MD[1]*; Matthew B. Burn, MD*[2]*; Michael Holzman, MD*[1]*; John W. Munz, MD*[1]*;*
John Heydemann, MD[1]*; Matthew Galpin, RC*[1]*; Timothy S. Achor, MD*[1]*;*
Manickam Kumaravel, MD, FRCS[3]*;*
[1]*University of Texas Health Science Center–Houston, Department of Orthopaedic Surgery, Houston, Texas, USA;*
[2]*Houston Methodist Hospital–Texas Medical Center, Houston, Texas, USA;*
[3]*University of Texas Health Science Center–Houston, Department of Radiology, Houston, Texas, USA*

Purpose: Bony corridors for safe iliosacral screw placement in the first (S1) and second (S2) sacral segments are commonly used to place screws with diameters of 6.5 mm and greater in the adult pelvic ring. Data regarding the size of these corridors in pediatric patients are limited to case reports. We hypothesize that bony corridors for 6.5 mm diameter screws in the S1 and S2 segments will be less common in patients aged 2 to 10 years when compared to patients aged 10 to 16.

Methods: After obtaining IRB approval, our digital imaging archive was retrospectively searched for all patients between ages 2 and 16 years who underwent a CT scan including the pelvis from January 1, 2013 to February 12, 2013. The only exclusion criterion was incomplete imaging of the pelvic ring. A total of 175 patients were identified, with 91 males and 84 females. Average age was 10.7 years (SD = 3.9). CT images were transferred to TeraRecon (Foster City, CA) thin client 3D platform. Corrected axial images were created that were perpendicular to the plane of the sacrum centered at S1 and S2 corridors. Two representative images were transferred back to Centricity picture archiving and communication system (PACS) (GE Healthcare, Waukesha, WI): one of the S1 corridor and one of the S2 corridor. Three distances were defined in each hemipelvis. S1 reduction was defined as the shortest distance from anterior sacral cortex to the anterior border of the S1 nerve root tunnel that was perpendicular to the pathway of a sacroiliac or "reduction-type" screw. The S1 sacral corridor was defined as the shortest distance from the anterior border of the S1 foramen between a line connecting the anterior borders of the left and right S1 foramina and a line connecting the most posterior limits of the left and right anterior ilium or sacrum. The S2 corridor was defined as the shortest distance from the anterior border of the S2 foramen between a line connecting the anterior borders of the left and right S2 foramina and a line connecting the posterior borders of the S1 foramina. All measurements were independently made using PACS on a diagnostic quality monitor by three orthopaedic surgeons: a resident, a trauma fellow, and a trauma attending. Two means were compared using a paired Student *t*-test and proportions were compared using Fisher's exact test. Interobserver reliability was measured using the inter-rater reliability coefficient.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Results:

Average Bony Corridor (in mm)				
	Ages 2-10 (n = 70)		Ages 10-16 (n = 105)	
Measurement	R	L	R	L
S1 Reduction	14.2	14.1	17.9	17.7
S1 Sacral	5.8	5.8	8.1	8.0
S2	8.6	8.6	9.8	9.7

The interrater reliability coefficient between the three surgeons was greater than 0.93 for all six measurements. Measurements for bilateral S1 reduction, bilateral S1 sacral, and bilateral S2 were significantly less for ages 2-10 than ages 10-16 (all $P < 0.003$). All 175 patients had bilateral S1 reduction measurements >6.5 mm. S1 sacral measurements >6.5 mm were significantly higher in the older group and present in 48% of patients ages 2-10 and 68% of patients ages 10-16 ($P = 0.04$). S2 measurements >6.5 mm were present in 92% of patients ages 2-10 and 94% of patients ages 10-16 with no significant difference ($P = 0.77$).

Conclusion: Contrary to our hypothesis, 100% of pediatric patients aged 2-16 had a screw pathway to accommodate a 6.5 mm diameter screw in the S1 corridor in a "reduction-type" vector, and more than 93% of all patients had pathways for a 6.5 mm diameter screw in the S2 corridor. S1 corridors in a "sacral" vector are much less predictable and are more likely to accommodate a 6.5-mm screw with older age.

See pages 99 - 147 for financial disclosure information.

Risk of Hip Arthroplasty After Open Reduction Internal Fixation of a Fracture of the Acetabulum: A Matched Cohort Study

Sam Si-Hyeong Park, MD*; Patrick Henry, MD; David Wasserstein, MD;*
Michael Paterson, MSc; Hans J. Kreder, MD; Richard J. Jenkinson, MD;
Sunnybrook Health Sciences Center, University of Toronto, Toronto, Ontario, Canada

Purpose: Displaced or unstable fractures of the acetabulum are commonly treated with open reduction and internal fixation (ORIF) to restore hip joint congruity and minimize arthritic progression. The reported risk of subsequent hip replacement is between 8.5% and 14% in small case series. Using a longitudinal population-based cohort, our study aimed to: (1) define the rate and temporal relationship between acetabulum ORIF and eventual hip arthroplasty in a large population, and (2) identify risk-modifying patient, provider, and injury/surgical factors.

Methods: Administrative data sets (including the Ontario Health Insurance Plan physician billing database and the Canadian Institute of Health Information hospital admission database) were utilized to identify all patients over age 16 (for presumed skeletal maturity) in Ontario, Canada, who underwent acetabulum ORIF between July 1996 and March 2010. Excluded were non-Ontario residents, bilateral injuries, and prior hip surgery. The primary outcome was hip arthroplasty, defined by physician and procedural coding from cohort entry until March 2012. The Kaplan-Meier (K-M) time-to-event approach was utilized, censoring patients who died, emigrated from Ontario, or had hip fusion. Four patients from the general population were matched to each surgical patient for age, sex, income quintile, urban/rural address, and year of injury. Matched patients were excluded for prior hip surgery only. Rates of hip arthroplasty at 2, 5, and 10 years after the index date were compared. Among surgical cases, a Cox proportional hazards multivariate model was fit and included potentially predictive patient (demographic), surgical/injury (one- versus two-column fixation), and provider (surgeon volume, time from admission to surgery) factors for the risk of arthroplasty. Hazards ratios (HRs) with 95% confidence intervals were calculated.

Results: We identified 1725 patients (median age, 43 years [interquartile range (IQR) 30-54]; 72.5% male) who met criteria and were matched to 6900 controls. Among cases there was a 13.9% (N = 240) rate of hip arthroplasty after a median of 6.25 (IQR 3.5-10.1) years, compared to 0.6% (N = 38) among matched controls (relative risk = 23). The K-M survivorship was 99.9% (controls) and 91.4% (cases) at 2 years, 99.6% (controls) and 87.6% (cases) at 5 years, and 99.2% (controls) and 83.3% (cases) at 10 years. Only baseline comorbidity scores differed between cases and controls, which was adjusted in the final Cox model. Risk factors for hip arthroplasty among case patients included older age (HR 1.035 [1.027, 1.044]; $P < 0.0001$) and female sex (HR 1.65 [1.257, 2.165]; $P = 0.0003$). The median surgeon volume of acetabulum ORIF was 10 per year (IQR 4-19) overall, but was 7 per year (IQR 4-16) in patients who had an eventual arthroplasty, and 11 per year (IQR 4-19) in those who did not; a finding that was significant in multivariate Cox modeling, which revealed a 2.6% decreased risk of arthroplasty for each acetabulum ORIF above 10 per year (HR 0.974 [0.960, 0.989]; $P = 0.0007$) performed by the index surgeon.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Conclusion: Patients who underwent acetabulum fracture ORIF had a 23-times higher prevalence of hip arthroplasty after 6.25 years compared to age- and sex-matched controls. The risk of eventual arthroplasty was greater in females and older patients. Hip arthroplasty was less likely after acetabulum ORIF performed by higher volume surgeons.

See pages 99 - 147 for financial disclosure information.

Clinical Outcome and Survival of Total Hip Arthroplasty After Acetabular Fracture: A Case-Control Study

***Zachary Morison, MSc**; Dirk Jan Moojen, MD; Aaron Nauth, MD; Jeremy Hall, MD; Michael D. McKee, MD; James P. Waddell, MD; Emil H. Schemitsch, MD;*
St. Michael's Hospital, University of Toronto, Toronto, Ontario, Canada

Background/Purpose: Acetabular fractures are complex intra-articular injuries that occur in a bimodal distribution, typically in younger patients involved in high-energy blunt trauma and in older patients with low-energy falls in the setting of osteoporosis. Although modern fracture management techniques allow for near-anatomic reduction of these fractures, the incidence of posttraumatic arthritis is 20%-30% and total hip arthroplasty (THA) may be required. Many factors play a role in the outcomes of THA after acetabular fracture including age, management of the initial fracture, fracture pattern, and the amount of displacement. The aim of this study was to investigate the long-term clinical and radiographic results in patients who have undergone THA after an acetabular fracture as compared to patients who underwent THA for primary hip osteoarthritis.

Methods: This retrospective case-control study compared findings of patients who underwent THA after acetabular fracture versus a matched cohort of patients who had received a primary THA for nontraumatic osteoarthritis. 80 patients were identified from those who presented with an acetabular fracture between January 1, 1987 and March 31, 2011 at a Level I trauma center and who subsequently underwent THA. The second cohort of patients was matched for date of operation, age, gender, and type of implant to control for their confounding effects on outcomes. The primary outcome measurements were revision and complication rates. All patients who were treated for acetabular fracture (both operatively and nonoperatively) and subsequently underwent THA for posttraumatic arthritis were screened for inclusion in the study.

Results: The cohort of acetabular fracture patients included 55 male and 25 female patients with a mean age of 52 years (range, 25-85)and mean follow-up of 8.1 years (range, 2-23 years). The majority of acetabular fractures were treated by open reduction and internal fixation (ORIF) (74%), while 23% were treated nonoperatively and 3% had an acute THA. The mean time between the initial treatment of the acetabular fracture and the THA was 6.2 years (SD, 5.5 years) for patients after ORIF and 5.8 years (SD, 12.9 years) for patients after nonoperative treatment ($P = 0.941$). The number of revisions for patients with THA after acetabular fracture was 24/80 (30%) as compared to the matched cohort with 12/80 (15%) ($P = 0.038$). There was a significant difference in the time from the initial THA to the revision between patients with previous acetabular fracture (7.7 years; SD, 5.1 years) and the matched cohort (12.8 years; SD, 5.9 years; $P = 0.015$). Patients with previous acetabular fracture had a 6.25% rate of infection and a 10% dislocation rate compared to no infections and a 2.5% dislocation rate in the matched group. The functional outcome was assessed using a standardized hip score and was found to be significantly higher in the matched cohort than the acetabular fracture group at 1 year postoperative and at the most recent follow-up ($P < 0.01$).

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Conclusion: Patients with a prior acetabular fracture had a THA revision rate that was significantly higher than the matched cohort and also required a revision THA 5 years earlier than those without a prior acetabular fracture. This case-control study substantiates a higher complication rate and impaired function in patients who have undergone THA after an acetabular fracture.

See pages 99 - 147 for financial disclosure information.

A Predictive Model for Complications After Flap Coverage of Open Tibia Fractures

Brian M. Weatherford, MD[1]*; Andrew G. Dubina, BS*[1]*; Renan C. Castillo, PhD*[2]*;*
Jean-Claude D'Alleyrand, MD[1,3]*; Raymond Pensy, MD*[1]*; W. Andrew Eglseder, MD*[1]*;*
Robert V. O'Toole, MD[1]*;*
[1]*R Adams Cowley Shock Trauma Center, Department of Orthopaedics,*
University of Maryland School of Medicine, Baltimore, Maryland, USA;
[2]*Center for Injury Research & Policy, Johns Hopkins Bloomberg School of Public Health,*
Baltimore, Maryland, USA;
[3]*Walter Reed National Military Medical Center, Bethesda, Maryland, USA*

Purpose: Previous studies have reported high complication rates for treatment of open tibia fractures that require acute flap coverage for limb salvage; however, little data exist to predict the likelihood of complications for these mangled limbs. Our hypothesis is that risk factors can be identified that increase the likelihood of complication after flap coverage of type IIIB open tibia fractures.

Methods: A retrospective review of all acute fractures of the tibia requiring flap coverage at a single Level I trauma center yielded 134 patients (139 flaps) from 2005 to 2013. Patients were excluded if they required a delayed flap for failed primary closure of a traumatic wound, had a limb-threatening vascular injury, or inadequate follow-up. The primary outcome measure was any complication requiring unplanned surgical treatment of the study injury, including infection and flap complication such as thrombosis or necrosis. Patient, injury, and treatment characteristics were abstracted from the medical record. Bivariate and multiple variable regression techniques were used to identify independent predictors of flap complications while adjusting multiple confounders.

Results: Overall 55 patients (41%) experienced complications after flap coverage. Of these complications, 34% were flap-related (thrombosis, necrosis, hematoma, or dehiscence) and 66% were infectious. The limb salvage rate for the study population was 87%. A number of variables were tested and found not to be risk factors for flap complications including age, sex, body mass index, American Society of Anesthesiologists score, Injury Severity Score, use of negative-pressure wound therapy or an antibiotic bead pouch, external fixation, and type of definitive fracture fixation. Only three statistically significant predictors of flap complications were identified: patients with fractures classified as AO/OTA type B or C (odds ratio [OR]: 4.2, 95% confidence interval [CI]: 1.1, 16.3), delay of flap coverage >7 days (OR: 1.5, 95% CI: 0.6, 2.8), and patients treated with anterolateral thigh (ALT) free flaps (OR: 4.6, 95% CI: 1.7, 12.3). In this sample, patients with none of these risk factors had an 18% chance of complication after flap coverage (2/11). Those with one risk factor had a 32% chance of complication (24/74). Patients with two risk factors had a 44% chance of complication (21/48), and those with all three risk factors had a 90% chance of complication (9/10).

Conclusion: Analysis of this large cohort of type IIIB open tibia fractures identified strong predictors of complication including fracture severity, timing of surgery, and the type of tissue used for flap coverage. To our knowledge, we are the first to report an increased risk of complication with use of the ALT flap. The etiology of complications associated with the

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

ALT flap is unclear at this time and may be related to surgeon selection, limited ability of this flap to contour to large defects, the tenuous vascular pedicle, or an undetected variable in patients receiving coverage with this type of tissue.

See pages 99 - 147 for financial disclosure information.

CASE PRESENTATIONS

Humeral Shaft Fractures: When and How to Fix Surgically (Was Sarmiento Wrong?)
Moderator: *Lisa K. Cannada, MD*
Faculty: *Clifford B. Jones, MD* and *William T. Obremskey, MD*

Periprosthetic Fractures
Moderator: *Erik Kubiak, MD*
Faculty: *George J. Haidukewych, MD; Mark C. Reilly, MD* and *Mark S. Vrahas, MD;*

Distal Femur Cases
Moderator: *Jason W. Nascone, MD*
Faculty: *Christopher Doro, MD; Michael J. Gardner, MD; Conor P. Kleweno, MD* and *Hobie Summers, MD*

NOTES

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

SKILLS LABS

(SL5) **Knee or Ankle Spanning Ex-Fix**
Leader: *Edward A. Perez, MD*
Faculty: *Hassan R. Mir, MD; Amer J. Mirza, MD; Matthew I Rudloff, MD; John C. Weinlein, MD* and *William Wood Cross, MD*

(SL6) **ORIF of Anterior Acetabular Fractures**
Leader: *Michael T. Archdeacon, MD*
Faculty: *Cory A. Collinge, MD; Hassan Riaz Mir, MD; Milton L. "Chip" Routt, MD; Nirmal C. Tejwani, MD* and *Rahul Vaidya, MD*

NOTES

See pages 99 - 147 for financial disclosure information.

SYMPOSIUM III
TIBIAL PLATEAU FRACTURES: OPTIMIZING SURGICAL MANAGEMENT AND TECHNIQUE IN 2014

Moderator: *Todd O. McKinley, MD*

Faculty: *Ross K. Leighton, MD*
Aaron Nauth, MD
Emil H. Schemitsch, MD
Paul Tornetta III, MD
Mark S. Vrahas, MD

8:00 am **Lateral Plateau Fractures: Evidence Based Management**
Ross K. Leighton, MD

8:10 am **Bicondylar Plateau Fractures: Single Plate Versus Dual Plate Fixation**
Paul Tornetta, III, MD

8:20 am **Complex Fractures of the Plateau: When to Use a Posterior Approach**
Mark S. Vrahas, MD

8:30 am **Combined Fracture and Ligamentous Injuries: When to Fix Both**
Aaron Nauth, MD

8:40 am **Managing Complications in Tibial Plateau Surgery**
Emil H. Schemitsch, MD

8:50 am Cases and Discussion
All Faculty

NOTES

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

MINI SYMPOSIA

From Good to Great: Improving your Treatment of Acetabular Fractures
Moderators: *Jaimo Ahn, MD, PhD* and *Samir Mehta, MD*
Faculty: *David L. Helfet, MD; Steven A. Olson, MD; Mark C. Reilly, MD; Milton L. "Chip" Routt, MD* and *Mark S. Vrahas, MD*

Managing Nonunion: Theory and Practice
Moderator: *Christopher G. Moran, FRCS*
Faculty: *Pierre Guy, MD; R. Malcolm Smith, MD* and *John J. Wixted, MD*

How to Establish and Run a Fragility Fracture Program
Moderator: *James A. Goulet, MD*
Faculty: *Peter Althausen, MD; Joseph M. Lane, MD; Debra Sietsema, PhD, RN* and *Marc F. Swiontkowski, MD*

NOTES

See pages 99 - 147 for financial disclosure information.

Operative Treatment of Dislocated Midshaft Clavicle Fractures: Plate or Intramedullary Pin Fixation? A Randomized Controlled Trial

Olivier A. van der Meijden, MD[1]; R. Marijn Houwert, MD, PhD[1]; Martijn Hulsmans[1];
***Frans-Jasper G. Wijdicks, PhD**[1]; Marcel G.W. Dijkgraaf, PhD[2];*
Sven A.G. Meylaerts, MD, PhD[3]; Eric R. Hammacher, MD, PhD[4];
Michiel H.J. Verhofstad, MD, PhD[5,6]; Egbert J.M.M. Verleisdonk, MD, PhD[1];
[1]Department of Surgery, Diakonessenhuis, Utrecht, The Netherlands;
[2]Clinical Research Unit, Academic Medical Center, Amsterdam, The Netherlands;
[3]Department of Surgery, Medical Center Haaglanden, The Hague, The Netherlands;
[4]Department of Surgery, St. Antonius Hospital, Nieuwegein, The Netherlands;
[5]Department of Surgery, St. Elisabeth Hospital, Tilburg, The Netherlands;
[6]Department of Surgery, Erasmus Medical Center, Rotterdam, The Netherlands

Purpose: Over the past decades there has been a paradigm shift toward more aggressive treatment of dislocated midshaft clavicle fractures (DMCF). Open reduction and internal plate fixation and intramedullary (IM) nailing are the most commonly used operative techniques. The aim of this study was to compare short and midterm results of plate fixation and IM nailing for DMCF.

Methods: A multicenter randomized controlled trial was performed in four different hospitals. A total of 120 patients, age 18-65 years, were included and treated with either plate fixation (n = 58) or IM nailing (n = 62). Pre- and postoperative shoulder function scores and complications were documented up until 1 year postoperatively. Statistical significance was set at $P < 0.05$.

Results: There were no significant differences noted between the two surgical interventions for both the Disabilities of the Arm, Shoulder and Hand (DASH) and Constant-Murley score at 6 months postoperatively (3.0 and 99.2 for the plate group and 5.6 and 95.5 for the IM group). The area under the curve for the DASH score for the time period between 6 weeks and 6 months did differ significantly in favor of the plate group ($P = 0.02$). There was only one recorded nonunion, which occurred in the plate group, and there were 2 implant failures in the IM group. The cumulative number of complications was high and mainly implant-related. However, 1 year after surgery only 3% of patients in the plate group and 6% in the IM fixation group still experienced implant related irritation.

Conclusion: Patients in the plate group recovered faster than the patients in the IM group, but groups were similar at final follow-up. The rate of major complications was low yet implant-related complications occurred frequently and could often be treated by implant removal.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Reconstruction Plate Compared with Flexible Intramedullary Nailing for Midshaft Clavicular Fractures: A Prospective, Randomized Clinical Trial

Fernando Brandao, MD*; Kodi E. Kojima, MD; Jorge dos Santos Silva, MD;*
Rames Mattar Jr, MD;
Department of Orthopedics and Traumatology, University of Sao Paulo, Sao Paulo, Brazil

Purpose: Previous studies have shown good clinical results in patients with midshaft clavicular fractures treated with reconstruction plate fixation or elastic stable intramedullary nailing (ESIN). The objective of this study was to compare these methods in terms of functional results, radiographic parameters, postoperative pain, satisfaction rates, and complication rates. We hypothesized that there would be no difference between the treatment groups in terms of functional results.

Methods: This is a single-center, prospective, randomized controlled trial, with IRB approval. 59 patients between 16 and 65 years of age with a displaced midshaft clavicular fracture were randomly assigned to receive either reconstruction plate or ESIN fixation. The primary outcome was the Disabilities of the Arm, Shoulder and Hand (DASH) score at 6 months The secondary outcomes were the following: DASH score at 12 months, Constant-Murley scores at 6 and 12 months, radiographic parameters (time to union and residual shortening), visual analog scale (VAS) for pain on the first postoperative day, patient satisfaction rate, and complication rates, divided into minor and major complications.

Results: 29 patients in the plate group and 25 in the ESIN group completed the follow-up. The mean DASH score at 6 months was 9.9 in the plate group and 8.5 in the ESIN group ($P = 0.329$). Similarly, there were no differences in the DASH score at 12 months and the Constant scores at 6 and 12 months. The mean time to union was 16.8 weeks in the plate group and 15.9 weeks in the ESIN group ($P = 0.352$), whereas the residual shortening was significantly greater in the plate group ($P = 0.032$) but was not clinically relevant (0.4 cm). The VAS scores for pain and patient satisfaction rate were similar between the groups. Regarding minor complications, the rate of implant bending was significantly greater in the plate group (11 patients) than in the ESIN group (1 patient) ($P = 0.003$), whereas the rate of hardware-related pain was greater in the ESIN group (10 patients) than in the plate group (4 patients) ($P = 0.035$). There were similar rates of major complications in both groups, with one case of nonunion in the ESIN group, and no cases in the plate group ($P = 0.463$).

Conclusion: Reconstruction plates and ESIN yielded similar functional results, time to union, postoperative pain, and patient satisfaction rates in patients with displaced midshaft clavicular fractures. Reconstruction plates were more susceptible to implant bending, whereas ESIN caused more hardware-related pain. Both methods were safe in terms of major complications.

See pages 99 - 147 for financial disclosure information.

Does Insurance Status Affect the Management of Acute Clavicle Fractures?

Ryan Bliss, MD; Arthur M. Mora, MHA; ***Peter C. Krause, MD****;*
Louisiana State University Health Science Center, New Orleans, Louisiana, USA

Purpose: Acute clavicle fractures are a very common orthopaedic problem, representing 2.6% of all fractures. The management has evolved over the past decade with a trend from nonoperative to operative management. However, there is still much debate in the orthopaedic community. The purpose of this study is to evaluate whether insurance is an unrecognized factor that plays a role in a surgeon's decision-making. We hypothesize that orthopaedic surgeons are more likely to operate on clavicle fractures in an insured population, rather than an uninsured or underinsured population.

Methods: A retrospective, cross sectional analysis was performed using the Healthcare Cost and Utilization Project (HCUP) data for Florida in the year 2010. Discharge level data from emergency departments and ambulatory surgery settings were used to identify clavicle fractures by ICD-9 codes 81000, 81002, and 81003. Internal fixation was identified using the CPT code 23515. Clavicle fractures that did not result in a CPT code of 23515 were assumed to have been managed nonoperatively. Multivariate logistic regression, allowing for intragroup correlation among surgeons, was utilized to determine the influence of payer source on treatment modality adjusting for race, age, number of chronic conditions, and gender.

Results: In total there were 9734 clavicle fractures and 1129 instances of internal fixation. Observations were removed from the analysis if there were missing personal demographic data or if the ability to track patients from the emergency department to follow-up care was not possible. Therefore, the final sample consisted of 7633 clavicle fractures of which 976 received internal fixation (12.8%). The odds of a patient with private insurance receiving internal fixation was 3.83 times (95% confidence interval [CI] = 3.02-4.85, $P < 0.001$) greater than a self-pay patient, all else being held constant. Patients defined by "other" sources of coverage that includes Workers Compensation, CHAMPUS (military), CHAMPUSVA (veterans), or other government insurance other than Medicare and Medicaid were 2.85 (95% CI = 1.99-4.09, $P < 0.001$) times more likely to have surgery relative to self-pay patients, all else being held constant. The likelihood of patients with Medicare (95% CI = .54-1.16, $P = 0.23$) or Medicaid (95% CI = .91-1.78, $P = 0.16$) having surgery did not differ significantly from self-pay patients.

Conclusion: Patients with any form of payment versus the self-pay, Medicare, and Medicaid populations have a higher likelihood of operative intervention. As there continues to be debate about management of clavicle fractures, this study suggests that an underlying decision in operative management of acute clavicle fractures may be payer source or the patient's ability to pay. Future areas of inquiry could examine why insurance has this effect and whether insurance status plays a role in surgical decision-making in other orthopaedic injuries and diseases.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Long-Term Outcome of Isolated Stable Radial Head Fractures

Andrew D. Duckworth*; Neil R. Wickramasinghe, MBBS; Nicholas D. Clement, MRCS Ed; Charles M. Court-Brown, MD; Margaret M. McQueen, MD;*
Edinburgh Orthopaedic Trauma Unit, Royal Infirmary of Edinburgh, Edinburgh, United Kingdom

Purpose: There is evidence to support the primary nonoperative management of isolated stable fractures of the radial head (Mason type 1 and type 2 fractures). However, the long-term outcome of these fractures remains unclear. The aim of this study was to report the long-term outcome of stable isolated fractures of the radial head following primary nonoperative management.

Methods: We identified from a prospective proximal radial fracture database all patients who sustained a stable isolated Mason type 1 or type 2 fracture of the radial head or neck over an 18-month period. Inclusion criteria included all confirmed isolated stable fractures of the proximal radius that were primarily managed nonoperatively. Demographic data, fracture classification, management, complications, and subsequent surgeries were recorded. The primary long-term outcome measure was the Disabilities of the Arm, Shoulder and Hand (DASH) score.

Results: There were 100 patients in the study cohort with a mean age of 46 years (range, 17-79). A fall from standing height accounted for 69% of all injuries, with one or more comorbidities documented in 35 (35%) patients. There were 57 (57%) patients with a Mason type 1 fracture and 43 (43%) with a Mason type 2. At a mean of 10 years (range, 8.8-10.2) post injury, the mean DASH score was 5.8 (range, 0-67.2) and the mean Oxford Elbow Score was 46 (range, 14-48). Patient satisfaction was 92% with a median satisfaction score of 10 (range, 3-10). 14 (14%) patients reported stiffness and 24 (24%) some degree of pain. Two (2%) patients underwent subsequent surgery for persistent symptoms associated with the original fracture. The median time to return to work was 2 weeks (range, 0-36; n = 73), with a median time to return to sports of 6 weeks (range, 1-24; n = 72). An increased (worse) DASH score was found in older patients ($P = 0.002$), patients with one or more comorbidities ($P = 0.008$), increasing deprivation ($P = 0.026$), increasing fracture displacement ($P = 0.041$), and those patients who pursued compensation in relation to their injury ($P = 0.006$). Further analysis of deprivation adjusting for age, gender, and fracture classification demonstrated that patients in the most deprived quintile had a mean DASH score 13.3 points higher than the least deprived. There was a trend toward a significantly worse DASH for fractures displaced 4 mm or more (5.2 vs. 13.7, $P = 0.07$).

Conclusion: To our knowledge, this is the largest series in the literature documenting the long-term outcome of patients treated with primary nonoperative intervention for an isolated stable fracture of the radial head. Our data would suggest that the conservative management of these injuries is a reliable treatment option, yielding an excellent or good long-term result in the majority of cases. Despite a small number of patients reporting persistent pain and stiffness, patient satisfaction is high, the need for secondary intervention is negligible, and patients routinely return early to work and sports.

See pages 99 - 147 for financial disclosure information.

Radial Head Replacement for Complex Unstable Fractures of the Radial Head

Andrew D. Duckworth*; Neil R. Wickramasinghe, MBBS; Nicholas D. Clement, MRCS Ed; Charles M. Court-Brown, MD; Margaret M. McQueen, MD;*
Edinburgh Orthopaedic Trauma Unit, Royal Infirmary of Edinburgh, Edinburgh, United Kingdom

Purpose: The optimal treatment for unstable radial head fractures needs to balance the risks of radial head excision (eg, instability), the potential complications of open reduction and internal fixation (ORIF) (eg, nonunion), and the possible complications associated with a radial head prosthesis. It is acknowledged that further data are needed to document the longer-term outcome for radial head replacement, in particular the rate and risk factors associated with further surgery for removal and/or revision. The aim of our study was to determine (1) the frequency of revision or removal following radial head replacement (primary outcome) for acute complex unstable radial head fractures, (2) the risk factors for prosthesis revision or removal, and (3) the functional outcome (secondary outcomes) after radial head replacement.

Methods: We identified from our prospective trauma database 119 patients over a 15-year period who were managed acutely for an unstable complex fracture of the radial head with primary radial head replacement. Demographic data, fracture classification, management, complications, subsequent surgerie,s and range of movement at final follow-up were recorded following retrospective clinical record review. The primary outcome measure was failure of the radial head replacement, defined by revision of removal of the prosthesis for any cause.

Results: There were 105 (88%) patients in the study cohort with a mean age of 50 years (range, 16-93) and 54% (n = 57) were female. There were 95 (90%) radial head fractures and 96% were a Mason type 3 or 4 injury. There were 98 associated injuries in 70 patients (67%). All implants were uncemented monopolar prostheses, with 86% metallic and 14% silastic. At a mean of 1.1 years (range, 0.3-5.5 years) after surgery, the mean Broberg and Morrey score was 80 (range, 40-99). The mean elbow flexion arc was 112° (range, 10°-140°; SD, 25°), and the mean forearm rotation arc was 156° (range, 0°-180°; SD, 38°). At a mean of 6.7 years following injury (range, 1.8-17.8) 29 (28%) patients had undergone revision (n = 3) or removal (n = 26) of the prosthesis. Independent risk factors of prosthesis removal or revision were silastic implant type ($P = 0.004$) and younger age ($P = 0.002$).

Conclusions: This is the largest series in the literature documenting the outcome following acute radial head replacement for complex unstable fractures of the radial head. We have demonstrated a high rate of removal or revision following radial head replacement, with lower age and silastic implants independent risk factors. Younger patients should be counseled regarding the increased risk of requiring further surgery following radial head replacement. Future work should focus on the long-term patient-reported outcome following these injuries.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Early Mobilization Versus Plaster Immobilization of Simple Elbow Dislocations: Results of the FuncSiE Multicenter Randomized Clinical Trial

*Gijs I.T. Iordens, MD[1]; Esther M.M. Van Lieshout, PhD[1]; Niels W.L. Schep[2]; Jeroen De Haan[3]; Wim E. Tuinebreijer, MD, PhD, MSc, MA[1]; Ed F. Van Beeck[4]; Peter Patka, MD, Dmed, PhD[5]; Michael H.J. Verhofstad[1]; **Dennis Den Hartog, PhD**[1]; (on behalf of FuncSiE trial investigators)*
[1]Trauma Research Unit, Department of Surgery, Erasmus MC, University Medical Center Rotterdam, Rotterdam, The Netherlands;
[2]Trauma Unit, Department of Surgery, Academic Medical Center, Amsterdam, The Netherlands;
[3]Department of Surgery, Westfriesgasthuis, Hoorn, The Netherlands;
[4]Department of Public Health, Erasmus MC, University Medical Center Rotterdam, Rotterdam, The Netherlands;
[5]Department of Emergency Medicine, Erasmus MC, University Medical Center Rotterdam, Rotterdam, The Netherlands

Purpose: Simple elbow dislocations are traditionally immobilized in plaster following closed reduction. Theoretically, early mobilization may enhance functional outcome, but its relative merit is unknown. The aim of this study was to compare the outcomes of early mobilization and plaster immobilization in patients with a simple elbow dislocation.

Methods: This was a multicenter randomized controlled trial in patients aged 18 years or older with a simple elbow dislocation. Patients were randomized to early mobilization (immediate motion exercises) or 3 weeks plaster immobilization. Patients were followed for 1 year. Outcome measures included the *Quick*DASH, an abbreviated version of the Disabilities of the Arm, Shoulder, and Hand (DASH; primary), Oxford Elbow Score (OES), pain (Visual Analog Scale [VAS]), range of motion (ROM), and activity resumption.

Results: Between August 2009 and September 2012, 48 patients were assigned to early mobilization and 52 to plaster immobilization. At 6-week follow-up, patients in the early mobilization group reported significantly better scores for the *Quick*DASH (mean 12 vs. 19 after plaster immobilization) and the OES function subdomain (86 vs. 73); at that time, they also had a larger arc of ROM of flexion and extension (121 vs. 102). Patients returned to work sooner after early mobilization (10 vs. 18 days). At 1 week, patients in the plaster group reported less pain (mean VAS 2.2 vs. 3.2). Complications occurred in 12 patients; this appeared unrelated to treatment.

Conclusion: Early active mobilization is a safe and effective method of treatment in simple elbow dislocations. It resulted in faster recovery of elbow function and did not lead to recurrent dislocation.

See pages 99 - 147 for financial disclosure information.

Manipulation Under Anesthesia as a Treatment of Posttraumatic Elbow Stiffness

Daniel H. Doty, MD*; Clay A. Spitler, MD; Peter J. Nowotarski, MD; D. Marshall Jemison, MD; University of Tennessee College of Medicine Chattanooga, Chattanooga, Tennessee, USA*

Purpose: Loss of motion is common after traumatic injury to the elbow. There are limited data on the use of forcible passive stretching under anesthesia to improve motion in the posttraumatic elbow. Some authors suggest forcible manipulation may cause a higher rate of complications including ectopic bone formation, ulnar neuritis, and arthrofibrosis. This study is a review of forcible manipulation under anesthesia for patients with posttraumatic elbow stiffness. We hypothesize that manipulation under anesthesia for the treatment of posttraumatic elbow stiffness will significantly increase elbow flexion and extension arc without a high rate of complications.

Methods: A retrospective chart and radiographic review was performed of patients at a single institution who underwent isolated elbow manipulation under anesthesia in treatment of posttraumatic elbow stiffness from 2002 to 2011. The review included an analysis of patient demographics, initial injury data, timing of injury to manipulation, range of motion, previous nonoperative therapy, fracture union at time of manipulation, rate of complications, and additional reoperations. Manipulation was recommended in patients who failed to see adequate improvement in range of motion after elbow trauma. Manipulation involves cautious, but firm, alternating forcible flexion and extension, minimizing the length of the lever arm over which the force is applied.

Results: 46 patients were included in the review, with an average follow-up of 583 days (range, 76-1623). There were 20 open fractures (43.5%), 8 of which required soft-tissue coverage. Average premanipulation flexion arc was 56.6° and improved significantly at final follow-up to an average flexion arc of 83.7° ($P < 0.001$). Five patients developed clinically significant heterotopic ossification, two patients later required cubital tunnel decompression, and 13 patients underwent additional procedures to treat arthrofibrosis. There was no reported loss of fixation. The only acute complication of manipulation was minor tearing of a skin graft in one patient. Post hoc analysis of data identified two distinct subgroups: patients manipulated within 3 months of their final elbow surgery (G_1) and patients manipulated after 3 months of their final elbow surgery (G_2). G_1 had an average improvement in flexion arc of 38.3°; G_2 had an average improvement of 3.1°. This increase in range of motion from pre-manipulation to final follow-up was a significant improvement for G_1 ($P < 0.001$), but not for G_2. The difference in improvement between G_1 and G_2 was statistically significant in favor of the early manipulation group ($P < 0.001$).

Conclusion: Elbow manipulation under anesthesia within 3 months of final elbow surgery is an effective means of improving flexion arc for patients with posttraumatic elbow stiffness. Elbow manipulation after 3 months does not appear to be effective at improving flexion arc.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Galeazzi Fractures: Are Distal Radioulnar Joint (DRUJ) Injuries Predicted by Current Guidelines?

Paul Tornetta, III, MD; ***Tony Tsismenakis, MD;***
Boston University Medical Center, Boston, Massachusetts, USA

Background/Purpose: DRUJ injuries occur with isolated radial shaft fractures. Several methods have been proposed for their diagnosis on injury films. Based on biomechanical studies, radial shortening at the wrist of >5mm (positive ulnar variance of >5 mm) is predictive of DRUJ instability. Other authors have used fractures within 7.5 cm of the wrist joint as predictive. However, neither of these guidelines has ever been subjected to an evaluation against actual DRUJ injury in a larger data set, nor has the presence of an ulnar styloid fracture been assessed. The purpose of this study is to evaluate the literature-based predictors of DRUJ injury, as well as the presence of ulnar styloid fracture, against the actual operative findings of DRUJ instability.

Methods: All patients with isolated radial shaft fractures with complete radiographs were evaluated over a 10-year period at one Level I trauma center. Demographic, medical records, and radiographic data were tabulated. Radiographs were evaluated for fracture location, radial shortening at the wrist, DRUJ translation, radial angulation, and presence of ulnar styloid fracture. The gold standard of diagnosis of DRUJ instability was any intervention (casting in supination, pinning, direct repair, etc) for DRUJ instability after radial fixation in the operating room or late instability. All patients were specifically evaluated for instability after fixation by the attending orthopaedic surgeon.

Results: 66 patients (51 male, 15 female) with an average age of 34 years (range, 18-90) with 28 right and 38 left radial shaft fractures were included. Mechanism of injury was motor vehicle or fall in 45. By thirds, there were 10 proximal (15%), 27 middle (41%), and 29 distal (44%) fractures. 13 (20%) had an associated ulnar styloid fracture. There were 7 (11%) patients with DRUJ instability after radial fixation. Radial shortening averaged 4.43 ± 5.2 mm (range, –2.6 to 22) and 21 were >5 mm. 26 (39%) of fractures were within 7.5 cm of the wrist joint. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of these findings are in Table 1. Even greater shortening did not predict instability with only 3/7 patients with >10 mm shortening having a true injury. However, 4/7 cases with instability had ulnar styloid fractures ($P = 0.02$). In 7 cases, the final radiology report indicated DRUJ "dislocation" rather than other descriptions such as "injury" or "subluxation." Only 2/7 (29%) were actually unstable.

Table 1. Predictors of Instability

Predictor	Sensitivity	Specificity	PPV	NPV
>5 mm radial shortening	86%	67%	27%	97%
Fracture <7.5 mm from wrist	57%	63%	15%	93%
Ulnar styloid fracture	50%	84%	31%	92%

See pages 99 - 147 for financial disclosure information.

Conclusion: We evaluated a large series of isolated radial shaft fractures to determine the relative importance of previously reported guidelines, as well as the presence of an ulnar styloid fracture, for the diagnosis of DRUJ instability. We found that using radial shortening >5 mm or fractures within 7.5 cm of the wrist had 86% and 57% sensitivity, and only 67% and 63% specificity, respectively. Even cases with >10 mm shortening had only a 43% incidence of injury. The presence of an ulnar styloid fracture had specificity, PPV, and NPV similar to or better than previously published guidelines. In conclusion, using a larger data set than has historically been evaluated, we found that previously reported guidelines for DRUJ injury are only moderately accurate and lack specificity, and that the presence of an ulnar styloid fracture can be helpful. Surgeons should be aware of these associations but rely primarily on intraoperative assessment of the DRUJ after radial fixation to determine treatment.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Modern Treatment of 3 and 4-Part Proximal Humerus Fractures: ORIF Demonstrates Better Range of Shoulder Motion Than Reverse Total Shoulder Arthroplasty

Kenneth A. Egol, MD*; Christina Capriccioso, BSE; Thomas Wright, MD;*
Pierre Henri Flurin, MD; Joseph D. Zuckerman, MD;
NYU Hospital for Joint Diseases, New York, New York, USA

Purpose: This study investigates clinical outcomes of patients who sustained 3- or 4-part proximal humerus fractures (PHFs) treated with open reduction and internal fixation (ORIF) or reverse total shoulder arthroplasty (rTSA).

Methods: 102 patients who sustained 103 3- or 4-part PHFs were identified from a prospective database of PHF patients treated with ORIF by one of 3 fellowship-trained fracture surgeons. These patients were compared to 43 patients who underwent rTSA for a 3- or 4-part PHF by a fellowship-trained shoulder surgeon experienced in the technique. Clinical outcomes were assessed via chart review. Functional outcome scores for the ORIF cohort were assessed via the Disabilities of the Arm, Shoulder and Hand (DASH) survey and a generated American Shoulder and Elbow Surgeons (ASES) score. Functional outcomes for the rTSA group were assessed via the Simple Shoulder Test (SST), UCLA Shoulder Rating Scale, Constant Shoulder Score, and ASES Shoulder Survey. All patients had minimum 1-year follow-up.

Results: The ORIF and rTSA study groups were similar except for age and body mass index (BMI). Patients in the rTSA cohort were older and thinner with an average age of 75.7 years and BMI of 26.7 kg/m^2, compared to 62.8 years and average BMI of 29.4 in the ORIF cohort ($P < 0.001$, $P = 0.004$). Shoulder range of motion in patients who were treated with ORIF had an average active forward elevation of 130.8°, compared to 124.6° in the rTSA cohort ($P = 0.273$) and active external rotation of 44.2°, compared with 31.2° in the rTSA cohort ($P = 0.001$). At latest follow-up, no functional difference was seen between groups with patients in the ORIF cohort having a mean ASES score of 73.4 (±23.7) and patients in the rTSA cohort a mean ASES score of 77.6 (±13.7) ($P = 0.774$).

Conclusion: Patients who sustain 3- or 4-part proximal humerus fractures and are treated with reverse total shoulder arthroplasty tend to be older and have a lower BMI than those treated with ORIF. Functionally, patients treated with ORIF had greater final range of motion than those treated with rTSA. However, both strategies resulted in a functional range of shoulder motion. Functional outcome scores between groups were similar and reached population norms at latest follow-up.

See pages 99 - 147 for financial disclosure information.

Operative Versus Nonoperative Management of Humerus Fractures

Reza Firoozabadi, MD, MA[1]*; Edward Westrick, MD*[2]*; Benjamin Hamilton, MS*[3]*;*
Bradford Henley, MD, MBA[1]*;*
[1]*Harborview Medical Center/University of Washington, Seattle, Washington, USA;*
[2]*Allegheny General Hospital, Pittsburgh, Pennsylvania, USA;*
[3]*Case Western Reserve University, Cleveland, Ohio, USA*

Purpose: The ideal treatment of humeral shaft fractures remains controversial. Both operative and nonoperative interventions have limitations, although functional bracing is thought to result in a low rate of complications.

Methods: Patients with humeral shaft fractures (AO 12-A, B, C) from 2000-2011 were identified from our institution's prospective patient data registry. Patient characteristics, treatment type, consolidation period, injury mechanism, nerve palsy, nonunion and other injuries were retrieved from the electronic medical record. Data were analyzed using SPSS version 21.0 for Windows.

Results: A total of 505 patients with acute humeral shaft fractures were identified. 209 patients were excluded for the following reasons: pathologic fracture, age less than 16 years old or failure to follow up to radiographic union; 296 patients met inclusion criteria. A total of 227 fractures were treated operatively, and 69 treated with functional bracing. A high-energy mechanism was identified in 67% of nonoperative and 79% of operative patients. 44% of nonoperative fractures were isolated injuries compared with only 21% treated operatively. The nonunion rate was 9.7% in operative fractures and 23.2% with functional bracing. 12 nonunions resulted after intramedullary nail (54.5%), 9 after plate osteosynthesis (41%), and 1 after external fixation (4.5%). In the nonoperative nonunions, 44% were wedge (12-B2/3), 31% transverse (12-A3), 18.75% oblique (12-A2), and 6.25% comminuted (12-C3). Nerve palsies were identified in 84 operative patients (37%), with 82 palsies diagnosed preoperatively. 14 nonoperatively treated patients sustained nerve palsies (20%). One nonoperative and 10 operative palsies resulted in permanent dysfunction. Seven operatively treated arterial injuries (3%) were identified.

Conclusion: This study of mostly polytraumatized patients demonstrates a higher nerve palsy rate than previously reported for both operative and nonoperative treatment of humeral shaft fractures, likely resulting from high-energy trauma. The incidence of nonunion is higher than previously reported for nonoperative management.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

A Randomized Controlled Trial of Percutaneous Fixation With Kirschner Wires Versus Volar Locking-Plate Fixation in the Treatment of Adult Patients With a Dorsally Displaced Fracture of the Distal Radius

Matthew L. Costa, MD, FRCS; Amar Rangan, MD, FRCS; ***Andrew C. Gray, MD, FRCS****;*
Warwick Clinical Trials Unit, University of Warwick, Coventry, United Kingdom

Purpose: This study compared Kirschner wire (K-wire) fixation with locking-plate fixation for patients with dorsally displaced fractures of the distal radius. We hypothesized that locking-plates would provide better improvements in the Patient-Rated Wrist Evaluation (PRWE) in the 12 months after surgery.

Methods: In this multicenter Distal Radius Acute Fracture Fixation Trial (DRAFFT), we randomly assigned 461 adult patients having surgery for an acute, dorsally displaced fracture of the distal radius to either K-wire fixation or locking-plate fixation. The primary outcome measure was the PRWE at 12 months after the fracture. We also collected information on complications, and combined costs and quality-adjusted life years (QALYs) to assess cost-effectiveness.

Results: The baseline characteristics of the two groups were well balanced and over 90% of patients completed follow-up. Both groups of patients recovered wrist function by 12 months. There was no difference in the PRWE score at 3 months, 6 months, or 12 months (difference –1.3; 95% confidence interval [CI] –4.5 to 1.8; $P = 0.398$). There was no difference in the number of complications in each group and negligible differences in QALY gains; K-wire fixation represents a cost-saving intervention, particularly in younger patients.

Conclusion: Contrary to the existing literature, and against the increasing use of plate fixation, this trial shows that there is no difference between K-wires and volar locking-plates for patients with dorsally displaced fractures of the distal radius. K-wire fixation is less expensive and quicker to perform.

See pages 99 - 147 for financial disclosure information.

Clinical Trial in the Treatment of A2-OTA Type Fractures of the Distal Radius by Casting

Amir R. Kachooei, MD*; Ali Moradi, MD; Taghi Peivandi, MD;*
Mohammad H. Ebrahimzadeh, MD;
Orthopedic Research Center, Mashhad University of Medical Sciences, Mashhad, Iran

Purpose: This trial was conducted to compare the final results of distal radius A2-OTA type fractures treated with either long or short arm casts.

Methods: This prospective randomized clinical trial was performed on 100 patients with distal radius fractures. Fifty patients were treated in each group either by short or long arm cast. Data were recorded during the 6th and 18th weeks after the reduction and casting.

Results: There were no significant differences between groups regarding age, gender, and the type of fracture. There were significant differences between the two groups regarding the range of elbow flexion and extension and forearm supination and pronation that were decreased with time. There was no significant difference regarding the stability of the distal radioulnar joint. There was no malunion, nonunion, carpal tunnel syndrome, or compartment syndrome in either group.

Conclusion: According to this short-term study, a short arm cast with three-point molding provides adequate therapeutic result in A2-OTA type fracture with low cost and good acceptability.

Table 1.
Preoperative Characteristics of the Fracture in the Long and Short Arm Cast Groups

Fracture Characteristics		Type of Cast		*P* Value
		Long arm cast N (%)	Short arm cast N (%)	
Radial inclination in plain AP view	≤10°	0	0	0.52
	11°-15°	15 (30%)	19 (38%)	
	>15°	35 (70%)	31 (62%)	
Dorsal tilt angulations in lateral view	≤9°	34 (68%)	30 (60%)	0.53
	10°-19°	16 (32%)	20 (40%)	
	≥20°	0	0	
Radial shortening in plain AP view	≤5 mm	38 (76%)	40 (80%)	0.6
	6-9 mm	12 (24%)	10 (20%)	
	≥10 mm	0	0	

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Table 2. Evaluation of the Patients at 6- and 18-Week Follow-up*

	Follow-up	LAC	SAC	*P*
Limitation of range of flexion - extension of the elbow	Week 6	26 (52%)	0	<0.05
	Week 18	4 (8%)	0	<0.05
Limitation of range of supination and pronation of the forearm	Week 6	28 (56%)	1 (2%)	<0.05
	Week 18	5 (10%)	0	<0.05
DRUJ Instability	Week 6	1 (2%)	2 (4%)	>0.05
	Week 18	0	0	

*LAC = long arm cast, SAC = short arm cast, DRUJ = distal radioulnar joint.

See pages 99 - 147 for financial disclosure information.

Volar Locking Plate Versus External Fixator/Cast Fixation for the Treatment of Distal Radius Fractures: A Randomized, Controlled Prospective Trial

Lidia Koval, MBBS[1]*; Herwig Drobetz, MD*[2]*;*
[1]*The Prince Charles Hospital, Brisbane, Queensland, Australia;*
[2]*Mackay Base Hospital, Mackay, Queensland, Australia*

Purpose: Osteosynthesis with a volar locking plate (VLP) is the only treatment option that allows immediate postoperative mobilization of the wrist. However, a VLP is an expensive and technically demanding form of treatment. This study compares the short-term functional outcomes of treatment without postoperative immobilization versus treatment by other modalities.

Methods: Group 1 consisted of distal radius fractures treated with a VLP, with no postoperative immobilization and unrestricted usage of the wrist in activities of daily living (ADL) allowed. Group 2 fractures were treated with either an external fixator ± Kirschner wires (K-wires) or forearm cast ± K-wires, with subsequent immobilization for 6 weeks. Both groups had radiological and clinical controls at 2 weeks, 6 weeks, and 12 weeks. The end points were time to return to work or return to ADLs, range of motion (ROM) of the wrist, and grip strength. Outcomes were evaluate with Disabilities of the Arm, Shoulder and Hand (DASH) and Patient-Rated Wrist Evaluation (PRWE) scores, collected 3 months after the injury.

Results: A total of 60 patients have been recruited, with 28 patients assigned to Group 1 (VLP) and 32 patients to Group 2 (non-VLP). Mean age of group 1 was 52 years, and of group 2 61 years. The predominant fracture type was AO/ASIF type C. All eligible participants completed the required follow-up. Nine patients either failed to attend the OPD, or were discharged early with no follow-up, and 1 patient was found to have bilateral wrist fractures on the follow-up, and was excluded. The average DASH score was the same for both groups (mean = 45). The average PRWE score was 21 for group 1, and 46 for group 2. The mean grip strength for group 1 was 64.33% and for group 2 patients 41.92% of the unaffected arm. Mean flexion was equal for both group; mean extension was for group 1 and for group 2. *Complications:* In group 1, one patient had symptoms of ulnar nerve weakness and one had flexor tendon rupture. One patient had complex regional pain syndrome (CRPS). Two patients requested to have the VLP removed. In group 2, two patients underwent lengthening surgery for malunion with shortening of the radius. Two patients developed symptoms suggestive of CRPS.

Conclusion: It appears that the results of treatment of the distal radius fractures with a volar locking plate followed by immediate postoperative immobilization are not significantly different from the nonoperative treatment of such injuries, as demonstrated by similar mean DASH and flexion in both groups. However, the mean PRWE is lower, and the mean grip strength and extension appear to be higher in the VLP-treated patients.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Open Reduction and Internal Fixation of the Distal Radius: Catastrophic Thinking Leads to Stiff Fingers

Teun Teunis, MD*; Arjan G. Bot, MD; Emily R. Thornton, BSc; David Ring, MD, PhD; Massachusetts General Hospital - Harvard Medical School, Boston, Massachusetts, USA*

Background/Purpose: There is debate whether patients who have greater pain and disability than expected after musculoskeletal injury have a distinct pathophysiological process (eg, increased sympathetic nerve activity) or ineffective coping strategies such as excessive catastrophic thinking. This study aims to establish predictors of finger stiffness after distal radius fracture surgery. We hypothesize that there are no physical or psychological factors associated with finger stiffness measured by (1) range of motion and (2) distance to palmar crease at 8 weeks after surgical treatment.

Methods: After IRB approval, we prospectively enrolled 116 patients at the time of suture removal after volar plate fixation of a distal radius fracture. At inclusion we recorded patients' demographics, pain intensity, catastrophic thinking (Pain Catastrophizing Scale), symptoms of depression (Patient Health Questionnaire), health anxiety (Whiteley Index), and index through small finger's motion and distance to palmar crease. Motion and distance to palmar crease were evaluated in 96 patients 5 weeks after enrollment (approximately 8 weeks after fracture). 17% (20/116) of the patients did not have a second evaluation: 8 sought follow-up care closer to home and 12 were missed by the research assistant when an appointment was rescheduled.

Results: Age ($r = -0.45$, $P < 0.001$), having another pain condition (pain condition 938° ± 168° versus no pain condition 999° ± 99°, $P = 0.044$), years of education ($r = 0.32$, $P = 0.0017$), catastrophic thinking ($r = -0.42$, $P < 0.001$), health anxiety ($r = -0.22$, $P = 0.033$) and pain score ($r = -0.26$, $P = 0.010$) at enrollment were associated with range of motion 8 weeks after surgery. Age (beta = –3.2, 95% confidence interval [CI] –4.6 to –1.8, $P < 0.001$), years of education (beta = 10, 95% CI 3.1 to 18; $P = 0.006$), and catastrophic thinking (beta = –6.3, 95% CI –9.8 to –2.8, $P = 0.001$) were retained in the final model for range of motion (adjusted R^2 0.35, $P < 0.001$). The same variables were associated with increased distance to palmar crease 8 weeks after surgery: age ($r = -0.28$, $P < 0.0053$), having another pain condition (pain condition 3.9 ± 7.3 cm vs. no pain condition 1.3 ± 3.5 cm, $P = 0.031$), years of education ($r = -0.29$, $P = 0.0042$), catastrophic thinking ($r = 0.59$, $P < 0.001$), health anxiety ($r = 0.38$, $P = <0.001$), and pain score ($r = 0.25$, $P = 0.013$). Years of education (beta = –0.32, 95% CI –0.61 to –0.040; $P = 0.026$), and catastrophic thinking (beta = 0.45, 95% CI 0.32 to 0.58, $P < 0.001$) were retained in the final model for increased distance to palmar crease (adjusted R^2 0.37, $P < 0.001$).

Conclusion: A maladaptive coping response to pain (catastrophic thinking) leads to stiff fingers. Surgeons and therapists should acknowledge the counterintuitive aspects of recovery and help patients change their mindset so that they feel healthy about using their sore arm and doing uncomfortable stretching exercises.

See pages 99 - 147 for financial disclosure information.

The Role of Depression in Outcomes of Low-Energy Distal Radius Fractures in Patients Over 55 Years Old

Jane Yeoh, BSc, MD; Jeffrey Pike, MD, MPH, FRCSC; Henry Broekhuyse, MD, FRCSC; Peter O'Brien, MD, FRCSC; ***Kelly A Lefaivre, BScH, MD, MSc, FRCSC****;*
Division of Orthopaedic Trauma, Department of Orthopaedic Surgery,
University of British Columbia, Vancouver, British Columbia, Canada

Purpose: This study aims to determine the effect of depression on functional outcome, complications, and the occurrence of complex regional pain syndrome (CRPS) in patients over 55 years old with isolated distal radius fractures.

Methods: Data were prospectively collected in patients over 55 with acute distal radius fractures in one Level I trauma center. Patient and treatment characteristics collected include age, gender, medical comorbidities, education, smoking, and operative versus nonoperative treatment. General and limb-specific health status was measured at baseline, 3 months, and 1 year using the Short Form-36 (SF-36), and Disabilities of the Arm, Shoulder and Hand (DASH) score. Depression was measured using the Centre of Epidemiologic Studies Depression Scale (CES-D) at the same time intervals. All complications, and specifically symptoms consistent with CRPS were recorded. Univariate analysis was utilized to examine the relationship between depression and complications, and between depression and outcomes. Linear regression models were utilized to assess the effect of depression and other factors on functional outcomes.

Results: 228 patients were enrolled, 204 women and 24 men. The mean age was 67 ± 0.59 years. 120 distal radius fractures were treated nonoperatively and 108 treated operatively. A large portion of patients were depressed at baseline (24.8%), and this rate increased 3 months after injury (32.1%), and returned close to baseline 1 year after injury (26.3%). 32 patients reported some type of complication (14.0%), and 22 of these patients had symptoms consistent with CRPS (10.3%). Univariate analysis showed a significant association between depression at baseline (P = 0.0732) and 3 months (P = 0.0017) and the occurrence of CRPS. This relationship did not exist with complications at baseline, but did at 3 months (P = 0.0211). There was a statistically significant association between baseline depression and worse 1-year SF-36 scores. Patients with baseline depression had worse absolute 1-year DASH scores of 20.14 ± 2.32 compared to 11.60 ± 1.33 in nondepressed patients (P = 0.0031), and worse change in DASH score between baseline and 1 year (P = 0.0229). Using linear regression, baseline depression is the strongest predictor of worse 1-year DASH scores (3.720, P = 0.0078), and more change in DASH score over the first year (2.896, P = 0.0255) controlling for gender, age, treatment, comorbidity, and complications.

Conclusion: A significant portion of patients over 55 with distal radius fracture present with depression, and experience new depression during treatment. In this study, rates of CRPS complicating recovery from distal radius fracture were consistent with previous literature (10.3%). We found an association between CRPS and baseline depression as well as depression at 3 months after injury. There is no

PAPER ABSTRACTS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

association between baseline depression and complications overall, yet there is an association between 3-month depression and complications. Baseline depression predicts poorer general functional and limb-specific functional outcome at 1 year. Depression is the most important predictor of DASH at 1 year, and change in DASH over treatment, even after controlling for other important predictors of upper extremity function.

See pages 99 - 147 for financial disclosure information.

Efficacy of Postoperative Pain Control After Distal Radius Fracture Fixation: A Prospective Randomized Study

David Galos, MD; David P. Taormina, MS; Alexander Crespo, BS; David Ding, MD; Anthony Sapienza, MD; Sudheer Jain, MD; ***Nirmal C. Tejwani, MD, FRCS;***
NYU Langone Medical Center Hospital for Joint Diseases, New York, New York, USA

Purpose: This study was undertaken to determine the efficacy of brachial plexus blockade as compared to general anesthesia for pain control in patients undergoing operative fixation of distal radius fractures.

Methods: Forty patients with acute distal radius fractures (OTA 23A-C) requiring operative fixation that met inclusion criteria were identified. Patients were assigned to one of two groups, general anesthesia (GA) or brachial plexus blockade (BPB) randomly. Post-anesthesia care unit (PACU) pain medications and data were recorded. Patients were discharged on oxycodone/acetaminophen (Percocet) 5/325 mg for pain control and visual analog scale (VAS) forms were provided. Patients were called at predetermined intervals postoperatively (2, 4, 6, 12, 24, 48, and 72 hours) to gather pain scores, using the VAS, and to document the doses of analgesics consumed. Patients followed up in the operative surgeon's office until union and then continued to be followed until maximal medical improvement. At each follow-up visit, patients were given a short questionnaire regarding satisfaction with pain control. Pain scores were again recorded using VAS at these visits.

Results: All patients, 18 males and 22 females, obtained adequate follow-up. Twenty patients were randomized to the GA group and twenty to the BPB group. Average pain was significantly greater in the GA group at 2 hours postoperatively (6.7 vs.1.4; $P < 0.001$), while average pain was significantly greater for the BPB group at 12 hours (6.6 vs. 3.8; $P < 0.001$) and 24 hours postoperatively (5.6 vs. 3.8; $P < 0.032$). The average amount of PACU Percocet did not differ between the groups ($P = 0.5$). PACU fentanyl and morphine use was significantly higher for GAs than BPBs ($P < 0.003$). Time in PACU was significantly longer for GA than BPB (4:49 vs. 3:20; $P < 0.032$). There was no difference in average total pain medication used at home ($P = 0.777$). The overall satisfaction with pain control was not statistically different between the two group ($P = 0.279$).

Conclusion: Brachial plexus blockade provides superior pain control in the immediate postoperative period while patients who received general anesthesia have significantly lower pain scores at 12 and 24 hours postoperatively. This may be related to rebound pain after the nerve block subsides. Immediate postoperative pain can be controlled in a safe manner in the PACU, but in instances of poorly controlled pain after BPB has worn off, increasing discomfort, anxiety, and fear of unanticipated sequelae may lead to unnecessary emergency room visits and physician phone calls.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Pain Over Time: GA Versus BPB

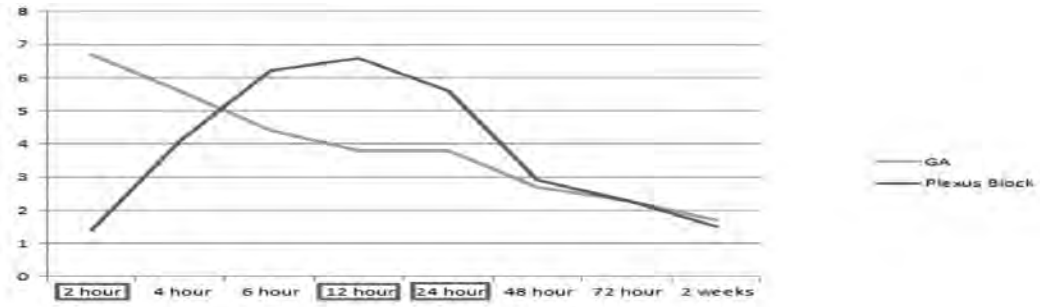


Figure 1. Average VAS scores at each follow-up time point. The GA group had significantly more pain at 2 hours (while in the PACU), while the BPB group had significantly more pain at 12 and 24 hours.

See pages 99 - 147 for financial disclosure information.

Radiation Exposure to the Surgeon's Hands:
A Practical Comparison of Large and Mini C-Arm Fluoroscopy

Michael M. Vosbikian, MD[1]*; Charles F. Leinberry, MD*[2]*; Derek Watson, RT*[3]*;*
Asif M. Ilyas, MD[2]*;*
[1]*Thomas Jefferson University Hospital – Department of Orthopaedic Surgery, Philadelphia, Pennsylvania, USA;*
[2]*The Rothman Institute at Thomas Jefferson University Hospital, Philadelphia, Pennsylvania, USA;*
[3]*Nazareth Hospital – Department of Radiology, Philadelphia, Pennsylvania, USA*

Purpose: Controversy persists as to whether mini C-arm fluoroscopy units are safer than standard units. In particular, radiation exposure to the surgeon's hand, which is often closest to the surgical field, is also not well understood. To determine and compare the radiation exposure to the orthopaedic surgeon's hands with use of a standard and mini C-arm fluoroscopy units in a practical, clinically-based model.

Methods: Two attending hand surgeons monitored the radiation exposure to their hands with a ring dosimeter over a 14-month period using standard and mini C-arm fluoroscopic units. One surgeon performed all cases with a standard C-arm unit in a hospital setting, while the other performed all cases with mini C-arms in surgical centers. For each case, fluoroscopic time, the final dose displayed on the unit, and radiation per unit time were recorded and analyzed.

Results: A total of 160 consecutive cases were reviewed with 71 cases and 89 cases in the standard and mini C-arm limbs of the study, respectively. The median fluoroscopy time per case was 37.7 seconds with the large C-arm and 88 seconds with the mini C-arm. The median dose reported by the large C-arm was 0.68 mGy/case, while the median dose reported by the mini C-arm was 9.97 mGy/case. With dose as a product of time, the median calculated values were 0.02 mGy/second for the large C-arm group and 0.28 mGy/second for the mini C-arm group. The ring exposures showed an exposure of 380 mrem and 1100 mrem for the large and small C-arm groupd, respectively.

Conclusion: The mini C-arm resulted in more than a 10-time increase in radiation exposure dose and more than 3 times greater dosimeter absorption to the surgeon's hand, compared to the standard C-arm. While it has been shown that the mini C-arm produces less scatter of ionizing radiation, in a practical model the mini C-arm may not be a safer alternative to the large C-arm with respect to the surgeon's hands. Although below the maximum recommended radiation dose per year with either model, based on these findings, we would recommend taking precautions toward radiation exposure by utilizing protective equipment and minimizing fluoroscopic time.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Dorsal Screw Penetration With the Use of Volar Plating of Distal Radius Fractures: How Can You Best Detect?

Brian W. Hill, MD*; Irshad A. Shakir, MD; Lisa K. Cannada, MD;*
Saint Louis University, St. Louis, Missouri, USA

Purpose: The valley between the sigmoid notch and Lister's tubercle make evaluation of screw prominence difficult with conventional fluoroscopic images. Various projections have been described to detect dorsal cortex screw penetration. This cadaveric study is designed to evaluate which described fluoroscopic images are useful to detect dorsal cortex penetration with the use of volar locking plates.

Methods: 21 embalmed forearm cadaveric specimens were used. Volar locking plates (Smith & Nephew, Memphis, TN) were secured in position proximally. Four 2.5-mm locking screws were inserted distally using 18 mm, 20 mm, and 22 mm screws in 7 specimens for each length. The specimen was evaluated to count the number of screws breaching the dorsal cortex. Four fluoroscopic images (lateral, 45° supination, 45° pronation, dorsal tangential view) were taken of each wrist. A group of 63 orthopaedic surgeons with different levels of experience were then asked to evaluate if the screws penetrated the dorsal cortex after viewing each image. The data were analyzed for sensitivity and specificity in the evaluation of dorsal screw penetration and interobserver reliability using the interclass correlation coefficient.

Results: The 21 cadaveric specimens had an average age of 78 years (range, 25-91). Dorsal cortex screw penetration of at least one screw occurred in 14% (1/7) of specimens with 18 mm screw, 57% (4/7) of specimens with 20 mm screw, and 86% (6/7) specimens with 22 mm screws. The sensitivity of the lateral view was 64.1%, 90.3% on the 45° supination view, 63.9% on the 45° pronation view, and 73.2% on the dorsal tangential view. An increase in the number of years of orthopaedic experience demonstrated an inverse relationship with respect to sensitivity/specificity (Table 1).

Conclusion: Dorsal cortex screw penetration can lead to tendon irritation and rupture. This can occur especially with penetration of the third dorsal compartment due to its relationship to Lister's tubercle. This cadaveric study gave us direct visualization of screw penetration to accurately determine which fluoroscopic images detected this breach. The lateral and 45° pronation views detected screw penetration about two-thirds of the time. The sensitivity increased with dorsal tangential views to 73% and the 45° supination view to 90%. Clinicians should consider use of these views to diagnose dorsal screw penetration after volar plating.

See pages 99 - 147 for financial disclosure information.

Table 1. Sensitivity and Specificity of the 4 Fluoroscopic Views in Detecting a Screw Penetrating the Dorsal Cortex

Years Experience	Lateral View		45° Supination View		45° Pronation View		Dorsal Tangential View	
	Se.	**Sp.**	**Se.**	**Sp.**	**Se.**	**Sp.**	**Se.**	**Sp.**
>10	58.3%	72.5%	88.6%	79.2%	51.0%	66.3%	62.9%	74.2%
6-10	54.0%	81.8%	86.1%	84.7%	50.0%	70.6%	67.4%	80.6%
1-5	57.6%	80.0%	86.4%	80.0%	54.2%	78.3%	66.7%	86.7%
Resident	64.2%	67.1%	90.4%	70.6%	58.8%	61.2%	70.6%	80.6%
Cumulative	64.1%	82.0%	90.3%	78.1%	63.9%	66.7%	73.2%	78.4%

Values expressed as a percentage. Se = sensitivity, Sp = specificity.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

MINI SYMPOSIA

Coding Update and Challenging Case Review
Moderator: *J. Scott Broderick, MD*
Faculty: *William R. Creevy, MD* and *Austin Hill, MD*

Management Strategies for Physeal Fractures Around the Knee and Ankle *(Co-branded by the Pediatric Orthopaedic Society of North America)*
Moderator: *David A. Podeszwa, MD*
Faculty: *Christine A. Ho, MD; Anthony I. Riccio, MD* and *Robert L. Wimberly, MD*

How Do You Decide Who Should be a "Co-Author"? The Expert Panel Perspective *(Sponsored by the Journal of Orthopaedic Trauma)*
Moderator: *Craig S. Roberts, MD*
Faculty: *Thomas A. DeCoster, MD; Ellen J. Mackenzie, PhD* and *Marc F. Swiontkowski, MD*

Developing a Successful Clinical Research Program
Moderator: *Heather A. Vallier, MD*
Faculty: *Mary A. Breslin, BA* and *William T. Obremskey, MD, MPH*

NOTES

See pages 99 - 147 for financial disclosure information.

Removal of Implants After Open Reduction and Internal Fixation of Tibial Plateau Fractures Improves Clinical Outcomes

Matthew R. Garner, MD*; Marschall B. Berkes, MD; Amelia Ni, BA; Jackie Birnbaum, BA; Dean G. Lorich, MD;*
Hospital for Special Surgery, New York, New York, USA

Purpose: Tibial plateau fractures are common injuries often treated with open reduction and internal fixation. Anecdotally, we have noted improved patient satisfaction following hardware removal for these patients. The purpose of this study was to objectively assess the effect of the removal of surgical implants after union on patient reported outcomes.

Methods: Since 2009 all patients at our Level I trauma center undergoing open reduction and internal fixation by the senior surgeon (D.G.L.) are enrolled into a prospective registry and have outcomes recorded routinely at follow-up (Knee Outcomes Survey [KOS] and Lower Extremity Functional Scale [LEFS]). Visual analog scale (VAS) pain was also recorded. This registry was divided into two cohorts: those who had undergone removal of their surgical implants and those who had not. The decision to remove implants was based upon patient preference. Outcome scores were compared between the two study populations using a two-tailed Student *t*-test.

Results: A total of 80 patients were identified as having completed outcome scores: 33 had retained implants and 47 had implants removed. Results can be seen in Table 1. Outcomes were significantly better in patients who had implants removed compared to those who did not ($P = 0.002$ for KOS, $P = 0.002$ for LEFS). There was no significant difference seen in VAS pain scores (1.59 vs. 1.56, $P = 0.94$).

Conclusion: The results of this study indicate that patients who have removal of their surgical implants after open reduction and internal fixation of a tibial plateau fracture have significantly better outcomes than those who have retained implants. Patients who are unhappy with their clinical result should be counseled that removal of the implant may improve function, but may not improve pain.

Table 1. Follow-up and Outcome Scores for Patients with and without Retained Implants.

	Retained	Removed	*P* Value
Follow-up (mos)*	8.2 (2.9-30.1)	6.1 (0.3-20.4)	0.094
KOS (avg.)	52.7 (14-72)	63.4 (31-80)	0.002
LEFS (avg.)	44.7 (5-80)	61.7 (19-80)	0.0002
VAS	1.59 (0-5.8)	1.56 (0-7.4)	0.94

*Indicates months after most recent surgery

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Comparing Outcomes Between Hinged Knee Bracing and No Bracing After Open Reduction and Internal Fixation of Tibial Plateau Fractures

***Aakash Chauhan, MD, MBA**; Alan Slipak, BS; Kathryn Peticca, BS; Gregory T. Altman, MD; Daniel T. Altman, MD;*
Allegheny General Hospital, Pittsburgh, Pennsylvania, USA

Purpose: This trial was conducted to compare outcomes of hinged knee bracing to no bracing for patients after tibial plateau fracture open reduction and internal fixation (ORIF). Drawbacks of bracing include additional cost to the patient, brace-related wound complications, and possible loss of motion. Our hypothesis is that there will be no difference between both groups in terms of long-term radiographic, functional, and subjective outcomes.

Methods: After IRB approval, a prospective trial was initiated that randomized patients to either 6 weeks of hinged knee bracing or no bracing after tibial plateau fracture ORIF. Radiographic union, failure of fixation, wound complications, and postoperative range of motion were followed. Short Form-36 (SF-36) questionnaires were administered at the longest possible follow-up either during office visits or by phone if they were unable to come back for re-evaluation. Patients with open physes, unstable ligamentous injuries, and <6 months of prospective data or clinical follow-up were excluded.

Results: The brace group (N = 24) had an average age of 51 ± 12 years with 13 females and the non-bracing group (N = 25) had an average age of 51 ± 15 years with 9 females. The braced group had 2 open fractures and included 13 AO/OTA 41-B3 (54%), 7 C1, 2 C2, and 2 C3 fractures; the non-braced group had 4 open fractures and included 2 AO/OTA 41-B1, 14 B3 (56%), 2 C1, 3 C2, and 4 C3 fractures. There were two wound complications in the brace group: a wound eschar treated nonoperatively, and one patient with an open fracture that had a wound infection treated 7 months after surgery. There were 4 wound complications in the non-braced group: two patients with local wound breakdown treated nonoperatively and two patients, both with open fractures, with one acute wound infection/dehiscence requiring surgery and the other with an infected nonunion treated 6 months after surgery. Average radiographic union for the brace group was 12 ± 5 weeks with one nonunion, and for the non-braced group was 12 ± 4 weeks ($P = 0.90$) with two nonunions. Average final postoperative extension for bracing was 1° ± 2° and for non-bracing was 1° ± 3° ($P = 0.85$). Average final postoperative flexion for bracing was 118° ± 15° and for non-bracing was 123° ± 11° ($P = 0.13$). Average final clinical follow-up for range of motion was 9 ± 3 months for bracing and 9.4 ± 3 months for no bracing. At final radiographic follow-up for braced patients there were no alignment changes. For the non-braced group there was one late joint collapse with valgus malalignment (>10°). The SF-36 scores for the braced group at an average follow-up of 18 ± 11 months revealed Physical and Mental Component Summary scores of 40 ± 9 and 50 ± 12 compared to the non-bracing group, which had an average follow-up 21 ± 12 months with Physical and Mental Component Summary scores of 39 ± 10 ($P = 0.64$) and 48 ± 10 ($P = 0.57$).

Conclusion: Based on our study, there is no statistically significant difference between bracing and no bracing in terms of long-term radiographic, functional, and subjective

See pages 99 - 147 for financial disclosure information.

outcomes. A larger multicenter study may prove valuable, but based on our data, there is no benefit to bracing. Bracing has been discontinued for routine postoperative management of tibial plateau fracture ORIF at our institution.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

ΔRandomized Clinical Trial of Supra- Versus Infrapatellar Tibial Nailing: A Pilot Study

Daniel S. Chan, MD*; Barbara Steverson, RN; Rafael Serrano-Riera, MD; Anthony F. Infante, DO; David T. Watson, MD; H. Claude Sagi, MD; Roy Sanders, MD; Orthopaedic Trauma Service, Tampa General Hospital, Tampa, Florida, USA; Florida Orthopaedic Institute, Tampa, Florida, USA*

Purpose: The standard treatment for tibial shaft fractures is intramedullary nailing. This procedure has been described to include two approaches: infrapatellar (IP) and suprapatellar (SP). To our knowledge, no study has directly compared these two techniques. The purpose of this study is through a randomized clinical trial to compare the clinical outcomes and functional status of the knee after IP versus SP tibial nailing.

Methods: After IRB approval, skeletally mature patients with middle 3/5 tibial shaft fractures were randomized into the IP or SP nailing groups after informed consent was obtained. Patients with intra-articular involvement, ipsilateral concomitant injuries, prior knee surgery, or history of gout, rheumatoid, or osteoarthritis were excluded. Standard surgical techniques were employed which included a medial parapatellar IP approach, and a longitudinal quadriceps tendon split SP approach. SP patients also underwent a pre- and post-nailing knee arthroscopy to obtain a visual description of the patellofemoral joint (reviewed by a fellowship-trained sports medicine orthopaedic surgeon). Patients underwent routine follow-up (6 weeks; 3, 6, and 12-months) with standard tibia and knee radiographs, as well as visual analog scale (VAS) and pain diagram documentation. At the 6- and 12-month visits, a complete knee function questionnaire (Lysholm knee scale) and Short Form-36 (SF-36v2) were completed. Additionally, MRI of the affected knee was obtained at 12 months and independently reviewed by a board-certified, fellowship-trained musculoskeletal radiologist. As a pilot study, formal sample size calculations were not performed, and the information obtained from this investigation would enable a proper power analysis for the future larger prospective study. Therefore, 20 patients in each group were planned, with consideration for patient attrition across 12 months of follow-up.

Results: 41 total patients were enrolled, and 26 patients (13 IP, 13 SP) completed 12 months of follow-up. The average ages were 40 and 41 years for IP and SP, respectively. Similarly, each group was comprised of 9 males in IP, 8 in SP. At 12 months, all 26 patients had proceeded to successful union, and functional VAS and Lysholm knee scores showed no significant differences between groups ($P > 0.05$). The SF-36v2 comparison also revealed no significant differences in the overall score, all 4 mental components, and 3 of 4 physical components ($P > 0.05$). The bodily pain component score was superior in the SP group (46 vs. 36, $P = 0.022$) suggesting less pain and disability. Clinically, the differences between the affected and unaffected knee in extension and flexion were both near zero (extension: 0° IP, 1° SP, $P = 0.5$; flexion 1° IP, –3° SP, $P = 1.0$). 11 of 13 SP patients obtained MRI at 1 year. Four of the interpretations included chondromalacia patellae; however, in three of these patients chondromalacia can be noted in their pre-nailing arthroscopy assessment. The fourth patient's pre- and post-nailing arthroscopy documented no appreciable changes in the patellofemoral articular surfaces.

Δ OTA Grant

See pages 99 - 147 for financial disclosure information.

Conclusion: Overall, there are no significant differences in pain, disability, or knee range of motion between these two tibial intramedullary nailing techniques after 12 months of follow-up. The suprapatellar approach can be performed safely with comparable clinical and functional outcomes to the infrapatellar method. A larger prospective trial with long-term follow-up is needed to improve statistical power and establish if any late sequelae exist.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Type III Open Tibia Fractures: Immediate Antibiotics and Earliest Possible Wound Coverage Minimize Infections

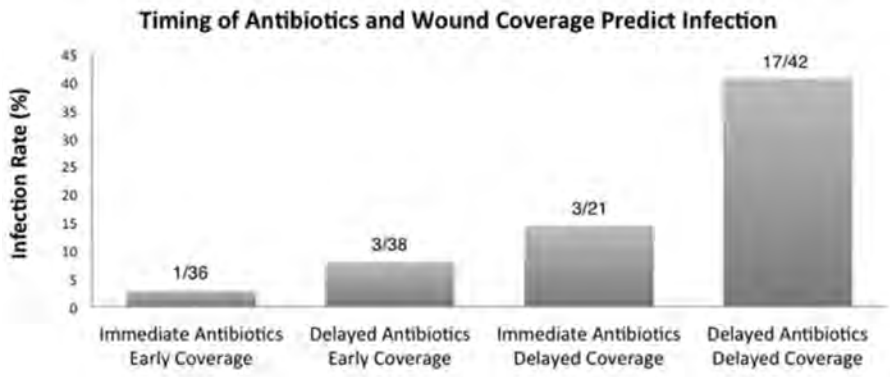
William D. Lack, MD[1]*; Madhav A. Karunakar, MD*[2]*; Marc Angerame, MD*[2]*;*
Rachel Seymour, PhD[2]*; Stephen H. Sims, MD*[2]*; James F. Kellam, MD*[2]*; Michael J. Bosse, MD*[2]*;*
[1]*Loyola University Medical Center, Maywood, Illinois, USA;*
[2]*Carolinas Medical Center, Charlotte, North Carolina, USA*

Purpose: Antibiotic prophylaxis is the standard of care after an open fracture. However, evidence regarding antibiotic timing is limited. Our purpose was to examine the association between antibiotic timing and deep infection of type III open tibia fractures.

Methods: We retrospectively studied 162 consecutive type III open tibia fractures at a Level I trauma center. The final population consisted of 137 patients after exclusions for missing data (13), nonreconstructible limbs (9), and/or absence of 90-day outcome (3). Deep infection within 90 days was the primary outcome defined by criteria from the Centers for Disease Control and Prevention. We analyzed days to wound coverage, time to antibiotics, open fracture subclassification (type IIIA vs. IIIB/C), ISS, antibiotic agent, age, smoking, and diabetes.

Results: Age, smoking, diabetes, ISS, type IIIA versus IIIB/C injury, and time to surgical debridement were not associated with infection on univariate analysis. Greater than 5 days to wound coverage ($P < 0.001$) and greater than 66 minutes to antibiotics ($P < 0.01$) were univariate predictors of infection. Multivariate analysis found wound coverage beyond 5 days (odds ratio 7.39, 95% confidence interval [CI] 2.33-23.45, $P < 0.001$) and antibiotics beyond an hour from injury (odds ratio 3.78, 95% CI 1.16-12.31, $P = 0.03$) independently predicted infection. Immediate antibiotics and early coverage limited the infection rate (1 of 36, 2.8%) relative to delay in either factor (6 of 59, 10.2%) or delay in both factors (17 of 42, 40.5%).

Conclusion: Time from injury to antibiotics and to wound coverage independently predict infection of type III open tibia fractures. Both should be achieved as early as possible, with coverage being dependent on the condition of the wound. Given the relatively short therapeutic window for antibiotic prophylaxis (within an hour of injury), prehospital antibiotics may substantially improve outcomes for severe open fractures.



See pages 99 - 147 for financial disclosure information.

Damage Control Plating in Open Tibial Shaft Fractures:
A Cheaper and Equally Effective Alternative to Spanning External Fixation

Aaron M. Perdue, MD; Arnold J. Silverberg, BS; Rachel V. Thakore, BS;
Vasanth Sathiyakumar, BA; Daniel J. Stinner, MD; Hassan R. Mir, MD;
David J. Polga, MD; William T. Obremskey, MD, MPH, MMHC; ***Manish K. Sethi, MD****;*
Vanderbilt University, Nashville, Tennessee, USA

Background/Purpose: External fixation has traditionally been utilized to provisionally stabilize open tibial shaft fractures when definitive fixation is not advisable. An alternative to external fixation is temporary damage control plating (DCP), which utilizes temporary internal fixation with a single plate to give temporary stability, length, and alignment. The purpose of this study is to determine whether DCP is a good alternative to external fixation for open tibial shaft fractures by comparing complication rates and implant costs.

Methods: A retrospective chart review at a Level I trauma center identified patients who underwent operative management of open tibial shaft fractures from 2008 to 2012. Radiographs were reviewed to identify patients who underwent DCP or external fixation followed by definitive fixation. Initial implants were removed at time of definitive fracture stabilization. Rates of complication requiring an unplanned surgical intervention were compared using a c^2 analysis. The implant costs were provided by the institution's financial services.

Results: 445 patients who underwent operative management of an open tibial shaft fracture were identified. 31 patients met inclusion criteria, 12 (39%) of whom had DCP and 19 (61%) of whom had external-fixation. Both DCP and external fixation samples were composed of mostly Gustilo grade III fractures (67% and 58%, respectively). There was no significant difference in the rate of complications between DCP (25.0%) and external fixation (26.3%). The average implant costs for DCP ranged from $360.50 to $1,879.50, which was 2.7 to 14 times less than the average costs for external fixation at $5073 (Figure 1).

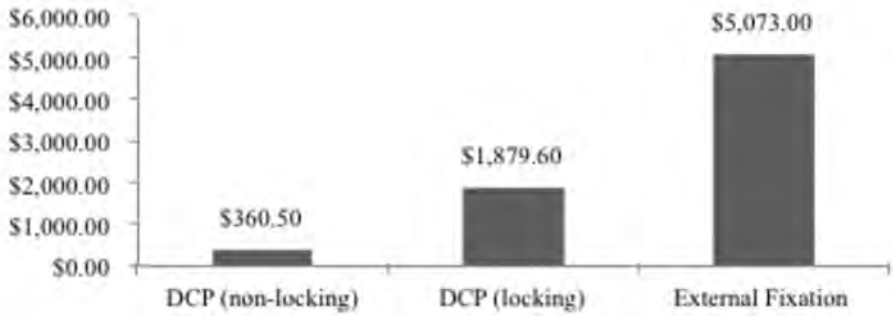


Figure 1. Costs for DCP and external fixation

Conclusion: As our health-care system renews focus on cost-cutting efforts, orthopaedic trauma surgeons must explore less expensive yet equally effective treatment alternatives. In this study, which is the first to compare the use of DCP and external fixation to temporize open tibial shaft fractures, data suggest that DCP is an equally safe yet less expensive alternative to external fixation for a tibial shaft fracture.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

The Gustilo-Anderson Classification System as Predictor of Nonunion and Infection in Open Tibia Fractures

Rachel V. Thakore, BS; Elvis L. Francois, BA; Michael A. Siuta, PhD; Michael A. Benvenuti, BS; Anne K. Smith, BS; Samuel K. Nwosu, MS; Kristin Archer, PhD, DPT; Jesse M. Ehrenfeld, MD, MPH; ***William T. Obremskey, MD, MPH, MMHC****; Manish K. Sethi, MD;*
Vanderbilt University, Nashville, Tennessee, USA

Purpose: Open tibia fractures are known to have a very high risk of complications. However, previous large studies, including the SPRINT trial (Study to Prospectively evaluate Reamed Intramedullary Nails in Tibial fractures), have focused primarily on closed injuries or excluded higher grade open fractures. The purpose of this study was to conduct the largest retrospective study to date of open tibia fractures and describe incidence of complications and evaluate potential predictive risk factors for complications.

Methods: After IRB approval, patients treated for open tibia fractures by intramedullary nailing across a 10-year period were identified by a CPT code search at a Level I trauma center. Charts were reviewed and potential risk factors including age, gender, American Society of Anesthesiologists (ASA) score, hospital length of stay (LOS), type (T) of open fracture, distance of fracture from the plafond, and the sum of 31 comorbidities were recorded. Patients under the age of 16 were excluded from analysis. Charts were reviewed for complications leading to reoperations including infection, nonunion, and amputation. A multivariate analysis was conducted to determine if any of the potential risk factors described above were associated with a greater risk of complications.

Results: 486 patients with open tibia fractures were analyzed (TI: 63, TII: 202, TIIIa: 140, TIIIb: 73, TIIIc: 8). The average age was 33 years (± 15; range, 16-85). 78% of patients were male. Overall 13% (n = 64) of patients had infections, 12% (n = 56) had nonunions, and 1% (n = 7) had amputations. Infection rates were TI, 2%; TII, 8%; TIIIa, 14%; TIIIb, 30%; and TIIIc, 62%: Nonunion rates were TI, 6%; TII, 7%; TIIIa, 11%; TIIIb, 26%; and TIIIc, 25%. Amputation rates were TI and TII, 0%; TIIIa, 1%; TIIIb, 7%; and TIIIc, 12%. TIII fractures had much higher rates of infection, nonunion, and amputation than TI and TII fractures (Table 1). After examining all potential risk factors described above, we found that fracture type was a highly significant risk factor for both nonunion and infection. The risk of nonunion was 4× higher with TIIIb fractures and 5× higher ($P = 0.001$) with TIIIc fractures ($P = 0.06$) compared to TI and TII fractures. In terms of infection, the risk was 2× higher for TIIIa fractures, 6× higher for TIIIb fractures, and 29× higher for TIIIc fractures compared to TI and TII fractures.

See pages 99 - 147 for financial disclosure information.

Table 1. Complications based on Gustilo Grade			
Grade	Infection	Nonunion	Amputation
I (n=63)	**2%** (1/63)	**6%**(4/63)	**0%**(0/63)
II (n=202)	**8%**(17/202)	**7%**(15/202)	**0%**(0/202)
IIIa (n=140)	**14%**(19/140)	**11%**(16/140)	**1%**(1/140)
IIIb (n=73)	**30%**(22/73)	**26%**(19/73)	**7%**(5/73)
IIIc (n=8)	**62%**(5/8)	**25%**(2/8)	**12%**(1/8)
Overall	**13%**(64/486)	**12%**(56/486)	**1%**(7/486)

Table 2.Odds ratio based on Gustilo Grade				
Grade	Nonunion		Infection	
	OR	p	OR	p
IIIa	1.409	0.368	2.132	0.036
IIIb	**3.810**	**0.001**	**5.993**	**<0.001**
IIIc	5.320	0.062	**28.570**	**<0.001**

Conclusion: This study, which is the largest analysis of open tibia fractures to date, determined that the Gustilo grade of open tibia fractures is by far the greatest predictor of nonunion and infection. The risk of nonunion and infection was 5× and 29× higher, respectively, for Type IIIc fractures compared to Type I/II fractures. Similar findings were found for Type IIIb fractures. Our findings can be used to compare similar fractures at any institution or study and develop a risk calculator for open tibias, which can be used by surgeons to predict care and advise patients with this high-risk injury.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Prediction of Tibial Nonunions at 3 Months After Intramedullary Nailing

Justin Fowler, MD[1]*; Andrew G. Dubina, BS*[1]*; Renan C. Castillo, PhD*[2]*;*
Christina L. Boulton, MD[1]*; Jason W. Nascone, MD*[1]*; Marcus F. Sciadini, MD*[1]*;*
Christopher T. LeBrun, MD; Robert V. O'Toole, MD[1]*;*
[1]*R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA;*
[2]*Center for Injury Research & Policy, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA*

Purpose: Interest exists in predicting which tibia fractures are likely to result in nonunion and require additional surgery. Multiple parameters might predict likelihood for nonunion, including patient and fracture characteristics, time until weight bearing is allowed, and the radiographic healing of the tibia or fibula. We hypothesized that a prediction tool could be created based on information available at 3 months that would be useful in predicting tibial nonunion.

Methods: A retrospective review of all tibia shaft fractures treated at a single Level I trauma facility between 2006 and 2012 yielded 59 nonunions. Patients were excluded if they were treated with anything other than an intramedullary nail, if there was a planned surgical intervention to prevent nonunion after the index procedure, or if the fracture pattern had a critical defect of >3 cm. 21 patients met the inclusion criteria and were compared to a randomly selected control group of 76 patients treated with an intramedullary nail who went on to radiographic union without the need for further intervention. Patient data were collected for each to include: fracture grade, American Society of Anesthesiologists Score (ASA) class, body mass index (BMI), smoking status, and time until weight bearing was allowed. An image set was created of these 97 cases utilizing their 3-month interval follow-up radiographs. The image set was presented in random order and viewed using standard clinical software to clinicians who were blinded to the final outcome. Four fellowship-trained orthopaedic traumatologists were asked to review the radiographs. The previously described RUST (radiographic union score of the tibia) score for each of the four cortices of the tibia were recorded as it was for the fibula. In the cases of a segmental fracture, the reviewer was asked to grade the fracture with the least amount of radiographic healing.

Results: As shown in Table 1, the tibia RUST score at 3 months was a powerful predictor of tibia nonunion. Patients with a score of 8 or above had a 0% (0/44) nonunion rate. Although application of the RUST score to the fibula at 3 months was predictive of nonunion in bivariate analysis ($P = 0.002$), this effect was not observed when used in combination with tibia RUST. For patients with tibia RUST scores below 8, a separate predictive model was developed. Predictors of nonunion in this model included: open fracture (odds ratio: 11.7, 95% confidence interval [CI] :1.2-118, $P = 0.04$) and tibia RUST score (odds ratio: 0.3 per RUST point, 95% CI: 0.14 to 0.67, $P = 0.003$). This model was highly predictive of tibial nonunion, accounting for >60% of variance in these outcomes.

See pages 99 - 147 for financial disclosure information.

Table 1. Tibia RUST Score at 3 Months and History of Open Fracture Versus Chance of Nonunion

	Tibia RUST Score			
Fracture Type	**8-12**	**7-7.9**	**6-6.9**	**4-5.9**
Closed	0% (0/26)	0% (0/8)	0% (0/3)	33% (2/6)
Open	0% (0/18)	18% (2/11)	50% (4/8)	76% (13/17)

Conclusion: The RUST score applied to tibia healing at 3 months appears to be a powerful predictor of need for tibial nonunion surgery. We have developed a simple, clinically practical model that predicts need for tibial nonunion surgery based on data available at the 3-month time point.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Does Progressive Radiographic Healing Result in Better Function? A Prospective Evaluation of PCS and RUST Scoring in Tibial Shaft Fractures Treated with IM Nailing

Paul Tornetta, III, MD[1]*; David Sanders, MD*[2]*; Emil Schemitsch, MD*[3]*; Yves LaFlamme, MD*[4]*; Diane Heels-Ansdell, MSc*[5]*; Jason Busse, PhD*[5]*; Mohit Bhandari, MD, MSc, PhD*[5]*;*
[1]*Boston University Medical Center, Boston, Massachusetts, USA;*
[2]*Victoria Hospital, London, Ontario, Canada;*
[3]*St. Michael's Hospital, Toronto, Ontario, Canada;*
[4]*University of Montreal, Montreal, Quebec, Canada;*
[5]*McMaster University, Hamilton, Ontario, Canada*

Background/Purpose: Multiple large trials have reported validated patient-based outcomes of tibial nailing at final follow-up, while others have reported on the problems of patients with nonunions. However, there are no data on the recovery of function over time, or how progressive radiographic healing is related to outcome. The purpose of this study is to describe the recovery curve of patients after intramedullary (IM) nailing using the SF-36 PCS (36-Item Short Form Health Survey, physical component summary score) and to evaluate its association with progressive healing using the RUST score (radiographic union score of the tibia).

Methods: In a prospective multicenter trial 501 patients were treated with IM nailing and followed at 6, 12, 18, 26, 38, and 52 weeks with SF-36 PCS at all visits and radiographs at each visit until an independent adjudication committee determined the fractures to be healed (defined as remodeled callus on 3 cortices). All radiographs were scored and adjudicated using the RUST method based on the callus on each of the 4 cortices. All disagreements in scoring were resolved by an adjudication panel resulting in a consensus decision. The association of PCS with RUST and with time from surgery was determined using a repeated-measures analysis. In a separate analysis, the PCS over time (recovery curve) of patients with delayed union (defined as not healed by 6 months) were compared with those patients who were united by 6 months.

Results: The recovery curve (mean PCS) and the mean RUST scores per visit are seen in Figure 1 for all patients. PCS plateaus at 6 months for the group as a whole. The PCS curve and the RUST curve have a strong statistical association ($P < 0.001$). PCS was also associated with time from surgery and decreased age after adjusting for the RUST score. Patients who were not healed by 6 months had statistically different PCS scores at all time points after 6 weeks than those who were healed by 6 months (Figure 2). The recovery curve for patients with delayed union was shifted to the right compared with those united by 6 months, indicating a strong association of progressive healing with PCS.

See pages 99 - 147 for financial disclosure information.

Figure 1 PCS blue, RUST green.

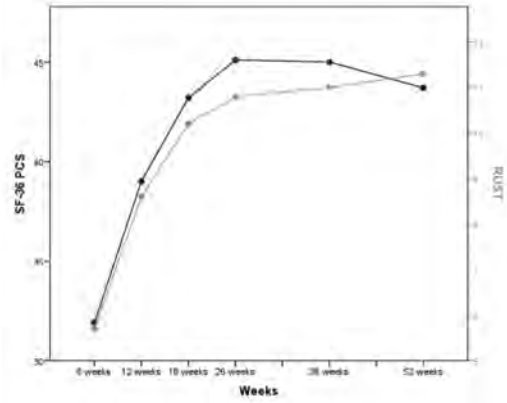
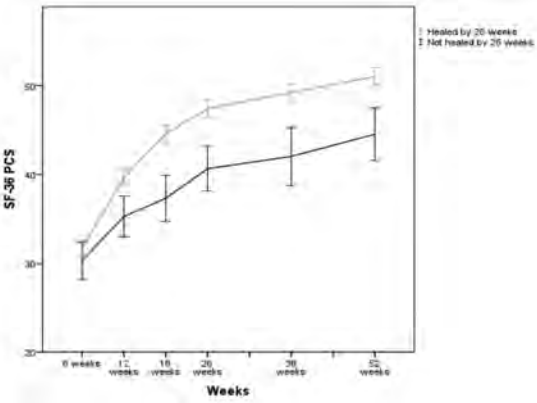


Figure 2 Healed <6 mos vs. >6 mos.



Conclusion: Recovery after tibial nailing is strongly associated with progressive radiographic healing. The average SF-36 PCS plateaus near 6 months for the majority of patients. This plateau is delayed until 52 weeks for patients with delayed union (not healed by 6 months). PCS was also associated with time from surgery and age. This is the first large trial to demonstrate the association of progressive healing with patient-based outcome, and to demonstrate the recovery curve after tibial nailing. Patients may be counseled regarding their expected outcomes based on their radiographic progress towards union.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

The Incidence of Deep Vein Thrombosis and Pulmonary Embolism in Fractures of the Tibia: An Analysis of the National Trauma Data Bank

Ronald T. Auer, MD*; John T. Riehl, MD;*
University of Louisville, Louisville, Kentucky, USA

Background/Purpose: The incidence of deep vein thrombosis (DVT) and pulmonary embolism (PE) after a fracture of tibia is generally believed to be low. There is disagreement in the literature and in clinical practice with regards to chemical prophylaxis after fracture and its subsequent treatment in tibia fractures.

Methods: The National Trauma Data Bank (NTDB) data set (2009 to 2011) was used to evaluate the incidence of thromboembolism after tibia fracture. Risk factors associated with the thromboembolic events were identified (Tables 1 and 2). The NTDB data included demographic information, comorbidities, procedure codes, diagnosis codes, and complication data, including DVT and PE, which were collected from the data set for analysis. We identified 148,936 patients with tibia fractures and excluded 51,569 with other lower extremity orthopaedic trauma and 11,291 with polytrauma. The remaining 86,076 patients were examined to evaluate the incidence of DVT and PE and identify risk factors for these complications

Results: The incidence of DVT and PE was 0.48% and 0.31%, respectively. The risk factors statistically significant for DVT and PE in tibia/fibula trauma were older age (DVT, odds ratio [OR] 1.02, 95% confidence interval [CI] 1.02 to 1.03; PE, OR 1.02, 95% CI 1.01 to 1.03), male gender (DVT, OR 1.64, 95% CI 1.27 to 2.12; PE, OR 1.46, 95% CI 1.09 to 1.97), and higher ISS (DVT, OR 1.16, 95% CI 1.12 to 1.20; PE, OR 1.08, 95% CI 1.04 to 1.12).

Conclusion: The incidence of thromboembolic events after fracture of the tibia is low. Those at low risk for DVT/PE with isolated fractures of the tibia can be treated safely without the routine use of antithromboembolic chemoprophylaxis.

See pages 99 - 147 for financial disclosure information.

Tables 1 and 2: Logistic Regression Analysis Results, Including Only Significant Variables, for Risk Factors Associated With DVT (Table 1) and PE (Table 2) (N = 66,952)

Deep Vein Thrombosis Variable	Odds Ratio	95% Confidence Interval	p-value
Gender	1.64	1.27-2.12	0.0002
Age	1.02	1.02-1.03	<.0001
ISS	1.16	1.12-1.20	<.0001
Obesity	2.51	1.72-3.65	<.0001
Prophylaxis	3.04	1.12-8.25	0.0290
Myocardial infarction	6.20	2.40-15.97	0.0002
ARDS	5.90	3.02-11.52	<.0001

Pulmonary Embolism Variable	Odds Ratio	95% Confidence Interval	p-value
Gender	1.46	1.09-1.97	0.0117
Age	1.02	1.01-1.03	<.0001
ISS	1.08	1.04-1.12	0.0003
Impaired sensorium	1.98	1.30-3.03	0.0016
Myocardial infarction	5.58	1.70-18.28	0.0045
ARDS	5.89	2.54-13.65	<.0001

ARDS= Acute respiratory distress syndrome

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Ankle Injuries in Spiral Distal Tibial Shaft Fractures: Results From an Institutional Change in Imaging Protocol

Stephen Warner, MD, PhD*; Patrick C. Schottel, MD; Matthew R. Garner, MD;*
David L. Helfet, MD; Dean G. Lorich, MD;
Hospital for Special Surgery, New York, New York, USA

Background/Purpose: Posterior malleolus and other articular ankle injuries are known to concomitantly occur with tibial shaft fractures, especially spiral fractures of the distal one-third diaphysis (OTA 42-A1). Recent publications utilizing CT have shown that the rate of this combined injury is higher than previously reported with an incidence of 39% to 49%. Due to our heightened awareness of this combined injury, our department instituted a new preoperative ankle imaging protocol for all distal one-third spiral tibia shaft fractures. The purpose of this study was to evaluate the effectiveness of an imaging protocol involving radiographs, CT, and MRI in a distal one-third spiral tibia fracture cohort.

Methods: All operatively treated patients with a spiral distal one-third tibial shaft fracture (OTA 42-A1) from February 2012 to March 2013 underwent a standardized ankle imaging protocol. Patients had preoperative orthogonal ankle radiographs as well as a CT scan of the tibia that included the ankle. All ankle imaging was scrutinized by the on-call orthopaedic resident for evidence of an articular ankle injury such as a posterior malleolus fracture (PMF), medial malleolus fracture (MMF), or other tibial plafond fracture variant. If no articular ankle fracture was identified, patients would then undergo ankle MRI. All patients with an acute distal one-third spiral tibial shaft fracture and completion of the imaging protocol were included for analysis. Patients less than 16 years of age and individuals with evidence of a prior ankle fracture and retained surgical implants were excluded.

Results: 25 patients met the inclusion and exclusion criteria for this study. The average patient age was 47.4 years (range, 16.9-94.6) and 52% (13/25) were male. Of these patients, concomitant ankle injuries were identified by radiograph and CT in 56% (14/25) of cases. The remaining 44% (11/25) of patients had no evidence of a combined injury by radiograph or CT and therefore underwent MRI. Of the MRI cohort, 64% (7/11) were found to have an occult articular ankle fracture including five occult fractures of the posterior malleolus (71%), one fracture of the medial malleolus (14%), and one AITFL (anterior inferior tibiofibular ligament) avulsion fracture (14%). The overall incidence of a combined injury using our protocol was 84% (21/25). Identification of an occult injury led to a change in the surgical plan or rehabilitation for all of these patients.

Conclusions: Concomitant ipsilateral articular ankle and distal one-third spiral tibial shaft fractures are more common than previously reported. Utilizing an imaging protocol that consisted of orthogonal ankle radiographs, CT, and MRI, we found that the incidence of this combined injury was 84%. The addition of MRI to our imaging protocol resulted in a 50% increase in the diagnosis of these combined injuries. Recognition of the ankle fracture component in this tibial shaft cohort can be important as it may alter the surgical plan and postoperative management.

See pages 99 - 147 for financial disclosure information.

ΔDo Postoperative Prophylactic Antibiotics Decrease the Risk of Postoperative Infection After ORIF?--A Prospective Double-Blinded Randomized Placebo-Controlled Trial

Brett D. Crist, MD; David D. Greenberg, MD; Gregory J. Della Rocca, MD, PhD; Yvonne M. Murtha, MD; David A. Volgas, MD; ***James P. Stannard, MD****;*
University of Missouri, Columbia, Missouri, USA

Purpose: To determine if postoperative prophylactic cefazolin for 23 hours postoperatively decreases the risk of infection after fracture ORIF. The benefit of preoperative prophylactic antibiotics has been established, but the benefit of postoperative antibiotics has not been justified but has become part of the SCIP initiative.

Methods: After IRB approval, patients undergoing ORIF of closed fractures that had a planned postoperative stay of at least 23 hours were randomized to either receiving 23 hours of cefazolin or a placebo. Both groups received preoperative cefazolin, based on weight, and intra-operative re-dosing at 3-hour intervals until surgery completion. The primary endpoint was infection. Patients were clinically followed until bony union.

Results: 229 patients were randomized to either receiving postoperative cefazolin or placebo, and 146 patients completed clinical follow-up to bony union. There were 75 patients in the cefazolin group and 71 in the placebo group. Infections occurred in 4 (1 superficial and 3 deep) patients in the cefazolin group and 9 (8 superficial and 1 deep) in the placebo group (p=0.12). Risk factors that significantly increased the rate of infection included diabetes (p=0.038) and surgery >3 hours (p=0.049).

Conclusions: In a randomized double-blinded placebo-controlled prospective trial, postoperative prophylactic cefazolin did not significantly decrease the risk of postoperative infection in patients undergoing ORIF for closed limb fractures. 23 hours of postoperative antibiotics should still be considered for patients with diabetes mellitus and patients where the operative time is greater than 3 hours. This still complies with the SCIP initiative.

Δ OTA Grant

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Regional and Seasonal Variations in Posttraumatic Infections After Open Fracture

H. Claude Sagi, MD[1]; *Seth Cooper, MD[1]; David Donohue, MD[1];*
David P. Barei, MD, FRCS(C)[2]; Justin C. Siebler, MD[3]; Michael T. Archdeacon, MD[4];
Marcus F. Sciadini, MD[5]; Michelle Romeo, MD[5]; Patrick F. Bergin, MD[6];
Thomas F. Higgins, MD[7];
[1]Orthopaedic Trauma Service, Florida Orthopaedic Institute, Tampa, Florida, USA;
[2]Harborview Medical Center, University of Washington, Seattle, Washington, USA;
[3]Creighton University, Omaha, Nebraska, USA;
[4]University of Cincinnati, Cincinnati, Ohio, USA;
[5]R Adams Cowley Shock Trauma Center, Department of Orthopaedics,
University of Maryland School of Medicine, Baltimore, Maryland, USA;
[6]University of Mississippi, Jackson, Mississippi, USA;
[7]University of Utah, Salt Lake City, Utah, USA

Purpose: The purpose of this study was to determine if either the incidence of posttraumatic infection or the causative organism varies with season of the year or geographic region in which an open fracture occurred.

Methods: A representative Level I trauma center from each of the seven climatic regions of the United States (Northwest, High Plains, Midwest/Ohio Valley, New England/Mid-Atlantic, Southeast, South, and Southwest) took part in this study. A retrospective review of all skeletally mature patients sustaining an open fracture of either the upper or lower extremity between 2007 and 2012 was undertaken. Charts were analyzed to extract information regarding date of injury, Gustilo-Anderson grade of open fracture, any subsequent treatment for a posttraumatic wound infection, and the causative organisms. Patients from each region were placed into one of four groups based on the time of year that the injury occurred: spring (March-May), summer (June-August), fall (September-November), and winter (December – February). χ^2 analysis was used to assess whether any observed differences were of statistical significance.

Results: A total of 4149 patients were included in the analysis. The overall incidence of infection for all open fractures across the US was 8.9% (368 patients) and this did not vary significantly by season (spring 10.1%, summer 8.0%, fall 9.1%, winter 8.5%). There were, however, significant differences in overall infection rates between the climatic regions: Southeast 5.1%, Northwest 6.7% ($P = 0.1077$), Southwest 8.1% ($P = 0.0008$). Midwest/Ohio Valley 10.1% ($P < 0.0001$), High Plains 14.6% ($P < 0.0001$), and South 15.1% ($P < 0.0001$). Additionally, some climatic regions showed a significant seasonal variation in the incidence of infection. The Northwest region was lowest in spring and highest in winter (5.0% vs. 10.6%, $P = 0.0066$), the Southwest was lowest in summer and highest in fall (4.4% vs. 12.0%, $P < 0.0001$), the High Plains region was lowest in summer and highest in fall (6.5% vs. 21.4%, $P = 0.0033$), and the Southeast was lowest in fall and highest in spring (3.8% vs. 6.7%, $P = 0.0057$). The Midwest/Ohio Valley and the South did not demonstrate a seasonal variation in infection rates. The most common causative organism varied not only by region, but peak season as well. The regions with the highest rate of infection in the spring (South, Southeast, and Midwest/Ohio Valley) reported methicillin-resistant *Staphylococcus*

See pages 99 - 147 for financial disclosure information.

aureus (MRSA) as the most common causative organism, while the regions with the highest infection rates in the fall and winter (High Plains, Southwest, and Northwest) reported methicillin-sensitive *S. aureus* (MSSA). Within the individual regions, seasonal variations existed with respect to the causative organism as well.

Conclusion: A significant seasonal and regional variation exists regarding both the incidence of infection as well as the causative organisms for posttraumatic wound infection following open fractures. We recommend that surgeons consult with their infectious disease colleagues to better understand these variations for their individual hospital, and adjust their treatment regimens accordingly.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

The Effect of Acute High-Dose Vitamin D Supplementation on Fracture Union in Patients With Hypovitaminosis D: A Pilot Study

Nikkole Marie Haines, MD; *Laurence Kempton, MD; Rachel Seymour, PhD; Madhav A. Karunakar, MD; TRACC (Trauma Research Collaborative of the Carolinas: Michael J. Bosse, MD; Joseph R. Hsu, MD; Stephen H. Sims, MD; James F. Kellam, MD) Carolinas Medical Center, Charlotte, North Carolina, USA*

Purpose: Vitamin D deficiency has been implicated as a potential etiology of nonunion. Recent studies suggest that hypovitaminosis D occurs in more than two-thirds of orthopaedic trauma patients. Despite its frequency, little information exists on the rate of nonunion after fracture in vitamin D–deficient patients. The purpose of this study is to determine the rate of nonunion in vitamin D–deficient patients with long bone fractures and to evaluate the feasibility of utilizing acute high-dose vitamin D supplementation in patients with hypovitaminosis D.

Methods: 102 adult patients with long bone fractures (humerus, tibia, and femur), presenting to a tertiary Level I trauma center between July 2011 and July 2013, enrolled in an IRB-approved prospective, randomized double-blind placebo-controlled trial to study the effect of acute vitamin D supplementation on fracture union. Serum vitamin D levels were measured for all 102 patients: 89 patients demonstrated vitamin D deficiency (<30 ng/mL) and were randomized to receive either a single dose of 100,000 IU of vitamin D orally within the first 2 weeks following injury (treatment group [TG], N = 44), or a placebo (control group [CG], N = 45). Demographics, fracture location and treatment, vitamin D levels, time to fracture union, and complications including vitamin D toxicity were recorded. Outcomes included healed, nonunion, fixation failure, and lost to follow-up. Nonunion was defined as the absence of bridging bone on 2/4 cortices with a stable implant at 6 months or fixation failure after 6 months. Fixation failure prior to 6 months fell into the fixation failure group. Patients without an outcome and no follow-up for 2 months or more were deemed lost to follow-up. *t*-test and cross tabulations were used to compare groups and verify adequacy of randomization. An intention-to-treat analysis was carried out to build a multivariate model.

Results: Hypovitaminosis D occurred in 87% of enrolled patients (89/102). There were 43 femur fractures (48.3%), 33 tibia fractures (37.1%), and 13 humerus fractures (14.6%). Time to outcomes averaged 5 months for all patients, with a range of 6 weeks to 15 months. TG and CG demonstrated similar demographic and injury characteristics ($P > 0.05$ for all comparisons). Initial vitamin D levels were 16.3 and 16.7 ng/mL in the CG and TG, respectively ($P = 0.831$). 15 randomized patients were lost to follow-up (17%; 8 in the TG, 7 in the CG) and two had failure of fixation prior to union (one per group). No patients exhibited toxicity related to high-dose vitamin D supplementation. The overall nonunion rate for the study cohort was 4.5% (N = 4) with 2.3% in the TG (N = 1) and 6.7% in the CG (N = 3). However, this difference was not statistically significant ($P = 0.855$).

Conclusion: At a Level I trauma center in the Southeastern United States, hypovitaminosis D affected 87% of patients enrolled in this prospective randomized study. Acute high-dose vitamin D supplementation was administered to 44 patients without any adverse effects or toxicity. The nonunion rate observed in the TG was 2.3% versus 6.7% in the CG. To

See pages 99 - 147 for financial disclosure information.

discriminate the effect of vitamin D supplementation, using the observed nonunion rates, power analysis requires 830 patients (415 per group), assuming a power of 80%, significance of 5%, and a 20% attrition rate. Further study of the effect of vitamin D on acute fracture healing is warranted.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Statistical Significance in Trauma Research: Too Unstable to Trust?

*Paul Tornetta III, MD[1]; Mohit Bhandari, MD, MSc, PhD[2]; **Robert L. Parisien, MD[1]**; Jesse Dashe, MD[1]; Patrick Cronin[1];*
[1]Boston University Medical Center, Boston, Massachusetts, USA;
[2]McMaster University, Hamilton, Ontario, Canada

Background/Purpose: Comparison trials are the most compelling evidence available for surgeons to make decisions. The outcomes of trials are based on hypothesis testing with an a priori statistical cutoff, which is generally accepted to be $P < 0.05$. This is to say that with 95% certainty one treatment is better than another and should therefore influence decision-making. However, when categorical outcomes are considered (such as nonunion, infection, etc), the statistical outcome of trials is dependent on the number of "outcome events", which are often a small percentage of the overall study population. We sought to examine how easily the statistical significance of comparison trials in fracture care would change if the number of events in one group were incrementally changed. By example, in one study, if 15 infections had occurred in one arm instead of 12, the P value would change from $P = 0.02$ to $P = 0.08$, changing its statistical significance (from <0.05 to >0.05) and likely how it would influence practice.

Methods: We screened all fracture care studies in the *Journal of Bone and Joint Surgery* and the *Journal of Orthopaedic Trauma* over a 20-year period. Inclusion criteria were comparison trials whose outcomes were categorical and had data included to be evaluated. Data on the number of patients in each arm of the trial, the number of events in each arm, and the number lost to follow-up were tabulated. Reported outcomes were considered "significant" if the P value was <0.05. For each study outcome we confirmed the P value that was reported and then we changed the number of events in one arm enough to "flip" the significance of the study. If the outcome was significant, then the required number of event changes to raise P to above 0.05 was determined, and if the outcome was not significant, the number of event changes that would drop P to <0.05 was determined. Analyses were performed using Fisher's exact test. The number of events as a percentage of the arm and the study population was calculated.

Results: Of 4040 studies, 198 met inclusion criteria and had 253 primary and 516 secondary outcomes. There were 118 randomized controlled trials (RCTs) and 80 retrospective studies. 230 outcomes were significant as reported and 539 were not. The median P value for significant studies was 0.003 (1.3E-09–0.049) and for nonsignificant studies was 0.6 (0.51-1). There were no differences in the findings for randomized versus nonrandomized trials so the data are presented together. The median number of patients in the studies was 95 (12-6000). The number of event changes in one arm for each outcome that would flip the significance is seen in Table 1 separated by the initial reporting of significant and nonsignificant results. The median number of events that were needed to flip the significance of the trials was only 5, which was on average 8.9% of one arm and 3.8% of the total study population. By comparison, the average lost to follow-up for the studies was 3%. Initially significant and nonsignificant studies were affected equally by event changes.

See pages 99 - 147 for financial disclosure information.

Table 1. Events Needed to Flip the Significance of RCTs

	Median No. of Events	Range	% of One Arm of Study	% of Study Population
Studies $P < 0.05$	4	1-340	7.8%	3.4%
Studies $P \geq 0.05$	5	1-40	9.1%	3.8%
All studies	5	1-340	8.9%	3.8%

Conclusion: The statistical outcomes of comparison trials that rely on noncontinuous variables such as infection, nonunion, secondary procedures, etc may not be as stable as previously thought. When evaluating trials that rely on events, small numbers of events may change the statistical significance of the trial. In evaluating 769 outcomes of 198 trials, we found that a median of only 4 events would flip studies with reported P values of <0.05 to over 0.05 and 5 events would make significant trials initially reporting $P \geq 0.05$. The overall percentage of the study population that would change significance was only 3.8% for all studies. Importantly, randomized trials faired no better than nonrandomized trials in this analysis. This highlights the need for readers to understand how P values relate to study findings and that using a discreet cutoff for P value in determining importance is likely not appropriate.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Are We Evidence-Based? The Effect of Level I Evidence on Surgical Decision-Making

Paul Tornetta III, MD[1]; Andrew Jawa, MD[1]; Mohit Bhandari, MD, MSc, PhD[2]; Jason L. Pittman, MD, PhD[1]; Scott Koenig, MD[1];
[1]Boston University Medical Center, Boston, Massachusetts, USA;
[2]McMaster University, Hamilton, Ontario, Canada

Background/Purpose: With limited resources available for patient care, surgeons are being called on to make cost-conscious decisions. Comparative analysis is being utilized to determine which procedures are most effective in improving patients' outcomes and should be supported by payers. However, surgeons also rely on their past experience in making decisions, particularly as it relates to surgical indications. We sought to examine the effect of two types of randomized trials on surgeons' indications for surgery. One trial favored surgery, and the other did not. Our hypothesis was that a high-quality study favoring surgery would shift practice toward more surgery and that a trial that did not favor surgery would shift practice towards nonoperative care.

Methods: Two Level I studies served as the basis of this study. One was a randomized trial comparing operative and nonoperative treatment of displaced clavicle fractures and the other, operative versus accelerated rehabilitation for complete Achilles tendon ruptures. These trials were chosen as they were both multicenter studies published in the same journal over a year prior to our survey. Both studies were of high methodological quality (5 on the Jadad scale and 6 on the Guyatt scale) and both scored highly on the Detsky and CONSORT (Consolidated Standards of Reporting Trials) reporting criteria (clavicle 16 and 28, Achilles 19 and 28). Thus, both studies are objectively high quality and should have an equal effect on practice patterns. We used e-mail to survey US orthopaedic surgeons regarding their operative indications for displaced clavicle fractures and complete Achilles tendon ruptures. Each surgeon received either the clavicle or the Achilles survey, but not both, and if they did not respond, they were sent two reminders. Each survey asked how the surgeon would treat 5 sample patients (all of whom met the inclusion criteria of their respective study), whether the surgeon was aware of the Level I trial, whether they had changed their indications based on the trial, and also how their operative indications had changed over the prior 5 years. The sample patients were similar for both surveys with respect to age and activity level.

Results: Our data are based on 1430 clavicle and 1009 Achilles surveys that were returned. Surgeons strongly favored surgery for 4 of the 5 scenarios presented in the Achilles survey, choosing operative management in 68% to 96%. The only scenario in which nonoperative management was favored was a 65-year-old community ambulator. Additionally, only 27% of respondents operate on fewer ruptures than they did 5 years ago. Surgery was favored for 3 of the 5 clavicle scenarios (54%-79%) and 64% of surgeons operate on more clavicle fractures than 5 years ago. 71% of survey respondents were aware of the clavicle trial and 77% the Achilles trial. Table 1 demonstrates a statistically greater effect of the trial favoring surgery on practice than the trial that did not, $P = 0.0001$ (Fisher's exact).

See pages 99 - 147 for financial disclosure information.

Table 1. Effect of Level I Evidence on Practice ($P = 0.0001$)

	Change in Practice	No Change in Practice
Clavicle trial	61%	39%
Achilles trial	43%	57%

Conclusion: We surveyed surgeons regarding their practices related to two equally high-quality multicenter Level I trials of surgical versus nonsurgical care, one favoring surgery and one that did not. Surgeons' practices were more influenced when the trial favors surgery than when it demonstrated no advantage to surgery. Surgeons strongly favored surgery for 4 of the 5 scenarios of Achilles rupture patients presented to them, despite the trial demonstrating no advantage of operative management (including one case of a 50-year-old orthopaedic surgeon whose activities included only golf). In conclusion, surgeons seem more willing to alter their practice to evidence-based indications based on a trial that favors surgery than one that does not.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Determining Preinjury Physical Function Scores in Orthopaedic Trauma Patients

Ami R. Stuart, PhD; *Erik Kubiak, MD; Man Hung, PhD; David Rothberg, MD; Thomas F. Higgins, MD; Charles L. Saltzman, MD;*
University of Utah, Salt Lake City, Utah, USA

Background/Purpose: Use of patient-reported outcome (PRO) measurement instruments has become a common way to determine health status, with a plentitude of validated and reliable tools available. Computer adaptive tests (CATs) have reduced patient burden and increased availability of these functional tests. Establishing pre- and postintervention functional scores is quite simple in elective surgical practice. However, in orthopaedic trauma, functional status scores are not collected before injury. Further, the patient is often unable to complete the instrument upon entry into the hospital. Due to a lack of baseline data, surgeons are unable to determine if patients have returned to previous physical function. Attempts to rectify this gap in the data focus on patient recall or proxy assessment. This has not been addressed, and is of critical importance to, the orthopaedic trauma literature on functional assessment.

Methods: Orthopaedic trauma patients had their first postoperative appointment approximately 2 weeks after surgery. Any patient who met the selection criteria (over 18 years of age, English-speaking, attending the appointment with a proxy) as determined through chart review and interview were asked to participate in the IRB-approved study, as were their proxies (over 18 years of age, English-speaking, had witnessed the patient at their highest level of functioning in the previous 6 months). Participants were asked to complete the PROMIS Physical Function Computer Adaptive Test (PF CAT) and a preinjury activity questionnaire (FITT). Patients were asked to respond to the physical function questions as they believed they were able to function prior to injury. Patient proxies were asked to respond to the physical function questions as they believed the patient was able to function prior to injury. Intraclass correlation as well as paired-sample *t*-tests and 95% confidence intervals (CIs) were used to analyze agreement between patient and proxy responses on both questionnaires. A correlation of 0.7 represents a large effect and shows agreement between patient and proxy responses.

Results: 50 patient-proxy pairs completed both questionnaires at an average of 14.33 days postoperative. Patient mean PF CAT T-score was found to be 57.92 (SD = 10.38). Proxy mean PF CAT T-score was found to be 56.59 (SD = 11.50). Paired-samples *t*-test showed that on average, patient's PF CAT score is not different from proxy's PF CAT score (mean score difference = 1.33; 95% CI = –1.28, 3.94; $P = 0.311$). Intraclass correlation between patient's score and proxy's score is 0.79. Patient mean FITT score was found to be 11.32 (SD = 5.46). Proxy mean FITT score was found to be 10.86 (SD = 5.49). Paired-samples *t*-test showed that on average, patient's FITT score is not different from proxy's FITT score (mean score difference = 0.46; 95% CI = –0.70, 1.62; $P = 0.429$). Intraclass correlation between patient's score and proxy's score is 0.84.

Conclusion: High agreement in PF CAT and FITT responses between patients and proxies who have been present for the patient's highest level of functioning in the 6 months prior to injury suggest we can be confident in patients' ability to report accurate preinjury

See pages 99 - 147 for financial disclosure information.

physical functioning at their first postoperative follow-up appointment. This is critical to furthering research on orthopaedic trauma functional outcomes, as it establishes the ability to assess preinjury function from the patient. Only with this information will it be possible to determine return to functional baseline after traumatic injury.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Reduction of Radiation Exposure From C-Arm Fluoroscopy During Orthopaedic Trauma Operations With Introduction of Real-Time Dosimetry

Rita Baumgartner, MD[1]; *Kiley Libuit, BS[2]; Dennis Ren, BA[2]; Omar Bakr, BS[2]; Nathan Singh, MD[2]; Utku Kandemir, MD[2]; Meir Tibi Marmor, MD[2]; Saam Morshed, MD PhD[2];*
[1]Duke University, Durham, North Carolina, USA;
[2]University of California, San Francisco, San Francisco, California, USA

Purpose: The use of fluoroscopy for indirect visualization and closed reductions in orthopaedic trauma surgery has dramatically increased. Approaches to decrease radiation exposure in orthopaedic trauma surgery have been limited. The purpose of this investigation is to assess how real-time visualization of radiation exposure impacts radiation dose levels during orthopaedic trauma operations.

Methods: This was a 2-phase observational comparative study of radiation dosing to operating room staff before and after blinding to real-time, intraoperative information reported by a dosimetry device. In each phase, operations on 54 patients with fractures of the distal radius, ankle, tibia, femur, and acetabulum were included. Real-time dosimetry badges were worn by the primary surgeon, assistant surgeon, scrub nurse, x-ray technologist, and patient. Prior to each phase, a mandatory 1-hour course on radiation safety techniques for use of intraoperative fluoroscopy was required for each participating surgeon. Phase 1 was the blinded arm of the study, during which participants were unable to see their radiation exposure. During phase 2, the badges were enabled to project real-time radiation exposure data to a screen connected to the C-arm image viewer. The radiation exposure of each badge for the duration of each operation was collected. Dosing levels were assessed and compared between the 2 phases of the study using the Student *t*-test and analysis of variance.

Results: Mean surgeon (MS; average of primary and assistant surgeon) radiation exposure including all fracture types was not different between the 2 phases of the study ($P = 0.06$). In phase 1, MS exposure was highest in femoral shaft fractures (mean 146.2 μSv, SD 163.4 μSv) and acetabular fractures (mean 158.1 μSv, SD 106.9 μSv). Mean non-surgeon personnel (MNSP; average of scrub nurse, x-ray technologist, and patient) exposure was highest in tibial shaft fractures (mean 19.8 μSv; SD 34.0 μSv). In these highest radiation cases, MS and MNSP exposure was significantly decreased in phase 2. MS radiation for femoral shaft fractures demonstrated a mean decrease of 107.2 μSv (95% confidence interval [CI] 38.2-176.2) and of 128.9 μSv (95% CI 69.1-188.6) for acetabular fractures. MNSP radiation exposure for tibial shaft fractures had a mean difference of 19.7 μSv (95% CI 11.4-27.9). Radiation dose (mGy) and duration of C-arm use (minutes) as recorded by the C-arm, and number of fluoroscopy shots were significantly decreased during acetabular fracture surgeries in the unblinded as compared to the blinded phase of the study ($P < 0.0001$; $P = 0.002$; $P = 0.004$ respectively).

Conclusion: Surgeon radiation exposure is highest during femoral shaft fracture and acetabular fracture repair. Our data demonstrate that real-time visualization of radiation exposure during orthopaedic trauma operations can significantly decrease radiation exposure, presumably through immediate feedback and motivation of use of dose-minimizing

See pages 99 - 147 for financial disclosure information.

techniques. Further research is necessary to establish the health effects of the exposure levels and to further understand how interventions, such as real-time radiation exposure data, can mitigate exposure.

• The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

ΔAssessing the Oncogenic Risk to Patients From Fluoroscopy During Trauma Surgery

Michael J. Beebe, MD*; Peter A. Jenkins, PhD, CHP; Erik N. Kubiak, MD;*
David L. Rothberg MD, Thomas F. Higgins, MD;
University of Utah Department of Orthopaedics, Salt Lake City, Utah, USA

Purpose: Recent increased concern about radiation exposure during surgery has focused primarily on exposure to the surgeon. However, the patient is more directly exposed to radiation and, in surgery about the pelvis and hip, cannot be shielded. The purpose of this study was to prospectively evaluate patients' exposure to radiation during fracture surgery of the acetabulum, pelvic ring, and femur for calculation of future cancer incidence (CI) based on previously validated models.

Methods: After IRB approval, 63 patients with acetabulum, pelvic ring, and femur fractures were prospectively identified for inclusion through routine trauma workup at a Level I trauma center. Patients were treated by a fellowship-trained orthopaedic trauma surgeon through standard of care treatment as dictated by their injuries. After obtaining informed consent, dosimeters were placed on the patient in locations determined for each surgery by a certified radiation health physicist. The age, sex, injury pattern, weight, height, surgeon, operation performed, operative time, total fluoroscopy time, fixation construct, and average emission energy of the x-ray tube were recorded for each patient. Study dosimeters were processed with a control dosimeter to account for radiation exposure during travel and storage. Total effective dose equivalent (TEDE), or whole body dose, and specific organ doses were determined using custom mapping through commercially available software. Lifetime CI calculations were based on validated BEIR VII models for a 30-year-old patient (National Research Council, 2006).

Results: 41% of patients were female and the average body mass index was 27.2 ± 6.6 kg/m^2. 18 patients were treated for acetabular fractures, 30 for femoral shaft or intertrochanteric femur fractures, and 15 for pelvic ring injuries. Patients with acetabular injuries received the highest TEDE at 1.970 ± 0.147 mGy and 1.650 ± 0.062 mGy for women and men, respectively. The lifetime CI, for any cancer type, associated with these doses is 0.021% for females and 0.011% for males. The greatest mean single-organ dose to the ovaries (8.100 ± 0.617 mGy) occurred during acetabular fracture surgery and correlated to an increased ovarian cancer risk of 0.003%. The greatest mean single-organ dose to the prostate (8.48 ± 5.180 mGy) occurred during pelvis fracture surgery and was correlated to an increased prostate cancer risk of 0.003%.

Conclusion: While fracture surgeries around the pelvis and femur are some of the most fluoroscopic-dependent orthopaedic procedures performed, the radiation exposure incurred presents a relatively small increased risk to the average patient of future cancer development.

Funding: This study was supported by an OTA grant.

Δ OTA Grant

See pages 99 - 147 for financial disclosure information.

	Female		Male	
	TEDE*	Ovarian Dose*	TEDE*	Prostate Dose*
Acetabulum	1.970 ± 0.147	8.100 ± 0.617	1.650 ± 0.062	7.750 ± 0.261
Femur	0.193 ± 0.117	0.088 ± 0.070	0.282 ± 0.185	0.582 ± 0.518
Pelvic ring	0.563 ± 0.324	2.730 ± 1.570	1.120 ± 0.717	8.480 ± 5.180
	Overall CI	Ovarian CI	Overall CI	Prostate CI
Acetabulum	0.021%	0.003%	0.011%	0.003%
Femur	0.002%	<0.001%	0.002%	<0.001%
Pelvic ring	0.006%	0.001%	0.008%	0.003%

*All values in milligray (mGy)

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Adverse Events in Orthopaedic Surgery: Is Trauma More Risky? An Analysis of the NSQIP Data

Cesar S. Molina, MD*; Rachel V. Thakore, BS; Eduardo J. Burgos, MD; William T. Obremskey, MD, MPH, MMHC; Manish K. Sethi, MD; Vanderbilt University, Nashville, Tennessee, USA*

Background/Purpose: As we move toward a value-based system of health care, surgeons will increasingly be measured on perioperative complication rates and outcomes. Recently, through an analysis of the American College of Surgeons-National Surgical Quality Improvement Program (ACS-NSQIP) database, studies have demonstrated relatively low perioperative complication rates across the field of orthopaedics. In this study utilizing the NSQIP data, we wanted to better understand the perioperative complication rates and risk factors in orthopaedic trauma and compare them to general orthopaedics. While many insurers group trauma as a subspecialty within orthopaedics (ortho) in terms of adverse events, it is important to evaluate if differences exist, especially in the current payer environment.

Methods: Utilizing the NSQIP database, a total of 1066 ortho procedures with 146,773 patients were identified. Of these procedures, 91 were ortho trauma (upper/lower extremity and hip/pelvis fractures) involving 22,361 patients. The remaining 975 codes represented all other ortho surgeries (hand surgery, arthroplasty, etc) involving 124,412 patients. Perioperative complications were recorded and categorized as minor (MiC) (wound dehiscence, superficial surgical site infection, pneumonia, and urinary tract infection) or major (MaC) (death, deep wound infection, myocardial infarction, pulmonary embolism, sepsis, etc). Using a multivariate analysis controlling for age, medical comorbidities, American Society of Anesthesiologists (ASA) status, operative time, and baseline functional status, perioperative complications were compared between the two groups.

Results: The overall complication rate in the ortho trauma group was 11.4% (2554/22,361) versus 4.1% (5137/124,412) in the general ortho group, $P = 0.001$. Table 1 displays the minor and major complication rates and the differences between ortho trauma and general orthopaedic patients. Similar variables were identified as risk factors for complications in both the ortho trauma group and the general ortho group (age >65, history of CHF [congestive heart failure], ASA >2, and longer operative time) (see Tables 2 and Table 3). When controlling for all variables, trauma was identified as a risk factor for developing any type of complication (odds ratio [OR]: 1.69, 95% confidence interval [CI]: 1.57-1.81).

Conclusion: Utilizing the NSQIP data we demonstrate that orthopaedic trauma patients are almost 2 times more likely than those in the general orthopaedic population to sustain complications, despite showing similar risk factors and controlling for individual patient factors. Furthermore we demonstrate a significant difference between complication rates between the two groups (11.4% vs. 4.1%). Our data suggest that orthopaedic trauma should not be grouped with general orthopaedic surgery when benchmarking for complication rates and adverse events.

See pages 99 - 147 for financial disclosure information.

Table 1 **Complications** *$P < 0.05$

	Major*	Minor*	All*
General	2973 (2.4%)	2733 (2.2%)	5137 (4.13%)
Trauma	1592 (7.1%)	1384 (6.2%)	2554 (11.4%)

Table 2. Risk Factors for Complications in Ortho Trauma *$P < 0.05$

Variable	OR	95% CI
Age (>65)	1.96*	1.70-2.26
History of CHF	1.63*	1.26-2.11
ASA >2	2.49*	2.13-2.89
Op time >90 min	1.15*	1.03-1.32

Table 3. Risk Factors for Complications in General Orthopaedics *$P < 0.05$

Variable	OR	95% CI
Age (>65)	1.42*	1.32-1.53
History of CHF	2.16*	1.54-3.01
ASA >2	1.71*	1.59-1.85
Op time >90 min	1.69*	1.55-1.92

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

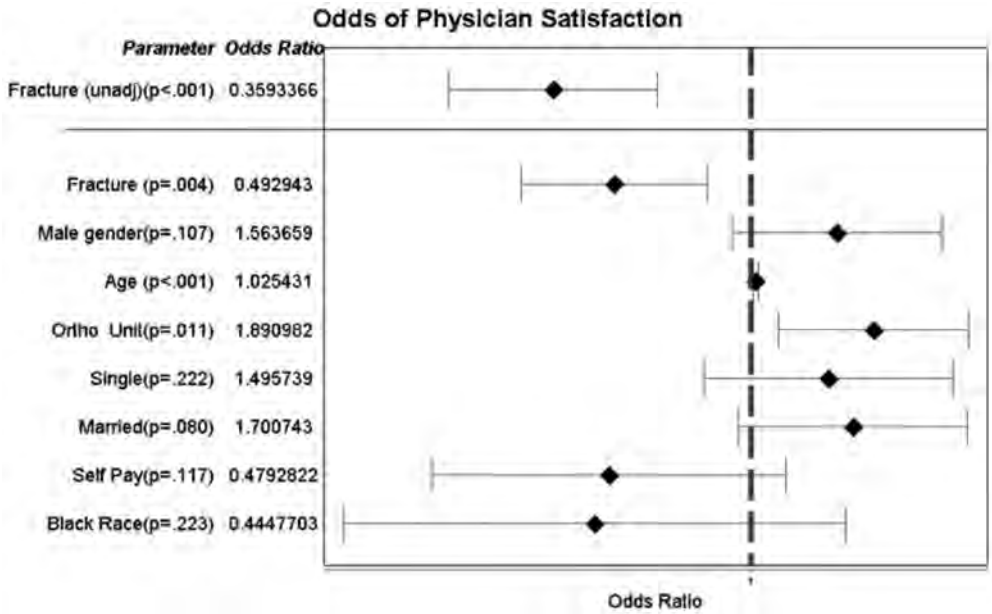
Diagnosis of Fracture Is Associated with Lower Satisfaction with Physician Performance Among Orthopaedic Surgery Patients

John S. Vorhies, MD*; Julius A. Bishop, MD;*
Stanford Hospital and Clinics Department of Orthopaedic Surgery,
Redwood City, California, USA

Purpose: Survey-based patient experience data are becoming increasingly important as a tool to guide performance improvement as well as physician and hospital reimbursement. This study is designed to identify risk factors associated with decreased patient satisfaction with physician performance. We hypothesized orthopaedic patients with fractures would be less satisfied with their physicians.

Methods: From November 2010 to November 2012, Press-Ganey satisfaction surveys were sent to all patients after an inpatient stay at a suburban Level I trauma center, which is a quaternary care teaching hospital. Our primary outcome was the proportion of patients that were satisfied or very satisfied with physician performance. We compared this outcome for all orthopaedic patients with and without fractures, controlling for demographic differences in patient population as well as other factors with a logistic regression model.

Results: 8554 surveys were analyzed with a 30% response rate. 1084 of these patients were admitted to an orthopaedic service. Of all patients admitted to orthopaedic services, those with fractures (n = 114) were significantly less likely to be satisfied with the performance of their physicians (79% vs. 91%, $P < 0.001$). A diagnosis of fracture remained a significant risk factor for decreased satisfaction even after controlling for other demographics in multivariate logistic regression (Figure 1).



See pages 99 - 147 for financial disclosure information.

Conclusion: Orthopaedic trauma patients and elective orthopaedic patients may view their care differently because of the unplanned admissions and unpleasant prognoses commonly associated with trauma. We have demonstrated that having a fracture is a strong risk factor for decreased satisfaction with physician performance even when controlling for other relevant variables. As patient satisfaction data are increasingly being used to evaluate hospital and physician performance and to determine reimbursement, it will be important to adjust for factors such as traumatic injury to avoid penalizing those that provide orthopaedic trauma services.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Does Physician Reimbursement Correlate to Risk in Orthopaedic Trauma?

Rachel V. Thakore, BS; Cesar S. Molina, MD; William T. Obremskey, MD, MPH, MMHC;
Manish K. Sethi, MD
Vanderbilt University, Nashville, Tennessee, USA

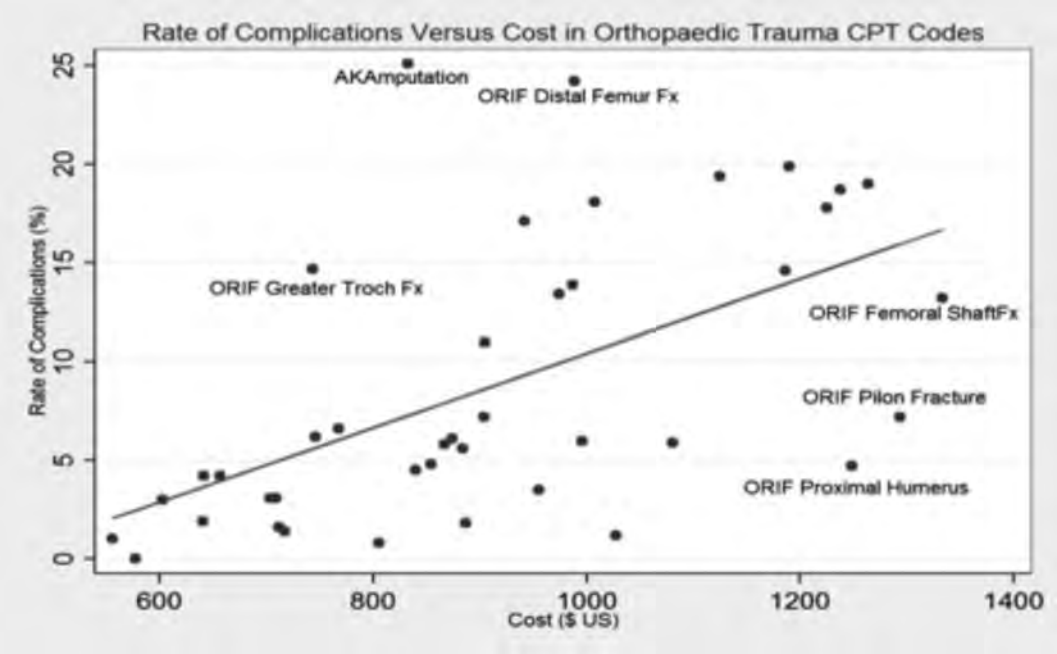
Purpose: With the recent dramatic changes in the American health-care landscape, orthopaedic trauma reimbursement models are likely to also shift. But in developing new reimbursement policy, how will the risk of complications for a given injury be considered? Utilizing the ACS-NSQIP (American College of Surgeons National Surgical Quality Improvement Program) database to explore the rate of adverse events for orthopaedic trauma procedures and comparing them with Medicare reimbursement data, we sought to evaluate the relationship between reimbursement and risk in order to determine if procedures with higher risk of complications received increased physician compensation.

Methods: 91 CPT codes representing all orthopaedic trauma surgeries, which included hip/pelvis (HP), upper extremity (UE), and lower extremity (LE) fractures (fx), were identified in the 2005-2011 ACS-NSQIP database. 50 CPT codes that had less than 100 patients were excluded. Perioperative complications including wound dehiscence, superficial surgical site infection, pneumonia, urinary tract infection, deep wound infection, myocardial infarction, deep venous thrombosis, pulmonary embolism, peripheral nerve injury, sepsis and septic shock, and death were recorded. Physician payment (Medicare Part B) amounts for each CPT code were found using the 2011 Medicare fee schedule. A linear regression was performed to determine the correlation between complication rates and payment amounts.

Results: 41 orthopaedic trauma CPT codes representing 18,854 patients (HP = 5029, UE = 4091, LE = 8582) were included in the analysis. Only a moderate correlation between payment amount and complication rates was found ($r = 0.55$, $P = 0.001$). Overall, a 1.8% increase in complication rate was associated with a payment increase of only $100 dollars. As show in the figure, there was a minimal relationship between Medicare reimbursement and complication rate; for example, above-knee (AK) amputations demonstrate a complication rate of 25.1% and reimbursement of $832.00 and open reduction and internal fixation (ORIF) of the distal femur demonstrates a similar payment ($989) and high complication rate (24.2%). However, other injuries had much higher reimbursement but lower complication rates: pilon ($1294, 7.2%) and proximal humerus fractures ($1249, 5.7%).

Conclusion: Our data are the first to demonstrate that the current Medicare payment structure does not heavily weigh the risk of adverse events in providing compensation to physicians. However, in a future bundled payment plan that does not consider the risk of complications based on the injury, fractures with lower compensation but higher risks of complications will challenge the financial viability of caring for orthopaedic trauma patients.

See pages 99 - 147 for financial disclosure information.



- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Cerebral Fat Emboli and Cognitive Impairment Following Reamed Intramedullary Nailing

Kristin R. Archer, PhD*; Christine M. Abraham, MA; Justin E. Richards, MD; John A. Barwise, MB, ChB; William T. Obremskey, MD, MPH; Vanderbilt University Medical Center, Nashville, Tennessee, USA*

Purpose: The purpose of this study was to determine the incidence of cerebral fat emboli in patients with traumatic femoral shaft fracture undergoing a reamed intramedullary nail (IMN) procedure. A secondary objective was to examine the association between cerebral fat emboli and cognitive deficits at 6 weeks following hospital discharge. The hypotheses were that 25% of patients would experience cerebral fat emboli and that the presence of intraoperative cerebral fat emboli would be associated with cognitive impairment in patients with femoral shaft fractures.

Methods: This study prospectively enrolled 24 patients, 19 to 65 years of age, admitted to a Level I trauma center for surgical treatment of a femoral shaft fracture with a reamed IMN. Participants were enrolled prior to surgery. Transcranial Doppler (TCD) sonography was used to identify intraoperative cerebral embolic particles. An intake assessment during the hospital stay collected information on demographics, health habits, and preinjury function and general health as measured by the Katz Activities of Daily Living Scale, Functional Activities Questionnaire, and Short Form-12 (SF-12). Preexisting cognitive impairment was assessed with the Informant Questionnaire of Cognitive Decline in the Elderly, short form. Clinical characteristics were abstracted from the medical record. A follow-up assessment 6 weeks after hospitalization measured cognitive impairment using a battery of standardized executive functioning tests (Trails B, Verbal Fluency Test, and Delis-Kaplan Tower Test). Depressive and posttraumatic stress disorder (PTSD) symptoms were also measured at 6-week follow-up with the Patient Health Questionnniare-9 (PHQ-9) and PTSD Checklist–Civilian Version (PCL-C), respectively. Cognitive test scores were converted to T-scores and adjusted for age, education, and gender. Cognitive impairment was defined as having 2 cognitive test scores 1.5 SD below the normative population mean or 1 test score 2 SD below the mean. Differences in demographic, psychosocial, and clinical characteristics between those with and without cognitive impairment were examined with Wilcoxon rank-sum and Fisher exact tests. Association between emboli and presence of cognitive impairment was analyzed using logistic regression analysis. The level of significance was set at $\alpha = 0.05$.

Results: 20 patients completed a 6-week follow-up assessment (83%). Of these, 9 (45%) were admitted to the ICU. One patient in the ICU displayed symptoms of delirium over 5 days. None of the patients received mechanical ventilation. Three participants (15%) had at least two blood transfusions. The average ISS was 15.1 (SD 5.7) and patients stayed an average of 4.6 days in the hospital (SD 2.5). Cerebral fat emboli occurred in 30% of participants both prereaming and postreaming. Ten participants (50%) demonstrated cerebral fat emboli at either prereaming or postreaming. The average number of prereaming and postreaming emboli was 19.3 (SD 46.7) and 7.5 (SD 15.7), respectively. A total of 7 patients (35%) demonstrated cognitive impairment, with 6 having scores below the seventh per-

See pages 99 - 147 for financial disclosure information.

centile (T-score <35) on 2 of the 3 tests. None of the patients had preexisting cognitive impairment. The mean scores on the PHQ-9 and PCL-C at 6-week follow-up were 5.2 (SD 4) and 40 (SD 17.8), respectively. 15% reported clinically significant depressive symptoms (PHQ-9 ≥10) and 40% reported clinically significant PTSD symptoms (PCL-C ≥45). No statistically significant association was found between total number of cerebral fat emboli and cognitive impairment ($P = 0.41$).

Conclusion: Cerebral emboli are found in a significant percentage of patients with a femur fracture stabilized with an IMN. A large percentage (35%) exhibit cognitive deficits at 6 weeks postoperatively. 15% reported depressive symptoms and 40% reported PTSD symptoms. Cerebral emboli were not associated with these negative outcomes.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Sexual Function Is Impaired Following Common Orthopaedic Trauma

Brandon S. Shulman, BA[1]; David P. Taormina, MS[1]; Bianka Patsalos-Fox[1]; Roy I. Davidovitch, MD[1]; ***Kenneth A. Egol, MD[1,2];***
[1]NYU Hospital for Joint Diseases, New York, New York, USA;
[2]Jamaica Medical Center, Jamaica, New York, USA

Background/Purpose: Difficulty with sexual activity is an infrequently identified complaint in both men and women following fracture. While some research has been directed toward sexual activity following pelvic trauma, to our knowledge no study has investigated sexual dysfunction following non-pelvic orthopaedic trauma. The purpose of this study was to investigate the incidence and longitudinal improvement of patient-reported sexual dysfunction following 5 common orthopaedic traumatic conditions.

Methods: 1359 orthopaedic trauma patients were identified following 5 different orthopaedic fracture conditions. The functional status of patients with 4 acute traumatic conditions—proximal humerus fractures (n = 127), distal radius fractures (n = 391), tibial plateau fractures (n = 135), and ankle fractures (n = 434)—were followed with standard functional outcome measures. In addition, patients surgically treated for long bone fracture nonunion (n = 272) were analyzed. Data were collected at 3 distinct time points after treatment: 3, 6, and 12 months posttreatment. Patient-reported sexual dysfunction scores, acquired from validated functional outcome surveys, were compared to overall functional outcome scores and demographic information for both men and women. Subgroup analysis was analyzed for age, body mass index (BMI), marital status, and mechanism of injury.

Results:

Percentage of Postoperative Sexual Dysfunction at Standard Follow-up Intervals				
	Initial/Baseline	3 months	6 months	12 months
Proximal humerus fracture	Not recorded	30%	15%	15%
Distal radius fracture	6%	29%	17%	13%
Tibial plateau fracture	2%	43%	13%	9%
Ankle fracture	6%	11%	5%	4%
Long bone nonunion	42%	26%	17%	14%

All acute and chronic fracture conditions demonstrated significant correlation between patient-reported sexual dysfunction and their related overall DASH (Disabilities of the Arm, Shoulder and Hand) or SMFA (Short Musculoskeletal Function Assessment) functional indexes. Women reported a significantly higher degree of sexual dysfunction than men at 3-month ($P = 0.02$) and 6-month follow-up ($P = 0.01$). Women reported a borderline significant higher degree of dysfunction at 12 months ($P = 0.05$). However, women reported equivalent or better overall functional status than men at all intervals. Subgroup analysis did not show a significant effect.

Conclusion: In the first 3 months following treatment of 4 acute and 1 chronic orthopaedic trauma condition, a considerable number of patients experience sexual dysfunction. By 6

See pages 99 - 147 for financial disclosure information.

months, greater than 80% of both sexes return to baseline sexual activity levels. Women have a higher incidence of postoperative sexual dysfunction than men. While sexual dysfunction is highly correlated to functionality, functional status alone does not account for the gender disparity in postoperative sexual dysfunction. The results of this study should allow orthopaedic trauma surgeons to counsel patients regarding expectations of sexual function following traumatic orthopaedic conditions.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Familiar Faces: The Prevalence of Recidivism in Trauma Patients

Juliann C. Koleszar, BS; ***Heather A. Vallier, MD;***
MetroHealth Medical Center, Cleveland, Ohio, USA

Purpose: Treatment expenses related to trauma approach $500 billion per year in the US. High recidivism rates of trauma patients have been reported at some trauma centers, contributing to the financial burden as well as other social costs. The purpose of this study was to determine the prevalence of trauma recidivism among patients with operative musculoskeletal trauma and to identify associated patient and injury characteristics. We hypothesized that substance abuse and mental illness would be associated with recidivism.

Methods: We identified 880 patients, treated surgically for high-energy fractures of the pelvis, spine, and/or femur between 2007 and 2011 at an urban Level I trauma center. Records were assessed through the end of 2012 to identify recidivist patients. Recidivism was defined as presentation to the trauma center for new, unrelated injury, and a recurrent recidivist was a repeat patient who returned for treatment another time for an additional injury.

Results: 164 patients returned during the period of study for new injury, a recidivism rate of 18.6%. 28.8% of recidivists were admitted on a secondary trauma visit, and 34.8% of recidivists returned due to the same mechanism of injury as their initial trauma admission. Recidivists were more likely to be between the ages of 18 and 40, with mean age 37.2 years, versus 40.1 ($P = 0.02$). Recidivists were 80% male, and were more likely to be unmarried (76.2% vs. 67.2%, $P = 0.03$) and unemployed (40.4% vs. 19.6%, $P < 0.0001$). Recidivists were also more likely to be uninsured (33.5% vs. 17.9%, $P < 0.0001$) or to have Medicaid coverage (33.5% vs. 12.2%, $P < 0.0001$). Substance use among repeat patients was significantly higher than non-repeat patients, as recidivists were more likely to have ingested alcohol (47.2% vs. 32.0%, $P = 0.0001$) or be intoxicated (32.4% vs. 21.2%, $P < 0.0001$) when presenting to the hospital, and be tobacco (66.2% vs. 50.3, $P < 0.001$) or recreational drug users (59.1% vs. 43.1%, $P < 0.0001$) at baseline. Documented mental illness was also significantly higher in recidivists (28.1% vs. 20.0%, $P = 0.03$).

Conclusion: Trauma recidivism is common among an urban trauma population, with a prevalence of 19% among patients treated surgically for fractures of the femur, pelvis, or spine. We identified several factors associated with recidivism including: age, marital status, employment status, insurance coverage, and also substance use. Recidivists were twice as likely to be uninsured. The influence of alcohol at the time of injury for repeat patients, as well as the prevalence of tobacco, alcohol, and recreational drug use for both repeat and non-repeat patients, present opportunities for intervention in the hope of diminishing the incidence of trauma, especially for patients with multiple recurrences and persistent risky behaviors. Substantial opportunity exists for injury prevention, which should not only reduce morbidity but also should decrease health-care expenses.

See pages 99 - 147 for financial disclosure information.

Risk Factors for Thromboembolic Events After Ankle Fracture

Bryce A. Basques, BS*; Christopher P. Miller, MD; Nicholas S. Golinvaux, BA;*
Daniel D. Bohl, MPH; Jonathan N. Grauer, MD;
Yale School of Medicine, New Haven, Connecticut, USA

Purpose: Lower extremity fracture has been associated with increased risk of venous thromboembolic events (VTEs). There is limited information available describing which patients are at higher risk for thromboembolic events following ankle fracture. The purpose of this study is to use a large-volume, national database to identify independent risk factors for thromboembolic events after open reduction and internal fixation (ORIF) of ankle fractures.

Methods: Patients who underwent surgery for ankle fracture from 2005 to 2012 were identified in the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database. A thromboembolic event was defined as the occurrence of a deep vein thrombosis or a pulmonary embolism within the first 30 postoperative days. A history of heart disease was defined as a history of congestive heart failure, angina, myocardial infarction, cardiac surgery, or percutaneous coronary intervention. Patient characteristics were tested for association with occurrence of thromboembolic events using multivariate analysis.

Results: Of the 4412 ankle fracture patients who met inclusion criteria, 33 patients (0.75%) had a thromboembolic event within the first 30 postoperative days. Thromboembolic events occurred an average of 11.5 ± 9.6 (mean ± standard deviation) days after surgery. Multivariate analysis found that body mass index (BMI) 30 to 35 kg/m^2 (pdds ratio [OR] = 4.90; 95% confidence interval [CI] = 1.08 to 22.28; $P = 0.040$), BMI ≥35 kg/m^2 (OR = 4.91; 95% CI = 1.07 to 22.50; $P = 0.041$), heart disease (OR = 3.14; 95% CI = 1.15 to 8.56; $P = 0.025$), and dependent functional status (OR = 2.46; 95% CI = 1.05 to 5.75; $P = 0.037$) were independently associated with the occurrence of a VTE after ankle fracture ORIF (Table 1).

Conclusion: Early thromboembolic events occurred in 0.75% of patients after ORIF of ankle fracture. Patients with increased BMI, heart disease, or dependent functional status may be considered for VTE prophylaxis.

Table 1. Multivariate Analysis for the Association of Patient Characteristics with Occurrence of Thromboembolic Events.

Risk Factor	Odds Ratio (95% CI)	*P* Value
BMI 30 to 35 vs. BMI <25	4.90 (1.08 to 22.28)	0.040
BMI ≥35 vs. BMI <25	4.91 (1.07 to 22.50)	0.041
History of heart disease	3.14 (1.15 to 8.56)	0.025
Dependent functional status	2.46 (1.05 to 5.75)	0.037

POSTER ABSTRACTS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Comparison of Syndesmotic Malreduction Assessment Methods in a Supination-External Rotation IV Ankle Fracture Cohort

Richard M. Hinds, MD*; Matthew R. Garner, MD; Patrick C. Schottel, MD;*
David L. Helfet, MD; Dean G. Lorich, MD;
Hospital for Special Surgery; New York, New York, USA

Purpose: Multiple methods of evaluating syndesmotic reduction after surgical fixation of rotational ankle fractures have been proposed. However, no method has been shown to best correlate malreduction with patient outcomes. The purpose of this study is to evaluate syndesmotic malreduction as determined by various measurement methods and correlate them with quantitative clinical outcomes. We hypothesize that the most clinically predictive method of assessment will evaluate rotation, anteroposterior translation, and mediolateral translation of the fibula in the tibiofibular interval.

Methods: Records of 42 supination–external rotation (SER) IV ankle fractures that presented with syndesmotic disruption were reviewed. Each patient underwent postoperative bilateral CT scan and had a minimum of 12 months of postoperative clinical follow-up including Foot and Ankle Outcome Score (FAOS). Syndesmotic malreduction was assessed on post-operative bilateral axial CT scan 1 cm proximal to the tibial plafond utilizing 4 methods described in the literature: Method 1, Davidovitch et al assessed anteroposterior fibular translation, mediolateral fibular translation, and fibular rotation; Method 2, Phisitkul et al assessed anteroposterior fibular translation and mediolateral fibular translation; Method 3, hybrid method of Gardner et al and Naqvi et al assessed mediolateral fibular translation and fibular rotation; Method 4, Vasarhelyi et al assessed fibular rotation. Comparison of FAOS between ankles with and without syndesmotic malreduction was performed utilizing each method. Clinically significant differences were defined as ≥10 points.

Results: Syndesmotic malreduction was found in 67% of ankles utilizing Method 1, 21% of ankles utilizing Method 2, 26% of ankles utilizing Method 3, and 5% of ankles utilizing Method 4. Method 1 resulted in poorer FAOS Pain (67 vs. 89), Method 2 resulted in poorer FAOS Pain (63 vs. 85) and better FAOS Activities of Daily Living (ADL) (75 vs. 58), and Method 4 resulted in poorer FAOS Pain (63 vs. 86) and poorer FAOS Quality of Life (QOL) (28 vs. 48) scores in ankle fractures with syndesmotic malreduction compared to those without malreduction. Method 3 did not demonstrate any clinically significant differences and none of the assessment methods were found to have statistically significant differences in FAOS between ankles with and without syndesmotic malreduction.

Conclusion: Previously published methods of assessing syndesmotic malreduction poorly correlate with outcomes. Further investigation is needed to identify a clinically relevant method of assessing syndesmotic malreduction.

See pages 99 - 147 for financial disclosure information.

A Comparison of Anatomic Plating Versus Tubular Plating in the Treatment of Fibula Fractures

Justin Kane, MD[1]*; Andrew Kay, BA*[1]*; Joseph Daniel, DO*[2]*; David Pedowitz, MD*[2]*;*
Steven Raikin, MD[2]*; James Krieg, MD*[2]*;*
[1]*Thomas Jefferson University Hospital, Philadelphia, Pennsylvania, USA;*
[2]*Rothman Institute, Philadelphia, Pennsylvania, USA*

Background/Purpose: Numerous implant designs exist for the treatment of fibula fractures. Cadaveric studies looking at biomechanical strength of different constructs have demonstrated no difference in strength among one-third tubular plates, locking plates, and anatomic plates. There is literature suggesting that in the setting of osteoporotic bone a locking construct may be beneficial compared to standard one-third tubular plating. However, a paucity of data exist in the literature looking at fixation of fibula fractures in healthy patients with nonosteoporotic bone. The primary goal of this study is to review treatment of fibula fractures in the setting of type 44B or 44C fractures about the ankle with either standard one-third tubular plating or anatomic plating to assess whether there is a difference in quality of fracture reduction.

Methods: After obtaining IRB approval, a retrospective chart and radiograph review of 201 patients identified by ICD-9 performed by four foot and ankle fellowship-trained orthopaedic surgeons at a single tertiary care practice was undertaken from 2007-2013. Office notes, operative reports, preoperative imaging, and postoperative imaging were reviewed to collect patient demographics (body mass index, age, sex, tobacco use, diabetes) and assess the quality of reduction of the fibula. Quality of reduction was assessed using radiographic parameters to measure fibular length, rotation, joint congruency, and step-off in order to determine whether an anatomic reduction was achieved.

Results: One-third tubular plating was used to treat 120 patients. 111 (92.5%) of these patients had an anatomic reduction of their fibula fracture. Anatomic plating was used to treat 81 patients. 74 (91.4%) of these patients had an anatomic reduction of their fibula fracture. A Fisher exact test determined no statistical significance existed between one-third tubular plates and anatomic plates in achieving anatomic reduction ($P = 0.795$). An exact binomial test estimated the probability of achieving anatomic reduction of fibula fractures with one-third tubular plates at 92.5% (confidence interval [CI]: 0.0349-0.1376) and anatomic plates at 91.4% (CI: 0.0355-0.1699). Comparing the success rates of achieving an anatomic reduction for each plate design yielded no statistical significance. A 2-sample test for equality determined no significant difference between the success of achieving anatomic reduction between one-third tubular plating and anatomic plating ($P = 0.9779$).

Conclusion: With the rising cost of health care, the onus of responsibility falls on the orthopaedic surgeon to temper enthusiasm for costlier implants and new innovations that may offer no significant benefit to patients while increasing the overall cost of treatment. Newer implant designs for distal fibular fractures may be beneficial in certain circumstances. However, in the treatment of type 44B and 44C ankle fractures, no benefit was found comparing the costlier anatomic plates with one-third tubular plates in achieving anatomic reductions.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Open Ankle Fractures and Early Fixation: Are They Safe to Fix? A 10-Year Review of Isolated Open Ankle Injuries

David Joyce, MD; Rachel V. Thakore, BS; Vasanth Sathiyakumar, BA; William T. Obremskey, MD, MPH, MMHC; ***Manish K. Sethi, MD****; Vanderbilt University, Nashville, Tennessee, USA*

Background/Purpose: Little data exist to support immediate fixation of isolated open ankle fractures; one study of 95 patients with this injury demonstrated a similar complication rate (3%) to management of closed ankle injuries. Given limited evidence, surgeons often base their decision to acutely fix open ankle fractures on data surrounding closed injuries that have a quoted complication rate of 3.6%, when fixed early. This study sought to explore the complication rate of early fixation of open ankle injuries at a single Level I center. In a future health-care system that will potentially penalize complications, it is critical that orthopaedic trauma surgeons have a better understanding of the pitfalls in the acute management of these injuries and if indeed complication rates are similar to management of closed injuries.

Methods: An ankle fracture database was created by using CPT codes related to ankle fractures and identified 1469 patients between 2001 and 2011. From this database we identified 72 isolated open ankles in skeletally mature patients by confirming through radiographs and operative notes via the electronic medical record. From this information we performed a retrospective review of our open ankle fractures to determine rates of complications that included deep infection, hardware removal for pain, nonunion, and arthrodesis. Information was also gathered regarding numbers of surgeries and timing of definitive fixation. χ^2 analysis between open fracture types was performed.

Results: A total of 72 isolated open ankle fractures (Gustilo type I, n = 11 [15.27%]; type II, n = 34 [47.22%]; type III, n = 27 [37.5%]) were treated with operative fixation during their initial hospital admission. The overall complication rate was found to be 29.17% (n = 21). The most common complication was deep infection at 20.83% (n = 15). Other complications included hardware removal for pain (n = 3), nonunion (n = 3), fusion (n = 4), and 2 amputations. There was no significant difference in complication rates between fracture grades ($P > 0.05$). A subanalysis of fractures fixed within 24 hours (n = 54) showed a deep infection rate of 18.5% (n = 10).

Table 1. Complications based on Gustilo Type

Type	Infection	Hardware Pain	Nonunion
I (n = 11)	9.1% (1/11)	9.1% (1/11)	0.0% (0/11)
II (n = 34)	17.6% (6/34)	5.9% (2/34)	5.9% (2/34)
III (n = 27)	29.6% (8/27)	3.7% (1/27)	7.4% (2/27)
Overall (n = 72)	20.8% (15/72)	5.6% (4/72)	5.6% (4/72)
p	$P = 0.40$	$P = 0.77$	$P = 0.18$

See pages 99 - 147 for financial disclosure information.

Conclusion: Our data demonstrates an overall 29.17% complication rate in the acute management of open ankle fractures that is driven mostly by infections and wound complications. In fact, our data demonstrate striking similarity to the complication rates in acute fixation of pilon fractures. This study suggests that debridement and external fixation or splinting are warranted in the early management of open ankle fractures.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

The Impact of Diabetes on Hospital Length of Stay, Cost, and Inpatient Mortality Following Open Reduction and Internal Fixation of Ankle Fractures: An Argument for Increased Hospital Reimbursement

*Deirdre Regan, BA[1]; Arthur Manoli, BS[1]; Sanjit Konda, MD[1]; **Kenneth A. Egol, MD**[1,2];*
[1]NYU Hospital for Joint Diseases, New York, New York, USA;
[2]Jamaica Medical Center, Jamaica, New York, USA

Purpose: This study was conducted to evaluate the impact of diabetes on the cost, length of stay, and inpatient mortality following open reduction and internal fixation (ORIF) of the ankle.

Methods: The New York Statewide Planning and Research Cooperative System (SPARCS) database, which includes all admissions to New York State hospitals from 2000-2011, was queried for all patients who underwent the primary procedure of ORIF of an ankle fracture. We identified all patients with diabetes mellitus (DM) and a subgroup of these patients with complicated diabetes mellitus (C-DM). The control group was patients without diabetes mellitus (–DM). Inpatient length of stay, total hospital cost, inpatient mortality, and Charlson Comorbidity Index (CCI) were compared between –DM and DM and between DM and C-DM.

Results: From 2000-2011, 58,748 patients underwent ORIF of an ankle fracture, of whom 7501 (12.8%) had DM. The DM cohort was significantly older than the –DM cohort (62.5 ± 13.7 years vs. 46.6 ± 19.1 years, $P < 0.01$). Mean length of stay and total hospital charges were significantly greater for the DM cohort compared to the –DM cohort (5.8 ± 6.1 days vs. 3.9 ± 4.7 days, $P < 0.01$; \$26,492 ± \$26,405.74 vs. \$20,428.51 ± \$23,946.69, $P < 0.01$). The CCI scores were significantly higher for the DM cohort compared to the –DM cohort ($P < 0.01$), which was associated with a greater inpatient mortality rate in the DM cohort compared to the –DM cohort (0.3%, 25/7501 vs. 0.1%, 46/51,247, $P < 0.01$). Of the diabetic patients, there were 1098 patients (15%) with C-DM and there was no significant difference in age ($P = 0.178$) or gender ($P = 0.541$) between the DM and C-DM cohorts. The mean length of stay and total hospital costs for the C-DM cohort were 2.4 days longer and \$6895 more costly for the C-DM cohort compared to the DM cohort, respectively (both $P < 0.01$). The CCI scores were significantly higher for the C-DM cohort ($P < 0.01$), which was associated with a greater inpatient mortality rate in the C-DM cohort compared to the DM cohort (0.7%, 8/1098 vs. 0.3%, 17/6403, $P = 0.02$).

Conclusion: Diabetic patients undergoing ORIF of ankle fractures have significantly longer lengths of stay and incur significantly higher hospital charges when compared to those without diabetes. As patients with diabetes develop complicated diabetes, they have worsening medical comorbidities and this significantly increases their inpatient mortality risk (although overall risk remains minimal). As recent government regulations require physicians to certify estimated length of stay for hospital inpatient admissions for Medicare and Medicaid patients, these data provides useful information for physicians to more accurately estimate hospitalization for diabetics undergoing ORIF of ankle fractures. Increased hospitalization time is a factor linked to increased cost of treating diabetic ankle fractures and is associated with the increased number of comorbidities that require inpatient management. This data can be used to argue for increased hospital reimbursements for diabetics and complicated diabetics undergoing ORIF of ankle fractures.

See pages 99 - 147 for financial disclosure information.

Comparison of Closed AO/OTA Type 43-C Distal Tibial Pilon Fractures Treated with Open Reduction and Internal Fixation Versus Ilizarov External Fixation

Prism S. Schneider, MD, PhD, FRCSC[1]*; Krishna C. Vemulapalli*[1]*; Stephen Davis, MD*[1]*;*
Milan Sen, MD[1]*; Timothy S. Achor, MD*[1]*; Mark Brinker, MD*[2]*;*
[1]*University of Texas Health Science Center, Houston, Texas, USA;*
[2]*Texas Orthopaedic Hospital, Houston, Texas, USA*

Purpose: High-energy fractures of the distal tibial articular surface are associated with significant morbidity and postoperative complications. External fixation has been reported to have a lower rate of complications, at the cost of poorer reduction quality. The purpose of this study was to compare open reduction and internal fixation (ORIF) with Ilizarov treatment of closed AO/OTA 43-C pilon fractures. We hypothesized that there would be a higher complication rate associated with ORIF, but a higher rate of posttraumatic osteoarthritis (OA) associated with Ilizarov treatment.

Methods: After obtaining IRB approval, our institutional trauma databases were searched to identify patients with pilon fractures. Inclusion criteria were skeletally mature patients with closed AO/OTA 43-C fractures treated with ORIF or Ilizarov. Exclusion criteria were open fractures, follow-up <90 days, and AO/OTA 43-A or B-type fractures. Outcome measures included infection rate, nonunion rate, painful implants requiring removal, wound complications, and early, symptomatic posttraumatic OA. Statistical analysis included independent-samples *t*-tests and c^2 analysis for demographic variables; relative risk (RR) was calculated using the Crosstabs function of SPSS.

Results: A total of 68 patients met the inclusion criteria. 41 were treated with ORIF (mean age = 40.7 ± 14.1 years), and 27 were treated with Ilizarov with percutaneous joint reduction (mean age = 48.3 ± 11.4 yrs). There was no difference between groups for gender, body mass index (BMI), and follow-up ($P > 0.05$), but the ORIF group was significantly younger ($P = 0.022$). There were significantly greater infections requiring inpatient treatment in the ORIF group (22%) compared to the Ilizarov group (3.7%) ($P = 0.038$) and there was increased need for soft-tissue coverage in the ORIF group (14.6%), compared to none in the Ilizarov group. There was no significant difference between groups for nonunion (14.6% in ORIF group and 13.8% in Ilizarov group; $P = 0.067$), however, six patients in the Ilizarov group had delayed unions requiring partial fibulectomy and compression or bone marrow injection. Ten patients treated with ORIF required removal of painful hardware (24%), both Ilizarov patients with percutaneous screws required removal (7.4%). There was a significantly increased rate of early, symptomatic posttraumatic OA in the Ilizarov group (34.5%) compared to the ORIF group (22%) ($P = 0.002$) and three patients in the Ilizarov group required early arthrodesis. There was increased risk for infection with wound vacuum-assisted closure (VAC) (RR = 2.1), male gender (RR = 2.8), flap coverage (RR = 17.1), diabetes (RR = 2.0), and Ilizarov application >200 days (RR = 4.1). Risk factors for nonunion included wound VAC (RR = 2.0), male gender (RR = 2.9), BMI >30 (RR = 4.3), flap coverage (RR = 7.0), and diabetes (RR = 4.2).

Conclusion: High-energy pilon fractures can be treated with either ORIF or Ilizarov. There was an increased risk for infection, soft-tissue complications, and painful implants in patients treated with ORIF. Patients treated with Ilizarov were at increased risk for delayed union and symptomatic posttraumatic OA, requiring early arthrodesis.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Ankle Fracture Complexity Does Not Predict Functional Outcome: A New Validated Scoring System Contradicts Established Belief

Michael Maceroli, MD*; Michael Stanton, MD; Russell LaFrance, MD; John Gorczyca, MD; Adolph Flemister, MD;*
University of Rochester, Rochester, New York, USA

Purpose: The present study applies the validated Foot and Ankle Ability Measure (FAAM) to trimalleolar, bimalleolar, and isolated malleolar ankle fractures. We hypothesize that trimalleolar ankle fractures and fracture dislocations will result in significantly lower FAAM scores. Additionally, we hypothesize that the presence of a malreduced ankle or posterior malleolar fracture will result in lower functional outcome scores.

Methods: Patients treated for ankle fractures between January 2005 and January 2010 were identified through our institutional billing registry by CPT codes for operatively and nonoperatively treated ankle fractures, ankle fracture-dislocations, and syndesmotic injuries. All patients age 18 and older were included in the database query. Exclusion criteria included pilon fractures, concomitant ipsilateral extremity trauma, prior ankle injury, and subsequent ankle injury occurring prior to last follow-up. Patients were then recruited by phone and mailed the FAAM questionnaire. Patient charts were reviewed for demographic data and radiographs were reviewed to determine adequacy of reduction. Fractures were classified as isolated malleolar, bimalleolar, or trimalleolar. A subgroup with fracture-dislocations was also included. The presence of a syndesmotic injury, open fractures, and posterior malleolar fixation was noted for each patient. The mean outcome score was calculated for each group and data were analyzed using analysis of variance (ANOVA) or a Student *t*-test. The data str presented as a mean ± standard deviation.

Results: Our query of the billing database identified 395 patients who sustained a first-time isolated ankle fracture, ankle fracture-dislocation, or syndesmotic injury. Of these, 97 who met inclusion criteria completed the outcome questionnaires and were included in the final analysis. There were 52 isolated malleolar fractures, 19 bimalleolar, and 26 trimalleolar. Of these, there were 26 ankle fracture-dislocations. There were 63 females and 34 males with an overall average age of 55 ± 15.5 years. The FAAM questionnaire was administered at an average 3.4 years postinjury. One-way ANOVA found no significant difference between any of the four groups for FAAM-ADL(Activities of Daily Living) ($F_{3,119} = 1.25$), $P = 0.3$) or for FAAM-Sport ($F_{3,119} = 1.4$, $P = 0.24$). When asked to rate their current level of function, 82% in the isolated malleolar and 84% in the bimalleolar group reported normal to near-normal level of function as compared to 65% of trimalleolar and 73% of the fracture-dislocation groups. The presence or absence of a posterior malleolar fracture had no significant impact on the FAAM-ADL (83.3 ± 19 vs. 87.6 ± 14.5, $P = 0.35$) or FAAM-Sport subscales (67.5 ± 29.3 vs. 71.7 ± 27.1, $P = 0.6$). Additionally, there were no significant differences in FAAM score when controlled for malreduced fractures (ADL, 84.4 ± 17.5 vs. 88.7 ± 16.1, $P = 0.26$; Sport, 68.5 ± 31.1 vs. 77.1 ± 28.4, $P = 0.14$).

Conclusion: We were unable to demonstrate a difference in outcome score between different fracture types at mean 3.4-year follow-up. This observation remained constant even when controlling for fracture malreduction. Patients in the isolated malleolar and bimalleolar groups

See pages 99 - 147 for financial disclosure information.

reported higher rates of normalcy than the more complex patterns. When basic treatment principles of fracture care are applied to ankle fractures, the outcomes are similarly positive between fracture types at medium-term (3.4-year) follow-up.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Syndesmotic Overcompression After Fixation of Acute Syndesmotic Injuries

Steven M. Cherney, MD*; Jacob A. Haynes, MD; Amanda Spraggs-Hughes, MA; Christopher M. McAndrew, MD; William M. Ricci, MD; Michael J. Gardner, MD; Washington University School of Medicine, St. Louis, Missouri, USA*

Background/Purpose: Syndesmotic injuries are a common component of malleolar ankle fractures. Prior research has demonstrated that malreduction of the syndesmosis is one of the strongest predictors of poor outcome. Of the possible malreductions of the syndesmosis, excessive medialization ("overcompression") has not been studied clinically, although cadaver data hve variably reported whether this phenomenon is possible. Overcompression may compromise ankle motion and functional outcomes. Our hypothesis was that overcompression is common using standard reduction forceps in treating syndesmotic injuries.

Methods: At a single institution, a prospective cohort with an acute traumatic injury to the syndesmosis was treated with clamp reduction and screw fixation with the ankle in neutral. The cohort consisted of 27 patients (16 male and 11 female). Most (24/27) patients sustained their injury in a twisting, low-energy fall from standing height. Posterior malleolar injury occurred in 14/27 patients (52%), three of whom were treated operatively. Bilateral postoperative CT scans were obtained to assess the reduction accuracy by comparing the operative to the uninjured ankle. Multiple standardized measurements were made based on previously published protocols, and included sagittal translation, coronal plane translation, and rotation of the malleoli. Student *t*-tests were used to compare each measurement between injured and uninjured ankles from each subject. Furthermore, for a subset of seven of the patients, inter-rater reliability of the CT measurements was calculated.

Results: The fibula was translated medially (overcompressed) within the incisura an average of 1.02 mm compared to the uninjured side ($P < 0.001$). There was significant overcompression in both the group with and without posterior malleolar injuries, and the amount of overcompression was similar between groups. There were also a substantial number of malrotations through the syndesmosis. At the level of the talar dome, the fibula was externally rotated by more than 5° compared to the uninjured side in 10/27 patients (37%) (mean, 4.48°; $P = 0.002$). There was no significant malrotation in patients without an injury to the posterior malleolus. Inter-rater reliability was good to excellent in the aforementioned measurements.

Conclusion: In this clinical series, we found a statistically significant overcompression of the syndesmosis in patients with operatively fixed syndesmotic injuries. Malrotation of the fibula in the incisura was noted only in the group with a posterior malleolar injury. These malreductions may be avoided by decreasing clamp compression of the syndesmosis and accurate clamp vector positioning. The functional sequelae of overcompression and rigid fixation of the syndesmosis remains to be determined, but given the physiologic widening of the distal tibiofibular articulation with ankle dorsiflexion, it is possible that overcompression affects ankle motion and function.

See pages 99 - 147 for financial disclosure information.

Initial Management of Unstable Complex Ankle Injuries: The Use of Emergency Department Versus Operating Room External Fixation

Philip K. McClure, MD*; Stephen Klinge, MD; Dale Cassidy, MD; Roman Hayda, MD; Christopher T. Born, MD;*
Rhode Island Hospital Department of Orthopedics, Brown University, Providence, Rhode Island, USA

Purpose: This study was undertaken to demonstrate the utility of emergency department external fixation (ED ex-fix) of unstable ankle injuries in comparison to external fixation in the operating room (OR ex-fix).

Methods: Records were reviewed to identify patients who had a uniplanar external fixator placed in the ED versus the OR for either pilon or ankle fracture/dislocation. Radiographic and clinical data were thoroughly reviewed (Table).

Results: In terms of pilon fractures, patients treated with ED ex-fix underwent 1.69 operating room procedures compared to 2.53 OR visits for the OR ex-fix group ($P = 0.005$). 46% (12/26) of fixators placed in the ED required frame revision, half for residual subluxation. Patients had a 6-point pain improvement in the ED after fixator placement compared to a 2.9-point improvement after splinting in the OR group ($P = 0.047$). Time to definitive fixation was similar. For Lauge-Hansen type ankle fractures, patients treated with ED ex-fix were converted to internal fixation at 4.7 days compared to 10.75 days in the OR ex-fix group ($P = 0.045$), and patients underwent 1.59 compared to 2.29 surgeries ($P = 0.002$). 36% (8/22) of frames placed in the ED for Lauge-Hansen type ankle fractures were revised, predominantly for posterior subluxation of the tibiotalar joint. There were no dislocations after ED or OR ex-fix placement. Pain improvement was slightly improved compared to splinting alone, but the difference was not significant. There were no statistical differences in complication rates among either the pilon or ankle fracture groups. In addition, our revision rate decreased over the course of the study.

Conclusion: Advantages of the ED (versus OR) ex-fix include rapid and potentially universal availability, earlier advanced imaging, improved early pain control, and decreased use of OR resources. The ED ex-fix was tolerated well with comparably low complication rates. We advocate early ED ex-fix placement for both pilon and ankle fractures that do not otherwise require early treatment in the OR.

POSTER ABSTRACTS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Pilon

	ED ex fix		OR ex fix		
Number	26		15		
Age	44.2		39.1		
smoker	9	34.6%	4	26.7%	
Diabetic	4	15.4%	2	13.3%	
Time to stabilization	7:07:18		11:01:16		p=0.050
43B/C	9/17		8/7		
Adjustment	12	46.2%	1	6.7%	
Poor Reduction	6	23.1%			
ED pain scale change (10 point scale)	6.10		2.88		p=0.043
Time until Definitive Rx (days)	14.23		14.47		p=0.95
Surgeries	1.69		2.53		p=0.005
Wound complication	8	30.8%	4	26.7%	
compartment syndrome	2	7.7%	2	13.3%	
nonunion	1	3.8%	0	0.0%	
Deep infection	3	11.5%	2	13.3%	
DVT	0	0.0%	0	0.0%	
Nerve injury	3	11.5%	5	33.3%	

Ankle Fracture

	ED Ex Fix		OR Ex Fix		
Number	22		14		
Age	58.5		53.3		
smoker	4	18.2%	2	14.3%	
Diabetic	1	4.5%	2	14.3%	
Time to stabilization	6:15:51		14:23:07		p=0.047
43B/C					
Adjustment	8	36.4%	3	21.4%	
Poor Reduction	6	27.3%			
ED pain scale change (10 point scale)	5.31		3.75		p=0.61
Time until Definitive Rx (days)	6.41		12.43		p=0.08
Inpatient only	4.70		10.75		p=0.045
Surgeries	1.59		2.29		p=0.002
Wound complication	6	27.3%	3	21.4%	
compartment syndrome	0	0.0%	0	0.0%	
nonunion	3	13.6%	0	0.0%	
Deep infection	0	0.0%	1	7.1%	
DVT	0	0.0%	0	0.0%	
Nerve injury	4	18.2%	1	7.1%	

See pages 99 - 147 for financial disclosure information.

A New Technique for Identification and Stabilization of Dislocating Peroneal Tendons Following Open Treatment of Intra-Articular Calcaneus Fractures

Michael A. Maceroli, MD[1]*; Edward Shields, MD*[1]*; Roy W. Sanders, MD*[2]*; John Ketz, MD*[1]*;*
[1]*University of Rochester Medical Center, Rochester, New York, USA;*
[2]*Florida Orthopaedic Institute, Tampa, Florida, USA*

Purpose: Peroneal tendon subluxation is an established, painful complication of operatively treated intra-articular calcaneus fractures. Currently there is no established protocol for intraoperative evaluation of peroneal tendon stability following calcaneus fracture fixation. The purpose of this multicenter study is to introduce a new and reliable technique for diagnosis of peroneal tendon dislocation in the setting of calcaneus fractures and to identify specific risk factors that correlate with tendon instability.

Methods: All intra-articular calcaneus fractures treated by the authors from January 1, 2002 to December 31, 2012 were evaluated on preoperative radiographs and CT scans for evidence of peroneal tendon dysfunction. Preoperative imaging was reviewed to classify fractures (AO/OTA, Sanders) and identify radiographic findings suggestive of peroneal instability including tendon subluxation, fracture-dislocation, lateral wall displacement beyond the midaxis of the fibula, and associated fibular fracture/fleck sign. Extra-articular fractures and patients under age 18 were excluded. At time of surgery all calcaneus fractures were reduced and fixed prior to tendon evaluation. A Freer elevator was then inserted into the peroneal tendon sheath to the level of the fibular malleolus and anterior pressure was applied. Peroneal instability was defined as Freer displacement anterior to the fibula indicating the peroneal sheath had been torn off the fibula. All unstable cases were then repaired. All patients were followed for a minimum of 12 months postoperatively.

Results: 244 operatively treated calcaneus fractures were identified in 225 patients. Of these 244 calcaneus fractures, 19 had peroneal tendon instability identified intraoperatively using the described protocol for an 8% overall incidence. One of the remaining 225 fractures developed late symptomatic tendon dislocation after demonstrating stability on intraoperative testing. Preoperative CT scan had radiographic signs of peroneal tendon dislocation or subluxation in 30% of fractures; however, after open reduction and fixation only 20% of those identified radiographically were unstable on intraoperative examination. Furthermore, 78% of fractures with intraoperatively confirmed unstable tendons had no evidence of peroneal subluxation on preoperative imaging. 80% of fracture dislocations displayed true peroneal instability. In addition, 56% of associated distal fibula fracture/fleck sign and 44% of fractures with significant lateral wall displacement demonstrated intraoperative instability. There were no significant differences in complications between any of the groups.

Conclusion: The present study introduces a novel technique for intraoperative evaluation of peroneal tendon instability in the setting of intra-articular calcaneus fractures. The study protocol identified an 8% incidence of peroneal tendon instability. Although preoperative imaging can show peroneal dislocation, a large number of these cases will reduce and be stable following fracture fixation. Routine intraoperative examination of peroneal tendon stability is easy to perform and is associated with a low rate of postoperative peroneal tendon subluxation.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Reliability and Sensitivity of Fluoroscopic and Radiographic Assessment of Articular Congruency in Operatively Treated Ankle Fractures Is Poor

Matthew R. Garner, MD*; Peter D. Fabricant, MD, MPH; Patrick C. Schottel, MD; Marschall B. Berkes, MD; Andre D. Shaffer, MD; Amelia Ni, BA; Dean G. Lorich, MD; Hospital for Special Surgery, New York, New York, USA*

Purpose: Articular congruency after surgical fixation of ankle fractures has been shown to affect patient outcomes. While evaluation of articular congruency with intraoperative fluoroscopy and postoperative plain radiography is commonplace, the reliability of these modalities has not been determined. The purpose of this study was to determine the sensitivity and specificity as well as the interobserver and intraobserver reliability of intraoperative fluoroscopy and postoperative plain radiographs (XR) in the assessment of articular congruency after open reduction and internal fixation (ORIF) of bimalleolar and trimalleolar ankle fractures.

Methods: A prospectively maintained ankle fracture registry was queried for operatively treated ankle fracture patients. Intraoperative fluoroscopy images and initial 2-week postoperative radiographs were read by three independent observers and were compared with postoperative CT as the gold standard. An incongruent joint was defined as an articular step-off of >2 mm, the presence of an intra-articular loose body, or an articular gap of >2 mm.

Results: 105 patients were included for analysis. The sensitivities of fluoroscopy and XR were 0.21 and 0.36, respectively. Specificity was 0.95 (fluoroscopy) and 0.89 (XR). Reliability analysis of fluoroscopy resulted in an interobserver reliability of k = 0.15 and mean intraobserver reliability of k = 0.32. XR interobserver and mean intraobserver reliabilities were κ = 0.30 and κ =.59.

Conclusion: Although results show acceptable specificity, the reliability and sensitivity of both intraoperative fluoroscopy and postoperative XR in the assessment of ankle articular congruency is low. The results of this study show that articular incongruency may be identified in only 21% to 36% of patients when standard imaging modalities are utilized. This calls into question available literature correlating clinical results with articular reduction. During ORIF of an intra-articular ankle fracture, surgeons should be highly critical of fluoroscopic imaging that appears adequately reduced, and direct visualization of the articular surface should be used as a more reliable reduction aid if possible. Further, in the postoperative period, axial imaging may be warranted in patients who have poor clinical outcomes despite apparent anatomic articular reduction in order to evaluate for occult joint incongruence.

See pages 99 - 147 for financial disclosure information.

Analysis of PITFL Injuries in Unstable Ankle Fractures

Stephen J. Warner, MD, PhD*; Matthew R. Garner, MD; Patrick C. Schottel, MD;*
Richard M. Hinds, MD; Dean G. Lorich, MD;
Hospital for Special Surgery, New York, New York, USA

Background/Purpose: Reduction and stabilization of the syndesmosis in unstable ankle fractures is important for ankle mortise congruity and restoration of normal tibiotalar contact forces. Of the syndesmotic ligaments, the posterior inferior tibiofibular ligament (PITFL) provides the most strength for maintaining syndesmotic stability, and previous work has demonstrated the significance of restoring PITFL function when it remains intact to a posterior malleolus fracture. However, in cases where the PITFL is disrupted in the absence of a posterior malleolus fracture, little is known regarding the nature of this injury. The goal of this study is to describe the injury pattern to the PITFL based on MRI and intraoperative observation.

Methods: A prospective database of all operatively treated ankle fractures (OTA 44) by a single surgeon from 2010 through 2013 was used to identify patients who underwent operative fixation of supination–external rotation (SER) types III and IV ankle fractures according to the Lauge-Hansen classification. All patients included in the study had preoperative orthogonal ankle radiographs and MRI. Using a combination of preoperative imaging and intraoperative findings, we analyzed the nature of injuries to the PITFL.

Results: From our prospective database, 213 SER III and IV operatively treated ankle fractures (OTA 44) were identified. Of these, 185 had complete imaging and were included in the study. Analysis of the preoperative imaging and operative reports revealed 34% had posterior malleolus fractures. From the remaining 122 ankle fractures, the PITFL was delaminated from the posterior malleolus in the 97% of cases (Figure 1). A smaller proportion had intrasubstance ruptures (3%) to the PITFL.

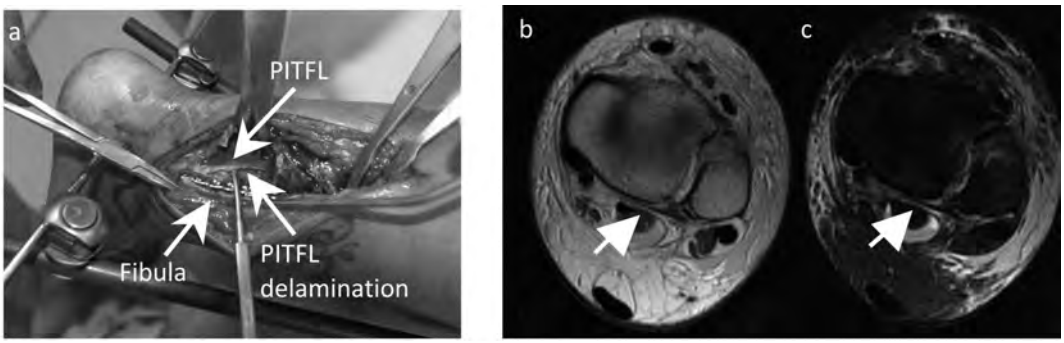


Figure 1. Intraoperative image (a) and axial proton density (b) and short-tau inversion recovery (STIR) (c) magnetic resonance images of PITFL delaminations from the posterior malleolus.

Conclusions: Accurate and stable syndesmotic reduction is a significant component of restoring the ankle mortise after unstable ankle fractures. In our large cohort of unstable

POSTER ABSTRACTS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

ankle fractures without posterior malleolus fractures, we found that the majority of PITFL injuries occur as a delamination off the posterior malleolus. This predictable injury pattern of the PITFL may be used to guide new methods for stabilizing the syndesmosis in these patients.

See pages 99 - 147 for financial disclosure information.

Measurement of 91 Normal Distal Tibiofibular Syndesmoses by Computed Tomography

Samuel L. Rosenbaum, MD*; John J. Lee, MD; Mark Hake, MD; Sven A. Holcombe, MS; Stewart C. Wang, MD, PhD; James A. Goulet, MD;*
Department of Orthopaedic Surgery, University of Michigan, Ann Arbor, Michigan, USA

Purpose: Anatomic reduction of the distal tibiofibular syndesmosis is essential to achieving a good functional outcome after injury. Plain radiographic assessment for diagnosis and reduction of syndesmotic injures is of limited value. CT is a more reliable method of assessment; however, study of the normal CT parameters of the ankle syndesmosis has been limited. The purpose of this study was to test the hypotheses that the syndesmosis is asymmetric from anterior to posterior and that there are side-to-side differences in syndesmotic morphology.

Methods: Ankle CT scans from 71 patients (51 unilateral, 20 bilateral; 91 ankles) without a known ankle injury were reviewed retrospectively from our institution's morphomics registry database by two orthopaedic surgeons. CT scans were reformatted along the tibial axis. For each ankle, 6 measurements were taken each at 5 mm, 10 mm and 15 mm above the tibiotalar joint. The articulating portion of the distal tibiofibular joint was divided into 3 equal sections and the distance between the tibia and fibula was measured by drawing a line perpendicular to the fibula at the center of each section. The depth of the tibial incisura was measured by drawing a line between the lateral extents of the anterior and posterior facets of the tibial incisura and measuring the greatest distance to the incisura perpendicular to this line. For tibial incisurae with two concavities, an additional measurement was taken. *P* values were determined using the 90th percentile of the absolute value of the differences in means over standard deviations.

Results: Average age was 41.3 years (18.1 SD). 38% (27/71) were female, 62% (44/71) male. Among all ankles, the mean difference between the anterior and posterior thirds was 1.1 mm (0.7 SD) at 5 mm, 1.4 mm (0.9 SD) at 10 mm, and 1.6 mm (1.1 SD) at 15 mm. A greater than 2-mm difference between the anterior and posterior thirds was noted in 12% (11/91) at 5 mm, in 23% (21/91) at 10 mm, and 32% (29/91) at 15 mm. The depth of the incisura was 3.3 mm (1.12 SD, 0.8-5.7 mm) at 5 mm, 3.9 mm (1.2 SD, 1.3-6.0 mm) at 10 mm, and 3.4 mm (1.4 SD, 0.2-7.9 mm) at 15 mm. Overall, 44% (40/91) had biconcave distal fibula incisurae at 5 mm, 15% (14/91) at 10 mm, and 2% (2/91) at 15 mm. Among bilateral ankles, the mean side-to-side difference in the anterior third was 0.94 mm (0.74 SD) at 5 mm ($P = 0.052$), 0.64 mm (0.39 SD) at 10 mm ($P = 0.025$), and 0.68 mm (0.54 SD) at 15 mm ($P = 0.053$). Mean posterior difference was 0.68 mm (0.46 SD) at 5 mm ($P = 0.034$), 0.61 mm (0.46 SD) at 10 mm ($P = 0.047$), and 0.64 mm (0.46 SD) at 15 mm ($P = 0.042$). The mean difference in depth of the incisura was 0.63 mm (0.42 SD) at 5 mm ($P = 0.034$), 0.85 mm (0.66 SD) at 10 mm ($P = 0.049$), and 0.86 mm (0.88 SD) at 15 mm ($P = 0.083$).

Conclusion: Among our bilateral ankles, there was a mean side-to-side difference of <1 mm at all levels in each third, suggesting the contralateral ankle may be used as a guide for reduction. The depth of the tibial incisura varied greatly between patients. This may influence the ease of reduction and should be considered during preoperative planning. It

POSTER ABSTRACTS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

has been suggested that an anterior-posterior difference in the syndesmosis of >2 mm on CT should be considered a malreduction. Depending on the level measured, however, 12% to 32% of ankles in this study had a normal difference of greater than 2 mm. This suggests that using this evaluation for reduction may overestimate the rate of malreduction and a different evaluation should be considered.

See pages 99 - 147 for financial disclosure information.

Nonunions of Fifth Metatarsal Fractures: Our Institutional Experience

Michalis Panteli, MD; *Ippokrates Pountos, MD; Peter Giannoudis, MD, FRCS;*
Academic Unit of Trauma and Orthopaedics, University of Leeds, Leeds, United Kingdom

Purpose: Painful nonunion is a well-described complication of proximal 5th metatarsal (MT) fractures despite the fact that the vast majority of them heal uneventfully. The aim of this study was to present the incidence and evaluate the safety and efficacy of the management of symptomatic 5th MT nonunions.

Methods: This is a case series of patients treated in our institution for isolated 5th MT symptomatic nonunion following failure of nonoperative management. The fractures were classified according to the Lawrence classification. A nonunion was defined as a painful 5th metatarsal fracture 3 months after presentation with radiographic evidence of bone resorption with radiolucency at the fracture line along with obliteration of the medullary canal by sclerotic bone for fractures distal to the tuberosity and absence of callus formation in two orthogonal radiographs for Type I fractures. Patients with an open fracture, injuries involving the Lisfranc complex, and polytrauma patients were excluded. The following parameters were collected and evaluated: (1) patient demographics, (2) mechanism of injury, (3) type of operation, (4) time to solid radiographic union, (5) time to return to previous everyday activities, and (6) complications. The patients were followed up until clinical and radiographic union were evident.

Results: Over a 7-year period, 41 patients (mean age, 33.3 years; range, 9-66) out of 2940 (1.39%) with 5th metatarsal fractures treated in our institution developed a painful non-union. 7 out of 2268 (0.6%), 22 out of 168 (13.1%), and 12 out of 504 (2.4%) Type I, II, and III fractures, respectively, developed a symptomatic nonunion. The most common mechanisms of injury were participation in sports (32.5%) and fall from a standing height or an ankle twist with the forefoot fixed (35%). 19 patients were smokers and 3 suffered from diabetes. The median time from the index fracture to the operation for the nonunion was 16 weeks. 26 of them had cannulated screw fixation, 12 underwent open reduction and internal fixation (ORIF), and 3 fragment excision. In 9 patients there was a residual gap following reduction and autologous bone graft was used to augment the fixation. The mean time to healing was 14.4 weeks (range, 6-106 weeks); in one patient an ORIF was revised to a cannulated screw because of a persistent nonunion and the fracture finally united after 106 weeks. The most common complication was prominent metalwork (7 patients); in 6 of them the metalwork was removed and the symptoms improved, whereas one patient refused any further procedures. At the time of union all but the patients who had a second operation reported that they had returned to their previous everyday activities. The patient who had a revision surgery for a persistent nonunion became symptom-free 3 months after the second operation. The rest of the patients assumed symptom-free foot function a month after the removal of implants.

Conclusion: Surgical management of symptomatic 5th metatarsal nonunions is a safe and efficient procedure. We recommend either excision or fixation depending upon the fracture size, closed intramedullary screw fixation, and ORIF for nonunions of Type I, II, and III fractures, respectively.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

The Efficacy of a Single-Incision Versus Two-Incision Four-Compartment Fasciotomy of the Leg: A Cadaveric Model

Meredith Neal, LCDR MC USN*; Andrew Henebry, LT MC USN;*
Christiaan N. Mamczak, LCDR MC USN; Robert Ruland, CAPT MC USN;
Department of Orthopaedic Surgery, Naval Medical Center, Portsmouth, Virginia, USA

Background/Purpose: Techniques for one- and two-incision four-compartment fasciotomies of the leg are well described in the literature. The two-incision technique remains the gold standard for addressing acute compartment syndrome of the leg. Controversy exists as to whether a single-incision approach adequately releases the deep posterior compartment. Replicating an established cadaveric model, this study investigates the efficacy of single-incision and two-incision fasciotomies to satisfactorily decompress all four compartments of the leg. We hypothesized that both techniques would adequately release all compartments of the leg and that a compartment syndrome could not be recreated in the deep posterior compartment after release by either technique.

Methods: Acute compartment syndrome was simulated in eight paired, fresh-frozen cadaver legs by infusing normal saline into all four compartments until pressures were greater than 60 mm Hg without evidence of decay. Subsequent four-compartment fasciotomies were performed on each pair, randomizing the legs to one- and two-incision techniques. Pressures were recorded at the proximal and distal third of each compartment before and after the decompression. Following fascial release, the deep posterior compartment was re-infused in an attempt to recreate an acute compartment syndrome. Statistical analysis was performed using the Student *t*-test with significance set at a P value <0.05.

Results: Sustainable pressures of greater than 60 mm Hg were established in all four compartments of each specimen. The post-fasciotomy pressures in all compartments were reduced to less than 30 mm Hg using both the single-incision and two-incision techniques. There was no statistically significant difference in post-release pressure between the two techniques in any compartment. The average post-release pressure in the deep posterior compartment was 4.6 mm Hg (range, 0-10 mm Hg) for those limbs receiving the single-incision technique and 5.6 mm Hg (range, 1-10 mm Hg) for specimens that underwent the two-incision technique($P = 0.44$). After complete fasciotomy, it was not possible to recreate acute compartment syndrome in the deep posterior compartment of any specimen, with post-reinfusion pressures ranging from 0-16 mm Hg for the single-incision group and 3-15 mm Hg for the two-incision group.

Conclusion: A single-incision four-compartment fasciotomy is as effective as a two-incision technique for release of acute compartment syndrome in this cadaveric model. Successful deep posterior compartment decompression is achieved with either approach. Further clinical studies to determine the efficacy of the single-incision technique for decompression of acute compartment syndrome of the leg are warranted.

See pages 99 - 147 for financial disclosure information.

Determination of Radiographic Healing: An Assessment of Consistency Using RUST and Modified RUST in Metadiaphyseal Fractures

*Jody Litrenta, MD[1]; **Paul Tornetta III, MD**[1]; Mohit Bhandari, MD, MSc, PhD[2]; Clifford B. Jones, MD[3]; Samir Mehta, MD[4]; Robert O'Toole, MD[5]; Robert Ostrum, MD[6]; Stephen Kottmeier, MD[7]; Kenneth Egol, MD[8]; William Ricci, MD[9]; Emil Schemitsch, MD[10]; Daniel Horwitz, MD[11];*
[1]Boston University Medical Center, Boston, Massachusetts, USA;
[2]McMaster University, Hamilton, Ontario, Canada;
[3]Orthopaedic Associates of Grand Rapids, Grand Rapids, Michigan, USA;
[4]University of Pennsylvania, Philadelphia, Pennsylvania, USA;
[5]University of Maryland Medical Center, Baltimore, Maryland, USA;
[6]Carolinas Medical Center, Charlotte, North Carolina, USA;
[7]Stony Brook Medical Center, East Setauket, New York, USA;
[8]NYU Langone Medical Center, New York, New York, USA;
[9]Washington University, St. Louis, Missouri, USA;
[10]St. Michael's Hospital, Toronto, Ontario, Canada;
[11]Geisinger Health System, Danville, Pennsylvania, USA

Background/Purpose: There are many criteria that contribute to fracture healing, yet no definition of radiographic union exists. Cortical continuity, elimination of the fracture line, and the number of bridging cortices have all been used, without clear consensus. Recently, the Radiographic Union Scale for Tibia fractures (RUST) was developed to score the healing of diaphyseal tibia fractures after intramedullary nailing. This score has reported reliability and validity; however, there is no value that defines union. Furthermore, it has not been validated for metaphyseal fractures or those treated with plate fixation. The purpose of our study was to determine the reliability of this method in quantifying healing and to define a value for radiographic union in a large series of metaphyseal tibia and femur fractures treated with plates or intramedullary nails.

Methods: Metadiaphyseal healing was evaluated using two prospective methods: *Part 1*: 12 orthopaedic trauma surgeons evaluated a series of radiographs of 27 distal femur fractures treated with either plate or retrograde nail fixation at various stages of healing in random order using a modified RUST score. Each cortex on the AP and lateral radiograph was scored as: 1 = no callus, 2 = callus present, 3 = bridging callus, 4 = remodeled, fracture not visible. For each radiographic set, the grader indicated if the fracture was radiographically healed or not. *Part 2*: We reviewed the radiographic results of two multicenter randomized trials comparing plate versus nail fixation of 81 distal femur (37 plate, 44 nail) and 46 proximal tibia (22 plate, 24 nail) fractures. Radiographs were scored at 3, 6, and 12 months using the modified RUST score above. At each time point investigators indicated if the fracture was healed or not. *Evaluations*: The intraclass correlation coefficient (ICC) was determined for each cortex, the modified RUST score, the standard RUST score (by collapsing "callus present" and "bridging callus"), and the assignment of union for the part 1 data. The RUST and modified RUST that defined "union" were determined for both parts of the study and the ICC was determined for part 1.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Results: *ICC:* The modified RUST score demonstrated higher ICC than the standard RUST (0.68 vs. 0.63). Better ICC was seen in nails than plates for both modified and standard RUST (0.74 and 0.67 vs. 0.59 and 0.53). The modified RUST had substantial agreement for plates and nails while RUST had moderate agreement. *Union:* There was no difference in scoring between distal femur and proximal tibia for part 2 data so it is reported together. The average RUST and modified RUST score at union for nails was higher than plates (P <0.01) (Table 1). The ICC for union was 0.53 (nails: 0.58; plates: 0.51), which indicates moderate agreement. However, union may best be defined by the percentage of reviewers assigning it at various scores as seen in Table 2.

Table 1. Average RUST and Modified RUST Values Considered United

	Part 1		Part 2		Combined (Part 1 + 2)	
	RUST	Modified	RUST	Modified	RUST	Modified
All	8.3 ± 1.8	11.1 ± 2.6	9.1 ± 1.7	12.3 ± 2.5	8.5 ± 1.8	11.4 ± 2.6
Nail	8.9 ± 1.5	12.2 ± 2.1	9.2 ± 1.7	12.4 ± 2.6	9.0 ± 1.6	12.3 ± 2.3
Plate	7.9 ± 1.8	10.4 ± 2.6	8.9 ± 1.7	12.2 ± 2.4	8.2 ± 1.8	10.8 ± 2.7

Table 2. Percentage of Reviewers Assigning Union (Part 1 Data)

	RUST			Modified RUST		
Score	8	9	10	9	10	13
% United	42%	76%	94%	16%	58%	91%

Conclusion: The ICC for the modified RUST is slightly higher than for RUST in metadiaphyseal fractures and had substantial agreement. The average RUST and modified RUST at union was 8.5 and 11.4. The ICC for the assessment of union was 0.53, which is moderate agreement. A minimum threshold for union of 9 for RUST and 10 for modified RUST may be reasonable as the majority of reviewers assigned union at that point. Definite union would be 10 and 13 with over 90% of reviewers assigning union. These are the first data-driven estimates of union for these scores.

See pages 99 - 147 for financial disclosure information.

Single-Stage Orthoplastic Reconstruction of Gustilo-Anderson Grade III Open Tibial Fractures Greatly Reduces Infection Rates

John A. Mathews*; Jayne Ward; Michael B. Kelly;*
Frenchay Hospital, North Bristol Trust, Bristol, United Kingdom

Purpose: Severe open tibial fractures are difficult to treat, with the best infection rates for grade IIIB and C fractures around 17%. Most need specialist orthopaedic trauma and plastics surgical expertise. The latter is not always readily available. The standard is often to deal with the fracture then refer to the plastic surgeons for definitive cover. The hypothesis for this paper was that a single-stage combined definitive skeletal fixation and soft-tissue coverage result in an improvement in infection rate.

Methods: A consecutive cohort of 73 patients were identified who presented to a major trauma center with 74 Gustilo-Anderson grade III open tibia fractures between March 2010 and January 2013. The philosophy of the unit is to achieve single-stage definitive orthopaedic fixation and plastic surgical coverage, where possible. Postoperatively patients were followed up in a combined ortho-plastics clinic. Medical records and clinic notes were reviewed retrospectively for demographics, fracture classification, operative procedures, pharmacological intervention,s and outcomes. Infection was a clinical diagnosis; deep infection was defined by a clinical situation necessitating intravenous antibiotics or operative intervention. Study groups were analyzed using Fisher's exact test. P values <0.05 were considered significant.

Results: *Combined Single-Stage Orthoplastic Fixation and Coverage:* 48 fractures were managed with definitive orthopaedic fixation and plastic surgical coverage performed at the same time, while 26 had these performed at separate stages. Of those subjects who had definitive fixation and coverage in one procedure, 2 (4.2%) developed deep infections, compared with 9 (34.6%) deep infections ($P < 0.001$) in those who underwent definitive fixation and coverage at separate operations. *Timing of Surgery:* Of the fractures that had definitive fixation and coverage completed within 72 hours of injury, 5 (20%) developed deep infections, compared with 6 (12.2 %) deep infections ($P = 0.711$) in those whose definitive fixation/coverage was completed at later than 72 hours. 12 patients either underwent orthopaedic fixation at other hospitals and were referred for definitive coverage, or were clinically too unwell for definitive surgery and thus had operations at later than 7 days from injury. Of these 3/12 (25%) developed deep infection.

Conclusion: This study presents a safe, practical protocol for the management of grade III open tibia fractures. The infection rates presented in our single-stage group are among the lowest published in patients with these injuries. While early surgery should be strived for, emphasis should ultimately be placed on timely transfer to a specialist center, aiming for a single-stage combined definitive orthoplastic procedure.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Does Obesity Impact the Perioperative Course of Patients with Isolated Diaphyseal Tibia Fractures?

Matthew J. Schessler, MD*; Alan Slipak, BS; Michael Palmer, MD; Mark C. Miller, PhD; Edward R. Westrick, MD; Gregory T. Altman, MD; Daniel T. Altman, MD;*
Allegheny General Hospital, Pittsburgh, Pennsylvania, USA

Purpose: Prior studies have examined the effect of obesity in polytrauma, isolated ankle fractures, and elective orthopaedic procedures. This study aims to examine the impact of obesity on the perioperative course of patients with isolated diaphyseal tibia fractures.

Methods: Adults with isolated diaphyseal tibia fractures (AO/OTA 42) operatively treated at a Level I trauma center from 2007-2012 were retrospectively analyzed. We obtained IRB approval. Patients were divided into 4 groups based upon body mass index (BMI): underweight (BMI <18.5 kg/m^2), normal (BMI 18.5-24.9), overweight (BMI 25-29.9), and obese (BMI >30). Outcome measures include length of stay (LOS), intensive care requirement, surgical time, estimated blood loss (EBL), and number of complications. Complications were classified as major or minor. Major complications are adverse events that require invasive treatment, prolonged hospital stay, or were life- or limb-threatening.

Results: 253 patients with diaphyseal tibia fractures were identified in our institutional trauma database. We excluded polytraumatized patients and those with additional orthopaedic injuries. 151 consecutive patients with isolated diaphyseal tibia fractures treated operatively were included in the study population. 75% had closed fractures and 25% had open fractures. 49 patients (32%) possessed a normal BMI, 51 patients (34%) were overweight, and 48 patients (32%) were obese. Only 3 patients (2%) were underweight. No significant difference existed among groups regarding average age, medical comorbidities, tobacco use, average ISS, AO/OTA fracture classification, number of open fractures, or fixation type. There were 27 complications, 14 major and 13 minor. Significantly more major complications occurred in the obese group ($p<0.05$). 10 of 14 (71%) major complications occurred in the obese group including acute hypoxic respiratory failure (3/14), acute renal failure (1/14), cerebrovascular accident (1/14), decubitus ulcer (1/14), iatrogenic fracture during external fixation (1/14), pneumonia (2/14), and pulmonary embolism (1/14). No major complications occurred in the normal BMI group. Average EBL for the normal, overweight, and obese groups was 134 cm^3 (range, 25-300), 136 cm^3 (range, 20-400), and 157 cm^3 (range, 35-500), respectively. Postoperative intensive care requirement for the normal, overweight, and obese groups averaged 0.1 days (range, 0-2 days), 0.2 days (range, 0-4), and 0.5 days (range, 0-8), respectively. Linear regression analysis reveals a significant relationship between BMI and EBL ($P < 0.05$, $r^2 = 0.03$) and BMI and postoperative intensive care requirement ($P < 0.05$, $r^2 = 0.15$). Trends toward longer LOS and longer operative times existed with increasing BMI, but were not statistically significant.

Conclusion: Obese patients face a complicated, challenging perioperative course. Obese patients sustained serious medical and surgical complications not observed in normal weight individuals. Further research could investigate the impact of obesity on long-term outcomes and hospital costs in patients with diaphyseal tibia fractures.

See pages 99 - 147 for financial disclosure information.

Open Distal Tibial Shaft Fractures: A Retrospective Comparison of Medial Plate Versus Nail Fixation

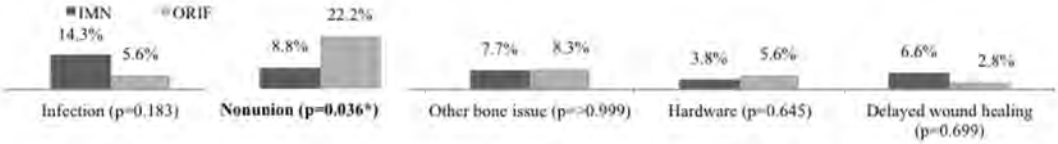
Rachel V. Thakore, BS; Vasanth Sathiyakumar, BA; Elvis L. Francois, BA; Michael A. Siuta, PhD; Michael A. Benvenuti, BS; Anne K. Smith, BS; Jesse M. Ehrenfeld, MD, MPH; Jason M. Evans, MD; William T. Obremskey, MD, MPH, MMHC; ***Manish K. Sethi, MD****; Vanderbilt University, Nashville Tennessee, USA*

Background/Purpose: The treatment of open distal tibial shaft fractures by either open reduction and internal fixation (ORIF) or intramedullary nailing (IMN) remains controversial. The few studies that have compared IMN and ORIF for distal tibia fractures have found similar complication rates between these two methods. However, these studies focused primarily on closed distal tibia fractures and included only a small number of open distal tibias in their analyses. Therefore, it remains unclear whether IMN or ORIF is associated with better outcomes for open distal tibia fractures. The purpose of this undertaking was to conduct the largest retrospective study to date comparing complication rates for IMN and ORIF of open distal tibia shaft fractures.

Methods: Following IRB approval, patients who were treated for open tibia fractures by ORIF or IMN over a 10-year period were identified through a CPT code search at a Level I trauma center. Patient charts were reviewed for demographic information including age, gender, American Society of Anesthesiologists (ASA) score, hospital length of stay (LOS), and Gustilo grade of open fracture. Only patients who underwent ORIF with a medial plate were included in analysis. Distal tibia fractures were identified by reviewing radiographs for fractures that were 4 to 11 cm from the plafond consistent with prior studies. Patient charts were reviewed to determine if any complications leading to reoperations occurred. Complications were categorized into five groups including hardware pain/prominence, wound-healing issues, infection, nonunion, and other bone issues (segmental defect, malunion, delayed union). A multivariate analysis comparing complication rates while controlling for age, gender, ASA score, hospital length of stay (LOS), and fracture grade was performed.

Results: Of the 216 patients with open distal tibia shaft fractures included in analysis, 83.3% (n = 180: G1, 22; G2, 78; G3, 80) were treated with IMN. 16.7% (n = 36: G1, 10; G2, 16; G3, 10) were treated with medial plating. After controlling for fracture grade, age, gender, ASA score, and LOS, no significant difference in overall complication rate between IMN (31.7%, n = 57) and ORIF (44.4%, n = 16) was found (Table 1). When further breaking down the complications into the five categories mentioned above, the ORIF group was found to have a significantly higher rate of nonunion (22.2%, n = 8) when compared to IMN (8.9%, n = 16). No significant difference in the rate of infection, hardware pain, delayed wound healing, or other bone issues was found (Figure 1).

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.



	IMN (n = 180)	ORIF (n = 36)	*P* Value
Overall complication rate	31.7% (n = 57)	44.4% (n = 16)	0.175

Conclusion: This study, which is the largest retrospective comparison of open distal tibia fractures treated with IMN or medial plating, demonstrates a significantly higher rate of nonunion in the ORIF group. Our findings differ from the current literature demonstrating similar union rates regardless of the implant used. When utilizing plate fixation in such patients as compared to IMN, orthopaedic surgeons should advise their patients of the potential need for further surgeries including early bone grafting.

See pages 99 - 147 for financial disclosure information.

Evidence-Based Fit Assessment of Anatomic Distal Medial Tibia Plates

Andreas Petersik, PhD[1]*; Walter W. Virkus, MD*[2]*; Rainer Burgkart, MD*[3]*; Geert von Oldenburg*[1]*;*
[1]*Stryker Trauma GmbH, Schoenkirchen, Germany;*
[2]*IU Health, Indianapolis, Indiana, USA;*
[3]*Clinic of Orthopaedics and Sports Orthopaedics, Technical University of Munich, Munich, Germany*

Purpose: A good anatomical fit of precontoured plates is ideal to decrease malalignment of fracture fragments, reduce operating room time, and avoid unnecessary soft-tissue prominence. This last point is of great importance when plating the distal medial tibia, since the soft-tissue coverage is very thin. This study quantitatively compares the plate fit of seven different anatomic distal medial tibia plates from four different manufacturers on a large collection of 3-dimensional (3D) tibia models created from high-resolution clinical CT scans.

Methods: We generated 573 3D models of the tibias from CT scans of healthy subjects. 403 models were created from scans of Caucasian patients, and 170 models were created from the Asian population. There were female models (51%) and male models (49%). All models were created by using standard segmentation software (Materialise Mimics and MeVisLab). Automatic fitting software was developed, which quantitatively determines how well a given implant fits to a large collection of varying 3D tibia models. With help of a least-squares approach, the software finds an implant placement for every individual tibia that closely resembles a surgical placement. The software calculates the so-called fitting error (fe) in mm^2 for every plate-tibia combination. The lower the value for the fitting error, the better the anatomical fit of the implant, and the larger number of patients can be treated without the need to bend the implant. For this study, seven different distal medial tibia plates were optically scanned and imported to the computer software: DePuy ALPS 9-hole (8162-10-009), Synthes LCP 3.5-mm 8-hole (238.705), Stryker AxSOS 10-hole (627410), Smith & Nephew Peri-Loc 3.5-mm 10-hole (7182-1110), Synthes 2.7/3.5-mm LCP 10-hole (439.913), Synthes 2.7/3.5-mm VA-LCP 12-hole (02.118.011), and Stryker AxSOS 16-hole (627416).

Results: The analysis reveals that all plates are fit better on the Asian population tibial models compared to the Caucasian population tibial models. In the group of shorter plates (168-176 mm) the Synthes LCP 3.5-mm shows the worst fit (fe = 3.05), the DePuy ALPS shows an intermediate fit (fe = 2.14), and the Stryker AxSOS shows the best fit (fe = 1.51, $P < 0.001$). In the "long" group (185-254 mm) Smith & Nephew Peri-Loc 3.5-mm (fe = 5.24), Synthes 2.7/3.5-mm LCP (fe = 5.48), and Synthes 2.7/3.5-mm VA-LCP (fe = 5.33) show a highly significant worse fit than the Stryker AxSOS (fe = 1.96, $P < 0.001$). In addition to the highly significant difference in the fitting error for the "average" population, the error margins were also better than the competitive devices in the "outlier" size models.

Conclusion: The analysis reveals that the Stryker distal medial tibia plates show a significantly better anatomical fit to the 573 tibia models than the comparable plates from DePuy, Smith & Nephew, and Synthes. We also demonstrated that the Stryker plates show better results for a larger percentage of the population of tibias. These superior plate-to-bone fitting results suggest an improved anatomical fit with a reduced need for plate-bending when using these plates.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

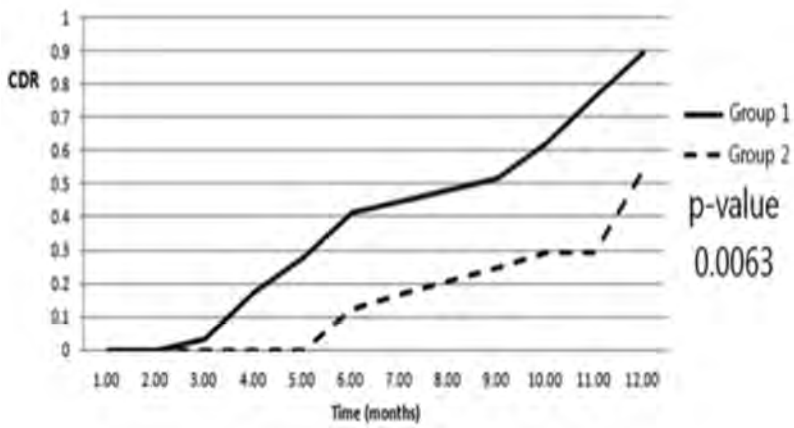
The Role of Appositional Screw Fixation in Minimally Invasive Plate Osteosynthesis for Distal Tibial Fracture

Yougun Won, MD[1]*; Hyung-Keun Song, MD*[2]*; Dong-Hyun Kang, MD*[1]*; Sung-Jun Kim, MD*[1]*; Kyu-Hyun Yang, MD, PhD*[1]*;*
[2]*Yonsei University College of Medicine, Seoul, Korea;*
[2]*Aju University College of Medicine, Suwon, Korea*

Purpose: Over the decades, minimally invasive plate osteosynthesis (MIPO) has been well established as a treatment of distal tibial shaft fractures. However, the effect of interfragmentary appositional screw fixation has not been adequately investigated.

Methods: In this IRB-approved study, we performed MIPO in 60 patients who were diagnosed as distal tibia fracture without displaced articular fragment between January 2002 and June 2012 in our hospital. 30 patients (group 1) of the 60 patients were treated with MIPO with appositional screw fixation and the other 30 (group 2) were treated without the screw. Radiographic results were assessed for time to initial callus formation, visible bridging callus formation in posteromedial cortex, and radiological union defined as the presence of a bridging callus in three cortices. Clinical union was defined when patients were fully weight bearing without significant local discomfort and radiographs demonstrated bridging callus formation. Clinical outcomes were assessed using the American Orthopaedic Foot & Ankle Society (AOFAS) Scores at the final follow-up examination. The marginal model using the robust sandwich estimate in the Cox proportional hazard model for recurrent event data was used to detect differences among cumulative detection rate curves. Statistical significance was defined when *P* value was less than 0.05.

Results: Mean follow-up was 20 months. In group 1, the rate of clinical union was significantly higher than that in group 2 in analysis of the 1-year cumulative detection rate (CDR) (figure). In group 2, the duration before initial callus formation and radiological union was significantly longer than in group 1 ($P = 0.044$, $P = 0.002$). Four nonunion patients in group 2 achieved union after placement of an additional bone graft and none of patients in group 1 were diagnosed with delayed union or nonunion ($P = 0.022$). None of the patients of both groups had malreduction, skin problems, or infection. Overall, the AOFAS score did not significantly differ between groups 1 and 2 ($P = 0.43$).



See pages 99 - 147 for financial disclosure information.

Conclusion: The group without appositional screw fixation had significantly extended healing time and higher incidence of nonunion and delayed union that required additional operation, thus significantly extending times for clinical union and radiological union.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Antibiotic Elution Profiles of Two Methods of Nail Preparations

Matthew R. Karek, MD[1]; *Raul Vaidya, MD[1,2]; Nancy M. Jackson, PhD[1,3]; Jeffrey C. Flynn, PhD[1,3]; David C. Markel, MD[1,3];*
[1]Detroit Medical Center/Providence Hospital Orthopaedic Surgery Residency Program, Detroit, Michigan, USA;
[2]Detroit Receiving Hospital, Detroit, Michigan, USA;
[3]Providence Hospital and Medical Centers, Southfield, Michigan, USA

Purpose: Antibiotic-coated intramedullary nails (AIMNs) or guidewires (AIMGs) are accepted treatment options for infected long bone nonunions. While the nails may be locked and structurally more desirable, it is generally felt that the thicker coating on AIMGs provides greater levels and duration of antibiotic delivery. The purpose of this study is to compare the elution profiles of antibiotics from AIMNs and AIMGs to determine if differences exist and if these could be linked to cement porosity or curing temperature.

Methods: 2-cm segments of 8-mm nails or 3.5-mm guidewires were coated with cement containing tobramycin (1 g) or tobramycin (2.2 g) and vancomycin (1 g). Simplex cement was used. All samples were partially cured in 40-French chest tubes as a mold (Atrium). Probe thermometers were used to measure curing temperatures. Micro-CT (Scanco) was used to measure porosity. Segments were soaked in sterile phosphate-buffered saline and entire aliquots were exchanged at scheduled time intervals over a 6-week period. Antibiotic concentrations were measured on a Roche / Hitachi Cobas C system. Bactericidal activity was measured as decreased ABS_{600} in the linear growth phase of *Staphylococcus aureus* cultures. Statistical analysis was performed using the Student *t*-test ($P < 0.05$ significant).

Results: The majority of antibiotics eluted from both devices in the first 48 hours. The elution of tobramycin from 1-g tobramycin-loaded cement was the same for the AIMNs and AIMGs. However, more tobramycin was released from AIMNs than AIMGs when additional tobramycin and vancomycin were mixed into the cement. The antibiotic continued to be released and was bactericidal for up to 6 weeks. The mean percent porosity of the cement was significantly greater ($P = 0.042$) in AIMGs supplemented with vancomycin and extra tobramycin (5.4 ± 2.3) compared to AIMNs (2.9 ± 1.7). The mean peak curing temperature for cement on AIMNs (93°F) was significantly lower ($P < 0.05$) than that of cement on AIMGs (148°F).

Conclusion: Our data demonstrated that AIMNs can provide effective delivery of antibiotics to infected long bone nonunions and do so at a lower curing temperature that may preserve antibiotic efficacy as well as patient tissue viability.

See pages 99 - 147 for financial disclosure information.

An Alternative Approach to Intramedullary Nailing of the Tibia: The SeMid Technique (Semi-Extended Midvastus Tibial Nailing)

Thomas H. Sanders, MD*; A. Stephen Malekzadeh, MD; Daniel Dziadosz, MD; Cary Schwartzbach, MD; Lolita Ramsey, PhD;*
INOVA Fairfax Hospital, Falls Church, Virginia, USA

Background/Purpose: Anterior knee pain continues to be a common complaint among patients recovering from intramedullary nailing of the tibia. Although more orthopaedic surgeons are utilizing the semi-extended technique for tibial nailing, there are concerns regarding iatrogenic injury to the patellofemoral joint. The midvastus approach is a viable alternative to the standard parapatellar arthrotomy for total knee arthroplasty (TKA) and has documented benefits with recovery and rehabilitation. The purpose of this study was to investigate the potential benefit of using this proven approach for semi-extended tibial nailing. This approach merges many of the known advantages of semi-extended tibial nailing, with the benefits of the midvastus approach. We hypothesize that intramedullary nailing of the tibia shaft using a midvastus approach will improve functional outcomes, good range of motion and minimize postoperative knee pain.

Methods: This study was a retrospective review of surveys administered as part of standard postoperative care visits and continues as a prospective, observational study. Patients were included for (1) age 18 to 75 years, (2) tibial shaft fracture, and (3) treated by 1 of 3 orthopaedic trauma surgeons using the midvastus approach. At each follow-up visit (2, 6, 12, 26, and 52 weeks), patients completed surveys, including the Short Musculoskeletal Function Assessment (SMFA) and visual analog scale (VAS) assessing current knee pain and pain in the past 4 weeks. Range of motion and radiographic examination were also evaluated. This study was approved by the hospital IRB. Preliminary results are presented.

Results: Since April 2011, 67 patients underwent intramedullary nailing of the tibia using the midvastus approach. Of this total, 39 were eligible, 13 were missing data at 1 year, and 13 are being actively followed. A total of 13 patients (15 tibias), with an average age of 43.3 years (±17.8 SD), completed follow-up at 1 year. The majority were male (77%) with 53.4 (±11.5 SD) weeks of follow-up. Using a VAS from 0 (no pain) to 10 (worst possible pain), patients had an average final (1-year) current pain rating of 1.50 (±1.56 SD) and a rating of 2.35 (±1.76 SD) in the 4 weeks prior to their 1-year visit. Five patients (38%) denied any knee pain the day of their last visit. The SMFA had low index scores and good functional outcomes: mean dysfunction index standardized = 10.36 (±7.04 SD); mean bothersome index standardized score = 9.58 (±6.34 SD). Mean scores were also low for each of the four categories composing the dysfunction index, with little difficulty with mobility (18.45 ± 14.56 SD). Patients achieved full range of motion between 26 and 52 weeks postoperatively (0°-135°). The average knee flexion was 137.67° (± 3.20 SD) and the average knee extension was –1.40° (±2.85 SD). No significant iatrogenic damage to the patella or femoral trochlear cartilage was noted at the time of closure of the arthrotomy. There were no infections or nonunions.

Conclusion: Semi-extended tibial nailing using the midvastus approach has shown promising early clinical results with respect to postoperative knee pain and function. At 1 year after

POSTER ABSTRACTS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

surgery, patients reported minimal pain and low levels of dysfunction and bothersomeness. Therefore, the midvastus approach allows the surgeon to benefit from the logistical and technical advantages of semi-extended tibial nailing without violating the patellofemoral cartilage, hopefully leading to less anterior knee pain and maintaining knee range of motion.

See pages 99 - 147 for financial disclosure information.

Management of Distal Metaphyseal Tibia Fractures with the SIGN Intramedullary Nail in Three Developing Countries

Kyle R. Stephens, DO[1]*; Faseeh Shahab, MBBS*[2]*; Daniel Galat, MD*[3]*; Duane Anderson, MD*[4]*; Shahab Ud Din, MBBS, FCPS (Ortho)*[2]*; Paul S. Whiting, MD*[5]*; Douglas W. Lundy, MD*[6]*;*
[1]*Henry Ford Macomb Hospital, Clinton Township, Michigan, USA;*
[2]*Lady Reading Hospital, Peshawar, Pakistan;*
[3]*Tenwek Hospital, Bomet, Kenya;*
[4]*Soddo Christian Hospital, Soddo, Ethiopia;*
[5]*Tufts University, Boston, Massachusetts, USA;*
[6]*Resurgens Orthopaedics, Marietta, Georgia, USA*

Purpose: The Surgical Implant Generation Network (SIGN) intramedullary nail is designed for use in low-resource settings without fluoroscopy, power instrumentation, or special operating tables. Our purpose was to evaluate its use in distal metaphyseal tibia fractures in three developing countries.

Methods: Data from the SIGN online surgical database was reviewed for all AO/OTA 43A distal tibia fractures treated with the SIGN nail at three hospitals in developing countries. Patient demographics, clinical information about the fracture and surgery, and postoperative outcome information were collected. Patient follow-up in the developing world is an extremely challenging issue, so only patients with a minimum of one postoperative visit were included.

Results: Between February 2009 and October 2013, 160 patients with 162 fractures were included. Average age was 35.3 years ± 13.1. 79% were male. Mean time to surgery was 4.1 days. Rate of fracture union was 97.3%. Average time to union was 105 days (15 weeks). 60% of fractures were closed. Patients with open fractures accounted for 63% of total complications ($P = 0.001$) and 86% of infections ($P = 0.0004$). Open reduction of closed fractures was performed in 53% (n = 51) of cases. 151 fractures (93%) had an associated fibula fracture, but only 12 fractures (7.4%) underwent fibular fixation in addition to tibial nailing. Acceptable alignment (less than 5° deformity) was found in 83% (n = 134) of fractures. Tibia fractures with an associated fibula fracture at the same level had a higher incidence of malalignment (22%) as compared with fractures at different levels (13%) ($P = 0.257$). Valgus was the most common deformity overall although varus deformity was most common with proximal fibula fractures. Complications included 3 nonunions (1.8%), 14 infections (8.6%), and revision surgery in 10 fractures (6.2%).

Conclusion: Distal metaphyseal tibia fractures can be managed successfully with the SIGN intramedullary nail in low- and middle-income countries with excellent outcomes equal to results in developed nations with far more financial resources, technology, and healthcare infrastructure. Open fractures are at a significantly increased risk for complications and infection. Open reduction of closed distal tibia fractures in developing settings is safe and effective. Malalignment, especially valgus, is more common in fractures with same-level fibula fractures. For the surgeon interested in disaster relief or international work in developing countries, the SIGN nail is an effective means of managing distal tibia fractures.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Development of Compartment Syndrome Negatively Impacts Length of Stay and Cost Following Tibia Fracture

Alexander M Crespo, BS[1]; Arthur Manoli III, BS[1]; Sanjit R. Konda, MD[1,2];
Kenneth A. Egol, MD[1,2];
[1]NYU Langone Medical Center, Hospital for Joint Diseases, New York, New York, USA;
[2]Jamaica Hospital Medical Center, Jamaica, New York, USA

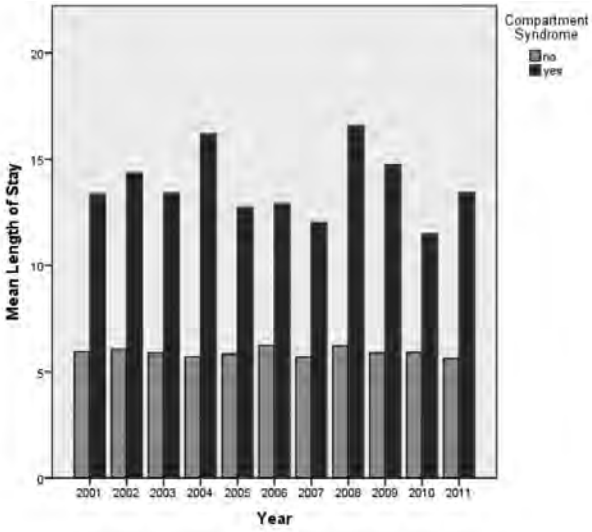
Purpose: This study was undertaken to evaluate the impact of lower extremity compartment syndrome on length of stay and total hospital charges among patients who have sustained an ipsilateral tibial shaft fracture.

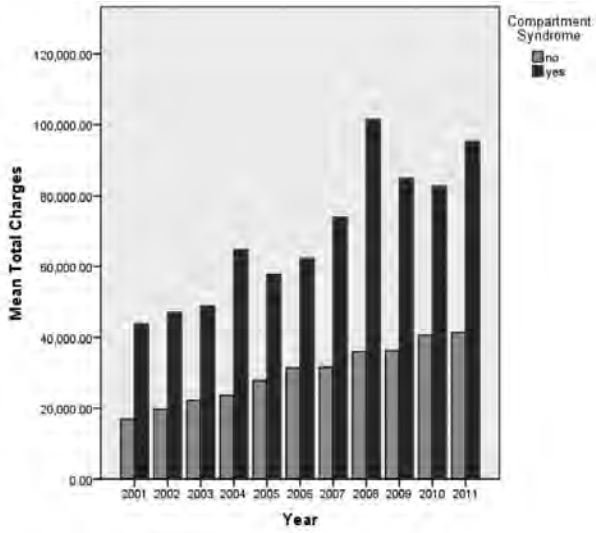
Methods: The SPARCS (Statewide Planning and Research Cooperative System) database, established by New York State in 1979, was queried by principal diagnosis for inpatients primarily treated for a tibia and/or fibula fracture between the years 2001-2011 (n = 47,380). In order to eliminate confounding factors, patients were further screened by Clinical Classification Software Procedure Categories to ensure only those being treated principally for fracture were included in the study, leaving a sample size of n = 38,479. To further eliminate confounding variables, a Charlson Comorbidity Score was calculated for all patients. Any patient with a score greater than zero was eliminated to ensure length of stay and charges were not impacted by treatment for ailments unrelated to tibia/fibula fracture. The final sample size was n = 33,629. All charges were adjusted for inflation to the year 2013 using the CPI Inflation Calculator from the Bureau of Labor Statistics. Descriptive statistics were computed and differences among groups were compared using the Student *t*-test with statistical significance set at $P < 0.05$.

Results: A total of 33,629 patients with tibial shaft fracture were included in the study. Compartment syndrome developed in 692 of these cases, yielding an incidence of 2.1%. Of patients who developed compartment syndrome, 565 were male (81.6%) and 182 cases occurred in the setting of an open fracture (26.3%). There were 32,937 patients who did not develop a compartment syndrome. For this group, the mean length of stay was 6 days (mode = 3) and the mean hospital charges were $34,000. Patients with compartment syndrome remained in-house for an average of 14 days with average charges totaling $79,000. These differences were highly significant for both length of stay and hospital charges ($P < 0.001$).

Conclusion: Besides the obvious physical detriment experienced by patients with compartment syndrome, there is also a significant economic impact to the health-care system. Compartment syndrome more than doubles length of stay and total hospital charges in the setting of a tibial shaft fracture. These findings highlight the need for a standardized care algorithm aimed towards efficiently and adequately treating acute compartment syndrome. Such an algorithm would optimize cost of care and presumably decrease length of stay.

See pages 99 - 147 for financial disclosure information.





- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Open Tibia Fractures Treated with Intramedullary Nailing: Effects of Provisional Plate Stabilization

*Meryl Ludwig, MD[1]; **Robert A. Hymes, MD**[2]; Lolita Ramsey, RN, PhD[2]; Michael Pitta, MD[1]; Jeff E. Schulman, MD[2];*
[1]Georgetown University Medical Center, Washington, District of Columbia, USA;
[2]Inova Fairfax Medical Campus, Falls Church, Virginia, USA

Purpose: This study is designed to analyze the risk of complications in open tibia shaft fractures treated with intramedullary nailing and small or mini-plate provisional fixation. Our hypothesis is that the use of a provisional plate fixation prior to nailing will not increase the risk of complications.

Methods: This study was approved by the local hospital IRB. A list of patients was compiled from the surgical billing database, using ICD-9 and CPT codes. Records met inclusion criteria if patients were (1) 18 years of age or older; (2) admitted to our Level I trauma center between January 1, 2005 and June 30, 2013; (3) diagnosed with an open fracture of the tibia; and (4) operatively treated with intramedullary nailing, with or without provisional plate fixation. A review of hospital medical records was conducted to collect demographic data including age, sex, and history of diabetes and smoking. Mechanism of injury, side of injury, Gustilo and AO/OTA classifications, and secondary procedures were also extracted from the records. Operative reports were reviewed to determine the utilization of provisional plating. Postoperative complications were tracked and included infection (superficial or deep), delayed or nonunion, compartment syndrome and death. Descriptive statistics, univariate, and multivariate logistic regression was conducted using SPSS (Version 18, IBM), with α= .05 significance level.

Results: There were 143 patients diagnosed with an open tibia fracture during the study period. Seven patients were excluded for age, four patients died, one underwent acute amputation, and 27 patients had insufficient follow-up leaving 104 patients in the study group. Four patients had bilateral tibia fractures. Patients in this study averaged 37 years of age (±12.92 SD), 75% were male, and 67.3% were related to motor vehicle collisions. 44% of injured extremities were classified as a Gustilo type 3 fractures and mean follow-up was 10 months. Overall use of a provisional plate occurred in 32.4% of extremities (n = 35), of which 57.1% were kept on permanently and 42.9% were removed. In this study, 27.8% of patients developed a complication, of which 16.7% had a superficial or deep infection (4.6% wound breakdown) and 11.1% had other types of complications (delayed union, nonunion, hardware failure). Age, Gustilo classification (type 3 vs. 1 and 2), and AO/OTA classification were considered confounding variables with provisional plate use and complication. After controlling for these variables, provisional plate use had slightly higher odds for infection (adjusted odds ratio [AOR] = 1.64, 95% confidence interval [CI] = 0.51, 5.32) but did not significantly increase the odds for any type of complication (AOR = 1.24, 95% CI = 0.46, 3.35). When assessing only the patients who had the provisional plate (n = 35), removing the plate decreased one's odds for infection (AOR = 0.43, 95% CI = 0.07, 2.69), and any complication (AOR = 0.55, 95% CI = 0.12, 2.46), compared to patients in whom the provisional implant was retained.

See pages 99 - 147 for financial disclosure information.

Conclusion: Provisional plate stabilization used to maintain fracture alignment in open tibia fractures undergoing intramedullary nailing should be used with caution in the setting of concern for infection. Although the local wound complication rate is low, removal of the plate after nailing should be considered in order to decrease the likelihood of developing an infection or other orthopaedic complication.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Single- Versus Two-Stage Repair for Infected Tibial Nonunions

Daniel S. Chan, MD*; K. Cronin, MD; M. Lago, MD; H. Claude Sagi, MD; Roy Sanders, MD;*
Orthopaedic Trauma Service, Tampa General Hospital
Florida Orthopaedic Institute, Tampa Florida

Background/Purpose: The standard treatment of an infected diaphyseal tibial nonunion involves removal of hardware, irrigation and debridement, followed by an appropriate course of systemic antibiotic administration. The eradication of the infection is required before proceeding with the repair nonunion. The assessment of this aseptic state is typically achieved through infectious laboratory measurements, namely white blood cell count, erythrocyte sedimentation rate, and C-reactive protein. However, the possibility of false negative infectious indices does exist and attempting a nonunion repair in a septic environment is suboptimal. Therefore, a two-staged approach is often used that includes a first-stage bone culture and Gram stain to prove the absence of bacteria at the nonunion site, followed by a second-stage repair nonunion procedure after negative culture results. To our knowledge, no study has directly compared the single- (1S) versus two-staged (2S) repair of infected diaphyseal tibial nonunions. The purpose of this study is to directly compare these two techniques with regard to infection recurrence and union.

Methods: After IRB approval, a retrospective chart review was performed at a Level I academic trauma center of patients treated for infected tibial diaphyseal nonunions from 2005 through 2013. Inclusion criteria included skeletal maturity with diaphyseal infected tibial nonunions that underwent appropriate irrigation and debridement, and hardware removal, followed by a minimum of 6 weeks of systemic antibiotics, and minimum 1-year follow-up after nonunion repair procedure. Data collected included patient demographics, comorbidities, history of open fracture or soft-tissue reconstruction, use of antibiotics and antibiotic cement for the treatment of osteomyelitis, single- versus two-stage repair nonunion, culture and infectious indices results, chronic antibiotic use, union, and infection recurrence. Recurrence was defined as the evidence of deep infection after the completion of antibiotic course and nonunion repair.

Results: 34 patients were treated for infected diaphyseal tibial nonunions. 16 patients were treated via 1S, and 18 patients underwent the 2S approach. The average age of the 1S group was 47 years, 81% were male, 100% originally had open tibia fractures, and 69% required soft-tissue reconstruction. Similarly, the 2S average age was 45 years, 67% were male, 89% originally had open fractures, and 83% required soft-tissue reconstruction. 50% (8/16) in 1S and 44% (8/18) in 2S experienced recurrent infections and persistent nonunion ($P = 0.61$). 50% (8/16) in 1S and 56% (10/18) in 2S achieved successful union ($P = 0.75$). Three of the eight (38%) patients who achieved union in 1S required chronic antibiotic oral antibiotics, compared to one of ten (10%) patients in 2S ($P = 0.27$).

Conclusion: There are no significant differences found between a single- versus two-staged approach to infected tibial nonunion repair in this study. After the appropriate removal of hardware, irrigation and debridement, followed by an appropriate course of systemic antibiotics, the additional operative trip to obtain a bone culture before the definitive nonunion repair appears to be unnecessary and does not circumvent false negative infectious indices. Further investigation is warranted with larger sample sizes.

See pages 99 - 147 for financial disclosure information.

Autogenous Iliac Crest Bone Grafting Revisited: The Most Reliable Solution for Tibial Nonunions

David P. Taormina, MS[1]; Sanjit R. Konda, MD[1]; Roy I. Davidovitch, MD[1];
Kenneth A. Egol, MD[1,2]
NYU Hospital for Joint Diseases, New York, New York, USA;
Jamaica Hospital Medical Center, Jamaica, New York, USA

Purpose: Tibial nonunion remains a considerable burden for patients and the surgeons who treat them. The purpose of this study was to evaluate the efficacy of autogenous iliac crest bone graft in the treatment of tibial shaft nonunion.

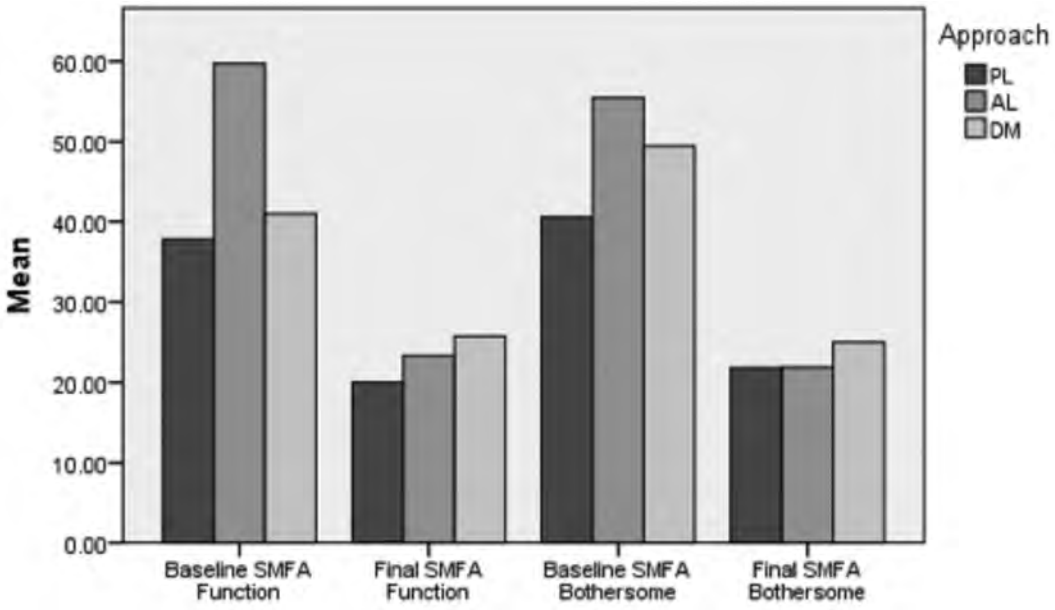
Methods: 46 patients who underwent autogenous bone graft in the treatment of tibial shaft fracture nonunion were identified from a trauma research registry. All patients presented with persistent nonunion and were indicated for autogenous iliac crest bone grafting (ICBG). The operative approaches used were posterolateral (PL), anterolateral (AL), or direct medial (DM). Surgical treatment was similar and consisted of bone grafting with or without supplemental fixation. All patients adhered to a standardized postoperative protocol requiring non–weight-bearing for 6 weeks and then partial weight-bearing until radiographic healing. Demographic data were recorded at baseline encounters and patients were scheduled for follow-up at standard intervals for a minimum of 1 year. Achieving union, time to union, postoperative pain assessed via the visual analog scale (VAS), and functional outcomes via the Short Musculoskeletal Function Assessment (SMFA) were evaluated for the entire group and then compared based on the surgical approach used for graft implantation.

Results: The mean age was 42.8 years (range, 19-71). 34 patients (73.9%) had initially sustained open fractures. 39% of patients had intramedullary nails, 39% had plate fixation, and 22% were definitively treated with dynamic external fixation at their initial surgery. The mean follow-up time was 19.9 ± 13.4 months. Surgical approach included 50% PL, 17% AL, and 33% DM. Bony union was achieved by 96% (44/46) of patients, including 3 patients who underwent secondary ICBG. The mean time to union for all patients was 7.9 ± 5.4 months and there was no significant difference among the 3 groups (PL = 7.7 months, AL = 8.8 months, DM = 7.9 months; $P = 0.88$). Pain scores improved 49% from preoperative values (mean = 4.9 ± 3.6; $P = 0.89$) to final follow-up values (mean = 2.5 ± 2.9; $P = 0.55$). Mean SMFA at final follow-up was similar among all 3 groups across all indices of the SMFA ($P = 0.29$; Figure 1). Overall, there was a 17.4% complication rate at the nonunion site and this was similar among groups. In addition, there were three iliac donor site complications (6.5%), one hematoma, and two abscesses requiring wash-out.

Conclusion: Autogenous iliac crest bone grafting is the most effective intervention in the management of persistent tibial nonunions regardless of approach. This treatment paradigm is not without risks, but has proven to be highly efficacious and remains the gold standard for complex tibial nonunions.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Figure 1. SMFA function and bothersome indices at baseline versus final follow-up based on surgical approach.



See pages 99 - 147 for financial disclosure information.

Return to Sports After Major Trauma—Fact or Fiction?
A Series of 465 Cases with a Minimum Follow-up of 10 Years

Christian D. Weber, MD[1]*; Thomas Dienstknecht, MD*[1]*; Klemens Horst, MD*[1]*;*
Magdalena J. Bader[1]*; Boris A. Zelle, MD*[2]*; Hans-Christoph Pape, MD, PhD, FACS*[1]*;*
[1]*RWTH Aachen University Medical Center, Department of Orthopedic Trauma,*
Aachen, Germany;
[2]*University of Texas, Health Science Center, San Antonio, Texas, USA*

Purpose: The aim of this study was to compare the long-term outcome after major trauma in athletes and nonathletic individuals. We hypothesized that athletes outperform non-athletes regarding rehabilitation and analyzed which injuries might impair athletes when returning to sport.

Methods: We conducted a cohort study with 637 patients at a Level I trauma center to assess the long-term outcome after severe trauma. The minimum follow-up period was 10 years. Only patients with multiple injuries and complete data sets concerning injury characteristics, treatment protocol, documented preinjury physical activity, standardized outcome scores including the Glasgow Outcome Scale (GOS), Short-Form 12-Item Health Survey (SF-12), Hannover Score for Polytrauma Outcome (HASPOC), and clinical follow-up examination were included. The population was separated into athletic (TAS ≥5) and non-athletic individuals (TAS <5) by means of Tegner Activity Scale (TAS). The return to preinjury sports participation was considered as the primary outcome parameter.

Results: The average duration of follow-up was 17 ± 5 years. We finally studied 465 trauma victims, including 207 (44.5%) athletic individuals. The average ISS was 21 points. The long-term outcome regarding quality of life measured with objective score systems was comparable for both groups (SF-12: 43.9 vs. 42.8, $P = 0.153$; HASPOC: 66.7 vs. 67, $P = 0.40$). The number of activities declined significantly in athletes. In particular knee injuries (23.9%) were identified as career-ending.

Conclusion: Decades after severe trauma, patients experience a poor outcome independent from their preinjury sporting activity. Our results demonstrate a significant posttraumatic shift from high-impact and team sports to low-impact activities. Injuries of the lower extremities, especially around the knee joint, seem to have the highest life-changing potential preventing individuals to return to their previous sporting activities.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Traumatic Proximal Tibiofibular Dislocation: A Marker of Severely Traumatized Extremities

***Greg A. Herzog, MD**; Rafael Serrano-Riera, MD; H. Claude Sagi, MD;*
Orthopaedic Trauma Service, Florida Orthopaedic Institute, Tampa, Florida, USA

Purpose: Traumatic dislocation of the proximal tibiofibular joint (PTFD) is not well documented in the literature. The purpose of this analysis is to report on the clinical implications and epidemiology of this injury.

Methods: The institutional trauma database was queried to collect skeletally mature patients with operatively treated proximal tibiofibular joint dislocations. The search included all patients treated between July 1, 2006 and December 31, 2013. To obtain our denominator, we queried the database to find all operatively treated tibial plateau and tibial shaft fractures over the same period. Patients included in this analysis had their charts and radiographs analyzed for age, sex, mechanism of injury, injury pattern, OTA classification, open fracture, compartment syndrome, vascular injury, and neurologic injury and recovery.

Results: There were 31 dislocations in 31 patients. PTFD was associated with a tibia shaft fracture in 45% (14/31) and with a tibial plateau fracture in 55% (17/31) of cases. The incidence of PTFD was 1.4% (14/1013) of operative tibial shaft fractures and 2.1% (17/803) of operative tibial plateau fractures. Patients had an open fracture associated with their PTFD in 61% (19/31) of cases. Two patients (6.5%) presented with a vascular injury that underwent a successful repair without vascular sequalae. Two different patients (6.5%) subsequently underwent an amputation for mangled extremity (one above the knee and one below the knee). In the remaining 29 patients without early amputation, the incidence of compartment syndrome was 28% (8/29) and the incidence of peroneal nerve palsy was 35% (10/29). Only 30% (3/10) of the nerve palsies clinically recovered within the observation period.

Conclusion: Traumatic PTFDs are infrequent injuries (approximately 2% of tibial fractures) that can be associated with both tibial plateau and tibial shaft fractures. However, this seemingly innocuous injury is a marker for a severely traumatized limb carrying a very high rate of compartment syndrome (28%), open fractures (61%), and peroneal nerve palsies (35%) that, for the majority, do not recover.

See pages 99 - 147 for financial disclosure information.

A Biomechanical Comparison of Transosseous Versus Anchor Technique for Patellar Tendon Repair

MAJ Joseph T. Lanzi Jr, MD*; CDT Justin Felix; MAJ Christopher J. Tucker, MD; Kenneth L. Cameron, PhD, MPH; John Rogers, PhD; LTC Brett D. Owens, MD; LTC(P) Steven J. Svoboda, MD; John A. Feagin Jr;*
West Point Sports Medicine Fellowship, Keller Army Community Hospital, West Point, New York, USA

Background/Purpose: Minimizing gap formation and maximizing the strength of patellar tendon repairs are two critical factors for the successful healing of these injuries. The purpose of this study was to compare transosseous and screw-in anchor repair techniques to determine if there were differences in gap formation and failure load of the constructs. Our primary research hypotheses were that the anchor construct would have significantly less gap formation and significantly greater load to failure.

Methods: 24 porcine specimens were randomly assigned into transosseous and 4.75-mm PEEK (polyetheretherketone) screw-in anchor repair groups. A tendon rupture was simulated by transecting the tendon at the insertion on the inferior pole of the patella. Repairs were conducted using two, No. 2 braided, nonabsorbable polyethylene-based sutures and were performed with a Krackow suture method that included 4 locking loops placed at 5-mm intervals with four strands crossing the repair site in both groups. The transosseous repairs were performed by drilling three tunnels from inferior pole to superior pole. For the anchor group, pilot holes were created to allow placement of two anchors. All tendons were mounted on a custom-made soft-tissue grip and pretensioned at a load of 175 N for 5 minutes. The repairs were then completed and each specimen was mounted on the materials testing device (MTS Insight 150kN Universal Test System with a 1-kN load cell) and was loaded for a total of 1000 cycles between 20 N and 200 N. Gap formation was measured after 1, 10, 250, 500, and 1000 cycles. Load to failure was recorded for each specimen after 1000 cycles. Independent *t*-tests were conducted to analyze the data using STATA version 10.1.

Results: 12 specimens in each group were tested to completion. Average gap formation in the transosseous group was significantly greater (5.7 mm ± 1.6) when compared to the anchor group (2.2 mm ± 1.8), $P = 0.0001$. Ultimate load to failure testing demonstrated that the average load to failure was significantly higher in the anchor group (669.9 N ± 91.8) when compared to the transosseous repair group (582.8 N ± 92.6), $P = 0.03$. The average yield point observed between the anchor (480.6 N ± 123.16) and transosseous (410.99 N ± 50.98) repair groups failed to reach significance, $P = 0.091$.

Conclusion: The results support our primary research hypotheses. Statistically significant gap formation and load to failure differences were found between the two repair techniques. Those repairs performed with 4.75-mm PEEK screw-in anchors compared to those performed with transosseous sutures demonstrated a greater failure load as well as less gap formation at the repair site. These findings suggest that the 4.75-mm screw-in anchor construct may be superior to the transosseous technique for minimizing gap formation and improving load to failure strength following surgical repair of the patellar tendon.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Fracture Mapping of the Tibial Plateau

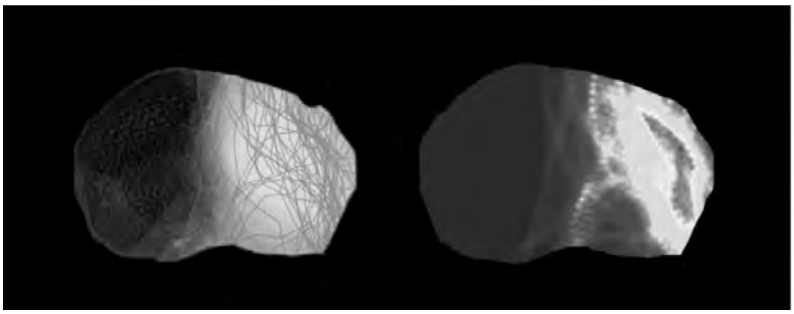
***Rik J. Molenaars, MSc**; Job N. Doornberg, MD, PhD; Jos J. Mellema, MD;*
Peter Kloen, MD, PhD;
Department of Orthopaedic Surgery, Academic Medical Center; Orthotrauma Research Center, Amsterdam, The Netherlands

Background/Purpose: To date, morphologic characteristics of tibial plateau fractures have been studied using standardized imaging techniques. Two recent studies applied a novel technique of fracture mapping to characterize pilon and scapula fractures with two-dimensional fracture mapping. Using CT, maps of fracture lines and zones of comminution were superimposed to identify major and minor fracture lines and define fracture patterns. In the current study, this novel technique is applied in a large series of tibial plateau fractures, in order to (1) visualize fracture characteristics and morphology, and (2) help define predictable tibial plateau fracture patterns.

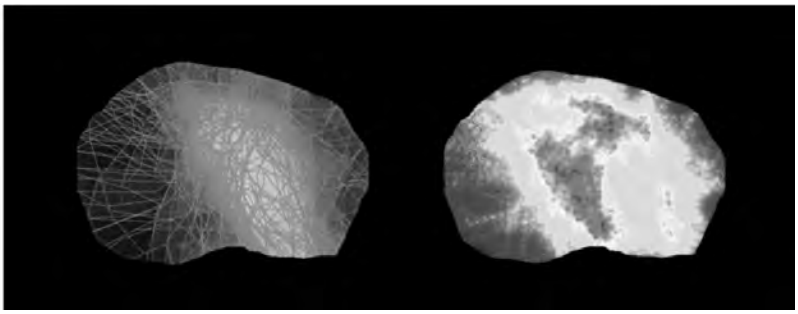
Methods: A consecutive series of 127 tibial plateau fractures were included in this study. Fractures were classified according to the Schatzker classification (type I to VI) by six observers in consensus agreement. The fracture mapping technique was used to graphically superimpose fracture lines (blue) and zones of comminution (yellow) onto an axial template CT of an intact tibial plateau, resulting in a frequency diagram based on density. First, fracture mapping was applied to well defined simple tibial plateau fracture patterns (Schatzker I to III) to create the "Simple" plateau map. Second, complex tibial plateau fractures (Schatzker IV to VI) were analyzed to create the "Complex" plateau map. MATLAB software was used to convert initial fracture maps into fracture heat maps to enhance visualization of fracture patterns. The analysis was descriptive.

Results: We included 64 simple fractures, and 63 complex fractures, in 73 females and 54 males, with an average age of 47 years (ranges, 17-91). Fractures classified as Schatzker I to III included 6 type I (4.7%), 48 type II (37.8%), and 10 type III (7.9%). Complex Schatzker IV to VI fractures included 15 type IV (11.8%), 26 type V (20.5%), and 22 type VI (17.3%). Fracture mapping of Schatzker I, II, and III type fractures resulted in predictable and reproducible patterns of fracture lines and zones of comminution, largely in accordance with Schatzker's original description. The "Complex" plateau map shows a complicated and diverse diagram of fracture lines, and zones of comminution, beyond Schatzker's original description. Descriptive analysis revealed reproducible major components of complex injury: (1) the clustering of posteromedial-oriented oblique fracture lines, supporting the importance of the "posterior column" and posterior-type shearing fractures not included in Schatzker's original classification; (2) lateral-sided depression with split fragments; and (3) clustering of "U-shaped" fracture lines of the anterior tuberosity fragment in between (1) and (2).

See pages 99 - 147 for financial disclosure information.



"Simple" plateau map (Schatzker I, II, III)



"Complex" plateau map (Schatzker IV, V, VI)

Conclusion: The "Simple" plateau map supports our current understanding of pathoanatomy and etiology: knee extension in combination with forced valgus stress results in impression of the lateral convex femur condyle into the lateral convex articular surface of the tibial plateau, leading to the "classic" Schatzker type I, II, or III fractures. The "Complex" plateau map reveals reproducible patterns of fracture lines in which the clustering of posteromedial-oriented oblique fracture lines starting from the posterior eminence is salient. Furthermore, the medial concave articular surface of the tibial plateau seems less frequently involved in complex tibial plateau fractures than the lateral articular surface. In all, the novel "Cole" fracture mapping technique of the tibial plateau offers promising new opportunities to qualify and characterize these challenging fractures.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Tibial Eminence Involvement with Tibial Plateau Fracture Leads to Slower Recovery

Sanjit R. Konda, MD*; Arthur Manoli III, BS; Roy I. Davidovitch, MD; Kenneth A. Egol, MD; NYU Hospital for Joint Diseases, New York, New York, USA*

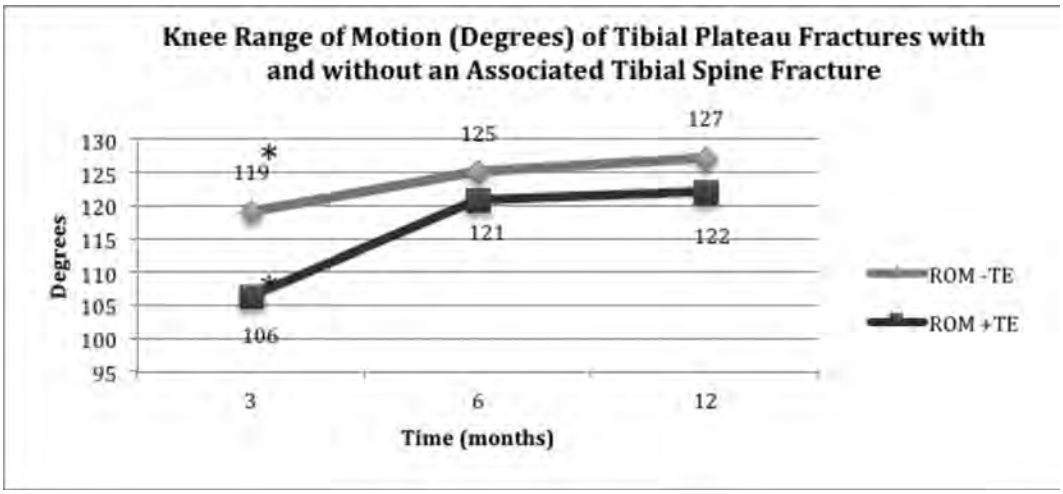
Purpose: The association between tibial eminence fractures in the setting of tibial plateau fractures is not well described in the literature. We hypothesized that tibial plateau fractures with tibial eminence fractures have worse functional outcome, knee range of motion (ROM), and pain at all time points during the postoperative period.

Methods: All patients who were treated by one of 2 trauma surgeons were identified in a prospective operative tibial plateau registry at a single institution. All patients underwent similar surgical approaches and fixation techniques for OTA 41-B and 41-C fractures. Patients were divided into tibial eminence fracture (+TE) and no tibial eminence fracture (–TE) cohorts. Demographic, injury characteristics, and fracture classifications (Schatzker [SH] and OTA) were compared between cohorts. SMFA (Short Musculoskeletal Function Assessment), pain (visual analog scale [VAS]), and knee ROM were evaluated at 3, 6, and 12 months postoperatively and also compared between cohorts.

Results: 95 patients had complete data and were included for review. The +TE and –TE cohorts were comprised of 63 (66%) and 32 (34%) patients, respectively. All patients healed at a mean of 4.1 ± 2.1 months. There was no difference in sex, gender, race, basal metabolic index, smoking, or Workers' Compensation status between the cohorts. Schatzker VI fractures had significantly more +TE versus –TE (68% vs. 32%, $P < 0.01$), whereas Schatzker II fractures had significantly fewer +TE vs. –TE (20% vs. 80%, $P < 0.01$). Overall, Schatzker VI and II fractures comprised 53% and 28% of all +TE and –TE, respectively. Patients with OTA 41-C fractures had significantly more +TE compared to 41-B fractures (57% vs. 33%, $P < 0.01$). Fibula fractures had no significant association with +TE cohort. There was no difference in complication rates or reoperation rates between the cohorts. At 3 months postoperatively, there was no difference in total SMFA or VAS scores; however, the +TE cohort was noted to have worse knee ROM (104° ± 30° vs. 117° ± 25°, $P = 0.05$). At 6 months, total SMFA was significantly worse in the +TE cohort (27 ± 17 vs. 18 ± 15, $P = 0.03$) but there was no difference in VAS or knee ROM. By 12 months postoperatively, there was no significant difference in any pain or function measure.

Conclusion: Tibial eminence fractures in the setting of tibial plateau fractures are more common in high-energy type fracture patterns (OTA 41-C and Schatzker VI) but they still occur in >25% of lateral split-depression type plateau fractures. Early (3-month) knee ROM is worse but achieves similar results to the –TE cohort by 6 months. Functional outcome improves less rapidly in the +TE cohort but achieves similar results by 1 year.

See pages 99 - 147 for financial disclosure information.



*Significant difference ($P = 0.05$).

POSTER ABSTRACTS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Management of External Fixation Devices for Staged Surgery

***Colin Crickard, MD**; Rachel Seymour, PhD; Madhav Karunakar, MD;*
Carolinas Medical Center, Charlotte, North Carolina, USA

Background/Purpose: Temporizing external fixation has been described for multiple orthopaedic trauma surgeries to provide soft-tissue stabilization and allow for reduced inflammation in patients undergoing lower extremity surgery. Multiple authors have evaluated the ability to surgically prep an external fixator with varying degrees of success. Given this difficulty with residual bacteria on the external fixator there is significant concern with prepping one into a sterile field. There is also little consensus on the appropriate timing of external fixation removal in relation to skin prep and skin incision. Our purpose was to quantify the risk of infection, defined as culture-positive wound infection requiring surgical debridement, resulting from differing timing of external fixation removal in relation to skin incision and final skin preparation.

Methods: A retrospective review of all patients enrolled in a database for complex proximal tibial fractures was performed. Inclusion criteria were defined as the presence of an OTA 41-C3 proximal tibial fracture and the placement of an external fixator for soft-tissue temporization. The primary outcome measure was soft-tissue infection requiring surgical debridement. Secondary data regarding the presence or absence of compartment syndrome, open fracture, diabetes, tobacco use, as well as the subtype of OTA 41-C3 fracture were included along with demographic data such as patient age and body mass index (BMI).

Results: 146 patients with OTA 41-C3 type proximal tibia fractures were identified. Of these patients 112 had placement of an external fixation for temporization of the soft tissues. 22 patients had incomplete data regarding the removal of external fixation and were excluded. Nine patients had retention of the external fixator after definitive surgery for various reasons and were also excluded. The remaining 81 patients comprised the data study group. Of these 81 patients, 38 had removal of the external fixator before skin incision and before the final skin preparation for surgery, defined as "pre-op". 43 patients had external fixation removed intraoperatively after skin incision for the definitive surgery, defined as "intra-op". The overall rate of infection in the "pre-op" group was 18.4% compared to 25% in the "intra-op" group. However, the difference in the rate of infection was not significant. In the "pre-op" removal group, age was associated with infection (53 years vs. 42 years, $P = 0.018$). In the "intra-op" group there was a significant association between the presence of open fracture and the risk of infection (4 vs. 1, $P = 0.011$). The mean BMI for the sample was 30 kg/m^2, the same in both groups ($P = 0.787$).

Conclusion: In this consecutive series of OTA 41-C3 tibial plateau fractures there was not a significant association with infection and timing of removal of the external fixator in relation to definitive operative fixation. Significant differences were noted within the "pre-op" and "intra-op" groups with regard to patient age and the presence of an open fracture.

See pages 99 - 147 for financial disclosure information.

Knee Arthrofibrosis Following Tibial Plateau Fracture

***Justin Haller, MD**; David Holt, MD; Molly McFadden, PhD; Thomas Higgins, MD; Erik Kubiak, MD;*
University of Utah Department of Orthopaedics, Salt Lake City, Utah, USA

Purpose: The purpose of this study is to determine the incidence and risk factors for developing arthrofibrosis following a tibial plateau fracture. Our hypothesis is that patients with high-energy tibial plateau fracture and patients who underwent spanning external fixator were at increased risk to develop arthrofibrosis, and patients who use a continuous passive motion (CPM) machine postoperatively were at reduced risk.

Methods: We retrospectively reviewed patients greater than 18 years of age who presented to our Level I trauma center with a tibial plateau fracture from 2005-2012. Patients with less than 6 months follow-up were excluded. Demographic data including age, sex, tobacco use, mechanism, and comorbidities were recorded. Fractures were grouped into low-energy (Schatzker classification I-III) and high-energy (Schatzker classification IV-VI) fracture patterns. Arthrofibrosis was defined as a patient who required either a manipulation under anesthesia (MUA) or Judet quadricepsplasty. Perioperative data including infection, surgical approach, use of spanning external fixator, and CPM use were recorded. Logistic multivariate regression model was used to predict the outcome of development of arthrofibrosis based on the following predictor variables: high- versus low-energy; CPM use; spanning external fixation; use of lateral, medial, or dual surgical approach; tobacco use; and presence of infection.

Results: Between 2005 and 2012, 404 tibial plateau fractures met inclusion criteria. 218 patients were excluded for <6 months follow-up, leaving 186 patients for the study cohort. The average patient age was 46 years (range, 19-83) and 60% were male. The average follow-up was 16 months (range, 6-80 months). 70% of patients sustained a high-energy tibial plateau fracture. A provisional external fixator was used for 98 patients (53%). The overall deep infection rate was 8.6%. 78 patients (41.9%) received a CPM machine in addition to physical therapy. There were 27 patients (14.5%) with arthrofibrosis requiring a secondary procedure (26 MUA and one quadricepsplasty). Of the 27 patients who developed arthrofibrosis, 23 patients were initially treated with a spanning external fixator (odds ratio [OR] = 4.63, 95% confidence interval [CI] 1.26-17.7, $P = 0.021$). The mean length of time in external fixation for those who developed arthrofibrosis was 12.1 days (SD ±5.9; range, 4-30 days) and for those who did not was 8.7 days (SD ±6.5; range, 1-33 days). The effect of time was found to be significant with an OR of 1.10 (95% CI 1.01-1.20, $P = 0.030$). 24 of 130 (18.5%) patients with high-energy plateau fracture developed arthrofibrosis. High-energy fracture and external fixation were highly associated (c^2, 1 df = 51.9, $P < 0.001$). Logistic regression modeling using all previously mentioned variables, with the exception external fixation, demonstrated that high-energy injury was not significantly associated with arthrofibrosis (OR = 2.44, 95% CI 0.47-12.7, $P = 0.29$). Surgical approach, infection, and tobacco use were not associated with increased development of arthrofibrosis. Similar analysis demonstrated that CPM use postoperatively was associated with significantly less arthrofibrosis (OR = 0.32, $P = 0.024$). Postoperative CPM use in patients with external fixation was significantly associated with less arthrofibrosis (OR = 0.3, $P = 0.011$).

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Conclusion: The incidence of arthrofibrosis following tibial plateau fracture was 14.5%. Provisional spanning external fixator was independently associated with increased development of arthrofibrosis. For each extra day of external fixation, the odds of developing arthrofibrosis increased by 10%. High-energy injury, surgical approach, infection, and tobacco use were not associated with the development of arthrofibrosis. Postoperative use of a CPM may decrease the risk of developing arthrofibrosis following tibial plateau fracture, especially in patients who undergo provisional spanning external fixation.

See pages 99 - 147 for financial disclosure information.

Risk Factors for Infection in Tibia Plateaus with Compartment Syndrome

Brian Etier, MD; Emily Keener, DO; ***Jason Lowe, MD****;*
University of Alabama at Birmingham, Birmingham, Alabama, USA

Background/Purpose: Infection is a known complication following surgical fixation of tibia plateau fractures with compartment syndrome. Factors leading to subsequent infection are not well defined. This study evaluated injury, patient, and treatment factors that contribute to infection. The hypotheses are: patient factors (diabetes, tobacco use, body mass index [BMI]), increasing fracture severity (Shatzker IV, V, and VI), and operative fixation through fasciotomy incisions positively correlate with postoperative infection.

Methods: Review of 925 tibia plateau fractures over a 12-year period revealed 42 tibia plateau fractures with concomitant compartment syndrome (4.5%). Patient factors, fracture patterns, and surgical treatment were reviewed. Superficial infection was defined as the use of antibiotics and local wound care. Deep infection was defined as culture-positive infection requiring surgical irrigation and debridement. Discrete predictors for infection were examined using Fisher's exact test; continuous predictors (age and BMI) were examined using *t*-tests. All other continuous variables were analyzed with the Mann Whitney *U*. A *P* value <0.05 was statistically significant.

Results: Overall incidence of superficial and deep infections was 38% and 21%, respectively. When incorporating the fasciotomy and operative incision, 10/12 (83%) patients developed a superficial or deep infection. Infection developed in 6/21 (28.6%) patients with fixation through a separate incision ($P = 0.003$). Diabetes tended toward deep infection (57% with diabetes vs. 15% without diabetes; $P = 0.080$). Low Schatzker scores (I, II, or III) tended toward superficial infection when compared to high Schatzker scores (IV, V, or VI) (80% vs. 32%, $P = 0.06$). Low Schatzker scores also tended toward deep infections when compared to high Schatzker scores (60% vs. 16%, $P = 0.057$).

Conclusion: Fasciotomy incision into an exposure for operative fixation is the only treatment factor that statistically increases the risk of postoperative infection. Separate surgical incisions should be utilized. Diabetic patients and low Schatzker fracture severity patterns tended toward an increase in postoperative infections.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Extensor Mechanism Injuries of the Knee: Patient Demographics and Comorbidities

Matthew R. Garner, MD*; Elizabeth B. Gausden, MD; Marschall B. Berkes, MD;*
Amelia Ni, BA; Dean G. Lorich, MD;
Hospital for Special Surgery, New York, New York, USA
New York Presbyterian Hospital, New York, New York, USA

Purpose: Extensor mechanism injuries, defined as quadriceps rupture, patella fracture, or patellar tendon rupture, are common injuries. The purpose of this study was to describe and compare extensor mechanism injuries with regard to age, gender, comorbidities, and body mass index (BMI).

Methods: Patients greater than 16 years of age undergoing surgical management of extensor mechanism injuries were queried at two separate institutions from 1986-2012. Charts were reviewed retrospectively for age at time of surgery, gender, height, and weight. Patients with chronic disruptions of the quadriceps or patellar tendon, those undergoing revision surgery, and injuries in the setting of total knee arthroplasty were excluded. Continuous data was analyzed with one-way analysis of variance (ANOVA) and two-tailed *t*-test; categorical data were analyzed with χ^2 test.

Results: 750 patients were included: 427 (57%) patella fractures, 222 (29.5%) quadriceps ruptures, and 101(13.5%) patellar tendon ruptures. 67% of all patella fractures were in females while 86% of quadriceps ruptures and 84% of patella tendon ruptures occurred in men ($P < 0.001$). Females were 12.7 times more likely to sustain a patella fracture rather than a tendon injury compared to men. Age distribution was also significantly different between the groups with quadriceps tendon ruptures averaging 61.1 ± 12.8 years (range, 20-92), patella fractures averaging 56.3 ± 17.4 years (16-91), and patellar tendons averaging 41.1 ± 14.0 years (18-80). Patella fractures showed a bimodal distribution with regard to both age and gender, with the median age of females being 62 years (range, 16-91) and the median age of males being 47 years (16-91), $P < 0.001$. BMI was also noted to vary significantly between the three groups with patella fractures averaging 24.9 ± 5.12 km/m^2, patellar tendon ruptures averaging 28.4 ± 5.5 km/m^2, and quadriceps tendons averaging 30.1 ± 6.57 km/m^2 ($P < 0.001$). Of the female patients sustaining soft-tissue injuries (4 patellar tendon, 19 quadriceps rupture), all but one had an underlying comorbidity, including 8 (35%) with hypertension, 5 (21.7%) with end stage renal disease, 3 (13%) with a thyroid disorder and 2 (8.7%) with sarcoidosis.

Conclusion: This series represents the largest series of extensor mechanism injuries in the literature and reveals striking demographic patterns. Our females with extensor mechanism injuries are more likely to be older and to sustain patella fractures, which is likely secondary to osteoporosis. These patients also tend to be thinner that non-fracture patients. Young males are more likely to sustain patellar tendon ruptures or patella fractures while older males are more likely to have the diagnosis of a quadriceps rupture. In female patients with patellar tendon or quadriceps tendon rupture, treating surgeons should have a high suspicion for underlying medical comorbidities.

See pages 99 - 147 for financial disclosure information.

The Hyperextension Varus Bicondylar Tibial Plateau Fracture

Reza Firoozabadi, MD, MA[1]*; Jason S. Schneidkraut, MD*[2]*;*
Daphne M. Beingessner, MD, FRCS(C)[1]*; Robert P. Dunbar, MD*[1]*;*
David P. Barei, MD, FRCS(C)[1]*;*
[1]*Harborview Medical Center, Seattle, Washington, USA;*
[2]*Elite Orthopaedics and Sports Medicine, Wayne, New Jersey, USA*

Purpose: Classification systems used to identify tibial plateau fracture have been developed to help recognize common injury patterns and help guide treatment as well provide a means to perform research. The authors have identified a certain subset of tibial plateau fractures—hyperextension varus bicondylar tibial plateau fractures. The primary aim of this study was to describe this specific fracture pattern and associated soft-tissue injuries that can accompany this injury.

Methods: A retrospective review of prospectively gathered data at a regional Level I orthopaedic trauma center was performed to identify patients who had bicondylar tibial plateau fractures (OTA 41C). Preoperative radiographs and CT scans were reviewed to identify patients sustaining bicondylar tibial plateau fractures with combined hyperextension and varus displacement patterns. Specifically, sagittal plane imaging was assessed for osseous compression failure of the proximal tibia anteriorly and tension failure posteriorly, with loss of normal posterior slope of the proximal tibial articular surface. Coronal plane imaging was assessed for a medial articular injury and an apex lateral or varus coronal plane deformity. Patients were included if they had the above-stated deformity on both planes.

Results: 212 bicondylar tibial plateau fractures were identified in 208 patients during the study period (May 2000-August 2010). 25 fractures in 23 patients satisfied the radiographic criteria described above and formed the study population, with an average age of 58 years. The remaining185 patients with 187 fractures who had non-varus hyperextension bicondylar tibial plateau fractures were an average age of 41 years. Mechanisms of injury included: 6 falls from standing, 5 falls from height, 11 involved motorized vehicles. Three patients were lost to follow-up. 32% of the fractures (8/25) demonstrated significant associated injuries. Three patients (13%) had a popliteal artery disruption that required repair. Four patients (17%) had an either partial or complete peroneal nerve injury. Three patients (13%) developed leg compartmental syndrome that required emergent four-compartment fasciotomies.

Conclusion: The hyperextension varus bicondylar tibial plateau is a unique fracture. Low-energy trauma can cause this fracture pattern and the associated injuries can be devastating. Specifically, the relatively high rate of popliteal artery disruption, which can result in limb loss if not identified.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Does Age Affect Functional Recovery Following Surgical Management of Tibial Plateau Fractures?

Arthur Manoli III, BS[1] Christina Capriccioso, BSE[1]; Sanjit R. Konda, MD[1,2];
Kenneth A. Egol, MD[1,2];
[1]NYU Hospital for Joint Diseases, New York, New York, USA;
[2]Jamaica Medical Center, Jamaica, New York, USA

Purpose: Tibial plateau fractures occur most frequently in middle-aged adults, with younger patients typically being men with high-energy mechanisms and older patients typically being females with lower-energy mechanisms. The purpose of this study is to examine how age affects functional recovery following surgical management of tibial plateau fractures.

Methods: 163 tibial plateau fractures (from 161patients) operated on by two surgeons at one academic medical center were included in this study. Patients were available for an average of 16 months of follow-up. Clinical and functional outcomes at the latest follow-up were retrospectively assessed via prospectively collected Short Musculoskeletal Function Assessment (SMFA) scores, pain levels, range of motion, and radiographic assessments. Linear regression analysis was used to analyze the effect of age (independent variable) on time to healing, postoperative range of motion, and SMFA scores (dependent variables). Logistic regression was used to assess the predictive capacity of age for complications and reoperations. Multivariate linear regression, controlling for preinjury SMFA scores, was then used to confirm all significant univariate SMFA findings.

Results: At the latest follow-up, age was not a significant predictor of time to healing (P = 0.154), range of motion (flexion P = 0.110, extension P = 0.064), visual analog scale (VAS) pain score (P = 0.061), complications (P = 0.635), or reoperations (P = 0.354). Age was found to be a significant predictor of increased (poorer functional outcome) total SMFA scores at the latest follow-up (β = 0.28, 95% confidence interval [CI] = 0.081-0.474, P = 0.006). However, while a significant predictor, age was only able to explain 5% of the variability in total SMFA scores. The strongest correlation within the individual SMFA subdomains was with the activities of daily living (ADL) subdomain (β = 0.46, 95% CI = 0.179-0.739, P = 0.001), where for every 10 years in age, SMFA ADL subdomain scores increased by 4.6 points (mean score at latest follow-up = 27.75 ± 26.52). Both the functional and bothersome subdomains were also significantly elevated at the latest followup. Only the emotional subdomain showed no significant association with age. Multivariate analysis confirmed the significance of all univariate findings.

Conclusion: While age is not a significant predictor of time to healing, postoperative range of motion, VAS pain scores, complications, or reoperations, it is associated with poorer clinical assessment scores that cannot be explained by preinjury functional status. While mild overall, the deficit appears to disproportionately affect patients' activities of daily living. Regardless of the impact, there is no evidence that older patients' injuries affect their emotional well-being any differently than younger patients with similar injuries.

See pages 99 - 147 for financial disclosure information.

Spinal Anesthesia Improves Early Functional Scores and Pain Levels Following Surgical Treatment of Tibial Plateau Fractures

Arthur Manoli III, BS[1]; Germaine Cuff, PhD[1]; Arthur Atchabahian, MD[1]; Roy I. Davidovitch, MD[1]; ***Kenneth A. Egol, MD[1,2]****;*
[1]NYU Hospital for Joint Diseases; New York, New York, USA;
[2]Jamaica Hospital Medical Center, Jamaica, New York, USA

Purpose: Data suggest that the use of regional anesthesia improves early clinical outcomes and pain levels in surgically managed ankle and wrist fractures. This study seeks to determine the effect of spinal anesthesia (SA) on clinical outcomes when compared to general anesthesia (GA) in operatively managed tibial plateau fractures.

Methods: Over 8 years, all operative tibial plateau fractures treated by two surgeons at a single institution were prospectively followed. Overall, 113 patients with a minimum of 12 months follow-up were identified for this study. Of these, 30 received SA and 83 received GA in a nonrandomized fashion. All patients were treated using a similar operative protocol. All patients were kept non–weight bearing postoperatively for a minimum of 10 weeks and were prescribed a similar physiotherapy regimen. Clinical outcomes were compared at 3 months, 6 months, and the latest follow-up (average 19.3 months). These outcomes include Short Musculoskeletal Function Assessment (SMFA) scores, pain levels, complications, and reoperations. Student *t*-tests and χ^2 tests were used to assess crude differences between the groups. Multivariate linear regression was used to confirm univariate differences in SMFA and pain scores by controlling for gender, age, race, Charlson comorbidity index (CCI), injury energy level, Workers' Compensation status, and residual plateau depression following operative management.

Results: Gender distribution was nonuniform, with men comprising 57% of GA and 35% of SA ($P = 0.040$). Additionally, race distribution was nonuniform with whites comprising 76% of SA but only 34% of GA ($P < 0.01$). High-velocity (HV) injuries were more likely to have occurred in those receiving GA (65%) versus those receiving SA (38%). There was one case of compartment syndrome in the GA group. No other differences were significant. Using univariate analysis, SMFA scores were significantly improved at 6 months in SA versus GA patients, which was confirmed using multivariate analysis ($\beta = -1.14$, 95% confidence interval [CI] = –2.06 to –0.23, $P = 0.015$). Additionally, using univariate analysis, pain scores were significantly lower in SA versus GA at 6 months ($P = 0.004$) and at the latest follow-up ($P = 0.012$). After controlling for group differences, however, pain scores were found to be lower in SA versus GA at 3 months ($\beta = -0.16$, 95% CI = –0.24 to 2.02, $P = 0.048$), but not at 6 months or the latest follow-up. Multivariate analysis revealed that the odds of a patient who received GA reporting a higher pain score at 3 months was 3.1 times (95% CI, 1.06 to 9.26, $P = 0.039$) that of patients receiving SA. At the latest follow-up, Caucasian race ($P = 0.02$) was the only predictor of improved outcome while a history of smoking ($P = 0.041$), advanced age ($P = 0.003$), and higher CCI ($P = 0.015$) were predictors of worse outcome. Anesthesia type was not a significant predictor of complications or reoperations.

Conclusion: In patients who undergo surgical management of a tibial plateau fracture, the use of spinal anesthesia is associated with improved functional scores and decreased pain levels up to 6 months postoperatively.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

An Anatomical Study of the Greater Trochanter Starting Point for Intramedullary Nailing

Kathleen Farhang, BS[1]; Ronak Desai, MD[1]; John H. Wilber, MD[1]; Daniel R. Cooperman, MD[2]; ***Raymond W. Liu, MD[1]****;*
[1]*Case Western Reserve University, Cleveland, Ohio, USA;*
[2]*Yale University, New Haven, Connecticut, USA*

Purpose: Intramedullary nail insertion through a greater trochanter starting point has been increasing in popularity. Although the optimal position for insertion in the coronal plane has been well characterized, sagittal plane insertion position is poorly defined.

Methods: 744 paired femora from well-preserved cadavers were placed both in a neutral apparent neck-shaft angle (ANSA) position, and with internal rotation to neutralize femoral anteversion in a true neck-shaft angle (TNSA) position. A marker was placed at the apex of the greater trochanter from the anterior viewpoint to simulate placement of a guidewire at the tip of the trochanter. The perpendicular distance between the marker and the center of the intramedullary canal was measured on AP and lateral images. The angle of anteversion was measured between the bicondylar plane and femoral neck. In a subset of 276 femora, the greater trochanter morphology was graded into 4 groups: anterior lean, posterior lean, centered, and flat. Multivariate Pearson product-moment correlation analysis was performed to determine the influence of morphological variance and anteversion on the accuracy of using the greater trochanteric apex as a starting point for intramedullary nail insertion.

Results: Mean age was 56 ± 11 years. In the sagittal plane, mean anterior displacement of the trochanteric apex was 5.0 ± 4.1 mm and 4.6 ± 4.2 mm relative to the intramedullary canal for the ANSA and TNSA positions, respectively ($P < 0.0005$). In the coronal plane, mean lateral displacement of the apex was 7.1 ± 4.6 mm for the ANSA view and 6.4 ± 4.6 mm for the TNSA view ($P < 0.0005$). In both the ANSA and TNSA views, there was a weakly positive association between anterior lean morphology and anterior displacement ($r = 0.156$, $P < 0.05$; $r = 0.173$, $P < 0.01$) and between flat morphology and lateral displacement ($r = 0.172$, $P < 0.01$; $r = 0.141$, $P < 0.05$). Anteversion negatively correlated with anterior displacement weakly in both ANSA and TNSA views ($r = –0.084$, $P < 0.05$; $r = –0.150$, $P < 0.01$).

Conclusion: The apex of the greater trochanter is lateral and anterior relative to the intramedullary canal, and the magnitude of lateral and anterior displacement is minimally changed when the femur is internally rotated. Trochanteric intramedullary nails are designed to compensate for lateral displacement of the greater trochanteric apex, but not for anterior displacement. Based on these data, intramedullary nail insertion sites should be about 5 mm posterior to the trochanteric apex to account for its anterior positioning.

See pages 99 - 147 for financial disclosure information.

"Length-Stable" Fully Threaded Screw Fixation of Femoral Neck Fractures: Does it Work?

Adam Sassoon, MD*; Casey deDeugd, BS; Joshua Langford, MD; Kenneth Koval, MD; George Haidukewych, MD;*
Orlando Regional Medical Center, Orlando, Florida, USA

Background/Purpose: An alternate technique of femoral neck fracture fixation with cannulated screws has emerged that utilizes a combination of both partially and fully threaded implants, the rationale for this combination being that once intraoperative compression at the fracture site is achieved initially with partially threaded screws, additional fully threaded screws will provide length-stable fixation and prevent collapse or shear through zones of comminution. This study investigates the clinical efficacy of this "length-stable" hybrid fixation construct compared to traditional methods using only partially threaded screws for compression.

Methods: Following IRB approval, patients undergoing cannulated screw fixation for femoral neck fractures between 2008 and 2012 were identified using our trauma registry. Patients were followed until bony union, failure, death, or for a minimum of 3 months. Patient age, gender, tobacco use, body mass index, and medical comorbidities were noted. Injury-related variables including mechanism, Garden classification, Pauwels angle, and associated injuries were recorded. Finally, treatment-related factors including time until surgical treatment, the need for open reduction, fixation construct, and reduction quality were assessed. Univariate analysis using a Cox proportional hazard model was used to determine relative risk of fixation type with the need for revision. Univariate logistical regression was used to determine an association between fixation type and postoperative pain and ambulation status as well.

Results: 265 femoral neck fractures were treated at our institution between 2008-2012. Of these, 72 were treated with cannulated screws in patients with a mean age of 65 years (range, 18-91). In 55 instances only partially threaded screws were employed, while 17 utilized a "length-stable" construct, using a combination of partially and fully threaded screws. 21 patients in the partially threaded group and 4 patients in the "length-stable" group were lost to follow-up, leaving 34 and 13 patients in each group, respectively, available for further retrospective review. Four patients (12%) in the partially threaded group developed a failure requiring revision to a total hip arthroplasty in 3 and a revision of fixation in 1. Five patients (38%) in the "length-stable" group developed a mechanical failure, all of whom required conversion to a total hip arthroplasty. Length-stable fixation was associated with a fourfold risk of revision when compared to standard fixation ($P = 0.04$). Length-stable fixation was also associated with increased postoperative pain ($P = 0.001$) and a need for ambulatory assistance ($P < 0.001$).

Conclusion: The addition of fully threaded screws to achieve a "length-stable" construct for the fixation of femoral neck fractures led to a significantly increased risk for revision when compared to traditional cannulated screw constructs. It is possible that length-stable constructs were selectively chosen for more unstable fracture patterns; however, this study demonstrates that adding fully threaded screws in such situations did not improve outcomes. We have abandoned this technique based on these data.

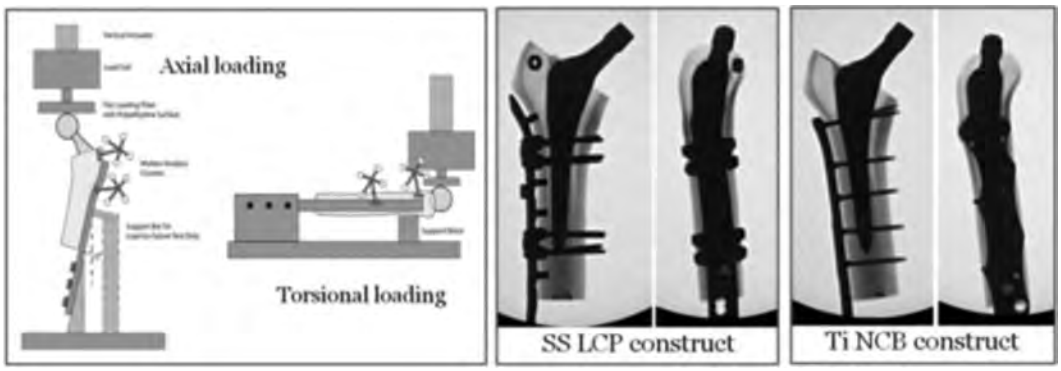
- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Tangential Bicortical Locked Fixation Techniques Give Improved Stability for Fixation of Vancouver B1 Periprosthetic Femur Fractures

Gregory S. Lewis, PhD[1]; Michele Bramer, MD[2]; Cyrus Caroom, MD[3]; Hwa Bok Wee, PhD[1]; Darin Jurgensmeier, MD[1]; Shane Rothermel, BS[1]; Samuel McArthur, MD[1];
J. Spence Reid, MD[1];
[1]Penn State University College of Medicine, Hershey, Pennsylvania, USA;
[2]West Virginia University College of Medicine, Morgantown, West Virginia, USA;
[3]Texas Tech University College of Medicine, Lubbock, Texas, USA

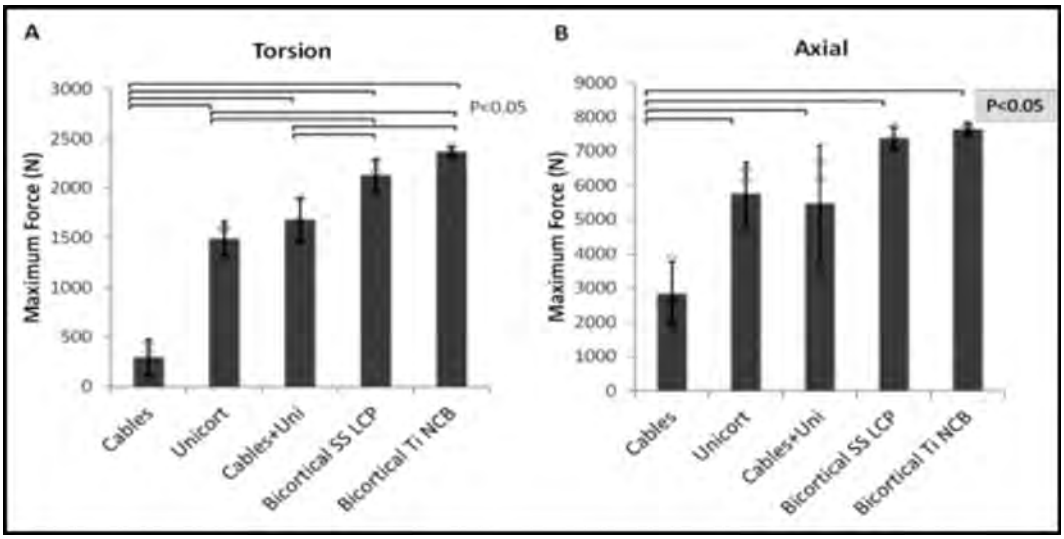
Purpose: The biomechanical difficulty in fixation of a Vancouver B1 periprosthetic fracture is purchase of the proximal femoral segment in the presence of the hip stem with or without a cement mantle. Several newer technologies have addressed this by providing the ability to place bicortical locking screws tangential to the hip stem with much longer lengths of screw purchase compared to unicortical screws (Synthes SS LCP, Zimmer Ti NCB). This study compares the stability of these newer constructs with previous methods (cables, unicortical screws, cables + unicortical screws) in a modern composite synthetic bone model.

Methods: 5 testing groups were created with each group containing 3 specimens (15 torsion, 15 axial). A Zimmer APS (size 5) prosthesis was cemented using a custom jig and vacuum cement techniques. The method of Zdero et al was modified to remove the distal femur segment and mount the distal plate directly on the testing apparatus mimicking a segmental defect. Specimens were loaded to failure in torsion and axial modes.



See pages 99 - 147 for financial disclosure information.

Results:



Conclusion: The addition of unicortical screws to a cable construct significantly improved load to failure. Both of the newer plate constructs incorporating bicortical tangential locked screws displayed significantly higher torsional load to failure (with trends toward higher axial load to failure) compared to the unicortical screw and cable constructs, and cables were inferior to other constructs in both loading modes. Fixation stability of the proximal segment of a Vancouver B1 fracture is significantly improved with the use of tangentially directed bicortical locking screws.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

ΔExtramedullary Versus Intramedullary Implants for Intertrochanteric Hip Fractures: 30-Day Outcomes Among 4432 Cases from the ACS-NSQIP Database

Daniel D. Bohl, MPH*; Bryce A. Basques, BS; Nicholas S. Golinvaux, BA; Christopher P. Miller, MD; Michael R. Baumgaertner, MD; Jonathan N. Grauer, MD; Yale School of Medicine, New Haven, Connecticut, USA*

Background/Purpose: For more than 35 years, the sliding hip screw, an extramedullary (EM) implant, has been the "gold standard" for stabilization of intertrochanteric fractures. However, over the last decade, intramedullary (IM) implants have surpassed EM implants as the most commonly used type of implant in the United States. This change in surgical practice has occurred without strong evidence of superior outcomes. The purpose of this study is to use a large national database to evaluate for differences in general surgical adverse event rates and other perioperative and postoperative outcomes between treatment of intertrochanteric hip fractures treated with EM and IM implants.

Methods: A retrospective cohort study was conducted using the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database. Patients over 70 years old with intertrochanteric fractures that were treated with EM or IM implants during 2009-2012 were identified. Outcomes were compared between implant types with adjustment for demographics and comorbidities.

Results: A total of 4432 patients were identified, of whom 1612 (36.4%) were treated with EM implants and 2820 (63.6%) were treated with IM implants. Demographics and comorbidities did not differ by implant type. The rates of "serious adverse events" and "any adverse events" did not differ by implant type. Postoperative length of stay was shorter with IM than EM implants (5.4 vs. 6.5 days; $P < 0.001$; Figure 1). Operation time, operating room time, and the rate of hospital readmission did not differ by implant type.

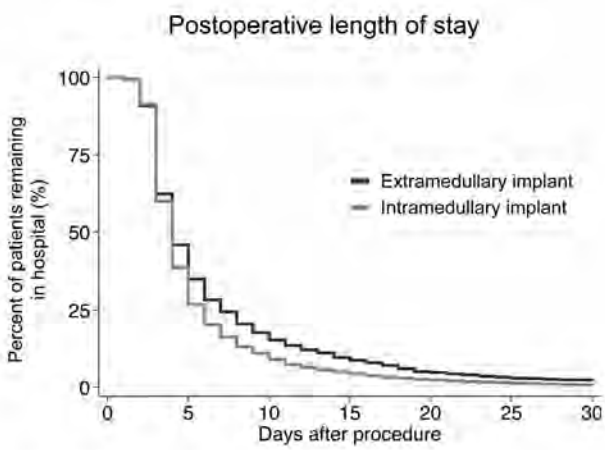


Figure 1

Conclusion: These results reinforce the results of randomized trials, demonstrating little difference in rates of general surgical adverse events between implant types. Due to its much larger sample size and nationally representative sample, this study presents an important departure from the trials in its finding that patients treated with IM implants have on average a shorter postoperative length of stay (by 1.1 days). The finding has significant implications, as it may negate or reverse the excess cost perceived to be associated with IM treatment.

Δ OTA Grant

See pages 99 - 147 for financial disclosure information.

Garden 1 and 2 Femoral Neck Fractures Collapse More Than Expected After CRPP

Paul Tornetta III, MD[1]*; Michael Kain, MD*[2]*; Andrew Marcantonio, MD*[2]*; Patrick Cronin*[1]*;*
[1]*Boston University Medical Center, Boston, Massachusetts, USA;*
[2]*Lahey Medical Center, Burlington, Massachusetts, USA*

Background/Purpose: The outcome of CRPP (closed reduction and percutaneous pinning) of the femoral neck has been widely reported and shortening has been correlated with outcome. However, most reports are of displaced femoral neck fractures and little is known about the degree of shortening seen in minimally displaced and valgus impacted fractures. Most surgeons believe that these fractures are relatively stable and that shortening is not significant. The purpose of this study is to report on the final displacement after CRPP for Garden type 1 and 2 fractures in height, neck shortening, and loss of lever arm.

Methods: We reviewed the charts and radiographs of all patients with Garden 1 and 2 fractures seen at two hospitals over an 8-year period based on a prospective database of orthopaedic fractures. All initial radiographs were reclassified by a senior trauma attending prior to inclusion. Fractures with any varus were excluded. Garden 1 fractures were incomplete or valgus impacted with minimal angulation on the lateral radiograph. Fractures were considered Garden 2 if they were not displaced but had some angulation on the lateral radiograph. No fracture was displaced. Only patients with clearly united fractures were included; any patient who failed management or was not followed to unequivocal union was excluded. All fractures were fixed with an inverted triangle with attempts to place a screw close to the calcar and get wide spread, and all cases had screws in 3 quadrants. Screws were either 8.0 mm or 6.5 mm depending on the size of the patient. Radiographs were evaluated using a previously published method (Zlowodzki et al). The amount of displacement in millimeters was determined using the known screw width as a baseline for actual size. The final position at union was evaluated for femoral height, femoral neck shortening, and change in lever arm.

Results: A total of 115 patients (72 F, 43 M), average age 75 years, sustained 69 Garden 1 and 46 Garden 2 femoral neck fractures. Maximal shortening occurred in the plane of the femoral neck. Garden 2 fractures demonstrated more shortening than did Garden 1 fractures; however, both averaged ≥1 cm of femoral neck shortening. The results in all three planes are seen in Table 1. The range of displacements was 0 mm to 39 mm as measured along the femoral neck. 28/69 (41%) of Garden 1 and 27/46 (59%) of Garden 2 fractures demonstrated ≥10 mm of neck shortening.

Table 1. Shortening in Millimeters

	Femoral Neck	Femoral Height	Offset
Garden 1 (69)	10 ± 6 mm	3 ± 4 mm	10 ± 7 mm
Garden 2 (46)	13 ± 8 mm	6 ± 7 mm	10 ± 9 mm
P value	0.032	0.026	0.97

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Conclusion: It has been widely believed that CRPP of minimally displaced or impacted femoral neck fractures heal with minimal displacement. This was not seen in our series, with 41% and 59% of Garden 1 and 2 fractures demonstrating at least 1 cm of neck shortening, which has been linked to worse outcomes in previous trials. In conclusion, Garden 1 fractures shorten less than Garden 2 fractures, but both have high rates of shortening when treated to union with CRPP.

See pages 99 - 147 for financial disclosure information.

Dynamic Locked Screws Versus Conventional Locked Screws in Comminuted Distal Femur Fractures: A Matched Cohort Study

Steven M. Cherney, MD*; Michael J. Gardner, MD; Amanda Spraggs-Hughes, MA; William M. Ricci, MD; Christopher M. McAndrew, MD;*
Orthopaedic Trauma Service, Washington University School of Medicine, St Louis, Missouri, USA

Background/Purpose: Locked bridge plating of comminuted supracondylar femur fractures has become extremely common. Despite promising results of early series, reports have demonstrated nonunion rates between 10% and 20%. Construct stiffness and eccentric plate positioning likely contribute to insufficient and asymmetric fracture site motion. A newer concept of "dynamic" locked screws, which allow for motion within the screw shaft, has been proposed to provide an improved mechanical environment for callus formation. Our hypothesis was that dynamic locked plating constructs allow for greater callus formation and higher union rates than standard locked plating constructs.

Methods: 34 patients with comminuted supracondylar femur fractures amenable to bridge plating technique were treated with locked plating between August 2011 and August 2013. Based on surgeon preference and implant availability, the patients were treated either with standard locking screws (SLS) or dynamic locking screws (DLS; Synthes, Paoli, PA) for proximal plate fixation. 17 patients were treated with DLS and 17 with SLS. Subjects in the DLS and SLS groups were matched post hoc based on working length (within 1 hole) and injury type (OTA classification). 24 subjects (12 pairs) were matched using these criteria. Three patients lost to follow-up and one patient who expired were excluded from the DLS group. In the SLS group, one patient lost to follow-up and one patient treated with membrane induction technique were excluded. Of the remaining 28 patients (average age 66.8 years; range, 27-98), 7 sustained high-energy mechanisms and 21 sustained falls from standing height. The groups did not differ in age, gender, mechanism, smoking status, diabetic status, open/closed fracture, or a history of ipsilateral knee arthroplasty ($P > 0.05$). Routine clinical and radiographic examinations were evaluated. Painless weight bearing and radiographic bridging of 3 cortices defined fracture union. Three observers, blinded to fixation type, made callus measurements on a 4-point ordinal scale (none, minimal, moderate, robust). Intraclass correlation was used to measure interobserver agreement. Radiographic callus analysis was performed between 12 and 18 weeks postoperatively. Coronal and sagittal plane alignment was measured on the immediate postoperative and final radiographs. Student *t* and Mann-Whitney *U* tests were used to analyze continuous and ordinal data between groups. Paired *t*, Wilcoxon signed ranks, and McNemar's tests were used to analyze pairs.

Results: Intraclass correlation analysis showed excellent agreement among observers in both consistency (0.83) and absolute score (0.83). The mean callus score was 1.92 for DLS and 1.49 for SLS ($P = 0.21$). In the DLS group, one subject had delayed healing (union at 11 months) and one subject had failure of distal fixation. The SLS group had one nonunion with failure across the working length, and three had distal fixation failure. No difference in nonunion rate was seen between groups ($P = 0.32$). Coronal (3.3° vs. 4.7°, $P = 0.49$) and sagittal (5.4° vs. 3.0°, $P = 0.08$) plane alignment change were not different between the DLS

POSTER ABSTRACTS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

and SLS groups, respectively. The DLS group tended toward higher callus ranks, but these findings were not significant in group ($P = 0.23$) and matched pairs ($P = 0.56$) testing.

Conclusion: Recent data demonstrate high nonunion rates for locked plating of supracondylar femur fractures. This has been attributed to overly stiff constructs and eccentric fixation. Novel screw technologies are available that allow for increased axial motion, particularly at the near cortex. This technique appears to be safe. However, we are unable to demonstrate a difference in callus formation and nonunion rates compared with standard locked plating.

See pages 99 - 147 for financial disclosure information.

Symptomatic Atypical Femoral Fractures Are Related to Underlying Hip Geometry

David P. Taormina, MS[1]; Alejandro I. Marcano, MD[1]; Raj Karia, MPH[1]; Kenneth A. Egol, MD[1,2]; ***Nirmal C. Tejwani, MD[1];***
[1]*NYU Hospital for Joint Diseases, New York, New York, USA;*
[2]*Jamaica Hospital Medical Center, Jamaica, New York, USA*

Background/Purpose: The objective of this study was to characterize the prefracture proximal femur and hip geometry of a chronic bisphosphonate user group that developed either incomplete or complete atypical femur fractures and to compare the bony anatomy of these patients with two demographically similar patient groups: chronic bisphosphonate users who never developed symptoms and a group of patients who sustained displaced hip fracture. We hypothesized that the preinjury femoral neck-shaft geometry of ultimately symptomatic users would be more varus with greater hip-axis length than comparative groups.

Methods: 53 chronic bisphosphonate users who sustained complete or incomplete atypical femoral fracture ("Atypical Fracture Patients" [AFPs]) were treated between 2004 and 2013 at one institution and a chart review was performed to procure bilateral radiographs captured pre-lesion. Radiographic measurements, using standardized published techniques, were made for neck-shaft angle (NSA), hip axis length (HAL), and center-edge (CE) angle. Radiographic measurements of the AFP group were compared with: (1) asymptomatic chronic bisphosphonate users enrolled in an independent research registry at the same institution ("No Fracture Patients" [NFPs]), and (2) patients who presented to our institution after sustaining displaced intertrochanteric hip fracture (ITF). Reliability of NSA and HAL measurements were compared using three trained independent raters using a random sampling of 30 radiographs.

Results: Radiographs of 53 AFPs were retrieved and compared with 43 NFPs and 64 ITF patients. The radiographic measures and main demographic data are presented in the table. The age and gender of the bisphosphonate groups were similar, but incongruous with the ITF group ($P < 0.001$ and $P < 0.01$, respectively). Duration of bisphosphonate use did not statistically differ between groups (7.9 ± 3.5 vs. 7.7 ± 3.3 years, $P = 0.7$). Regression analysis revealed associations between neck-shaft angle (odds ratio [OR] = 0.89, 95% confidence interval [CI] = 0.81-0.97; $P = 0.01$) and body mass index (BMI) (OR = 1.15, 95% CI =1.02-1.31; $P = 0.03$) with fracture development. Receiver operating characteristic curve analysis determined that a cut-off point for NSA <128.3° yielded 69% sensitivity and 63% specificity for development of atypical femoral fracture. Comparison of radiographic measurements between reviewers revealed a high degree of reliability (NSA ICC [intraclass correlation coefficient] = 0.98, $P < 0.001$; HAL ICC = 0.99; $P < 0.001$).

	Patients #	Age(yrs)*	%Female*	Height(in.)	BMI	NSA(°)*	Hip-Axis(mm.)*	CE Angle(°)*
AFP	53	69.5 [10.1]	96.2	62.6 [3.5]	25.8 [6.7]	126.4 [6.6]	120.3 [11.7]	42.6 [6.2]
NFP	43	68.8 [10.3]	90.7	63.1 [3.1]	23.8 [3.3]	130.3 [5.8]	127.3 [12.4]	45.1 [4.8]
ITF	64	79.9 [12.3]	78.1	63.1[4.0]	24.9 [5.1]	131.1 [5.6]	128.2 [13.4]	45.8 [5.0]

*p≤0.05

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Conclusion: Differences in proximal femur anatomy may explain predisposition for the development of bony changes and symptoms in chronic bisphosphonate users. While these findings support our hypothesis by associating more varus preinjury hip geometry with later development of atypical femur fracture, we unpredictably found symptomatic patients had shorter preinjury hip axis length.

See pages 99 - 147 for financial disclosure information.

Dynamic Stress Fluoroscopy (DSF) for Evaluation of the Femoral Neck After Intramedullary Nails: Faster, Cheaper, and Equally Effective as Intraoperative AP Pelvis Radiograph

David M. Joyce, MD*; Jason M. Evans, MD; Hassan R. Mir, MD, MBA;*
Vanderbilt University, Nashville, Tennessee, USA

Background/Purpose: Femoral neck fractures are often encountered in high-energy injuries to the ipsilateral femoral shaft. Several protocols have been proposed in the literature to prevent a patient from leaving the operating room (OR) with a missed femoral neck fracture, with the most recent being a combination of preoperative radiographs and CT scan, and intraoperative static fluoroscopy (SF) and an AP pelvis radiograph prior to waking the patient. No prior study has looked at intraoperative dynamic stress fluoroscopy (DSF) to identify ipsilateral femoral neck fractures after intramedullary nailing (IMN). We sought to compare a protocol utilizing intraoperative DSF as an alternative to AP pelvis radiographs to identify femoral neck fractures associated with ipsilateral femoral shaft fractures.

Methods: Following IRB approval, all adult femoral shaft fractures treated at our institution from 2011-2013 were retrospectively collected (N = 737). Exclusion criteria were pathologic fractures, nonunion cases, malunion cases, flexible nails, and plates, leaving 671 acute adult femoral shaft fractures treated with IMN. All patients underwent identical preoperative workup including femur and pelvic radiographs and pelvic CT scans. Patients were divided into 2 groups based on intraoperative testing determined by attending surgeon preference: (1) Group 1 (N = 159) underwent DSF examination at the conclusion of the IMN (2 attending surgeons); (2) Group 2 (N = 512) had an intraoperative AP pelvis radiograph at the conclusion of the IMN (4 attending surgeons). The electronic medical record was used to identify femoral neck fractures found prior to OR, in the OR, and after leaving the OR (missed). Imaging was reviewed to verify the operative reports. Performance statistics for diagnostic tests were utilized.

Results: There were 33 femoral neck fractures (33/671 = 4.9%), with 20 of those identified prior to OR. In Group 1 (DSF), 9 fractures were identified prior to OR, 1 was identified in the OR (with DSF), and 1 was missed. In Group 2 (AP), 11 fractures were identified prior to OR, 9 in the OR (6 with SF, 3 with AP pelvis radiograph), and 2 were missed. Utilizing the protocol for Group 1 (DSF), the following performance measures were obtained: sensitivity = 90.9%, specificity = 100%, positive predictive value (PPV) = 100%, and negative predictive value (NPV) = 99.3%. Utilizing the protocol for Group 2 (AP), the following performance measures were obtained: sensitivity = 90.9%, specificity = 100%, PPV = 100%, and NPV = 99.6%. There was no statistical difference when comparing the 2 protocols ($P = 1.000$).

Conclusion: A protocol using DSF was found to be equally clinically effective to one using intraoperative AP pelvic radiographs in detecting femoral neck fractures associated with ipsilateral femoral shaft fractures treated with IMN. Obtaining an intraoperative AP pelvis radiograph can be time-consuming and costly when considering the film itself (~$100) and the additional OR time required (~$62/minute). Surgeons may proceed with confidence utilizing a protocol with dynamic stress fluoroscopy (DSF) as it saves time and money with no detriment to patient care in comparison to a protocol with intraoperative AP pelvis radiographs.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

The Effect of Antegrade Femoral Nailing on Femoral Head Perfusion: A Quantitative MRI and Cadaveric Dissection Study Comparing Piriformis and Trochanteric Entry Points

Patrick C. Schottel, MD; *Richard M. Hinds, MD; Lionel E. Lazaro, MD; Craig E. Klinger; Amelia Ni; David L. Helfet, MD; Dean G. Lorich, MD;*
Hospital for Special Surgery, New York, New York, USA

Background/Purpose: Antegrade intramedullary femoral nailing (AIFN) is the technique of choice for the treatment of femoral diaphyseal fractures. However, clinically significant complications such as chronic hip pain, loss of hip abductor strength, heterotopic ossification, and femoral head (FH) osteonecrosis have been reported. To potentially mitigate these complications laterally based starting points, such as the tip of the greater trochanter (TGT), are becoming more commonplace than the historically popular piriformis fossa. Further, a recent cadaveric study by Dora et al tested different AIFN starting positions and found that the piriformis fossa start point places the deep branch of the medial femoral circumflex artery (MFCA) and its distal terminal branches at 100% risk for damage. However, no study has quantitatively assessed what effect different AIFN starting points and their potential MFCA damage has on femoral head perfusion.

Methods: 12 fresh-frozen human cadaveric specimens with an intact pelvis and bilateral femurs were dissected and the MFCA origin was cannulated. Specimens were then randomly allocated to either a piriformis or TGT starting point. All starting points were established percutaneously using a guidewire and biplanar fluoroscopy. A proximal femoral canal opening was then created using a 13-mm reamer and soft-tissue protector. The contralateral hip was left intact and therefore served as an internal matched control. All specimens underwent MRI consisting of high-resolution fat-suppressed gradient echo sequences both before and after infusion of gadolinium contrast through the MFCA cannula. Gross dissection of the operative hip was then performed to assess the integrity of the deep branch of the MFCA and its distance to the opening reamer path. The number of damaged terminal branches of the deep MFCA was also recorded.

Results: MRI quantification analysis revealed near-full FH perfusion with no significant difference between the piriformis and TGT starting points (95% vs. 97%, $P = 0.94$). Additionally, there was no observed damage to the deep branch of the MFCA in either group. However, the average distance from the reamer path to the deep branch of the MFCA in the TGT group was 18.5 mm (range, 12-31 mm) compared to only 3.2 mm (range, 1-7 mm) in the piriformis group ($P = 0.001$). There was also a significantly greater number of terminal branches of deep MFCA damaged per specimen in the piriformis group (0 vs. 1; $P = 0.007$). There were no cases of iatrogenic femoral neck fracture or other complications between the two groups.

Conclusion: The deep branch of the MFCA was in greater jeopardy using a piriformis starting point with only 1 mm separating the vessel from the reamer path in 40% of specimens. Additionally, a significantly greater number of terminal branches were damaged. However, no statistically significant difference in FH perfusion was found between the piriformis and TGT starting point specimens using gadolinium-enhanced MRI. Based on our findings we believe that using a piriformis fossa starting point for AIFN can be a safe technique assuming the achievement of an accurate starting point and meticulous soft-tissue protection.

See pages 99 - 147 for financial disclosure information.

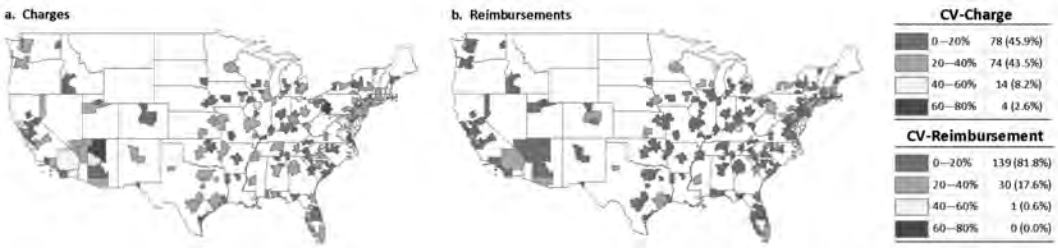
Geographic Variations in Orthopaedic Trauma Billing and Reimbursements for Pelvis, Acetabular, and Hip Fractures in the Medicare Population

Catherine M. Bulka, MPH; Rachel V. Thakore, BS; Melinda Buntin, PhD;
William T. Obremskey, MD, MPH, MMHC; Jesse M. Ehrenfeld, MD, MPH; David Joyce, MD;
Manish K. Sethi, MD;
Vanderbilt University, Nashville Tennessee, USA

Purpose: Recently, there has been much discussion about geographic variations in hospital billing and Medicare reimbursement practices. Acetabular, hip, and pelvis fractures are among the top 100 diagnosis-related groups (DRGs) billed to Medicare. No study has yet investigated the variations in hospital charges or payment data surrounding these frequent orthopedic trauma injuries in the Medicare population.

Methods: We obtained hospital charge and Medicare reimbursement data for DRG 536 (acetabular, hip, and pelvis fracture) from 1142 hospitals accounting for 22,728 patients in the U.S. for 2011. Hospitals were aggregated into Core Based Statistical Areas (CBSAs), which are used by Medicare to assign a hospital wage index to all hospitals in the same area. These CBSAs control for variation in the cost of labor across the country. In order to evaluate the variations in both hospital billing and Medicare reimbursement within each area, we then calculated the coefficient of variation (CV) for each sector with regard to both the hospital charges and Medicare reimbursements. CV-Charge is calculated for each area as the ratio of the standard deviation (SD) of the hospital charges within the area to the mean hospital charge within the area multiplied by 100. CV-Reimbursement was calculated in a similar manner.

Figure 1. DRG 536: Acetabular, Hip, and Pelvis Fracture



Results: 875 hospitals, accounting for 22,634 patients with DRG 536, were assigned into 170 CBSAs. The average hospital charge and SD was $17,516 ± $8773 with a wide range of charges ($3986-$64,016). The average Medicare reimbursement and SD was $4790 ± $1070.31 with a range of reimbursements ($3217-$11,923). As demonstrated in Figure 1a, there was a very wide variation in hospital billing for DRG 536 within each area as evidenced by more areas with higher CVs; we identified 4 areas with very high CV-Charges between 60% and 80% (Fig. 1a, orange), and 14 with high CV-Charges between 40% and 60% (Fig. 1a, yellow). Medicare reimbursements also demonstrated variability within each area (Fig. 1b), but much less than hospital charges. Although the majority of areas (138) demonstrated a low CV (0-20%; Fig. 1b, blue), 30 areas maintained a higher CV (20%-40%; Fig. 1b, green).

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Conclusion: This study is the first to evaluate variability in hospital charges and Medicare reimbursement in patients with DRG 536. Hospital charges demonstrated a high degree of variability even when using areas to control for differences in hospital wages. We also found high variation in reimbursements in some areas that remain unexplained by Medicare's current method of calculating reimbursement. Medicare now makes charges per DRG public information and the driver of the variation in charges and reimbursement will be scrutinized by payers and the public. In a future bundled payment system in which Medicare could potentially provide a single payment for care, it is important for orthopaedic surgeons to understand the drivers behind such high variability in hospital charges for management of similar fractures.

See pages 99 - 147 for financial disclosure information.

Trends in Femoral Neck Fracture Management From 1998 to 2010

*Julius Bishop, MD; **Arthur Yang, MS**; Alex Sox-Harris, PhD;*
Stanford University, Stanford, California, USA

Purpose: Recent clinical evidence supports total hip arthroplasty (THA) as compared to hemiarthroplasty (HA) for the management of displaced femoral neck fractures in elderly patients. The purpose of this study was to examine trends in femoral neck fracture management over the last 12 years.

Methods: Using data from the Nationwide Inpatient Sample (NIS) database, we identified patients treated for femoral neck fracture between 1998 and 2010 with either THA, HA, or internal fixation (IF). We examined trends in treatment over time as well as demographic variables such as patient age, gender, and socioeconomic status as well as payer and hospital characteristics.

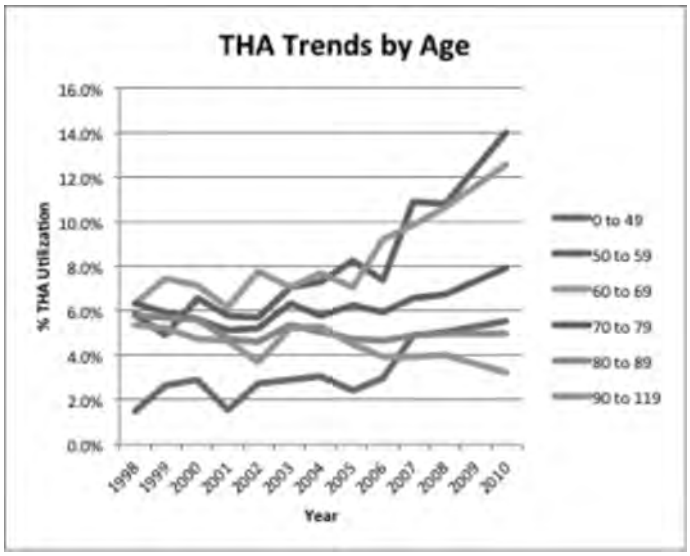
Results: We identified 334,929 femoral neck fracture patients treated with one of the three procedures between 1998 and 2010. Overall, there were statistically significant increases in the rates of THA and HA (THA: 5.8% to 6.7%; HA: 62.3% to 63.9%), while rates of IF decreased (32.0% to 29.4%). Utilization of THA varied based on patient age, with significant increases occurring in age groups 0-49 years (1.5% to 5.5%), 50-59 years (5.9% to 14.0%), 60-69 years (6.3% to 12.6%), and 70-79 years (6.3% to 7.9%). Conversely, patients in age groups 80-89 years (5.8% to 5.0%) and 90-119 years (5.4% to 3.2%) showed a decreasing trend for THA utilization. Utilization of THA also varied based on socioeconomic status and race. There was no increase in THA in patients of the lowest socioeconomic bracket (income $1-24,999), while rates of THA increased in all others. Utilization of THA decreased in Hispanics, did not change in blacks and Native Americans, and increased in Caucasian and Asian patients. Patient sex, urban versus rural hospital location, and teaching versus non-teaching hospital status were not related to rates of THA.

THA Trends by Age

Age Group	P-value
0 to 49	3.43E-10
50 to 59	2.20E-16
60 to 69	2.20E-16
70 to 79	3.54E-07
80 to 89	3.89E-05
90 to 119	1.09E-07

Overall Trends by Procedure

Procedure	P-value
THA	1.12E-09
HA	2.07E-11
IF	2.20E-16



- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Conclusion: Rates of THA for the treatment of femoral neck fractures increased between 1998 and 2010 in patients younger than 80 years of age, suggesting that surgeons are responding to mounting clinical evidence that THA is superior in these circumstances. This is the first study to demonstrate a change in practice pattern in response to this clinical evidence in the United States. Further research is indicated to explore the effect of socioeconomic status and race on femoral neck fracture management.

See pages 99 - 147 for financial disclosure information.

Final Frontal Plane Alignment of United Subtrochanteric Femur Fractures Is Not Affected by Antegrade Medullary Nail Start Point

***Geoffrey S. Marecek, MD**; Clifford Hou, MD; Julie Agel, MA, ATC; David P. Barei, MD; Harborview Medical Center, Seattle, Washington, USA*

Background/Purpose: Subtrochanteric femoral fractures are challenging entities. Varus malreduction, malunion, and nonunion are cited complications. Medullary nailing offers many benefits for the treatment of these fractures, but an improper starting point can contribute to varus malalignment. Similar results have been reported with use of piriformis and trochanteric starting points in diaphyseal femur fractures, but little evidence exists regarding the optimal starting point in subtrochanteric fractures. We sought to determine if the selection of a piriforims fossa (PF) or greater trochanteric (GT) entry portal had an effect on the alignment of subtrochanteric femur fractures after medullary nailing.

Methods: We queried a prospectively acquired trauma database for all OTA 31A3 and 32 fractures treated at our regional Level I trauma center from January 2000 to September 2012. A subtrochanteric femur fracture was defined as the dominant fracture line within 2 cortical diameters of the lesser trochanter. The neck-shaft angle was measured by the method of Neher and Ostrum at radiographic union with contralateral comparison. Patients were excluded for skeletal immaturity, pathologic fracture, a proximal fracture that could affect the neck-shaft angle (eg, femoral neck), or a contralateral neck-shaft angle that could not be accurately measured. The entry portal and implant were selected at the discretion of the operating surgeon. 270 fractures met enrollment criteria and 129 were followed to union.

Results: There were 86 patients in the PF group, and 43 in the GT group. The groups had no differences in age, side, gender, percentage of open fractures, or OTA classification. The difference in injured to uninjured neck-shaft angle at union was 5.3° in the PF group and 4.7° in the GT group (Table 1). There was no difference in reoperation rates between groups ($\chi^2 = 0.636$, Table 2).

Conclusion: With careful operative technique, comparable results can be obtained using either PF or GT start points for subtrochanteric femur fractures.

Table 1. Results at Union of Medullary Nailing for Subtrochanteric Femur Fractures*

	PF (n = 86)	GT (n = 43)	
Injured neck-shaft angle	128.6° (4.8)	126.8° (5.4)	$P = 0.063$
Uninjured neck-shaft angle	133.9° (6.8)	131.6° (4.9)	$P = 0.026$
Neck-shaft difference	5.3° (7.4)	4.7° (6.0)	$P = 0.65$
Time to union (days)	192 (53-856)	219 (57-814)	

*Values expressed as mean (SD).

POSTER ABSTRACTS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Table 2. Complications Related to Medullary Nailing for Subtrochanteric Femur Fractures*

	PF (n = 86)	GT (n = 43)
Revision	3 (3.5%)	2 (4.5%)
Intraoperative adjustments†	2 (2.3%)	4 (9.1%)
Heterotopic ossification excision	1 (1.2%)	0
Irrigation and debridement	0	1 (2.3%)
Removal of implants	6 (7.0%)	5 (11.4%)

*Values expressed as mean (SD). †Intraoperative adjustments included use of accessory techniques such as blocking screws or revising the starting point to improve alignment before final locking of the nail.

See pages 99 - 147 for financial disclosure information.

NIS and NSQIP Give Different Results in Hip Fracture Studies

Daniel D. Bohl, MPH*; Bryce A. Basques, BS; Nicholas S. Golinvaux, BA;*
Michael R. Baumgaertner, MD; Jonathan N. Grauer, MD;
Yale School of Medicine, New Haven, Connecticut, USA

Purpose: National databases are being used with increasing frequency to conduct orthopaedic trauma research. The purpose of this study is to explore the inter-database reliability of two commonly used national databases, the Nationwide Inpatient Sample (NIS) and the National Surgical Quality Improvement Program (NSQIP), for use in orthopaedic trauma research.

Methods: A retrospective cohort study of patients undergoing operative stabilization of transcervical and intertrochanteric hip fractures during 2009-2011 was performed in NIS and NSQIP. Totals of 122,712 and 5021 patients were included from NIS and NSQIP, respectively.

Results: Demographics and hospital lengths of stay were similar between the databases. In terms of comorbidities, the prevalences of non-morbid obesity, coagulopathy, and anemia in NSQIP were more than twice those in NIS; the prevalence of peripheral vascular disease in NIS was more than twice that in NSQIP. Four other comorbidities had prevalences that were within a two-fold difference between the two databases.

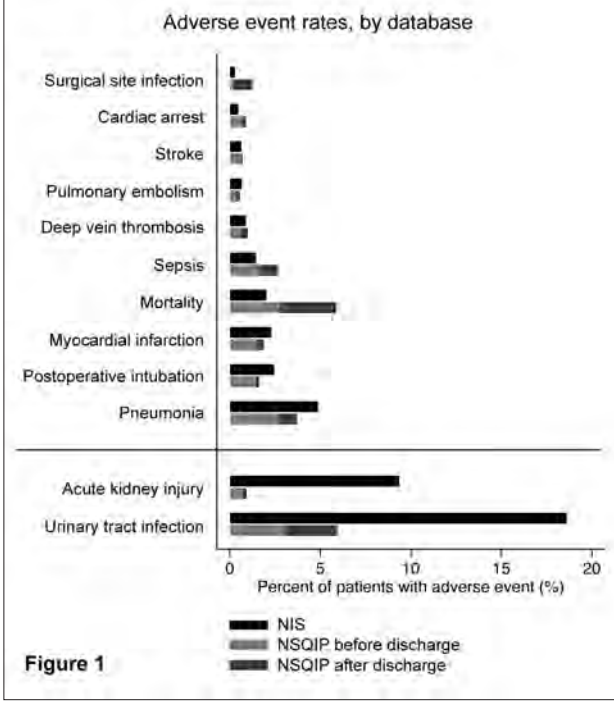


Figure 1

In terms of inpatient adverse events (Figure 1), the incidences of acute kidney injury and urinary tract infection in NIS were more than twice those in NSQIP (below the horizontal black line). Ten other inpatient adverse events had incidences that were within a twofold difference between the two databases (above the horizontal black line). NSQIP collects data both during the inpatient stay and after discharge until the 30th postoperative day. Because NIS does not collect data after patient discharge, comparison to NSQIP data demonstrates that NIS fails to capture over half of deaths and surgical site infections occurring in the first 30 postoperative days (Figure 1).

Conclusion: This study shows that two databases commonly used in orthopaedic trauma research can identify similar populations of operative patients, but may generate very different results for specific commonly studied comorbidities and adverse events.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Minimizing Leg-Length Discrepancy After Intramedullary Nailing of Comminuted Femoral Shaft Fractures: A Quality Improvement Initiative Using the Scout CT Scanogram

Rahul Vaidya, MD[1]*; Bryant W. Oliphant, MD*[1]*; Frederick E. Tonnos, DO*[2]*; Daniel Hoard, MD*[1]*; Blake Miller, DO*[2]*; Paul J. Dougherty, MD*[1]*; Anil Sethi, MD*[1]*;*
Detroit Medical Center/Wayne State University, Detroit, Michigan, USA;
Detroit Medical Center/Michigan State University, Detroit, Michigan, USA

Purpose: We attempted to minimize leg-length discrepancy (LLD) after intramedullary nailing of comminuted femoral shaft fractures, as a quality improvement initiative using the scout CT scanogram after all such cases over a 5-year period. We asked: (1) if we were better doing this with retrograde nails or antegrade nails, (2) if mechanism of injury of either gunshot wound (GSW) or motor vehicle accident (MVA) had an effect, and (3) if we improved over the course of this study.

Methods: An IRB-approved study following a quality improvement initiative was performed. Between June 2008 and August 2013, 74 consecutive patients with a Winquist III (20 patients) or IV (54 patients) (AO/OTA type C1, C2, and C3) femoral shaft fracture pattern were treated with a statically locked intramedullary nail (using our best efforts, ie, Bovie cord and radiolucent ruler) followed by a postoperative day 1 or 2 CT scanogram. The average age was 33 ± 16 years (range, 16-94; median, 28). There were 63 men and 11 women. 39 patients had an antegrade femoral nail whilse 35 patients had a retrograde nail. GSW (n = 45) was the most common mode of injury followed by MVA (n = 21) and falls (n = 7). The first 37 patients were compared to the last 37 patients.

Results: 44 femurs were short, 24 were long, and 6 had no difference in length. The average discrepancy was 9.6 mm ± 8.0 mm. Eight patients had >20 mm LLD, 7 had 15-19.9 mm LLD, 17 had 10-14.9 mm LLD, and 42 patients had 0-9.9 mm LLD. Although not significantly different, antegrade nail (6/39 [15%]) patients and 9/35 (26%) of retrograde nails patients had a significant LLD of ≥15 mm (P = 0.27). There was no significant difference in GSWs versus blunt trauma injuries. We found that our ability to normalize the LLD after these injuries did not improve from the first group of (7/37) patients to the second group of (8/37) patients. 13 out of 15 patients agreed to a correction that was performed at the time of the initial admission and was corrected to less than 6-mm discrepancy in every case.

Conclusion: The rate of significant LLD (≥15 mm) after locked intramedullary nailing of comminuted (Winquist III and IV) femur fractures at our institution was found to be 20%. We were better at antegrade nailing than retrograde nailing in our ability to equalize the leg lengths. Mechanism of injury did not make a significant difference in our ability to correctly accomplish this and we did not improve despite our best efforts during the course of this study. 13 of 15 patients were corrected during the same admission. We recommend using full-length CT scanograms after intramedullary nailing of comminuted femur fractures to ensure that LLD is minimized.

See pages 99 - 147 for financial disclosure information.

Reverse Oblique Intertrochanteric Femoral Fractures (AO/OTA 31-A3) Treated with the Cephalomedullary Nail

*Kaan S. Irgit, MD[1]; **Raveesh D. Richard, MD**[1]; Thomas R. Bowen, MD[1]; Michael Beebe, MD[2]; Erik Kubiak, MD[2]; Daniel S. Horwitz, MD[1];*
[1]Geisinger Medical Center, Danville, Pennsylvania, USA;
[2]University of Utah, Salt Lake City, Utah, USA

Purpose: Few studies with limited numbers exist that examine the increased trend towards using long cephalomedullary nails for the treatment of reverse oblique fractures (AO/OTA 31-A3). The purpose of this study was to review the clinical and radiographic outcomes of cephalomedullary nailing in 148 reverse obliquity intertrochanteric fractures at two different Level I trauma centers, comprising the largest retrospective study to date.

Methods: Patients with AO/OTA 31-A3 fractures that were identified from the comprehensive database at two Level I trauma institutions were included. Pathologic fractures were excluded. Outcomes for each patient were reviewed using the electronic medical record. The tip-apex distance (TAD) and quality of alignment were assessed from the final follow-up radiographs.

Results: According to the AO/OTA classification, 53 fractures were 31-A31, 24 were 31-A32, and 72 were 31-A33. Average follow-up was 53 months. One patient was lost to follow-up. The average age was 69.9 years. The injury mechanism was a simple fall in 118 patients and non-fatal high energy in 31 patients. There was one intraoperative fracture. The postoperative complication rate was 12% (n = 18) and 12 patients (8%) required reoperations. The quality of reduction was anatomic in 57 patients (38%), good in 64 patients (43%), and poor in 28 patients (19%). The average TAD for all patients measured 21 mm (range, 8-36). Two of the 24 patients (8%) with a TAD ≥25mm had postoperative complications. The 30-day, 6-month, and 1-year mortality rates were 4.7%, 8.7%, and 10.1%, respectively. None of the 30 patients less than 60 years died within the first year.

Conclusion: Long cephalomedullary nails demonstrate acceptable complication rates, low reoperation rates, and high rates of healing in the treatment of reverse oblique fractures. The TAD did not play a significant role in postoperative healing. The 1-year mortality of 10% in this group remained low compared to other types of hip fractures.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Risk for Postoperative Complications Following Hemiarthroplasty for Femoral Neck Fracture in Patients on Warfarin at the Time of Admission

Kristin McPhillips, MD, MPH*; Hemil Maniar, MD; Jove Graham, PhD; Daniel Horwitz, MD; Geisinger Hospital, Danville, Pennsylvania, USA*

Background/Purpose: Fractures of the femoral neck are a large and growing source of morbidity and mortality in the elderly population. There has been an increase in the number of patients taking warfarin and other blood thinners due to medical comorbidities, but no specific recommendations exist regarding the reversal of anticoagulation of these patients prior to hip fracture surgery. The risk of bleeding is thought to be less if the international normalized ratio (INR) is less than 1.5 at the time of surgery, but this has not been studied in orthopaedic patients. Furthermore, the risks of thromboembolic disease in these patients are unknown. We sought to examine the effect of INR at the time of surgery on the risk of postoperative hematoma or infection and also to describe the risk of thromboembolic disease in these patients.

Methods: This study was an IRB-approved retrospective review of electronic health records from patients who underwent hemiarthroplasty for a femoral neck fracture at two hospitals (a Level I and Level II trauma center in the same health system) between January 2004 and September 2013 and who were taking warfarin and had an INR >1.3 upon admission. INR at admission and at surgery, time from presentation to surgery, estimated blood loss, and the length of surgery were recorded. Diagnosis of hematoma was recorded as well as all other intraoperative complications. The primary outcome was hematoma or deep infection (HDI) requiring reoperation within 60 days.

Results: 91 hips in 88 patients were included in the study. The majority of patients were taking warfarin for atrial fibrillation. Mean INR at admission was 2.49 (range, 1.34-8.20) and the mean time until surgery was 42 hours. Mean INR at the time of surgery was 1.52 (range, 1.05-2.28). There were 7 HDI (5 confirmed infections and 2 noninfected hematomas) that required reoperation within 60 days of the procedure; 6 patients with HDI had INR ≥1.5 at the time of surgery, 1 had an INR below 1.5. There were 4 superficial hematomas that did not require reoperation; all had INR above 1.5 at the time of surgery. Two patients with thromboembolic complications having INR below 1.5 died. The mean estimated blood loss was 177 mL for patients with INR <1.5 and 237 mL for patients with INR ≥1.5 at time of surgery ($P = 0.02$).

Conclusion: Our data suggest that higher INR at the time of surgery may predispose to increased blood loss, hematoma, and infection, but that more aggressive reversal of anticoagulation may result in increased risk of thromboembolic disease. More data are needed to quantify this risk and to define the optimal pathway for patients on warfarin who present with femoral neck fractures requiring hemiarthroplasty.

See pages 99 - 147 for financial disclosure information.

INR at Surgery	n	Hematoma, n (%)		Infection, n (%)		Reoperation, n (%)	Any Hematoma or Infection, n (%)
		Deep	Superficial	Deep	Superficial		
<1.4	28	0 (0%)	0 (0%)	0 (0%)	2 (7%)	0 (0%)	2 (7%)
1.4-1.49	17	1 (6%)	0 (0%)	1(6%)	0 (0%)	1 (6%)	1 (6%)
1.5-1.59	16	1 (6%)	1 (6%)	1 (6%)	0 (0%)	2 (13%)	3 (19%)
1.6-1.69	14	2 (14%)	1 (7%)	2 (14%)	0 (0%)	3 (21%)	4 (28%)
≥1.7	16	1 (6%)	2 (13%)	1 (6%)	1 (6%)	1 (6%)	4 (25%)

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Postoperative Complications of Dynamic Hip Screw Versus Cephalomedullary Nail for Treatment of Intertrochanteric Hip Fractures

Jimmy Jiang, MD*; Min Lu, MD; Hue Luu, MD; Douglas Dirschl, MD;*
University of Chicago, Chicago, Illinois, USA

Purpose: Intertrochanteric hip fractures can be surgically treated with either cephalomedullary nails (CMN) or dynamic hip screws (DHS). Using a national database, the 30-day postoperative complication rates were compared for patients who underwent each method of surgical fixation.

Methods: The American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database for the 2006-2012 years was queried to identify all patients who underwent either a DHS (CPT = 27244) or CMN (CPT = 27245) for treatment of an intertrochanteric hip fracture (ICD-9 = 820.20-820.21). The ACS-NSQIP is a statistically representative sample of prospectively collected perioperative surgical data from participating hospitals across the nation. Demographics, comorbidities, preoperative laboratory values, and 30-day postoperative complications were compared between the patients treated with DHS versus CMN. Multivariate analysis was then performed to adjust for confounding patient characteristics and comorbidities in order to identify whether the type of surgical treatment was an independent predictor of postoperative complications.

Results: This retrospective analysis identified 3652 patients who underwent CMN and 2127 patients who underwent DHS over 7 consecutive years. The average age of the patients was 80.7 years for the CMN group and 80.5 years for the DHS group ($P = 0.58$). The percentage of females was 72% for the CMN group and 69% for the DHS group ($P = 0.01$). Preoperative comorbidities were significantly greater in the CMN group, including higher American Society of Anesthesiologists physical status classification ($P = 0.01$) and greater prevalence of hypertension ($P = 0.02$), congestive heart failure ($P = 0.03$), dyspnea ($P = 0.05$), prior cardiac stents ($P = 0.01$), and peripheral vascular disease ($P = 0.01$). The percentage of patients with any complication within 30 days after surgery was 16% for both groups ($P = 0.98$). Rates of return to the operating room were 1.9% for the CMN group and 1.6% for the DHS group ($P = 0.46$). The 30-day mortality was 6.4% in the CMN group and 4.9% in the DHS group ($P = 0.02$). Surgical time was similar ($P = 0.26$) between the two groups (55.8 minutes for CMN vs. 56.9 minutes for DHS). Rates of blood transfusions were 38.3% for patients who underwent CMN and 35.9% for those who underwent DHS ($P = 0.06$). The reintubation rate was 1.6% for the CMN group and 0.8% for the DHS group ($P = 0.05$). Average postoperative hospital length of stay (LOS) was 5.5 days for the CMN group and 6.8 days for the DHS group ($P < 0.001$). The proportion of patients who were discharged home was 10.4% for the CMN group and 14.0% for the DHS group ($P < 0.001$). After incorporating multivariate analyses to adjust for confounding variables, having a DHS was independently associated with lower 30-day mortality (relative risk [RR] = 0.76, $P = 0.03$) and lower reintubation rates (RR = 0.57, $P = 0.04$). There was also a statistical trend toward lower risk of deep venous thrombosis (RR = 0.61, $P = 0.07$) with a DHS.

Conclusion: We found that 16% of the patients in this study developed at least one complication within 30 days after operative treatment of an intertrochanteric hip fracture. Although

See pages 99 - 147 for financial disclosure information.

patients undergoing CMN had more comorbid conditions than those undergoing DHS, performing CMN offered no advantage in operative time or transfusion requirement. When controlling for preoperative comorbidities, having a DHS, as compared to a CMN, was independently associated with decreased 30-day mortality and reintubation rates.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Less Invasive Stabilization System (LISS) Plating Versus Locking Condylar Plates (LCPs) in Open and Closed Distal Femoral Fractures

Southeastern Fracture Consortium; ***William T. Obremskey, MD, MPH[2];***
[1]*Chapel Hill, North Carolina, USA;*
[2]*Vanderbilt University, Nashville, Tennessee, USA*

Purpose: Minimally invasive plate osteosynthesis techniques, including LISS plating and locking condylar plating, are viable treatment options for distal femoral fractures. However, there is currently no clear consensus on whether LISS or LCP plating should be used in treating these fractures. Here we compare postoperative complications rates between LISS and LCP plating techniques for open and closed distal femoral fracture fixation.

Methods: A multicenter, retrospective chart review at four institutions was performed on all patients identified through a hospital billing database who were treated operatively for supracondylar femur fractures using LISS or LCP plating techniques between January 2005 and July 2010. Patients were required to have at least 6 months of follow-up. 339 distal femoral fractures were identified among 316 patients. Preoperative radiographs were reviewed and fractures were classified according to AO/OTA guidelines. χ^2 and logistic regression analysis was performed to compare plating techniques in regard to postoperative infection and nonunion/reoperation.

Results: Of the 339 distal femoral fractures identified, 185 (54.6%) were repaired with a LISS plate and 154 (45.4%) were repaired with an LCP. In open fractures, nonunion was greater in LCPs (37.3%) compared to LISS plates (28.2%) but not statistically significant ($P = 0.20$). In closed fractures, nonunion was greater in LISS plates (17.8%) compared to LCPs (12.6%) ($P = 0.40$). In open fractures, infection occurred in 20.3% of LCPs and 11.5% of LISS plates ($P = 0.16$). In closed fractures, infection occurred in 6.3% of LCPs and 3.7% of LISS plates ($P = 0.40$). Open fractures were associated with higher rates of infection and nonunion compared to closed fractures. Multivariate analysis revealed open fractures to be a risk factor for both nonunion (odds ratio [OR] 2.27, $P = 0.01$) and infection (OR 3.47, $P = 0.02$).

Conclusion: In the largest comparison of supracondylar femur fractures reported, postoperative infection and nonunion rates are comparable between LISS and LCP plates for both open and closed distal femoral fracture fixation. Both open and closed fractures had relatively high rates of nonunion. Surgeons could consider early bone grafting in open and closed fractures to decrease the nonunion rate.

See pages 99 - 147 for financial disclosure information.

Quantitative Contribution of Progressively More Extensile Posterior Surgical Approaches to the Acetabulum

Colin Crickard, MD*; Luke Harmer, MD, MPH; Erica Andrews; Katie Sample; Stephen H. Sims, MD; Joseph R. Hsu, MD;*
Carolinas Medical Center, Charlotte, North Carolina, USA

Purpose: Our purpose was to (1) objectively quantify the surface area of acetabular exposure using the Kocher-Langenbeck (KL), trochanteric osteotomy (TO), and surgical dislocation of the hip (SD) approaches, and to (2) compare the qualitative ability of a surgeon to see or palpate important anatomic landmarks in each exposure.

Methods: Ten thawed, fresh-frozen cadavers with ten hips and lower extremities were used for the study. The cadavers were placed in the lateral decubitus position. Continuous data collection was obtained by taking a calibrated digital photograph (Image J, NIH, Bethesda, MD) from the surgeon's best view. Discrete data points consisted of relevant anatomic landmarks that were classified as visualized, palpated but not visualized, or not visualized or palpated. These landmarks consisted of the greater and lesser sciatic notches; the margins of the acetabulum anteriorly, superiorly, and inferiorly; the anterior inferior iliac spine (AIIS); the greater and lesser trochanters; the vastus ridge; the pelvic brim; the quadrilateral surface; the iliopectineal eminence; and the femoral head fovea. Each specimen had three approaches performed in series by a board-certified orthopaedic surgeon under the direct supervision of a fellowship-trained orthopaedic trauma surgeon. The KL approach was performed first. Calibrated photographs and discrete data were collected at this point. Next a TO was performed. The osteotomy was made from just anterior to the posterior one-third margin of the gluteus medius insertion on the greater trochanter extending distally to the lateral femur just distal to the vastus ridge. The remaining attachments of the gluteus medius to the trochanter were elevated with the osteotomized portion of greater trochanter along with the gluteus minimus off of the superior margin of the acetabulum. Data were collected for the TO at this point. Lastly, an SD through a Z-shaped anterior hip capsulotomy was performed. A sharp Hohmann retractor was then placed anteriorly between the anterior inferior and anterior superior iliac spines. A blunt Hohmann was placed inferior to the transverse acetabular ligament. Two human retractors were again placed in the greater and lesser sciatic notches as previously perfomed in both the KL and TO portions of the approach. Data were collected for the SD at this time.

Results: The acetabular surface area exposed with a KL approach was 27.66 (±6.67) cm^2; with a TO approach, 41.82 (±7.97) cm^2; and with the SD, 53.08(±9.04) cm^2. The surface area exposed was significantly increased for both the TO and SD when compared to the KL ($P < 0.001$). The ability to see and touch surgical landmarks was similar between the SD and TO approaches. The TO allowed palpable exposure of the exterior surface of the anterior column to the AIIS in 8/10 specimens and visual exposure of the AIIS in 3/10 specimens while the SD allowed palpable exposure of the exterior surface of the anterior column to the AIIS in 10/10 specimens and visual exposure of the AIIS in 8/10 specimens. Performing SD enabled the surgeon to touch the inferior acetabulum and to see femoral head fovea in every specimen whereas the KL and TO approaches only allowed palpation of the inferior margin of the acetabulum in 3 and 4 specimens, respectively.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Conclusion: The trochanteric osteotomy and the surgical dislocation can both improve surgical access to the acetabulum when compared with the Kocher-Langenbeck approach. Increases in acetabular exposure for the TO over the KL were primarily in the anterior and superior portions of the acetabulum. The SD exposure also increased anterior exposure to the AIIS as well as allowing access to the articular surface of the acetabulum and femoral head.

See pages 99 - 147 for financial disclosure information.

Failures in High-Energy Intertrochanteric (IT) Femur Fractures

*Michael H. Amini, MD[1]; John Feldman, MD[1]; **John C. Weinlein, MD**[1,2];*
[1]University of Tennessee-Campbell Clinic, Memphis, Tennessee, USA;
[2]Regional One Health, Memphis, Tennessee, USA

Background/Purpose: Much literature has been published in recent years suggesting that both a screw and side plate (SSP) and an intramedullary nail (IMN) perform well for geriatric IT fractures, with the exception of OTA A3 fractures. However, there is a paucity of evidence about young patients with these fractures as a result of high-energy mechanisms of injury (MOI), and the ideal treatment remains unknown. We sought to better define this cohort of patients, and we hypothesized that there would be no difference in complications between implants.

Methods: We retrospectively reviewed all IT fractures at a single urban Level I trauma center between January 2008 and January 2014. We excluded patients age 65 or older, fractures from a simple fall, pathologic fractures, patients without follow-up to union, and AO-OTA A3 fractures. Patients were grouped according to implant, either SSP or IMN. We compared differences in demographic data, fracture characteristics, measures of surgical quality, and complications. Data were compared using independent *t*-tests and Pearson c^2 tests. *P* values <0.05 were considered significant.

Results: We identified 37 patients with an average age of 45 years, 27 males and 10 females. Despite high-energy MOI, 84% of fractures were A1, and the remaining 16% were A2. The average ISS was 18.8, with 22 of 37 patients (59%) meeting the definition of polytrauma based on an ISS ≥17. We treated 21 patients with SSPs, and 16 with IMNs. There were no differences in age, sex, follow-up, fracture classification, smoking status, body mass index, MOI, or postoperative weight bearing (all $P > 0.05$). Regarding surgical parameters between cohorts, there were no differences in tip-apex distance (TAD), percentage of lag screws placed within 25 mm from the apex, position of the lag screw in the femoral head, or reduction quality. There were no differences in blood loss or surgical time. Only 19% of fractures reduced with traction alone, and the remaining 81% required an open reduction. The rate of major complications requiring revision was 13.5% overall, 19% of SSPs, and 6% of IMNs ($P = 0.36$). Among the SSPs, there were three cases of varus collapse and one periprosthetic fracture. All three cases of varus collapse were A1 fractures and had a TAD ≤25 mm (mean 20.3 mm). Among the IMNs, one patient developed a nonunion, but none developed varus collapse. Medialization of 4 mm or more occurred in 3 SSPs and 0 IMNs, and one SSP sustained an intraoperative lateral wall fracture that healed uneventfully.

Conclusion: Young patients with IT fractures present with a high rate of polytrauma as a result of their mechanism of injury. These fractures most often require an open reduction and are more prone to complications than their geriatric counterparts. In particular, varus collapse occurred at a high rate despite relatively simple fracture patterns, and satisfactory TAD and reduction quality.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

ORIF Versus Arthroplasty of Geriatric Acetabular Fractures: Results of a Randomized Controlled Feasibility Study

Ted Manson, MD*; Robert V. O'Toole, MD;*
R Adams Cowley Shock Trauma Center, Baltimore, Maryland, USA

Purpose: Geriatric acetabular fractures are a growing clinical challenge with diverse and controversial management strategies. Our goal was to determine the feasibility of a randomized controlled trial comparing open reduction and internal fixation (ORIF) to total hip arthroplasty with concomitant ORIF (THA). Our hypothesis was that a high percentage (>33%) of patients will be both eligible and willing to enroll in a randomized controlled trial.

Methods: The study design was a prospective randomized controlled trial with an observational arm for patients who refused randomization. From July 2011 to December 2013 all patients admitted with an acetabular fracture to a single trauma center were screened for study inclusion. Inclusion criteria were patients over age 60 with an acetabular fracture that had at least one of three characteristics previously identified to be associated with poor outcomes after ORIF in geriatric patients: (1) dome impaction, (2) posterior wall component, or (3) femoral head impaction injury. Exclusion criteria were physiologic inability to undergo surgery, clinical contraindication for either treatment arm, and severe dementia. Patients who declined randomization were treated with the patient's preferred method and included in the observational arm of the study. Patients in the ORIF group had standard plate and screw fixation through standard surgical approaches. Patients in the THA group underwent plate and screw fixation and then subsequent THA through the same approach and prep.

Results: Only 41.5% (27 of 65) patients with geriatric acetabular fractures met inclusion criteria. 33% (9 of 27, 95% confidence interval [CI]: 18-48%) of the eligible patients agreed to be randomized. Therefore only 14% (9 of 65, 95% CI: 0-27%, $P < 0.05$ from hypothesized 33% rate) of acetabular fractures over age 60 were eligible and agreed to enroll in a randomized controlled treatment trial. A larger percent (28% [n = 18], 95% CI: 11-45%) enrolled in the observational arm. The patients in the observational arm split evenly between ORIF (n = 9) and THA (n = 9). In the ORIF group (n = 15), 2 patients died in the index hospitalization, 2 had complications, and 25% have been converted to THA. In the THA group (n = 12) no patients died during the index hospitalization; there were no complications or repeat surgeries to date.

Conclusions: Multiple authors have argued that a randomized controlled trial is needed to determine the ideal treatment of geriatric acetabular fractures. To our knowledge, we report the first data from a prospective randomized trial indicating feasibility of such a study. In contrast to our hypothesis, only a small percentage of geriatric acetabular fracture patients were both eligible for the study and willing to be randomized (14%, n = 9 over 2.5 years). Our data indicate that a large consortium of clinical sites will likely be needed for such a randomized trial to succeed. Further, although all eligible patients agreed to participation in a study, they have strong treatment preferences that often make them unwilling to have their treatment randomized.

See pages 99 - 147 for financial disclosure information.

Risk Factors for Discharge to Rehab Among Hip Fracture Patients

Rachel V. Thakore, BS; Cesar S. Molina, MD; William T. Obremskey, MD, MPH, MMHC;
Manish K. Sethi, MD;
Vanderbilt University, Nashville, Tennessee, USA

Background/Purpose: Length of stay (LOS) is one of the most powerful drivers of cost in hip fracture surgery. One frequent cause of prolonged LOS is delayed transfer to rehabilitation (rehab) centers following surgery for multiple reasons including lack of appropriate discharge planning or availability of rehab beds. Very little data exist exploring potential predictive factors in determining which patients after hip fracture surgery will require rehab services. Using the recently expanded American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database, this is the first national multicenter study to identify risk factors for discharge to rehab for hip fracture patients.

Methods: A prospective cohort of 7808 hip fracture patients from 2005-2011 were identified in the ACS-NSQIP database using CPT codes 27235, 27236, 27244, and 27245, which represent the spectrum of hip fracture surgery. 5615 patients with available discharge information were included in analysis. Rehab destinations included skilled care (SNF), unskilled facility (USF), separate acute care (SAC), and rehab facility (RF). All other patients were discharged home. Using a multivariate logistic regression analysis, we determined odds ratios for 19 potential risk factors including type of procedure, age, medical comorbidities, American Society of Anesthesiologists (ASA) status, operative time, and baseline functional status.

Results: Of the 5615 hip fracture patients in this analysis, 71.0% were discharged to a rehab facility (SNF 44.3%, n = 2489; USF 0.6%, n = 34; SAC 2.0%, n = 112; RF 24.0%, n = 1349), and 29.0% were discharged home. Of the 19 variables analyzed, 6 were found to be significant risk factors for discharge to rehab. Type of hip fracture procedure was not found to significantly increase the risk of going to rehab ($P = 0.66$). Patients over the age of 65 were 4.25 times more likely to be discharged to rehab than those younger than 65, and females were 1.53 more likely to go to rehab than males ($P < 0.001$). Patients who received general anesthesia were 1.68 times more likely to be discharged to rehab than those who received regional and patients with an ASA score greater than 2 were 3.09 times more likely to be discharged to rehab ($P < 0.001$). Patients who had hypertension were 1.61 times more likely to go to rehab, while patients who needed dialysis were 8.74 times more likely ($P < 0.001$). Patients with poorer preinjury functional status were 1.92 times more likely to go to rehab ($P < 0.001$) (Table).

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Risk Factors for Rehabilitation	Odds Ratio	95% Confid. Interval	
General anesthesia*	1.68	1.26	2.26
Age >65*	4.25	3.00	6.03
Female*	1.53	1.14	2.04
Hypertension*	1.61	1.20	2.15
Dialysis†	8.74	1.16	65.94
ASA status (≤2 vs. >2)*	3.09	2.26	4.21
Preinjury functional status*	1.92	1.36	2.72

*$P < 0.001$. †$P < 0.05$.

Conclusion: In a large prospective series of patients with hip fractures, we demonstrate clear risk factors that predict potential postoperative transfer to rehab centers. Orthopaedic surgeons must utilize such predictors in planning for eventual discharge to rehab. In order to decrease LOS in this patient population, early discharge planning is vital and our study offers unique insight.

See pages 99 - 147 for financial disclosure information.

Predictors of Delay for Time to Surgery in Geriatric Hip Fractures: Results and Outcomes

D. D. Berglund, BA; J. H. Flaherty, MD; T. K. Malmstrom, PhD, ***J. Tracy Watson, MD****;*
Departments of Orthopaedic Surgery and Geriatric Medicine, St. Louis University School of Medicine, St. Louis, Missouri, USA

Purpose: It has been shown that a delay to definitive hip fracture surgery can be detrimental to the patient's overall outcome. The purpose of this study was to identify specific variables associated with a delayed time to surgery (>48 hours from admission) for geriatric hip fractures. Additionally, we sought to determine if the delay contributed to associated in-hospital complications such as delirium, or other medical complications.

Methods: This was an IRB-approved retrospective review of all hip fracture patients admitted over a 7-year time period (July 2004 thru December 2011). Inclusion criteria included 60 years or older, hip fracture as a result of a fall (minor trauma only), and the patients underwent surgical repair of the fracture at our institution. Data collection included patient demographics, the primary admitting service, medical comorbidities, American Society of Anesthesiologists (ASA) status, all admission laboratory values, and preoperative cardiac clearance and subsequent cardiac testing if obtained. Additionally, date of admission, time to surgery, and discharge date were recorded with respect to the actual day of the week. Charlson Comorbidity Index (CCI) was calculated and statistical analysis performed to determine significant variables associated with a delay in time to surgery

Results: 638 patients qualified and 321 met the inclusion criteria for complete review. 115 patients (35.83%) were male and 206 (64.17%) were female. Average age was 79.3 years (range, 60-98). 173 patients (53.9%) had surgery within 48 hours of admission and 148 (46.1%) had surgery more than 48 hours after admission (delayed time-to-surgery). Bivariate analysis demonstrated significance with: late week or weekend admission, admitting service other than the dedicated orthopaedic/geriatric service, an increased CCI, an increased ASA status, a creatinine level >1.2 mg/dL, and the presence of *any* preoperative cardiac tests were all significant in predicting a delayed time to surgery (>48 hours). Multivariate analysis adjusted for confounders determined that: admission near or on the weekend ($P = 0.012$, odds ratio [OR] = 2.013, 95% confidence interval [CI] 1.168-3.468), having an ASA status of 4 ($P = 0.002$, OR = 5.094, 95% CI 1.813-14.315), and the presence of *any* preoperative cardiac tests ($P < 0.001$, OR = 3.040, 95% CI 1.701-5.432) significantly predicted a delay to surgery. Changing hospital service before surgery and preoperative hemoglobin <10 g/dL demonstrated near significance for predicting delay. A delay of greater than 48 hours was a significant predictor for postoperative delirium ($P = 0.049$, OR = 1.856, 95% CI 1.003-3.437), which also significantly increased hospital stay. In-house mortality overall was not significant (2.4%).

Conclusion: Our results emphasize the importance of carefully weighing the effects of routine preoperative cardiac testing on time to surgery against any minimal perceived benefits so that postoperative complications, including postoperative delirium, may be avoided. Expediting preoperative cardiac testing may prove beneficial. Efficient clearance

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

by a dedicated combined orthopaedic/geriatric service helps limit delays. Strategies to increase weekend operating room volume may help decrease delays and sequelae that occur as a result of late week/weekend admission.

Variable	**OR (95% CI)**	***P* Value**
Weekend admission	2.013 (1.168-3.468)	0.012
Any preoperative cardiac tests	3.040 (1.701-5.432)	<0.001
ASA status 4 compared to ASA status 2	5.094 (1.813-14.315)	0.002

See pages 99 - 147 for financial disclosure information.

Predictors of Cement-Related Perioperative Death in Patients Undergoing Hip Hemiarthroplasty Surgery

***Ali Shah, MRCS**; Fahad S. Hossain, MRCS; Frank Howell, FRCS;*
Department of Trauma and Orthopaedics, North East Lincolnshire and Goole Hospitals, NHS Foundation Trust, United Kingdom

Background/Purpose: Cemented hemiarthroplasty for hip fractures of the elderly is widely accepted as the preferred method of fixation compared to uncemented prostheses due to optimal functional outcomes and lower complications. However, bone cement implantation syndrome (BCIS) remains an important cause of perioperative mortality in patients with underlying comorbidities. The aim of this study was to assess the rates, causes, and potential preoperative risk factors for perioperative mortality within 48 hours of cemented hip hemiarthroplasty surgery.

Methods: Retrospective review of data obtained from a nationally linked institutional database on a cohort of 546 consecutive intracapsular hip fracture patients treated with a hemiarthroplasty (cemented = 320; uncemented = 226) was undertaken. Details including age, sex, comorbidities, American Society of Anesthesiologists (ASA) grade, admission source, time to surgery, surgeon grade, andpreoperative blood parameters were recorded for all patients. Causes for intraoperative and perioperative mortality within 48 hours was examined. Cox regression analysis was undertaken to identify preoperative risk factors for 48-hour perioperative mortality.

Results: 13 (4.06%) and 2 (0.8%) patients died within 48 hours of their surgery in the cemented and uncemented groups, respectively. An intraoperative cardiac event (53.8%) was the predominant cause of death in our cohort. There was a statistically significant difference in the incidence of active cardiac disease ($P < 0.001$), chronic respiratory disease ($P = 0.049$), preoperative white cell count ($P = 0.019$), and the number of individual comorbidities ($P = 0.012$) between the two cohorts on univariate analysis. However a multivariate Cox model showed female gender (hazard ratio [HR] 8.8, $P = 0.037$), active cardiac disease (HR 31.4, $P = 0.001$), and a history of multiple comorbidities (HR 4.6, $P = 0.047$) to be the strongest preoperative predictors of increased risk of perioperative death associated with a cemented hemiarthroplasty.

Conclusion: Elderly female hip fracture patients with multiple comorbidities including that of active cardiac disease may be at in increased risk of perioperative mortality during cemented hip hemiarthroplasty surgery. Such patients should be identified preoperatively with a view to careful medical optimisation or alternative uncemented options.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Adherence to Preoperative Cardiac Clearance Guidelines in Hip Fracture Patients

Andrea Stitgen, MD; Kim Poludnianyk, DO; Elizabeth Dulaney-Cripe, MD;
Ronald Markert, PhD; ***Michael Prayson, MD****;*
Wright State University, Dayton, Ohio, USA

Background/Purpose: Multiple prior studies have shown the importance of early surgical intervention for hip fracture patients in decreasing perioperative morbidity and mortality. As geriatric patients often have multiple comorbidities, surgical delays can occur due to preoperative medical clearance (optimization and risk stratification). In 2007, the American College of Cardiology (ACC) Foundation and the American Heart Association (AHA) developed guidelines to assist in determining those patients who require further preoperative cardiac evaluation and treatment. Our study aims to identify if cardiac consults are made in accordance with the ACC/AHA guidelines and the delays in care after unnecessary consults.

Methods: A retrospective review of 315 patients with hip fractures admitted to a Level I trauma center over a 2-year period was conducted. After excluding patients under 65 years old and those admitted by the general surgery trauma service, 266 patients were included. Charts were reviewed for criteria that would meet the ACC/AHA guidelines recommending a cardiac consult. The time between admission and surgical intervention was calculated. Postoperative complications and disposition were also reviewed.

Results: Of the 266 patients reviewed, 56 patients (21%) received preoperative cardiac consultations, while 210 patients did not. Only 16 of the 56 patients (29%) with cardiac consults met ACC/AHA guidelines for preoperative cardiac evaluations, while 40 patients received unnecessary cardiac consults. Three patients met the ACC/AHA guidelines but did not receive cardiac consults. Of the 247 patients (40 with consults, 207 without consults) who did not meet guidelines for cardiac consults, those who received a preoperative cardiac consult had a significantly longer average time to surgery (43.0 hours vs. 23.1 hours, $P = 0.006$) and significantly longer hospital length of stay (LOS) (7.8 days vs. 5.3 days, $P = 0.012$). There were no significant differences in postoperative complications or disposition between the two groups. Only 2 of the 16 patients who met cardiac clearance guidelines required a cardiac catheterization preoperatively. Of the 40 patients with cardiac consultations who did not meet guidelines, 21 patients had further cardiac testing beyond an electrocardiogram, while none required a cardiac catheterization.

Conclusion: Preoperative cardiac consults are frequently overused and lead to delays to surgical intervention and longer hospital LOS while not revealing any further need for cardiac intervention or changing the rate of adverse events. Stricter adherence to the ACC/AHA guidelines will help decrease surgical delay and hospital LOS.

See pages 99 - 147 for financial disclosure information.

Femoral Anatomy Changes with Age Predisposing to Distal Anterior Malpositioning of Intramedullary Implants

Damien M. Tucker, MBChB, MRCS[1]*; T. Surup, Dip Eng*[2]*; Andreas Petersik, PhD*[2]*;*
M. Acharya, MD[1]*; T. Chesser, MD*[1]*; M. Kelly, MD*[1]*;*
[1]*North Bristol NHS Trust, Bristol, United Kingdom*
[2]*Stryker R&D Virtual Engineering, Kiel, Germany*

Purpose: Anterior positioning of a cephomedullary nail (CMN) in the distal femur occurs in up to 88% of cases. Conventionally, this is considered to occur because of a mismatch between the radius of curvature (ROC) of the femur and that of available implants. The hypothesis for this study was that the relative thicknesses of the cortices of the femur, particularly the posterior cortex, are important in determining the final position of an intramedullary implant and that the posterior cortical thickness corresponds to the linea aspera anatomically. The aim was to determine if these measurements changed with age.

Methods: This study used the data from CT scans undertaken as part of routine clinical practice in 919 patients with intact left femora (median age 66 years, range 20-93 years; 484 male and 435 female). The linea aspera was defined manually on the template bone by consensus between two orthopaedic surgeons and two anatomists. The length of the femur was measured from the tip of the greater trochanter proximally to the intercondylar notch distally. Transverse intervals were plotted on the femur between 25% and 60% femoral bone length (5% increments). The linea aspera was then defined at each interval on the template bone and mapped automatically to all individual femora in the database. Measurements of cortical diameters and orientation were then made as shown in Figure 1.

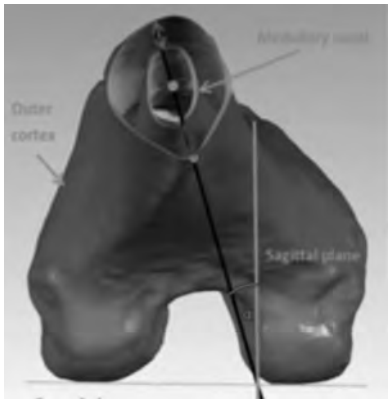


Figure 1: Definitions and measurements at an interval of femoral bone length

Results: The linea aspera was found to be internally rotated as compared to the sagittal plane referenced off the posterior femoral condyles. An age-related change in the posterior/anterior cortical thickness ratio was demonstrated. This ratio increases in all age groups from 25% to 60% bone length being maximal around 45% to 55% bone length. The ≥80-year-old cohort shows a disproportional posterior/anterior ratio increase of 70.0% from 25% to 50% bone length as compared to 48.1% for the <40-year-old cohort (Table below), which is statistically significant (Mann-Whitney test $P < 0.05$, $\alpha = 5\%$).

POSTER ABSTRACTS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Table. Median Posterior/Anterior Cortical Thickness Ratio Changes Along Femoral Bone Length

Measurement position→ Age group↓	25% bone length	30% bone length	35% bone length	40% bone length	45% bone length	50% bone length	55% bone length	60% bone length
<40 years	1.08	1.23	1.30	1.39	1.51	1.60	1.58	1.45
≥80 years	1.00	1.08	1.19	1.33	1.49	1.70	1.73	1.61

Conclusion: This study presents a novel method of investigating femoral anatomy with directly relevance to orthopaedic procedures. This study has shown that assessment in the sagittal plane may be inaccurate because the linea aspera changes in this plane throughout the length of the femur. It also shows the loss of the centering influence of the cortices with age with a relative thinning of the anterior cortex with a concomitant thickening of the posterior cortex moving distally in the femur. This has a very direct and significant influence on the positioning of intramedullary femoral implants, explaining the preponderance of anterior malpositioning of intramedullary implants in the elderly.

See pages 99 - 147 for financial disclosure information.

A Multicenter Retrospective Study of the Treatment of 253 Geriatric Acetabular Fractures: Should We Be Performing More Arthroplasty?

Ted Manson, MD[1]*; Lisa Reider, MS*[2]*; Paul Tornetta, MD*[3]*; Steven Sims, MD*[4]*;*
Robert O'Toole, MD[1]*; the METRC Investigators;*
[1]*R Adams Cowley Shock Trauma Center, Baltimore, Maryland, USA;*
[2]*Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA;*
[3]*Boston University Medical Center, Boston, Massachusetts, USA;*
[4]*Carolinas Medical Center, Charlotte, North Carolina, USA*

Background/Purpose: Treatment strategies for acetabular fractures in older adults include nonoperative, percutaneous fixation, standard open reduction and internal fixation (ORIF), or arthroplasty (THA) with or without ORIF. Currently there are no guidelines to determine the best treatment once the decision has been made to operate. The purpose of this study was to characterize current approaches to treating geriatric acetabular fractures. We hypothesized that patients with risk factors associated with poor outcomes after ORIF would be treated more often with THA.

Methods: A retrospective review of medical records from January 1-December 1, 2009 was conducted at 14 US Level I trauma centers for patients 60 years or older admitted for treatment of an acetabular fracture. Fracture characteristics, treatment, and patient demographics were collected. Three risk factors for poor outcome with ORIF identified from previous literature included presence of dome impaction, posterior wall fracture with marginal impaction, and femoral head impaction. The study group included 253 patients with unilateral acetabular fractures; 17% involved the posterior wall, 16% involved the anterior column, and 15% were anterior column–posterior hemitransverse. 60% of the fractures were treated operatively (n = 151), and of these 85% were treated with ORIF alone; 12% of patients received a THA as the initial treatment with or without concomitant ORIF.

Results: Among patients with at least one risk factor for poor outcome after ORIF (n = 102), only 15% (95% confidence interval [CI]: 8-22%) were treated with THA compared to 85% treated with ORIF. However, the odds of being treated with THA are 2.34 (95% CI: 0.61-13.33; $P = 0.27$) times higher for patients with compared to without at least one risk factor. The association is driven by the presence of dome impaction which was significantly associated with treatment with THA (odds ratio [OR] = 5.1; 95% CI: 1.57-19.42; $P = 0.003$). Interestingly, low-energy mechanism (eg, fall) was strongly associated with receiving treatment with THA (OR = 6.16; 95% CI: 1.95-21.78; $P = 0.001$); this may indicate that clinicians believe this is another risk factor for poor outcome with ORIF.

Conclusion: Consistent with our hypothesis, patients with risk factors for poor outcomes after ORIF were more likely to be treated with THA relative to patients with no risk factors. Nonetheless, clinicians at large trauma centers still commonly perform ORIF despite patients having risk factors for a poor outcome with that treatment; only 15% of at-risk patients are treated with THA. Data from a randomized trial are needed to determine how best to treat these injuries since it is currently unknown if these patients would have been better treated with arthroplasty.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Risk Factors for Poor Outcome of ORIF and Injury Mechanism by Treatment, % (n)

	ORIF (n = 128)	THA (with/without ORIF) (n = 18)	*P**
At least one risk factor	68% (87)	83% (15)	0.27
Dome impaction	34% (43)	72% (13)	0.003
Posterior wall marginal impaction	44% (57)	50% (9)	0.80
Femoral head impaction	20% (26)	28% (5)	0.54
Low-energy mechanism	24% (31)	66% (12)	0.001

P values from Fisher exact test.

See pages 99 - 147 for financial disclosure information.

Predictors of Failure for Cephalomedullary Nailing of Proximal Femoral Fractures

Aidin Kashigar, MD, BASc; *Alex Vincent; Matthew J. Gunton, MD, BSc;*
David Backstein, MD, MEd, FRCSC; Oleg Safir, MD, FRCSC;
Paul R.T. Kuzyk, MD, BSc(Eng), MASc, FRCSC;
Mount Sinai Hospital, Toronto, Ontario, Canada

Purpose: The purpose of this study was to identify factors that predict cut-out in cephalomedullary nailing of intertrochanteric and subtrochanteric hip fractures, and to test the significance of calcar-referenced tip-apex distance (CalTAD) as a new predictor for cut-out.

Methods: All patients who underwent cephalomedullary nailing for an intertrochanteric or subtrochanteric fracture between 2003 and 2013 were retrospectively reviewed. Pertinent data were extracted from chart reviews, and from radiographical images at time of diagnosis, immediately postoperatively, and at last follow-up.

Results: 170 consecutive patients underwent cephalomedullary nailing during the period studied. Of those, 77 patients met the inclusion criteria of a nonpathologic fracture with a minimum 80 days radiographic follow-up (average 408 days). Ten cut-outs (13.0%) were identified. Univariate analysis found TAD, CalTAD, cervical angle difference, and lag screw placement in the AP view (Parker's ratio index) as significant ($P < 0.01$). Age, gender, fracture side, fracture type (AO classification), Singh osteoporosis index, lag screw placement in the lateral view, and reduction quality (modified Baumgaertner's method) were not significant ($P > 0.01$). In the multivariate analysis, CalTAD was the only significant parameter ($P = 0.001$). CalTAD had an almost-perfect interobserver reliability (intraclass correlation coefficient [ICC] = 0.901).

Conclusion: Our data provide the first reported clinical evidence for CalTAD as a risk factor for cut-outs. The findings of CalTAD as the only significant parameter in the multivariate analysis, along with the univariate significance of Parker's ratio index in AP view, suggests that a more inferior placement of the lag screw is preferable for reduced cut-out rates.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Complications and Outcomes of Primary Total Hip Arthroplasty in Displaced Neck of Femur Fractures

Jillian Rutherford-Davies, FRCS (Tr&Orth); Aatif Mahmood, MRCS;
***Gunasekaran Kumar, FRCS (Tr&Orth)**;*
Royal Liverpool University Hospital, Liverpool, United Kingdom

Background/Purpose: Total hip arthroplasty (THA) has been shown to be better than hemiarthroplasty or internal fixation for treatment of displaced intracapsular neck of femur (NOF) fractures, due to reduced failure rates and better outcomes. Improvement in prostheses, bearing surfaces, enhanced rehabilitation, and better cost benefit in medium to long term have all played significant parts in the success of arthroplasty in NOF fractures. The aim of this study was to analyze the complications and outcomes of THA in isolated displaced NOF fractures in our institute.

Methods: A retrospective analysis of a prospective database was performed. All THAs for NOF fractures were identified between June 2008 and August 2013 and analyzed. Inclusion criteria for this study were: isolated low-energy displaced intracapsular NOF fractures and follow-up of at least 6 months. Exclusion criteria were high-energy injuries, pathological fractures (other than osteoporosis), associated ipsilateral hip arthritis, and associated injuries. Data collected included surgeon grade, time to surgery from presentation, hemoglobin (Hb) drop, type of prosthesis used, wound complications, unplanned surgery, periprosthetic fractures, Short Form–12 (SF-12) physical component summary (PCS) and mental component summary (MCS), Oxford Hip Score (OHS) (range, 0-48), limp, and radiographic outcomes (limb-length discrepancy [LLD], subsidence, and heterotrophic ossification [HO]).

Results: Between June 2008 and August 2013, 141 THAs performed for NOF fractures were included on the basis of inclusion/exclusion criteria. Of the 141 (33 males/108 females) THAs performed with a mean age of 71 years (range, 51-92), 124 had a follow-up of at least 6 months. Average follow-up was 14 months (range, 6-48). All patients were American Society of Anesthesiologists (ASA) 1 or 2 or 3, Abbreviated Mental Test (AMT) score of 8 or above, and community ambulators with or without walking aids. 63 THAs were performed via posterior approach and 78 were through a lateral approach. 123/141 were performed by consultants and the rest by the registrars. Time from presentation to surgery was 2.4 days (range, 0-9) and average Hb drop was 2.7 g/dL. The majority of THAs were uncemented (125) with a bearing surface combination of polyethylene on metal. All 124 patients had radiographs assessed for initial LLD. 14 patients had an initial LLD of >0.5 cm (–1.2 cm to +1.6 cm) and femoral subsidence in uncemented femoral stem of more than 2 mm was identified in 6 with no functional issues. Functional scores were available for 74 patients. Average OHS was 32 (23-45), SF-12 PCS 43 (31-56), and MCS 39 (33-55). There were 6 wound healing issues that required washout and primary closure. There were no deep infections. Revision to cemented long femoral stem was performed for 6 femoral periprosthetic fractures (4 uncemented, 2 cemented). There were 5 dislocations that were successfully treated with closed reduction and bracing and one case of HO that did not require surgery. Six patients were from out of area and were followed up elsewhere. There were 5 deaths within 6 months and 6 patients failed to attend follow up.

See pages 99 - 147 for financial disclosure information.

Conclusion: In selected patients, primary THA for low-energy displaced NOF fractures provides good functional outcomes and acceptable complication rates. Type of prosthesis used did not have any significant difference in outcomes.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

The Effects of Cephalomedullary Nail and Sliding Hip Screw on Perioperative Morbidity in Cases Being Converted to Total Hip Arthroplasty

Andrew J. Marcantonio, DO; K. J. Bramlett, PA; Richard Iorio, MD; John F. Tilzey, MD; Lawrence M. Specht, MD; ***Michael S. Kain, MD****;*
Lahey Hospital and Medical Center, Burlington, Massachusetts, USA

Background/Purpose: Intertrochanteric hip fractures can be treated with cephalomedullary nail (CMN) or sliding hip screw (SHS) devices. There has been an increased use of cephalomedullary nails in the last decade to treat these fractures. Some arthroplasty surgeons have suggested there is increased morbidity with the use of CMNs when a failure occurs and hips are converted to total hip replacement. These authors have suggested this is a reason to avoid using CMNs in treating intertrochanteric hip fractures, because there is a higher rate of trochanteric nonunions and increased perioperative morbidity. We hypothesized that this was not the case and sought to validate these findings by evaluating the perioperative differences for conversion to THA after the use CMN or SHS at our institution.

Methods: An 8-year, IRB-approved, retrospective review (2004-2012) was performed of patient charts, operative notes, and radiographs of conversion to THA cases. 142 patients were identified who required conversion to THA during this time period. 31 hips underwent conversion to THA after treatment for intertrochanteric hip fracture (SHS 17, CMN 15). Perioperative data, in addition to initial fracture stability (AO/OTA classification) and type of femoral stem used were collected.

Results: Median age was 80 years in the SHS group, 75 years in the CMN group (range, 53-93; $P = 0.56$). The SHS group comprised 6 stable fractures and 11 unstable fracture patterns. In the CMN group there were 8 stable and 7 unstable fracture patterns. Indications for conversion to THA in the CMN group included symptomatic osteoarthritis, osteonecrosis, and loss of fixation resulting in nonunion or malunion. Estimated blood loss (EBL), operating room (OR) time, transfusion rate, body mass index (BMI), and length of stay were similar between groups ($P > 0.05$). Complications in the SHS group consisted of a sciatic nerve palsy, femoral artery thrombosis, 1 periprosthetic infection, 1 superficial infection, 1 wound dehiscence, and 2 trochanteric nonunions. The CMN group had a trochanteric nonunion, a deep infection, and a periprosthetic fracture. The SHS group used 1 cemented, 10 metaphyseal, and 6 diaphyseal stems. The CMN group used 1 cemented, 6 metaphyseal, and 8 diaphyseal stems.

Conclusion: Whether a CMN or SHS was used for primary fixation of an intertrochanteric hip fracture; both implants had similar effects on the perioperative complication rate when a conversion to THA became necessary. Our series differ from other reports that demonstrated increased risk of trochanteric nonunion and increased perioperative complications for CMN. Our results demonstrated no differences in perioperative morbidity regardless of the implant used for primary fracture fixation, suggesting any morbidity observed with conversion to THA is related to factors other than the initial fracture fixation device. The complexity of revision surgery should not affect the decision to use a CMN or SHS as primary treatment for intertrochanteric hip fractures.

See pages 99 - 147 for financial disclosure information.

Revision Surgery in Stable Femoral Neck Fractures Treated With Percutaneous Screw Fixation in Elderly Patients

Michael S. Kain, MD*; Richard Iorio, MD; Andrew J. Marcantonio, DO;*
Lahey Hospital and Medical Center, Burlington, Massachusetts, USA

Purpose: Femoral neck fractures are a major public health problem. Multiple screw fixation is the most commonly used surgical technique for the treatment of stable femoral neck fractures. We determined (1) the rate of conversion to total hip arthroplasty (THA), and (2) the rate of repeat fracture surgery after percutaneous screw fixation of stable (Garden I and II) femoral neck fractures in patients older than 65 years.

Methods: We performed a retrospective study of all patients older than 65 years with stable femoral neck fractures secondary to low-energy trauma treated surgically at our institution between 2005 and 2008. We identified 121 fractures in 120 patients older than 65 years as Garden I or II (stable); all were treated with percutaneous, cannulated screw fixation in an inverted triangle without performing a capsulotomy or aspiration of the fracture hematoma at the time of surgery. Average age of the patients at the time of fracture was 80 years. Radiographs, operative reports, and medical records were reviewed. Fracture union, nonunion, osteonecrosis, intra-articular hardware, loss of fixation, and conversion to arthroplasty were noted. Follow-up averaged 11 months (range, 0-5 years) because all patients were included, including those who died. Mortality rate was 40% for all patients at the time of review.

Results: 12 fractures (9.9%) underwent conversion to THA at a mean of 8.8 months after the index fracture repair (range, 2-24 months); the indications for conversion to THA included osteonecrosis, nonunion, and loss of fixation. In total, 16 fractures (13%) underwent revision surgery, including the 12 for THA, 2 others had peri-implant subtrochanteric femur fractures treated by surgical repair with cephalomedullary nail, and 2 patients had removal of hardware.

Conclusion: Rates of revision surgery of stable femoral neck fractures were higher in this series than previously reported in the literature. The etiology for higher reoperation rate is likely due to poor bone quality and patient age, and some technical component, which leads us to believe other treatment options such as nonoperative mangagement or hemiarthroplasty may be viable options for some of these patients.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Biomechanical Comparison of Quadrilateral Surface Buttress Plates to Traditional Forms of Fixation for Transverse Acetabular Fractures

Brian J. Kistler, MD*; Ian Smithson, MD; Seth Cooper, MD; Jacob Cox, MD;*
Scott Marberry, MD; Aniruddh Nayak, MS; Brandon Santoni, PhD; H. Claude Sagi, MD;
Orthopaedic Trauma Service, Florida Orthopaedic Institute, Tampa, Florida, USA;
Foundation for Orthopaedic Research & Education, Tampa, Florida, USA;
University of South Florida, Tampa, Florida, USA

Purpose: This study evaluated the biomechanical stability conferred by two designs of quadrilateral surface (QLS) plates that can be used in conjunction with the anterior intrapelvic approach for fixation of transtectal transverse acetabular fractures. We hypothesized that the new fixation devices would be biomechanically equivalent to the current standard fixation constructs using buttress plates and lag screw fixation of both the anterior and posterior columns.

Methods: 35 synthetic hemipelves were allocated to one of five fixation groups after creation of a transtectal acetabular fracture (OTA 62-B1): (1) posterior column plate + anterior column lag screw (posterior column plate), (2) anterior column plate + posterior column lag screw (anterior column plate), (3) anterior and posterior column lag screws (lag screw), (4) infrapectineal QLS plate + anterior column plate (IP), and (5) suprapectineal QLS plate alone (SP). Testing (Fig. 1) consisted of (1) 10 cycles to 0.25 × body weight (BW) (17.5 N-175 N) to calculate baseline stiffness, (2) cyclical loading (1500 cycles using a stepwise increasing load protocol in 250-cycle increments to 2.5 × BW) to calculate final stiffness, and (3) load to failure at 1 mm/sec.

Results: After 1500 cycles, the IP and SP constructs exhibited the greatest final stiffness (Fig. 2). The IP group was significantly stiffer than the posterior column plate group ($P = 0.006$) and the SP group was significantly stiffer than the posterior column plate and anterior column plate groups ($P = 0.002$ and $P = 0.031$, respectively). The IP group demonstrated significantly less medial subluxation (average 1.2 mm) when compared to anterior column plate (average 2.1 mm, $P = 0.017$) and lag screw groups (average 2.7 mm, $P < 0.001$); the difference between the IP and posterior column plate group (1.4 mm) was not statistically significant ($P = 0.993$). The SP group was equivalent to the posterior column plate and anterior column plate groups in resisting medial subluxation.

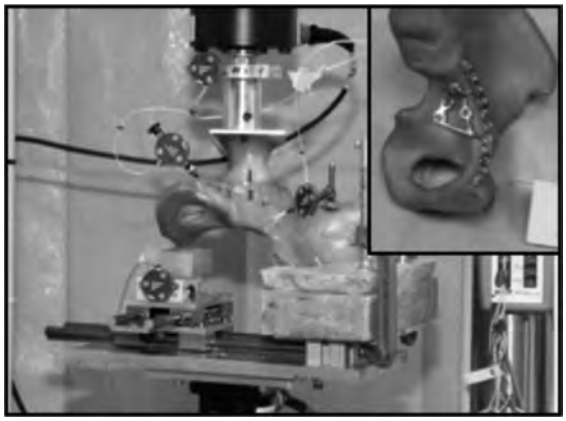


Fig. 1. Test setup. Inset: SP plate.

See pages 99 - 147 for financial disclosure information.

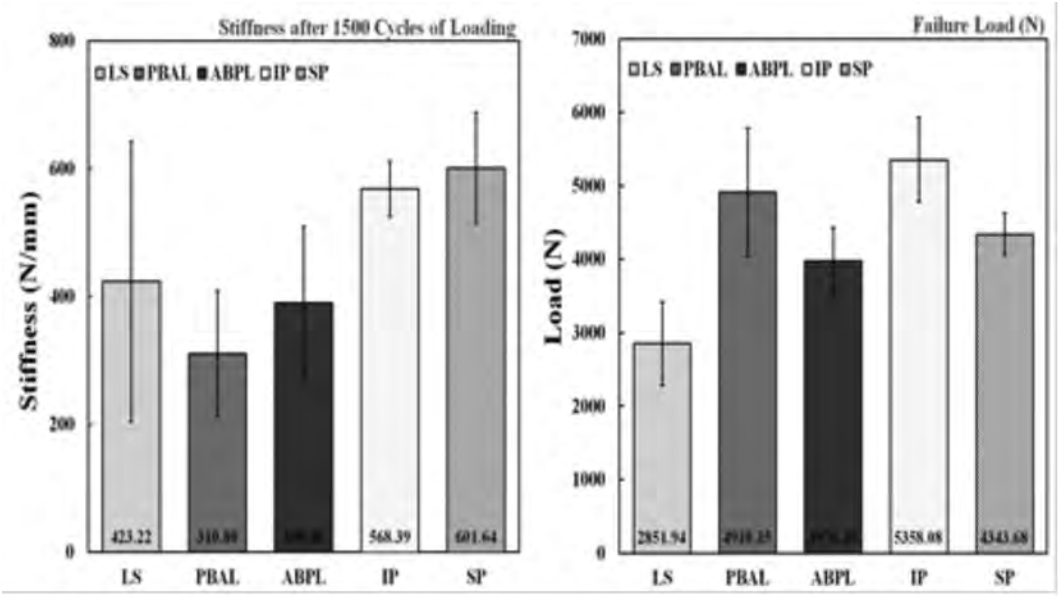


Fig. 2. Stiffness (left) and failure load (right) results.

Conclusion: Quadrilateral surface buttress plates (both infrapectineal and suprapectineal) spanning the posterior and anterior columns are at least equivalent and, in some cases, superior to traditional forms of fixation and may present a viable alternative for the treatment of transtectal transverse acetabular fractures when an anterior intrapelvic approach is performed.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Outcomes of Trochanteric Osteotomies for Acetabular Fracture Surgery

***Andrew Dubina**; Niluka Wickramaratne, BSE; Robert V. O'Toole, MD;*
Theodore T. Manson, MD;
R Adams Cowley Shock Trauma Center, Department of Orthopaedics,
University of Maryland School of Medicine, Baltimore, Maryland, USA

Background/Purpose: Trochanteric osteotomies are used to improve surgical exposure during open reduction and internal fixation of acetabular fractures when used in conjunction with standard approaches. The total hip arthroplasty literature has reported nonunion rates as high as 30% with trochanteric osteotomies; however, few data exist regarding the outcomes of trochanteric osteomoties for acetabular fracture surgery. Our primary hypothesis was that patients who received trochanteric osteotomies during open reduction and internal fixation of an acetabular fracture would have low rates of complications such as nonunion of the trochanteric fragment or need for removal of symptomatic hardware. A secondary hypothesis was that hip abduction precautions are not necessary in digastric type osteotomies.

Methods: A retrospective review was conducted of a prospectively collected database at an academic trauma center to identify patients with all acetabular fractures between July 2002 and June 2010 (n = 734 fractures) who required trochanteric osteotomies (n = 64, 8% of fractures). 47 of the fractures with trochanteric osteotomies met inclusion criteria of adequate follow-up (>56 days) to evaluate healing. No excluded patient had a complication. Fractures were classified by the attending orthopaedic surgeon using the Letournel-Judet classification system and grouped as 7 simple and 40 associated fractures. The study cohort of patients included 12 unigastric and 35 digastric osteotomies. Of the unigastric trochanteric osteotomies, 5 (42%) were for extended iliofemoral and 7 (58%) were for Kocher-Langenbeck approaches. Only 7 of 35 (20%) digastric osteotomies were given hip abduction precautions in the postoperative period. The primary outcome measure in this study was complete radiographic union of the osteotomy site as determined by an independent fellowship-trained orthopaedic trauma surgeon and maintenance of hardware of the trochanteric osteotomy site at final follow-up.

Results: All study patients demonstrated radiographic union of the trochanteric osteotomy site (100% union rate, n = 47). Only 20% of the digastric trochanteric osteotomies were given hip abduction precautions postoperatively yet they all (n = 35) healed uneventfully. No significant difference was found in the number of patients who had their trochanteric osteotomy screws removed between our data and a historical control (13% vs. 20%, $P = 0.43$).

Conclusion: Despite the infrequent application of abduction precautions that are intended to protect the osteotomy site and reduce the risk of nonunion or fixation failure, our data demonstrate a 100% union rate (n = 47) of trochanteric osteotomies at 8 weeks postoperatively. Additionally, it appears it may be safe to not use hip abduction precautions in patients with digastric trochanteric osteotomies. There are multiple protective factors against nonunion in this study population compared with prior arthroplasty patients as trauma patients are younger with better healing potential and are more likely to be non–weight bearing in the postoperative period, which might protect the osteotomy. Regardless, it appears that trochanteric osteotomies do not have a significant nonunion rate or a large rate of symptomatic hardware removal and that digastric osteotomies may be safe to manage without hip abduction precautions.

See pages 99 - 147 for financial disclosure information.

13-Year Experience in External Fixation of the Pelvis: Complications, Reduction, and Removal

Phillip M. Mitchell, MD; Chad M. Corrigan, MD; Neelam A. Patel, BA; Arnold J. Silverberg, BS; Rachel Thakore, BA; William T. Obremskey, MD, MPH; Jason M. Evans, MD; Jesse M. Ehrenfeld MD, MPH; ***Manish K. Sethi, MD****; Vanderbilt University, Nashville, Tennessee, USA*

Background/Purpose: External fixation (EF) of the pelvis together with sacroiliac (SI) screws is often employed as a definitive treatment for unstable disruptions of the pelvic ring in physiologically challenged patients. Previous studies of EF for pelvic ring injuries have reported a high incidence of complications, including infection rates of up to 50%. We reviewed the history of pelvic EF at our institution, including the utility of pelvic EF in maintaining reduction of the anterior ring and the risks of complications including readmission and infection. Finally, we reviewed the location of removal of these devices to evaluate the feasibility of removing a pelvic EF in a clinic setting.

Methods: We performed a retrospective chart review of patients who underwent anterior external fixation of the pelvis and SI screw placement for their pelvic ring injuries over a 13-year period at a Level I trauma center. The initial search of the database identified 195 patients. After excluding patients who did not survive their injuries, those who did not have adequate follow-up (minimum 2 months), and patients whose EF was not their definitive fixation, 130 patients met the inclusion criteria. These patients' charts were reviewed for age, sex, race, body mass index (BMI), duration of EF, location of EF removal, and associated injuries at initial presentation. Charts were also reviewed for any complications postoperatively, including the use of oral antibiotics for pin site concerns, presentation to an emergency department for EF concerns, readmissions, and unplanned reoperations on the pelvis. AP, inlet, and outlet radiographs of the pelvis were reviewed and measurements were made to quantify the symphysis diastasis and the vertical and posterior displacement of each hemi-pelvis relative to the contralateral side. From our cohort, 76 patients with radiographic follow-up of at least 2 months were identified and radiographs prior to EF removal and post removal were compared to evaluate for a loss of reduction, defined as a change of greater than 1 cm in one or more pelvic dimensions.

Results: 130 patients met the criteria of anterior EF of the pelvis and SI screw placement with a mean follow-up of 359 days. Mean duration of external fixation was 61 days. Of those patients undergoing EF, there were 14 patients (10.8%) who presented to an emergency department with issues related to the pelvic EF device, 7 (5.4%) of whom required readmission for deep infection. Of those requiring readmission, all were admitted for intravenous antibiotics and 6 (4.6%) required formal operative debridement. 13 patients (10.0%) had superficial pin site infections requiring oral antibiotics. Reduction was maintained in all patients (n = 76, average follow-up of 216 days) following removal of their pelvic EF with an average change in the symphysis diastasis, and anterior and posterior displacement of 1.2 mm, 3.9 mm, and 4.0 mm, respectively. 38 patients (30.2%) had their EF removed in clinic while the remaining 88 (69.8%) had them formally removed in the operating room.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Conclusion: We present the largest cohort of patients receiving prolonged EF of the pelvis with SI screws and the complications secondary to this treatment. While previous data suggest high complication rates in the definitive management of pelvic ring injuries with EF, data collected over a 13-year period suggest low complication rates while maintaining reduction of the pelvic ring. Additionally, we found that these devices could be reliably removed in a clinic setting, saving the additional time and expense associated with removing an EF in the operating room.

See pages 99 - 147 for financial disclosure information.

Precision of Computer-Navigated Versus Fluoroscopic Guided Fixation of Percutaneous Iliosacral Screws

Jan F.M. Verbeek, BSc[1]; Erik Hermans, MD[2]; Arie B. van Vugt, MD, PhD[2];
Jan Paul M Frölke, MD, PhD[1];
[1]Radboud University Medical Center, Nijmegen, The Netherlands;
[2] Medical Spectrum Twente, Enschede, The Netherlands

Background/Purpose: Percutaneous iliosacral (IS) screw fixation is commonly applied to stabilize the posterior pelvic ring in patients with unstable pelvic fractures. Adequate IS screw fixation is challenging and requires a high degree of spatial visualization skills and detailed knowledge of pelvic anatomy. Misplacement of the IS screw is not uncommon and may lead to iatrogenic nerve root injury. Therefore, it is of key importance to determine the most effective treatment strategy. Currently, IS screw fixation is assisted by two techniques; conventional fluoroscopy (CF) and computer-navigated surgery (CNS). However, evidence on the effectiveness of the technologies in practice is limited. The aim of this study is to compare CNS with CF on the accuracy of IS screw fixation by reviewing postoperative CT scans.

Methods: Patients with traumatic pelvic ring instability treated with percutaneous IS screw fixation (Biomet BV Dordrecht, The Netherlands) at two Level I trauma centers in the Netherlands in the period 2008-2013 were studied. A computer navigation system (Medtronic Heerlen, The Netherlands) had been implemented 3 years before. Excluded were patients with arthritis, osteoarthritis, pathologic fracture, tumor, and previous operation of the pelvic bone or acetabulum. Data on age, gender, body mass index (BMI), ISS, injury-surgery time interval, and Tile classification were collected. Insertion of the IS screws was assessed by postoperative CT scan and contrasted between CNS and CF.

Results: The computer-navigated group (n = 55) and the conventional fluoroscopic group (n = 24) were comparable in age (mean, 43 years), gender (58% male), BMI (25 kg/m^2), ISS (27), injury-surgery time interval (7 days), and Tile classification (40% B, 60% C on average). In the CNS patient group a total of 109 screws were placed (2.0 per patient), 73% adequately. In the CF group the findings were 40 screws (1.7 per patient), 75% adequately. Inadequate fixation comprised neural foramina hit: CNS 19 screws (17%) versus CF 5 screws (13%), $P = 0.90$; and extraosseous dislocation: CNS 11 screws (10%) versus CF 5 screws (12%), $P = 0.63$. The reoperation rates did not differ between CF and CNS.

Conclusion: In contrast to what has been suggested by previous studies, we found no benefit from computer-navigated IS screw fixation compared to fluoroscopic technique regarding precision of screw placement on postoperative CT scans.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

The Effect of Initial Reduction and Method of Reduction on Final Alignment in Type 3 Posterior Pelvic Ring Injuries

Paul Tornetta III, MD[1]*; Adam Lindsay, MD*[1]*; John Kurylo, MD*[1]*; David Templeman, MD*[2]*;*
[1]*Boston University Medical Center, Boston, Massachusetts, USA;*
[2]*Hennepin County Medical Center, Minneapolis, Minnesota, USA*

Background/Purpose: Malunion after Type 3 posterior pelvis injuries can lead to persistent pain and disability. While there are excellent data on the ability to reduce these fractures, there are little data about the change in position of pelvic injuries during healing. We sought to evaluate the effect of initial reduction quality and method of reduction on final alignment. We hypothesized that closed reduction and open reduction techniques would have equal efficacy in maintaining reduction to union and that greater postoperative displacement would lead to greater change in alignment.

Methods: We reviewed the records of 100 patients with unilateral Bucholz Type 3 posterior ring injuries treated by two physicians at two Level I trauma centers. Patients were treated with either open reduction or closed reduction with traction and multiple percutaneous iliosacral screws were used for posterior fixation in all cases. Patients were evaluated with immediate postoperative pelvis radiographs and radiographs at the time of union. Displacement was measured as the vertical difference in the iliac wing, sacrum, and ischial heights perpendicular to a plumb line on the AP pelvis radiographs. Displacements were compared using a two-tailed *t*-test assuming $P < 0.05$ for significance. Pearson's correlation was used to evaluate the relationship of initial displacement with the change in displacement during union.

Results: 40 patients were treated with a closed reduction and 60 with open reduction. There was no difference between the groups in initial displacement at the time of injury, gender, injury severity score or time to surgery. The average length of follow-up was 622 days. All injuries united. Initial postoperative displacement was greater in the open reduction group, and this difference was maintained through to union (Table 1). The average increase in displacement from immediate postoperative films to the final films after union was greater in the group treated with an open reduction technique (Table 2). Immediate postoperative displacement did not predict displacement over time for either group (Pearson's correlation –0.08 to –0.31). Additionally, there was no difference in the interval displacement in patients who were plated anteriorly versus those who were not ($P = 0.4$, 0.8, 0.9 for iliac, sacral, and ischial heights).

Table 1	**Displacement at Union (mm)**		
	ORIF	CRPP	*P* Value
Iliac wing height (AP)	5.1 ± 5.2	2.7 ± 1.5	0.006
Sacral height (AP)	4.1 ± 6.0	2.4 ± 1.5	0.086
Ischial height (AP)	5.9 ± 6.3	2.9 ± 1.8	0.003

ORIF = open reduction and internal fixation, CRPP = closed reduction and percutaneous pinning.

See pages 99 - 147 for financial disclosure information.

Table 2	Change in Displacement From Postoperatively to Union (mm)				
	ORIF	Range	CRPP	Range	*P* Value
Iliac wing height (AP)	2.6 ± 4.4	0 to 19.4	1.3 ± 1.3	0 to 5.4	0.066
Sacral height (AP)	2.0 ± 4.6	0 to 29.0	0.9 ± 1.5	0 to 7.5	0.159
Ischial height (AP)	2.6 ± 4.2	0 to 18.0	1.0 1.7	0 to 9.8	0.022

Conclusion: We evaluated the effect of reduction technique and initial postoperative displacement on maintenance of reduction to union in unstable posterior pelvic ring injuries. Our data suggest that a percutaneous reduction technique may have an influence on maintenance of reduction with statistically less displacement during union as well as better final alignment in iliac and ischial height. Sacral height trended toward better alignment. Greater postoperative malalignment did not correlate with change in alignment and the use of anterior fixation did not influence the displacement over time. Finally, we found that in both groups, there was a shift in alignment during union that was as high as 29 mm in the open group and 9.8 mm in the closed group.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

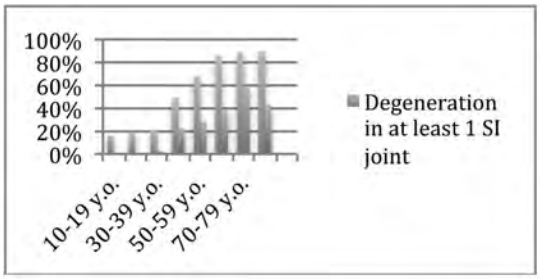
The Prevalence of Sacroiliac Joint Degeneration in Asymptomatic Adults: A Review of 500 CT Scans

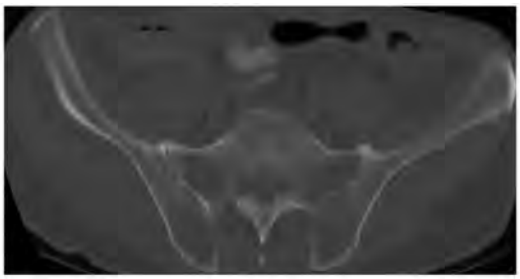
Jonathan-James T. Eno, MD*; Christopher R. Boone, MD; Michael J. Bellino, MD; Julius A. Bishop, MD;*
Stanford University, Stanford, California, USA

Purpose: Many physicians implicate degenerative changes in the sacroiliac (SI) joint as a potential cause of low back pain, especially in the setting of prior trauma to the pelvic ring. However, the age-related prevalence of SI joint degeneration in asymptomatic individuals has not been clearly established. The purpose of the study was to determine the prevalence of SI joint degeneration in asymptomatic patients.

Methods: Pelvic CT scans of 373 consecutive skeletally mature patients obtained for reasons other than back pain were reviewed for evidence of SI joint degeneration. Patients with a history of back pain, hip or spine surgery, trauma, metastatic cancer, or rheumatologic disease were excluded. SI joint degeneration was graded as type 0 if no degenerative changes were present, type 1 in the presence of minimal degenerative changes, type 2 in the setting of significant degenerative changes without ankylosis, and type 3 in the setting of ankylosis.

Results: The overall prevalence of degenerative changes in at least one SI joint was 35% and the prevalence of significant degeneration (type 2 or 3) in at least one SI joint was 30%. The prevalence increased with each decade of life with 16% of patients in the second decade of life and 90% in the 8th decade of life being affected. Significant degenerative changes were not observed in any patients younger than 25 years old (y.o.) but were present in 43% of patients in the 8th decade of life.





Conclusion: Degenerative changes of the SI joints are prevalent in an asymptomatic patient population and appear to be an expected part of human aging. Given the high prevalence of pain-free SI joint degeneration, surgeons must be cautious in attributing low back pain to SI joint degeneration seen on CT scan. Surgeons must be especially cautious in the post-traumatic setting, where often radiographic changes are assumed to be sequelae of prior trauma. Diagnostic tests to distinguish SI joint pain from other sources of back pain merit additional research.

See pages 99 - 147 for financial disclosure information.

Does Surgical Stabilization of Pelvic Ring Fractures Positively Impact Patients' Pain, Narcotic Requirement, and Mobilization?

*Jennifer Hagen, MD[1]; Renan Castillo, PhD[2]; Andrew Dubina[1]; Greg Gaski, MD[3]; Robert O'Toole, MD[1]; **Theodore Manson, MD**[1];*
[1]R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA;
[2]Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA;
[3]Indiana University Health System, Indianapolis, Indiana, USA

Purpose: There is continued debate over the role for surgical treatment in certain types of lateral compression (Young-Burgess, LC; OTA 61-B2) pelvic ring injuries. Some surgeons argue that operative stabilization limits pain and eases mobilization but data evaluating against a control group are not yet present. Our hypothesis is that patient-reported pain scores, narcotic use, and time to mobilization would all be lower in patients with LC1 and LC2 fractures treated operatively as compared to those treated nonoperatively.

Methods: We performed a retrospective review of consecutive LC1 and LC2 fractures treated definitively at one institution from 2007 to 2013. All operative cases, all nonoperative LC2, and all nonoperative LC1 fractures with complete sacral injury were included. The operative and nonoperative groups were matched for fracture type. In order to account for differences between patients treated operatively and nonoperatively, we used propensity-modeling techniques incorporating all treatment predictors. Propensity scores demonstrated good overlap, and were used as part of multiple variable regression models to account for selection bias between the operative and no-operative groups. Patient-reported pain scores and narcotic administration were tracked during the first 24 hours of hospitalization, at 48 hours after intervention, and in the 24 hours prior to discharge. Time from intervention to therapist-directed mobilization out of bed was recorded. 115 patients in the LC1 group (81 nonoperative, 34 operative) and 89 patients in the LC2 group (58 nonoperative, 31 operative) met inclusion criteria.

Results: Of the 12 analyses conducted (6 outcomes each for LC1 and LC2), 9 showed no significant difference, including days to mobilization, length of stay, pain at 48 hours and morphine equivalents at 24 hours. The pain scores were higher in the operative LC1 group at discharge ($P = 0.03$) as were the morphine requirements at 48 hours ($P = 0.008$). The only variable that favored operative treatment was morphine requirement at the 48-hour mark ($P = 0.04$) in the LC2 fractures.

Conclusion: We only found 1 of 12 analyses (narcotic requirement at 48 hours in the LC2 group) favored surgical treatment, while 3 analyses favored nonoperative treatment. The majority of analyses (9/12) showed no difference between groups. Fractures with more displacement, and perhaps more likelihood of having pain, are found more commonly in the operative groups. Therefore, even with propensity matching, we might still expect outcomes to appear to be in favor of the nonoperative group, but this was not generally the case. For this reason it remains unclear whether surgical stabilization of certain LC1 and LC2 pelvic fractures positively impacts patients' pain, narcotic requirement, and time to mobilization, although our data cast some doubt on the validity of this claim.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Does Application of a Pelvic Binder Affect the Sensitivity of Computed Tomography for Detecting Pelvic Ring Injuries?

John Swartz, DO; ***Rahul Vaidya, MD****; Paul Dougherty, MD; Fred Tonnos, MD; Bryant Oliphant, MD;*
Detroit Medical Center, Detroit, Michigan, USA

Background/Purpose: Placement of a pelvic circumferential compression device (PCCD) in the setting of an unstable pelvic ring injury is a well-accepted component of Advanced Trauma Life Support guidelines. These devices are effective in decreasing pelvic volume by reducing anterior and posterior ring injuries. Theoretically this could alter our ability to recognize the injury on radiographs and CT scans. The aim of this study was to determine how and when pelvic ring injuries might be obscured by the application of a pelvic binder, and to identify those patients at risk for missed injuries.

Methods: An IRB-approved retrospective study was preformed using the data from a Level I and Level II trauma center database for pelvic ring injuries. The database included 867 patients with pelvic ring injuries. Inclusion criteria were a significant pelvic ring injury that first had an AP pelvic radiograph followed by application of a pelvic binder, followed by a CT scan, then an examination under anesthesia (all had operative fixation). Exclusion criteria were pelvic binders placed prior to radiographs, after CT scans, inadequate radiographs, timing of pelvic binder not documented, or inadequate examination under anesthesia. We identified 43 patients who met the criteria. They were classified separately by both a senior orthopaedic resident and a fellowship-trained orthopaedic traumatologist using the AO/OTA classification system. All patents had a fluoroscopic examination under anesthesia at the time of definitive fixation. To determine the sensitivity of CT imaging, we defined a false negative as any OTA type B or C injury that was occult on CT but noted in either of the other modalities. To determine sensitivity of initial radiographs, a false negative was any injury that was occult on radiographs, but noted using either of the other modalities.

Results: The sensitivity of CT with pelvic binder in place was 83.7%. The CT scan yielded a less diagnostic classification in 7 patients when compared with the initial trauma radiograph, which was verified on the fluoroscopic examination under anesthesia. The sensitivity of initial trauma radiograph alone when compared to the combination of CT scan with binder and examination under anesthesia was comparable at 79.1%.

See pages 99 - 147 for financial disclosure information.

AO/OTA XR	AO/OTA CT	EUA
61-C1.2a2c5	No injury noted	Bilateral SI joint widening
61-B1.1c5 (right)	61-B1.1c4 (right)	Bilateral SI joint widening
61-C1.2a3c5	61-B1.1c5	Vertical instability
61-B3.1(1)c5	61-B1.1c4	Right SI widening
61-C1.2a1c4	61-B2.2c10	Vertical instability
61-B1.1c8 (right)	61-B1.1c8 (left)	Bilateral SI joint widening
61-C2.2a2b1.1c5	61-B3.1(1)c5	Right SI widening

XR = radiograph, EUA = examination under anesthesia, SI = sacroiliac.

Conclusion: The placement of a pelvic binder has the potential to mask the severity of some pelvic ring injuries when relying only on CT for diagnosis. This was particularly true for open book–type injury patterns. A pre-binder AP radiograph may be diagnostic in these situations. Fluoroscopic examination under anesthesia is an essential adjunct when a binder is placed prior to the start of any imaging.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Comparison of Circumferential Pelvic Sheeting Versus Commercially Available Pelvic Binders on Unstable Pelvic Injuries: A Biomechanical Cadaveric Study

Mark L. Prasarn, MD[1]*; Joshua L. Gary, MD*[1]*; MaryBeth Horodyski, PhD*[2]*;*
Glenn R. Rechtine, MD[3]*;*
[1]*University of Texas, Houston, Texas, USA;*
[2]*University of Florida, Gainesville, Florida, USA;*
[3]*University of Rochester, Rochester, New York, USA*

Background/Purpose: Commercially available binder devices are being increasingly applied to pelvic fractures, while many advocate simply placing a circumferential sheet for initial stabilization of such injuries. Control of hemorrhage in such situations is improved by a decrease in pelvic volume, but also immobilization of the fracture. We sought to determine whether these devices would provide more stability to an unstable pelvic injury as compared to circumferential pelvic sheeting, and compare them to each other. The null hypothesis was that there would be no significant differences in stability conferred by any of the tested devices.

Methods: Unstable pelvic injuries (OTA type 61-C-1) were surgically created in five fresh, lightly embalmed whole human cadavers. The pubic symphysis, rectus attachment, pelvic floor, anterior-posterior sacroiliac ligaments, sacrospinous, sacrotuberous, and iliolumbar ligaments were sharply transected unilaterally. Electromagnetic sensors were placed on each hemipelvis on each side of the pubic symphysis. The amount of angular motion during testing was measured using a Fastrak, three-dimensional, electromagnetic motion analysis device (Polhemus Inc, Colchester, VT). Either a T-POD, Sam Sling, Pelvic Binder, or circumferential sheet was applied in random order for testing by a fellowship-trained orthopaedic traumatologist. The measurements recorded in this investigation included maximum displacements for sagittal, coronal, and axial rotation during application of the device, bed-to-bed transfer, log-rolling, and head-of-bed elevation (45°).

Results: There were no differences in motion of the injured hemipelvis during application of any of the binder devices or the circumferential sheet. During the bed transfer, log-rolling, and head-of-bed elevation, there were no significant differences in displacements observed when the pelvis was immobilized with either a sheet or any of the pelvic binder devices. In addition, there were no differences when comparing the binders to each other (all $P > 0.05$).

Conclusion: There appear to be no advantages of using one particular commercially available binder to any of the devices commercially available with regard to the amount of stability provided to the unstable pelvic ring. A circumferential pelvic sheet is more readily available, costs less, is more versatile, and is equally as efficacious at immobilizing the unstable pelvis as compared to the commercially available pelvic binders tested. We advocate the use of circumferential sheeting for temporary stabilization of unstable pelvic injuries.

See pages 99 - 147 for financial disclosure information.

Surgical Approach Algorithm for Transverse + Posterior Wall Fractures

Yelena Bogdan, MD; Shashank Dwivedi, MS; ***Paul Tornetta III, MD;***
Boston University Medical Center, Boston, Massachusetts, USA

Background/Purpose: Transverse + posterior wall (TR-PW) fractures are difficult to treat and have historically poor results, which correlate with the reduction. The Kocher-Langenbeck (KL) approach is used most often, while the extended iliofemoral, which has greater risks, has been reserved for more complex variants. No data exist on the use of sequential anterior and posterior approaches for this pattern. The purpose of this study is to evaluate an algorithmic method to determine the choice of surgical approach(es) for TR-PW fractures. We aimed to evaluate the effectiveness of the algorithm with respect to the reduction of the fractures and to report on the results of patients treated with it in the context of prior literature.

Methods: This was a retrospective study of a single-surgeon series of open reduction and internal fixation (ORIF) of TR-PW fractures. Exclusion criteria were inadequate imaging or follow-up and percutaneous or nonoperative treatment. Demographic, injury, surgery, and complication data were collected from medical records. Images (5-view pelvis radiographs and CT scans) for each patient were evaluated for fracture pattern and subtype (transtectal, juxtatectal, or infratectal), associated dislocation, direction, and amount of displacement of the ischiopubic fragment after any dislocation was reduced, presence of impaction or intra-articular fragments, final reduction, and subsequent union. Anatomic reduction was defined as the fracture site not being visible or being visible with ≤1 mm displacement and no joint step-off (as per Matta). We also made an effort to contact each patient by telephone to obtain updated data on functional status (Merle d'Aubigné score) when they could not return to the clinic. Radiographic arthritis was defined by Matta criteria, and osteonecrosis was defined as any changes in the trabecular pattern of the head. Heterotopic ossification (HO)was graded by the Brooker method.

Results: Of 114 TR-PW fractures in the database, 49 were excluded and 65 patients met criteria; average follow-up was 23 months. 82% were treated with KL and 18% with sequential ilioinguinal and KL approaches. All juxtatectal and infratectal fractures were treated with the KL approach while the approach to transtectal fractures relied on further assessment of radiograph and CT scans. Direction of displacement, as defined by direction of translation of the ischiopubic segment on axial CT, was the most important determinant, followed by obliquity of the fracture line. The sequential approach was used when the TR fracture was more vertical, exiting high in the anterior column, for displacement >1cm, and for anterior translation. The algorithm resulted in 100% reduction within 1 mm (anatomic by Matta). Initial displacement was significantly higher in the sequential approach (p=0.01). The functional outcome as measured by Merle d'Aubigné score (average 16.3), radiographic arthritis (68% good/excellent), osteonecrosis (8%), revision (8%), grade III HO (1.5%), and infection (6%) rates are comparable with prior reports. Five patients went on to total hip arthroplasty (4 KL, 1 sequential) at 1-3 years after injury. Patients treated with the sequential approach had significantly less HO compared with the KL approach ($P = 0.04$); however, all but one patient had Brooker grade I or II, and no patient required excision.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Conclusion: The use of sequential ilioinguinal and KL approaches for specific TR-PW acetabular fractures allowed for anatomic reductions in all cases. The use of an algorithm taking into account the obliquity and separation of the fracture as well as the translational displacement leads to good clinical and radiographic outcomes, and has notably decreased HO rates. However, despite excellent reductions and no loss of reduction or nonunions, our results are similar to Matta and Letournel and demonstrate a higher rate of joint space narrowing and conversion to total hip arthroplasty than other patterns.

See pages 99 - 147 for financial disclosure information.

The Safety and Efficacy of Pelvic External Fixation as a Definitive Mode of Stabilization of the Anterior Pelvic Ring

*Hassaan Q. Sheikh; **Theodoros Tosounidis**; Nikolaos Kanakaris; Peter V. Giannoudis, MD; Academic Unit of Trauma and Orthopaedics, Leeds General Infirmary, Leeds, United Kingdom*

Background/Purpose: Pelvic external fixators (PEFs) are used either as a definitive or temporary stabilization device of the pelvis in the setting of trauma. When they are used as a definitive type of fixation, they can either be combined with posterior stabilization or used as a solitary definitive fixation depending upon the fracture configuration. The purpose of this study was to evaluate outcomes and complications of patients who sustained pelvic fractures and were treated with anterior PEFs as a definitive mode of fixation.

Methods: We identified all consecutive patients that were admitted in a Level I academic trauma center with pelvic fractures and had application of a PEF as definitive surgical management between March 2007 and December 2012. A retrospective analysis of prospectively documented data was performed. The clinical notes as well as all imaging studies (plain radiographs and CT scans) were independently reviewed by two pelvic surgeons. Patients with insufficient follow-up were excluded from the study. Details such as patient demographics, fracture type according to the Young-Burgess classification, ISS, associated injuries, and length of hospital stay were documented and analyzed. Particular emphasis was given to complications related to the PEF (superficial and deep infection, iatrogenic neurovascular injury, pin site loosening) and midterm efficacy of the procedure. The minimum follow-up was 12 months (range, 12-60).

Results: A total of 70 patients with a mean age of 36.3 years (range, 381) met the inclusion criteria with a mean ISS of 27.4 (range, 9-66). Fracture distribution included 6 APC (anterior-posterior compression), 56 LC (lateral compression), 3 VS (vertical shear), and 5 CM (combined mechanism) injuries. 65 PEFs were applied to the iliac crests and 5 to the supra-acetabular region. All the PEFs were applied utilizing small stab incisions. 12 PEFs were applied as the only definitive mode of fixation whereas 58 were applied in conjunction with anterior (retropubic screw) or posterior ring fixation (iliosacral screws or posterior open reduction and internal fixation [ORIF]). The PEFs were removed after a mean of 53 days (range, 30-94). The mean number of days to full weight bearing was 103 (range, 22-335). Mean inpatient stay was 27 days (range, 6-121) and mean intensive care stay was 5 days (range, 0-24). 13 patients (18.6%, 6 females and 7 males) developed superficial pin site infection that was managed with antibiotics. Mean time to diagnosis of infection was 23 days (range, 2-39). Another patient (1.4%) became septic from a deep pin site infection which required intensive care stay and pin site debridement. Only one patient (1.4%) had iatrogenic lateral femoral cutaneous nerve injury causing long-term paraesthesia. Pin site loosening was noted in 5 patients (7.1%), three of which occurred early in the course of management and required adjustment of the PEF. Two patients (2.9%) developed symptomatic pulmonary emboli. One patient (1.4%) with a VS injury developed a symptomatic nonunion of the pubic rami and sacrum. Loss of reduction at final follow-up defined as more than 1-cm displacement of the anterior pelvic ring compared to the intraoperative reduction was noted in 19 (27.1%) patients (16 LC, 1 VS, and 2 CM fractures). None of the

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

patients with anterior malunion complained of anterior pelvic pain that required secondary operative intervention.

Conclusion: The application of iliac crest and supra-acetabular PEFs is a safe and effective intervention for the management of pelvic injuries, either in isolation or in combination with other modes of posterior and/or anterior pelvic ring stabilization. We attribute our low local soft-tissue complication rate to meticulous technique and the fact that the PEFs were applied by specialized pelvic surgeons.

See pages 99 - 147 for financial disclosure information.

Biomechanical Analysis of Mechanically Unstable Pelvic Fractures: Retrograde Superior Pubic Ramus Screw Versus Anterior External Fixation

Justin A. Krajca, MD*; Hyunchul Kim, MS; Jason W. Nascone, MD; Theodore T. Manson, MD; Christina L. Boulton, MD; Adam H. Hsieh, PhD; Robert V. O'Toole, MD;*
R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA

Purpose: Little is known about the biomechanical properties of the superior pubic ramus (SPR) screw, which has been proposed as a percutaneous alternative to traditional anterior external fixation for pelvic ring disruptions. We hypothesize that the retrograde SPR screw will have no biomechanical advantage over traditional anterior external fixators in an unstable pelvic fracture model with posterior fixation in place that is typical in common clinical practice.

Methods: Using five commercially available fourth-generation composite pelvis bone models (Pacific Research Laboratories, Vashon Island, WA) for each test case, an unstable pelvic ring injury (OTA 61-B2.1, LCI) was simulated. We excised 1 cm from the left sacrum and ipsilateral superior and inferior pubic rami to represent a complete, comminuted sacral fracture with comminuted pubic rami fractures in Nakatani Zone II (mid-ramus). All five composite models had the posterior ring stabilized with two stainless steel, fully threaded, 7.3-mm cannulated iliosacral screws into the vertebral bodies of S1 and S2, as is done in clinical practice. External fixators were applied using single 5-mm Schanz pins in the supra-acetabular bone bilaterally, connected to a single 11-mm curved carbon fiber rod with standard pin-bar clamps. Retrograde SPR screws placed were 32-mm partially threaded, 7.3-mm cannulated screws (Synthes, West Chester, PA) extending to the lateral iliac cortex cephalad to the acetabulum. Four constructs were tested sequentially in a randomized order: (1) control with posterior fixation and no anterior fixation, (2) external fixation with clamps placed at 8 cm above the bone, (3) external fixation with clamps placed at 12 cm above the bone (simulating an obese patient), and (4) partially threaded retrograde SPR screw. An axial load through the hip joint of 250 N was cycled 30 times in an anatomically neutral position with a simulated single-legged stance and floating pelvis test configuration as previously described. Outcome measure was construct stiffness (N/mm). Analysis of variance was performed with significance at $P = 0.05$.

Results: In contrast to our hypothesis, the retrograde SPR screw (mean axial stiffness 118.9 N/mm ± 12.9 SD) had significantly improved biomechanics compared to the control with posterior fixation alone (36.0 N/mm ± 12.4 SD, $P < 0.001$). No significant difference was noted between the 8 cm or 12 cm external fixator constructs and the control (45.0 N/mm ± 12.9 SD, $P = 0.83$; 41.5 N/mm ± 12.9 SD, $P = 0.98$, respectively). The SPR screw was 164% ($P < 0.001$) and 186% ($P < 0.001$) stiffer than 8 cm and 12 cm external fixators.

Conclusion: In contrast to our hypothesis, the retrograde superior pubic ramus screw provides significantly improved biomechanical performance over external fixator constructs in an unstable pelvic fracture model. Despite the mechanical advantage of being closer to bone, the external fixator at 8 cm was not stiffer than when placed at 12 cm above the

POSTER ABSTRACTS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

bone. Neither external fixator construct had an axial stiffness significantly different from the control model with no anterior fixation. The clinical importance of this large difference is unknown, but SPR screws appear to confer a significant mechanical advantage over anterior external fixation in this loading scenario.

See pages 99 - 147 for financial disclosure information.

Is It Safe to Use Kinetic Bed Therapy During ICU Management of the Trauma Patient With an Unstable Cervical Spine Injury?

Mark L. Prasarn, MD[1]*; Caleb Behrend, MD*[2]*; MaryBeth Horodyski, PhD*[3]*;*
Glenn R. Rechtine, MD[2]*;*
[1]*University of Texas, Houston, Texas, USA;*
[2]*University of Rochester, Rochester, New York, USA;*
[3]*University of Florida, Gainesville, Florida, USA*

Background/Purpose: Polytrauma patients with spinal injuries are often too unstable physiologically for early surgery and must be managed in the ICU prior to surgical stabilization. During their stays in the ICU they must be removed from the spine board and managed for skin breakdown. This is typically accomplished by manually turning the patient with log-rolling by the nursing staff. We sought to evaluate whether a kinetic therapy bed would result in less spinal motion at an unstable cervical injury as occurs during manual log-rolling on a standard ICU bed.

Methods: Unstable C5-C6 ligamentous injuries were created in 15 fresh, whole cadavers. Sensors were rigidly affixed to C5 and C6 posteriorly and electromagnetic motion tracking analysis performed (Liberty device; Polhemus, Colchester, VT). Cervical collars were placed by a certified orthotist. The amount of angular motion and linear displacement that occurred at this injured level was measured during manual log-rolling and patient turning using a kinetic therapy bed. The maximum setting of 40° was used on the TotalCare Sp02RT bed (Hill-Rom, Batesville, IN). Log-rolling was done by turning the cadaver and placing two pillows underneath as is typical in the ICU setting. For statistical analysis, the range of motion for angles about each axis and displacement in each direction were analyzed by multivariate analysis of variance with repeated measures. Significance was set at a P value of 0.05 or less.

Results: When comparing manual log-rolling and kinetic bed therapy, significantly more angular motion was created by the log-roll maneuver in flexion-extension ($P = 0.03$) and lateral bending ($P = 0.01$). There was no significant difference in axial rotation between the two methods ($P = 0.80$). There were no significant differences demonstrated in medial-lateral and anterior-posterior translation. There was almost two times the axial displacement between manual log-rolling and the kinetic therapy bed and this reached statistical significance ($P = 0.05$).

Conclusion: There is less motion at an unstable cervical injury in flexion-extension, lateral bending, and axial displacement when turning a cadver using a kinetic therapy bed as opposed to traditional manual log-rolling. It may be advantageous to use a kinetic therapy bed rather than manual log-rolling for patients with cervical spine injuries as it results in less motion at the injured segment and there is less physical exertion on the ICU staff.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

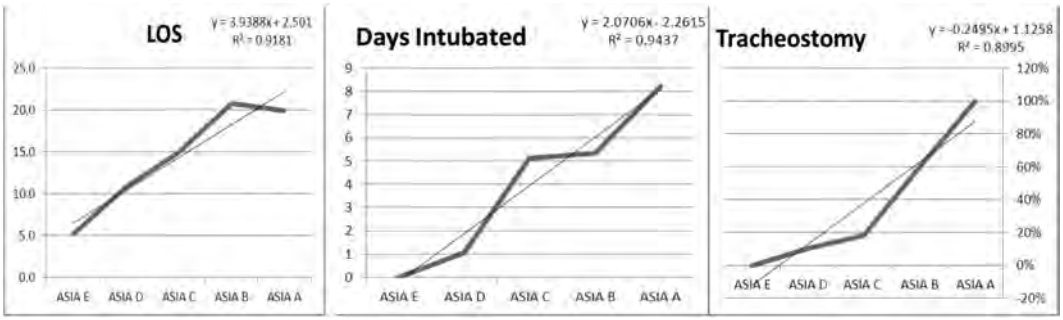
ASIA Impairment Scale Predicts the Need for Tracheostomy After Cervical Spine Injury

Benjamin R. Childs, BS; Timothy A. Moore, MD; John J. Como, MD, MPH;
Heather A. Vallier, MD;
MetroHealth Medical Center, Cleveland, Ohio, USA

Purpose: The objective of this study was to evaluate the ability of the American Spinal Injury Association (ASIA) impairment scale and neurologic level of injury to predict the need for mechanical ventilation as well as tracheostomy. We hypothesized that an increased ASIA impairment scale would be associated with greater need for mechanical ventilation regardless of injury level. We further hypothesized that the ASIA impairment scale in combination with level of cervical injury would help predict the need for tracheostomy.

Methods: 446 patients with fractures, dislocations, or ligamentous injury of the cervical spine were identified retrospectively from hospital records between January of 2007 and May of 2013. Charts were reviewed to determine demographics, ISS, Glasgow Coma Scale (GCS), presence and severity of chest injuries, length of hospital stay (LOS), ICU stay, mechanical ventilation time, and mortality. 54 patients had spinal cord injury, and had ASIA impairment scale and neurologic level recorded in the electronic record.

Results: 54 patients were included in the study. Of these, 9 patients were ASIA A (16.7%), 5 ASIA B (9.26%), 11 ASIA C (20.4%), 19 ASIA D (35.2%), and 10 ASIA E (18.5%). Increasing ASIA impairment correlated to higher ISS, but did not correlate to age or GCS. Greater ASIA impairment did correlate with longer LOS, days intubated, days on ventilation, and greater rate of tracheostomy. ASIA B or greater had a specificity of 95%, sensitivity of 73%, positive predictive value of 85%, and negative predictive value of 90% for predicting need for tracheostomy.



Conclusion: We investigated the ability of the ASIA impairment scale to predict tracheostomy in a general trauma setting, including other injuries. An ASIA impairment score of B or higher is both a specific and sensitive predictor of need for tracheostomy with relatively high positive and negative predictive value. Given the relatively low risk of tracheostomy and the potential benefits, an ASIA impairment score of B or higher would be a sensible criterion to include in a protocol to determine the need for tracheostomy.

See pages 99 - 147 for financial disclosure information.

•Biomechanical Comparison of Thoracolumbar Burst Fracture Stability with Traditional and Integrated Expandable Corpectomy Spacers: The Effect of Footprint Size, Supplemental Fixation, and Fracture Screws

*Ripul R. Panchal, DO[1]; **Erika Matheis, MS**[2]; Manasa Gudipally, MS[2]; Kanaan Salloum, BS[2]; Mir Hussain, BS[2]; Kee D. Kim, MD[1]; Brandon Bucklen, PhD[2];*
[1]Department of Neurological Surgery, University of California, Davis, Sacramento, California, USA;
[2]Globus Medical, Audubon, Pennsylvania, USA

Purpose: While traditional unstable burst fracture reconstruction has been evaluated clinically, there are several factors that remain unstudied—namely, effect of spacer footprint size, integrated screws inside the spacer, and the use of pedicle screw at the burst fracture level. This study evaluated L1 reconstruction and the motion profiles of the three variables mentioned, all of which have the potential to affect the kinematic signature.

Methods: Six human cadaveric spines (T11-L3) were tested on a six-degrees-of-freedom simulator enabling unconstrained motion in flexion-extension (FE), lateral bending (LB), and axial rotation (AR), following simulated burst fracture at L1. Expandable corpectomy spacers with/without integrated screws (Fi/F) (FORTIFY-I/FORTIFY, Globus Medical, Audubon, PA) were tested. Small end plates (21 × 23 mm) and large end plates (22 × 40-50 mm) were used on the expandable corpectomy spacer. Bilateral pedicle screw posterior instrumentation (PI) was used one level above/below the fracture. Alternately, a lateral plate (LP) was utilized. Additional bilateral pedicle screws were inserted at the burst fracture level (L1) for further fixation. Constructs were tested in order: (1) preoperative, (2) Fi_{21x23}, (3) Fi_{21x23} + PI, (4) Fi_{21x23} + PI + L1, (5) F_{21x23} + PI + L1, (6) F_{21x23} + PI, (7) F_{21x23} + PI + LP, (8) F_{21x23} + LP, (9) $F_{22x40\text{-}50}$ + LP, (10) $F_{22x40\text{-}50}$ + PI + LP, (11) $F_{22x40\text{-}50}$ + PI, (12) $Fi_{22x40\text{-}50}$ + PI, and (13) $Fi_{22x40\text{-}50}$.

Results: Across FE and LB loading modes, bilateral pedicle screws reduced preoperative motion by 69% on average; however, AR average motion increased. Significant differences were observed in FE and LB (except F_{21x23} + LP). The effect of spacer footprint size was negated in the presence of posterior rods, and resulted in near equivalent motion. While not significantly different, the $F_{22x40\text{-}50}$ + LP provided more stability than F_{21x23} + LP, especially in FE and AR. By and large, the spacer with integrated screws was comparable to spacer (without screws) + LP across all modes, the only exception being in LB, where the lateral plate imparts the majority of rigidity. All corpectomy spacers benefited from pedicle screws, especially in axial rotation where high levels of flexibility were seen with anterior-only constructs. Screws at the burst fracture level imparted additional stability compared to preoperative conditions (87% FE, 72% LB, 17% AR), especially in AR.

Conclusion: This study sought to quantify motion effects of various constructs in the context of L1 burst fracture reconstruction. With bilateral posterior fixation, integrated-screw expandable corpectomy spacers and expandable corpectomy spacers with lateral plate showed biomechanical similarity. There were no notable motion differences as a result of footprint size, except in the absence of pedicle screws. Clinical use of the larger end plate

• The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

has other benefits such as reduced propensity for fracture or subsidence via the stronger cortical ring. Bilateral pedicle screw fixation at the burst fracture level did provide additional stability; however, more stability may be needed in AR.

See pages 99 - 147 for financial disclosure information.

Do Attending Physicians Know Evidence-Based Guidelines for Cervical Spine Clearance in Blunt Trauma Patients?

Elizabeth Inkellis, MD*; Alexander Theologis, MD; R. Trigg McClellan, MD; Murat Pekmezci, MD;*
University of California San Francisco, San Francisco, California, USA

Purpose: This study was designed to investigate attending physician knowledge of cervical spine (C-spine) clearance in adult blunt trauma patients at an academic Level I trauma center as well as an academic tertiary care center.

Methods: Attending physicians in the departments of orthopaedic surgery, neurosurgery, general surgery, and emergency medicine at a Level I trauma center and spine surgeons at a tertiary care center affiliated with a single academic institution were emailed a survey investigating their knowledge of current evidence-based C-spine clearance protocols.

Results: The response rate was 46%. 47% of attendings are aware of the existence of an official C-spine clearance protocol at their institution. 95% of attending physicians use an acceptable clinical clearance guideline (NEXUS or NEXUS plus range of motion) when deciding which blunt trauma patients need imaging. 50% selected CT alone as the first-line imaging study. 92% correctly managed an alert patient following a negative CT scan by either continuing a collar, ordering MRI, or obtaining flexion/extension views. For an obtunded patient, 89% correctly managed the patient by continuing the hard collar until a reliable examination could be obtained, clearing the C-spine based on the CT only, or ordering MRI. 5% identified dynamic flexion/extension radiographs as an option for clearing the C-spine in an obtunded patient. When queried specifically about the 2009 Eastern Association for the Surgery of Trauma evidence-based guidelines for cervical spine clearance, only 58% were aware of the contents of the guidelines.

Conclusion: The majority of attending physicians appropriately managed case-based scenarios to clear the C-spine in adult blunt trauma patients. However, only half of attending physicians correctly identified CT scan alone as the appropriate first-line imaging following blunt trauma, which is in line with the current recommendations. Despite the evidence in the literature, there seems to be resistance to transitioning to CT scan alone for the initial imaging of blunt trauma patients.

Table 1. Percentage of Attendings by Department Who Selected an Appropriate Answer for Clinical Scenarios

Department	Clinical Clearance	Imaging	Patient with Neck Pain	Obtunded Patient
Orthopaedics	83	42	75	92
Neurosurgery	100	0	100	67
Emergency Dept	100	55	90	85
General Surg	100	100	100	100
Average	**95**	**50**	**87**	**87**

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Comparison of Methods of Halo Vest Application: A Biomechanical Study

Mark L. Prasarn, MD[1]*; Caleb J. Behrend, MD*[2]*; MaryBeth Horodyski, PhD*[3]*;*
Rex A. Marco, MD[1]*; Glenn R. Rechtine, MD*[2]*;*
[1]*University of Texas, Houston, Texas, USA;*
[2]*University of Rochester, Rochester, New York, USA;*
[3]*University of Florida, Gainesville, Florida, USA*

Purpose: It is a well-accepted tenet that spinal motion should be minimized when managing an unstable cervical spine fracture. Such injuries are oftentimes managed temporarily, or even definitively, with a halo vest. We sought to determine the best method to minimize motion of an unstable upper cervical spine injury during the application of a halo vest.

Methods: Unstable C1-C2 injuries were surgically created in 5 fresh, lightly embalmed human cadaver specimens. An electromagnetic motion analysis device (Liberty; Polhemus, Colchester, VT) was used to assess the amount of angular and linear motion at the injured C1-C2 segment. These sensors were rigidly affixed to the occiput and the lamina of C2. Measurements were recorded during the application of a halo vest using either the log-roll maneuver, or torso elevation of the cadaver. All trials were performed by a fellowship-trained spine surgeon.

Results: There were no differences in anterior-posterior displacement or flexion-extension with the two techniques. The log-roll maneuver resulted in more motion in axial rotation, lateral bending, medial-lateral translation, and axial displacement. This was statistically significant for axial rotation ($P = 0.04$) and medial-lateral translation ($P = 0.02$), and approached significance for lateral bending ($P = 0.06$). There was almost twice the motion in each of these planes when using the log-roll technique (Table 1).

Conclusion: There can be significant motion at an unstable upper cervical spine injury during the application of a halo vest. This undesirable motion can potentially result in secondary neurologic injury. Using the torso-elevation technique results in less unwanted motion, and may be a safer method to apply a halo vest than the log-roll maneuver. We propose a new method for application of the halo vest that results in less motion at an unstable upper cervical spine injury, possibly resulting in improved protection of the spinal cord.

See pages 99 - 147 for financial disclosure information.

Table 1

Technique		F/E	AR	LB	ML	AX	AP
Log-roll	Mean	16.21	20.89	15.48	19.99	18.41	22.53
	Std. Deviation	3.65	5.85	5.86	15.95	17.44	10.24
	N	15	15	15	15	15	15
Torso-elevation	Mean	17.39	11.40	8.72	11.22	12.31	19.67
	Std. Deviation	4.77	3.03	3.11	9.14	7.81	10.33
	N	15	15	15	15	15	15
Total	Mean	16.80	16.14	12.10	15.60	15.36	21.10
	Std. Deviation	4.22	6.65	5.75	13.53	13.63	10.21
	N	30	30	30	30	30	30

F/E = flexion-extension, AR = axial rotation, LB = lateral bending, ML = medial-lateral translation, AX = axial displacement, AP = anterior-posterior translation.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Atlantoaxial Instability in Acute Odontoid Fractures Is Associated with Nonunion and Mortality

Nathan Evaniew, MD; *Blake Yarascavitch, MD; Kim Madden, BSc;*
Michelle Ghert, MD, FRCSC; Brian Drew, MD, FRCSC; Mohit Bhandari, MD, PhD, FRCSC;
Desmond Kwok, MD, FRCSC;
McMaster University, Hamilton, Ontario, Canada

Purpose: Odontoid fractures are the most common geriatric cervical spine fractures. Nonunion rates have been reported to be up to 40%, mortality up to 35%, and poor functional outcomes are common. Atlantoaxial instability (AAI) is a plausible prognostic factor, but its role has not been previously examined. The objective of this retrospective cohort study was to determine the effect of severe AAI on the outcomes of nonunion and mortality in patients with acute odontoid fractures.

Methods: 124 consecutive patients with acute odontoid fractures were identified from a hospital database. Two independent blinded reviewers measured AAI using postinjury sagittal CT scans (Figure 1). Patients were classified as having "severe" or "minimal" AAI on the basis of greater versus less than or equal to 50% mean subluxation across each C1-C2 facet joint. Rates of nonunion and mortality were compared using independent-samples *t*-tests. The results were adjusted for age, fracture displacement, and subtype using univariate and multivariate binary logistic regression.

Results: 107 patients had minimal AAI, and 17 patients had severe AAI. Mean follow-up was 4.4 months (SD = 4.6). Patients with severe AAI were more likely to experience nonunion (29% vs. 10%, respectively; $P = 0.03$) and mortality (35% vs. 14%, respectively; $P = 0.03$) regardless of treatment modality (Figure 2). Fracture displacement correlated with AAI ($r^2 = 0.65$). When adjusted for patient age, the odds ratio (OR) of nonunion with severe AAI approached significance at 3.3 (95% confidence interval [CI]: 0.9-11.7). Mortality prediction with AAI approached a twofold increased risk (OR = 2.1; 95% CI: 0.6-6.8). In patients with type II fractures, the odds of mortality with severe AAI approached a threefold higher risk (OR = 3.3; 95% CI: 0.9-12.3).

Figure 1. Measurement of AAI.

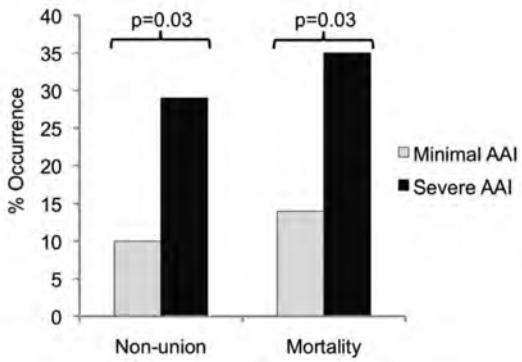


Figure 2. Nonunion and mortality between groups.

See pages 99 - 147 for financial disclosure information.

Conclusion: Patients with acute odontoid fractures and severe AAI may be more likely to experience nonunion and mortality, suggesting the possibility that aggressive management could be warranted. Further investigation with a large prospective study including patient-important functional outcomes is justified.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Incidence of Thoracolumbar Spine Injuries Is Increasing in the United States

Andrea Doud, MD; *Ashley Weaver, PhD; Jennifer Talton, MS; Ryan Barnard, MS; J. Wayne Meredith, MD; Joel Stitzel, PhD; Preston Miller III, MD; Anna N. Miller, MD; Wake Forest University School of Medicine, Winston-Salem, North Carolina, USA*

Background/Purpose: The National Highway Traffic Safety Administration issued a report in 2008 stating that from 1996 to 2005, there was a 23% decline in non-fatal injuries among motor vehicle crash (MVC) occupants. In contrast, a recent paper indicated that the incidence of MVC-related spinal fractures had increased in Wisconsin from 1994 to 2002. The purpose of this study was to investigate national trends in the incidence of non-fatal thoracolumbar spine (TL) injuries. A secondary aim was to evaluate potential "trade-off" injuries (ie, other injuries sustained because of or in relation to a change in TL injuries) should a trend in TL injuries be identified.

Methods: IRB approval was obtained. Retrospective review of injury information contained in three national databases was performed: the National Trauma Data Bank (NTDB) from 2002-2006, the National Automotive Sampling System (NASS) from 2000-2011, and the Nationwide Inpatient Sample (NIS) from 1998-2007. Within each database, the total number of MVC-related injuries and the total number of MVC-related TL injuries per year were identified using appropriate Abbreviated Injury Scale (AIS) or ICD-9 codes. Using these codes, sacral and pelvic (S-P) injuries were also identified to evaluate for their potential as "trade-off" injuries, given possible energy transfer from the spine to the pelvis. In NTDB and NASS, which report AIS codes, lower-severity (AIS1) injuries were excluded. A second analysis in NTDB (which also supplies ICD-9 codes) and an analysis in NIS evaluated TL and S-P injuries of all severities utilizing ICD-9 codes. Poisson regression models adjusting for age were used to analyze trends in the data over time.

Results: Evaluation of AIS2+ codes in NTDB demonstrated a significant increase in the incidence of TL injuries over time, with an 8.2 relative annual percent increase (95% confidence interval [CI]: 5.8%-10.7%, $P < 0.0001$). When non-fractures were excluded, the age-adjusted Poisson model remained significant with an 8.5 relative annual percent increase (95% CI: 6.0%-11.0%, $P < 0.0001$). Evaluation of ICD-9 codes in NTDB demonstrated similar patterns with significant increases in age-adjusted TL injury rates and a 9.9 relative annual percent increase after age adjustment and exclusion of non-fractures (95% CI: 7.3%-12.6%, $P < 0.0001$). Investigation of AIS2+ TL injuries in NASS produced analogous results with significant increases in TL injuries after age adjustment, and an 8.1 age-adjusted relative annual percent increase (95% CI: 4.9%-11.3%, $P < 0.0001$) after exclusion of non-fractures. Finally, NIS reinforced these trends, revealing an age-adjusted relative annual percent increase of 8.1 (95% CI: 7.2%-9.1%, $P < 0.0001$) among TL injuries, a pattern that held true after excluding non-fractures. When evaluating for compensatory decreases in S-P injuries in these databases, no consistent decreasing trends were discovered.

Conclusion: In an era of declining rates of fatal and non-fatal MVC-related injuries, these data demonstrate a significant increase in the incidence of TL injuries throughout the first decade of the 21st century. Although more sensitive screening tools in the emergency department have led to increased early diagnosis of TL injuries, it is not clear that such tools

See pages 99 - 147 for financial disclosure information.

have affected overall diagnosis. Furthermore, the incidence of TL injuries has continued to rise beyond the time such screening techniques became widely accepted. As seatbelt use has continued to rise, this trend may represent TL injuries emerging as a "trade-off" for other more severe injuries. No matter what the cause, this diagnosis carries significant morbidity and greatly impacts such factors as return to work. Further investigation to evaluate the root of this pattern is warranted.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Midshaft Clavicle Fracture Fixation: Comparison of Pin Versus Plate

Barry C. Davis, MD*; George K. Bal, MD; E. Barry McDonough, MD;*
West Virginia University, Morgantown, West Virginia, USA

Purpose: The purpose of this study was to compare the functional outcomes scores of displaced midshaft clavicle fractures (OTA 15B) treated with plate fixation versus those treated with intramedullary fixation.

Methods: After obtaining IRB approval, 61 patients with displaced midshaft clavicle fractures (OTA 15B) were prospectively randomized to osteosynthesis with either an intramedullary pin or with plate fixation. Patients younger than 18 years old, patients who were pregnant, and patients with concomitant injuries were excluded from this study.

Results: Of the 61 patients initially enrolled in our study, 29 patients had adequate follow-up. The pin group included 14 patients and the plate group included 15 patients. The mean age of the patients was 35.3 years (range, 18-61 years). Twenty patients were male, nine were female. ADL (activities of daily living), ASES (American Shoulder and Elbow Surgeons), PCS (physical component summary), MCS (mental component summary), and EQ5 (EuroQol 5D) scores were recorded for all patients at the time intervals shown in the table below.

ADL	Initial	6 weeks	3 months	6 months	1 year
Pin	1.8	11.1	15.9	25.8	27.6
Plate	3.9	17.3	25.9	26	29.1
ASES	Initial	6 weeks	3 months	6 months	1 year
Pin	24.9	54.9	73.8	81.9	90.7
Plate	25.4	66.2	88.5	94.3	96.9
PCS	Initial	6 weeks	3 months	6 months	1 year
Pin	37.1	38.4	45.4	50.3	52.6
Plate	33.5	46	53.5	55.1	55.4
MCS	Initial	6 weeks	3 months	6 months	1 year
Pin	53.9	50.1	51.8	57.5	54
Plate	51.8	49.9	51.4	52.4	53.2
EQ5	Initial	6 weeks	3 months	6 months	1 year
Pin	65.2	78.1	80.9	91.8	87.1
Plate	71.5	82.7	85.7	86	90.1

Conclusion: Based on our results, both groups treated allowed significant improvement in functional outcome scores and fracture union. There was no significant difference in functional outcome scores when comparing plate fixation versus intramedullary fixation.

See pages 99 - 147 for financial disclosure information.

Initial Varus Displacement of Proximal Humerus Fractures Results in Similar Function But Higher Complication Rates

Christina Capriccioso, BSE[1]; Arthur Manoli III, BS[1]; Joseph D. Zuckerman, MD[1];
Kenneth A. Egol, MD[1,2];
[1]NYU Hospital for Joint Diseases, New York, New York, USA;
[2]Jamaica Medical Center, Jamaica, New York, USA

Purpose: This review was conducted to investigate the effect of initial varus or valgus surgical neck alignment on outcomes of patients who sustained proximal humerus fractures treated with open reduction and internal fixation (ORIF).

Methods: An IRB-approved database of proximal humerus fractures treated with locked plates was reviewed. Of 185 fractures in the database, 101 fractures were identified and met inclusion criteria. Initial varus displacement was seen in 47 fractures (OTA types 11.A2.2, A3.1, A3.3, B1.2, B2.2, C1.2, C2.2, or C2.3) and initial valgus displacement was observed in 54 fractures (OTA types 11.A2.3, B1.1, C1.1, or C2.1). All patients were treated in a similar manner and examined by the treating physician at standard intervals. Functional outcomes were quantified via the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire and physical examination data at 12 months. Radiographs were reviewed for complications of healing. Additionally, complication rate and reoperation rate were investigated.

Results: At a minimum12 months follow-up, there was no statistically significant difference in DASH scores between those presenting with varus versus valgus fracture patterns. In addition, no statistically significant differences were seen in final shoulder range of motion in any plane (Table 1).

Table 1. Functional Outcome Measurements and Results*

	DASH Survey (P = 0.09)	Active Forward Elevation (P = 0.68)	External Rotation (P=0.06)
Varus	29.0 (±22.1)	130.7 (±34.3)	40.3 (±18.2)
Valgus	21.8 (±23.0)	134.0 (±32.7)	47.3 (±17.2)

*Significance was assessed via the Mann-Whitney U test. Values are expressed as mean ± standard deviation.

Overall, 30 patients included in this study developed a complication. A significantly greater number of patients in the initial varus cohort developed complications (40.4%), as compared to 20.3% of patients in the initial valgus cohort (P = 0.03). Differences between the groups for specific complications (Table 2) could not be determined due to inadequate power.

POSTER ABSTRACTS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Table 2. Complication Breakdown*

	Screw Penetration	ON	Malunion	HO	ROM/Pain (interferes with ADL at 12 mo.)	Infection	Varus angulation	Other
Varus	7 (14.9%)	4 (8.5%)	2 (4.3%)	0 (0%)	4 (8.5%)	2 (4.3%)	3 (6.4%)	4 (8.5%)
Valgus	4 (7.4%)	2 (3.7%)	3 (5.6%)	4 (7.4%)	2 (3.7%)	2 (3.7%)	0 (0.0%)	1 (1.9%)

*Values are expressed as number and percent within respective cohort. Other complications include osteoarthrosis, hardware failure, adhesive capsulitis of shoulder, and shoulder pseudosubluxation.
ON = osteonecrosis, HO = heterotopic ossification, ROM = range of motion

Of the 14 patients in this study who underwent reoperation, 9 of them (64.3%) had an initial varus displacement, while 5 (35.7%) had an initial valgus displacement ($P = 0.15$).

Conclusion: In this study, initial surgical neck displacement in varus or valgus was found to not significantly affect functional outcome. However, patients with varus displaced proximal humerus fractures may be at a greater risk of developing postoperative complications than those who present with initial valgus displaced fracture patterns.

See pages 99 - 147 for financial disclosure information.

Olecranon Fractures: Factors Influencing Reoperation

Mark C. Snoddy, MD; Maximilian F. Lang, BS; Phillip M. Mitchell, MD;
W. Jeffrey Grantham, MD; Benjamin S. Hooe, BS; Harrison F. Kay, BS; Ritwik Bhatia, BA;
Rachel Thakore, BS; Jason M. Evans, MD; William T. Obremskey, MD, MPH, MMHC;
Manish K. Sethi, MD;
Vanderbilt University, Nashville, Tennessee, USA

Purpose: Tension band (TB) and plating (open reduction and internal fixation [ORIF]) are two methods of fixation for olecranon fractures. While ORIF is used for comminuted fracture patterns, evidence is inconclusive regarding the best technique for simple fracture patterns requiring fixation. Often this decision is based on surgeon preference due to lack of significant outcomes data. In this study, we evaluate isolated olecranon fractures over a decade at a single Level I trauma center in order to investigate the factors influencing reoperation in TB versus ORIF.

Methods: A retrospective chart review at a Level I trauma center identified 489 patients who underwent operative management of olecranon fractures (CPT code 24685) from 2003 to 2013. These patients' charts were reviewed for information including gender, height, weight, body mass index (BMI), American Society of Anesthesiologists (ASA) classification, mechanism of injury, fracture type, and fracture classification. Charts were also reviewed for complications; any instance of infection, nonunion, malunion, loss of function, or hardware complication requiring an unplanned surgical intervention was noted. Patients with any additional injuries were excluded from the study. Electronic radiographs of these patients were reviewed to identify OTA fracture classification and patients who underwent TB or ORIF. Both c^2 and multivariate analyses were used to determine any statistical difference in complication rates between groups.

Results: 177 patients met inclusion criteria of isolated olecranon fractures. TB was used for fixation in 43 patients (24%) and ORIF in 134 patients (76%). There were 50 open fractures, with 10 in the TB group (grade 1 = 6, grade 2 = 4, grade 3 = 0) and 40 in the ORIF group (grade 1 = 7, grade 2 = 23, grade 3 = 10). Surprisingly, no statistical significance was found when comparing complication rates in open (36.0%) versus closed (36.2%) olecranon fractures ($P = 1$). In a multivariate analysis controlling for age, gender, ASA, open versus closed fractures, and OTA fracture classification, the key factor in outcome was method of fixation. Overall, 23 patients had complications (53.6%) in the TB group compared to 41 patients (30.6%) in the ORIF group with infection and hardware removal being markedly higher in the TB group (table). Patients with TB were 3.8 times more likely to return to the operating room compared to the ORIF group.

	TB	ORIF	*P* Value
Total patients with complications	23	41	0.01
Hardware removal	20	20	0.0005
Infection	6	8	0.11

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Conclusion: Our results demonstrate that the dominant factor driving reoperation in isolated olecranon fractures is the type of fixation employed. When controlling for all variables, there is a 3.82 times greater chance of reoperation in patients with TB fixation. Surgeons must be cognizant of the risk of a potential second operation when using TB fixation.

See pages 99 - 147 for financial disclosure information.

Factors Predicting Satisfactory Functional Outcomes in Patients Following Humeral Shaft Fractures

***Edward Shields, MD**; Leigh Sundem, BS; Sean Childs, BS; Michael Maceroli, MD; Catherine Humphrey, MD; John Ketz, MD; Gillian Soles, MD; John T. Gorczyca, MD; University of Rochester, Rochester, New York, USA*

Purpose: This study uses validated functional outcome measures and risk-adjusted analysis to determine if specific patient characteristics, treatment modality, fracture location, or etiology predict satisfactory functional outcomes.

Methods: Patients treated from 2004 through 2011 for humeral shaft fractures were identified from billing records. From this cohort, patients were excluded if they were less than 18 years old at time of injury (n = 38), if their fracture predominantly affected the metaphyseal/epiphyseal region of the humerus (n = 15), or if they were deceased (n = 22). Minimum follow-up period was 12 months. Patients from the remaining cohort (165 patients) were recruited by telephone to obtain the following functional outcome scores: Disabilities of the Arm, Shoulder and Hand (DASH), the Simple Shoulder Test (SST), and general health questionnaire Short Form-12 physical component summary (SF-12 PCS) and mental component summary (SF-12 MCS). Based on previous reports of population averages and minimal clinically important differences, patients were classified as having a satisfactory outcome if their DASH was <21, SST ≥10, SF-12 PCS ≥40, and SF-12 MCS ≥40. Patient chart reviews were conducted to obtain basic demographic data. Binomial logistic regression was performed with IBM SPSS v19 (Armonk, NY). Adjusted odds ratios (ORs) were calculated after adjusting for age, follow-up length, surgical versus nonoperative treatment, body mass index (BMI), presence of associated fractures, fracture location (proximal, middle, distal third), radial nerve palsy, smoking status, Charlson comorbidity index (CCI) score, insurance type, classification as high-energy mechanism, and history of psychiatric illness. Data are presented as ± standard deviation.

Results: 72 patients were successfully recruited (41 surgical, 31 nonoperative). Average age was 47 ± 20 years with average follow-up period being 47 ± 29 months. The odds of obtaining a satisfactory DASH score increased with longer follow-up (OR 1.024; $P = 0.045$), but decreased with increasing age (OR 0.945; $P = 0.017$) and absence of radial nerve palsy (OR 0.117; $P = 0.047$). The odds of obtaining a satisfactory SST score increased with absence of psychiatric history (OR 11.8; $P = 0.004$), and decreased with increasing age (OR 0.947; $P = 0.017$). The odds of obtaining a satisfactory SF-12 PCS score increased with absence of psychiatric history (OR 20.9; $P = 0.027$), having Medicare (OR 77; $P = 0.029$) or private insurance (OR 131; $P = 0.016$) compared to Workers' Compensation/motor vehicle insurance, and decreased with rising CCI score (OR 0.51; $P = 0.019$). The odds of obtaining a satisfactory SF-12 MCS score increased in the absence of psychiatric history (OR 26.0; $P = 0.009$), and decreased with rising CCI score (OR 0.544; $P = 0.033$).

Conclusion: The reporting of functional outcome scores after humeral shaft fracture treatment must include analysis of confounding variables. Patient age, length of follow-up period, history of psychiatric illness, insurance type, and CCI scores all significantly influ-

POSTER ABSTRACTS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

enced patient-reported functional outcomes following treatment of humeral shaft fractures regardless of treatment modality. Presence of radial nerve palsy immediately after injury significantly predicting less disability (DASH <21) may be due to chance or may result from these patients experiencing dramatic improvements in upper extremity function as most palsies completely resolve.

See pages 99 - 147 for financial disclosure information.

Functional Recovery of Complex Elbow Dislocations Treated with a Hinged External Elbow Fixator: Results of a Multicenter Prospective Study

*Gijs I.T. Iordens, MD[1]; **Dennis Den Hartog, MD, PhD[1]**;*
Esther M.M. Van Lieshout, MSc, PhD[1]; Wim Tuinebreijer, MD, PhD[1];
Jeroen de Haan, MD, PhD[2]; Peter Patka, MD, PhD[1]; Michael H.J. Verhofstad, MD, PhD[1];
Niels W.L. Schep, MD, PhD[3]; on behalf of the Dutch Elbow Collaborative;
[1]Erasmus MC, University Medical Center Rotterdam, Trauma Research Unit
Department of Surgery, Rotterdam, The Netherlands;
[2]Westfriesgasthuis, Department of Surgery, Hoorn, The Netherlands;
[3]AMC, Trauma Unit Department of Surgery, Amsterdam, The Netherlands

Purpose: A hinged external fixator theoretically allows collateral ligaments to heal without surgery while allowing functional after-treatment in patients with a complex elbow dislocation. The aim of this study was to assess the functional outcome in patients treated with a hinged external fixator after a complex elbow dislocation.

Methods: This is a multicenter prospective case series, between December 2009 and December 2011. Inclusion criteria were patients aged 18 years or older with a complex elbow dislocation who were treated with a hinged elbow fixator for residual instability. Primary outcome parameter was the QuickDASH, an abbreviated version of the Disabilities of the Arm, Shoulder and Hand (DASH) score after 1 year. Secondary outcome parameters were the Mayo Elbow Performance Index (MEPI), Oxford Elbow Score (OES), level of pain (visual analog scale [VAS]), and range of motion. Complications, secondary interventions, and radiographs were evaluated.

Results: 27 patients were included. 19 patients underwent open reduction and internal fixation (ORIF) or radial head replacement and 8 underwent closed reduction prior to hinged external fixation. One patient reported recurrent instability. Ten patients experienced fixator-related complications, of whom seven required secondary surgery. The median QuickDASH score was 6.8 after 1 year. The median VAS score for pain was 0.5, MEPI was 100, and the OES was 90 points. Median flexion-extension and forearm rotation arcs were 118° and 160°, respectively.

Conclusion: A hinged external elbow fixator provides enough stability to start early mobilization after an acute complex elbow dislocation and residual instability. This was reflected in good functional outcome scores and only slight disability despite a relatively high complication rate.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Initial Malalignment of Humeral Shaft Fractures Predicts Failure of Bracing: Results of a Treatment Protocol

*Alexander Crespo, BS[1]; Deirdre Regan, BA[1]; Sanjit Konda, MD[1,2]; **Kenneth Egol, MD**[1,2];*
[1]NYU Hospital for Joint Diseases, New York, New York, USA;
[2]Jamaica Medical Center, Jamaica, New York, USA

Purpose: The majority of humerus shaft fractures are managed nonoperatively with functional bracing. The purpose of this study was to evaluate changes in fracture angulation throughout the course of treatment with functional bracing.

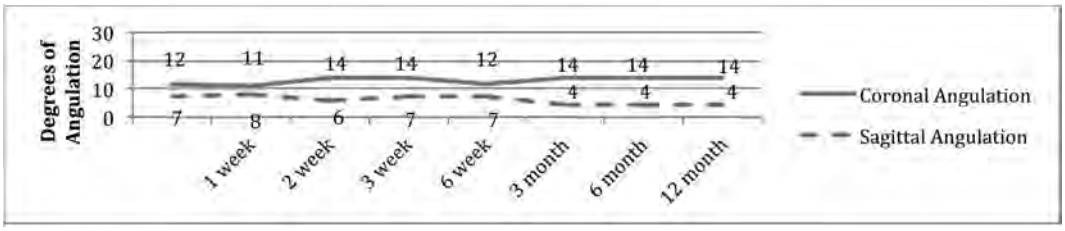
Methods: 522 radiographs from 72 patients who underwent nonoperative management of 72 humeral shaft fractures were critically reviewed. All patients were treated by a fellowship-trained traumatologist at a single institution utilizing an "off the shelf", plastic humeral fracture brace. Fracture patterns were classified according to AO/OTA system. Fracture angulation and displacement were measured in the coronal and sagittal planes on the picture archiving and communication system (PACS) before and after brace application. In the coronal plane, a line was drawn down the long axis of the humeral shaft; varus angulation was defined by positive values and valgus angulation by negative values. In the sagittal plane, procurvatum was defined by positive values and recurvatum was defined by negative values. Images were assessed post-brace application and at 1 week, 2 weeks, 3 weeks, 6 weeks, 3 months, 6 months, and 12 months. Mean coronal and sagittal angulation was calculated for each of the above intervals. Linear regression was performed for both coronal and sagittal measurements to mathematically define the observed changes between follow-up periods.

Results: All fractures were followed to healing or surgical intervention, (minimum 12 weeks); average final follow-up was 40 weeks. 66 patients (91.7%) successfully healed their fractures with nonoperative treatment. The average angulation observed on immediate post-brace radiograph was 12° varus and 7° procurvatum. At final follow-up average coronal angulation was 14° varus and 4° procurvatum. Fracture angulation changed a mean 2° in the AP plane and 3° in the sagittal plane over the course of care. 14 patients had a fracture in greater than 20° of varus after brace application, 4 of whom eventually underwent operative intervention (29%). Linear regression demonstrated fracture angulation progresses at a rate of 0.01° varus and 0.01° of posterior angulation per day.

Conclusion: Humeral shaft fractures treated nonoperatively heal with minimal change in angulation from initial brace application. Provided there is no history of repeat trauma and no cosmetic deformity, radiographs should be obtained at the following intervals: immediately after application of brace, 6 weeks, 3 months, 6 months, and 12 months. Increased radiographic evaluation is warranted when patients initially present with greater than 20° of varus angulation, as this degree of displacement was associated with a higher rate of conversion to operative fixation. Otherwise, patients should be followed with only history and physical examination at follow-up points prior to the 6-week radiographic evaluation.

See pages 99 - 147 for financial disclosure information.

Figure 1. Mean changes in angulation over time.



POSTER ABSTRACTS

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Unstable Distal Radius Fracture: Reduce Prior to Surgery?

Teun Teunis, MD*; Frans J. Mulder, BSc; Sjoerd P.F.T. Nota, MD; David Ring, MD, PhD; Massachusetts General Hospital–Harvard Medical School, Boston, Massachusetts, USA*

Background/Purpose: Most distal radius fractures are not considered for surgery until manipulative reduction is attempted. There is a subset of fractures, however, that can be considered for immediate surgery. We wonder if the discomfort and inconvenience of a closed reduction is worthwhile for the subset of patients who choose operative treatment prior to attempted reduction. We hypothesize that there are no differences in (1) adverse events and (2) subsequent surgeries between patients treated with manipulative reduction compared to those who were splinted without reduction prior to distal radius fracture surgery.

Methods: We retrospectively included 1565 patients who underwent plating of their distal radius fracture between January 1, 2007 and December 31, 2012 of which 108 (6.9%) were not reduced prior to surgery. We recorded any infections, hematomas, disproportionate finger stiffness, (transient) neuropathology after surgery and resultant delayed carpal tunnel release, malunion, loss of alignment, plate removal, and tendon ruptures within 1 year after surgery. Outcome measures were grouped to determine the overall adverse event rate and subsequent surgery rate.

Results: We recorded 291 adverse events in 265 patients (17%) and 114 subsequent surgeries in 96 patients (6%). We found no difference in specific adverse events between unreduced and reduced fractures. After adjusting for possible confounding variables by logistic regression, we found no difference in overall rates of adverse events (odds ratio 1.4, 95% confidence interval 0.84-2.2) and subsequent surgeries (odds ratio 0.58, 95% confidence interval 0.21-1.6) between the groups.

Conclusion: Conscious of the retrospective nature of this study, doctors could consider not putting the patient through the time and pain of closed reduction when surgery is planned within a few days.

See pages 99 - 147 for financial disclosure information.

Does Malunion in Multiple Planes Predict Worse Functional Outcomes in Distal Radius Fractures?

*Alejandro I. Marcano, MD[1]; Mathew Cantlon, MD[1]; James Lee[1]; **Kenneth A. Egol, MD**[1,2];*
[1]NYU Hospital for Joint Diseases, New York, New York, USA
[2]Jamaica Medical Center, Jamaica, New York, USA

Background/Purpose: Studies correlating radiographic deformity of the distal radius to clinical or functional outcomes have demonstrated no relationship to date. However, the majority of these studies analyzed only a single anatomic parameter, while few, if any, analyzed multiple parameters occurring in combination. The objective of this study was to investigate whether the total number of radiographic radial malalignments following fracture was associated with poor clinical outcomes.

Methods: Over a 7-year period, 382 patients who sustained a distal radius fracture were enrolled in a prospectively collected database and met our inclusion criteria. Patients were followed for a mean of 11 months. Radiographs were measured and the following parameters recorded: palmar (volar) tilt, radial inclination, radial length, ulnar variance, intra-articular step-off, and osteoarthritis index after initial reduction and at follow-up intervals. Patients were divided in three groups: those with normal radiographic alignment (group 1), those with one abnormal measurement (group 2), and those with two or more abnormal measurements (group 3). Each patient was assessed for the Disabilities of the Arm, Shoulder and Hand (DASH) and Short Form-36 (SF-36) clinical outcome scores, along with functional parameters such as grip strength and range of motion (ROM) during their long-term follow-up visit (between 6 months and 1 year). Clinical outcomes and wrist ROM measurements of the groups were compared using Mann Whitney *U* test and individual radiographic measurements plus the total number of abnormal measurements was correlated with clinical outcome scores and functional parameters using Spearman's correlation coefficient.

Results: 34% of patients had at least one abnormal radiographic measurement after initial reduction (IR), 21% at short-term (ST) and 24% at long-term (LT) follow-ups. The most commonly observed deformity was loss of radial inclination. Nevertheless, the long-term DASH was low (18.17 for group 2 and 12.12 for group 3) and the SF-36 was correspondingly high (77.36 for group 2 and 80.45 for group 3). The only positive finding was a significantly lower percentage of grip strength recovery in group 2 (62%) as compared to group 1 (79%). No individual radiographic measurement of wrist deformity or a combination of these was significantly correlated to any of the clinical outcome scores or functional parameters.

Conclusion: Our data confirm reports from previous studies that no single radiographic measurement was correlated with clinical or functional outcomes. Moreover, if analyzed in combination, malalignment in multiple planes did not result in a higher association with worse outcomes. These data lead us to question the importance of detailed analysis of distal radius radiographic parameters.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Ulnar Styloid Fracture in Association with Distal Radius Fracture Portends Poorer Outcome

*Omri Ayalon, MD[1]; Alejandro I. Marcano, MD[1]; Nader Paksima, DO[1]; **Kenneth Egol, MD**[1,2];*
[1]NYU Hospital for Joint Diseases, New York, New York, USA
[2]Jamaica Medical Center, Jamaica, New York, USA

Purpose: The literature is mixed on the effect of fractures of the ulnar styloid on ipsilateral distal radius (DR) fracture. The purpose of this study was to determine if an associated ulnar styloid fracture (USF) negatively impacted the outcomes of patients who had sustained an ipsilateral DR fracture.

Methods: We have conducted a retrospective evaluation of 373 patients who had sustained a DR fracture and were treated at our institution over a 7-year period. Of these patients, 217 were treated operatively, and 156 were treated nonoperatively. In each of these groups, patients who had an associated USF were identified. Patients were followed for a mean of 11 months. At follow-up intervals, patients were assessed with the Disabilities of the Arm, Shoulder and Hand (DASH) and Short Form-36 (SF-36) clinical outcome scores, along with functional parameters such as grip strength and wrist and finger range of motion (ROM). Radiographic parameters were followed and complications were recorded. Statistical analysis was performed using Student *t*-test.

Results: Overall, patients who sustained USF along with DR fracture experienced more pain (1.80 ± 2.37 vs. 1.31 ± 1.95; $P = 0.033$) and worse DASH scores (16.81 ± 18.86 vs. 12.84 ± 17.40; $P = 0.04$) at latest follow-up. Among patients who underwent surgical fixation of their DR fractures, those with concomitant USF also had more pain and poorer DASH functional scores than did those patients without USF. The presence of USF appeared to have no effect on outcomes among patients treated nonoperatively for DR fracture.

Conclusion: The presence of USF with DR fracture is associated with worse pain scores and lower function than those without, especially among those patients requiring surgical fixation.

See pages 99 - 147 for financial disclosure information.

Do Distal Radius Fractures Shift After External Fixation?

Paul Tornetta III, MD*; Andrew Jawa, MD; Regina Meis, MD; Joey LaMartina II, MD;*
Boston University Medical Center, Boston, Massachusetts, USA

Background/Purpose: The factors that predict the final position of distal radius fractures treated nonoperatively, as well as the change in position after cast removal, have been well studied. However, no data exist on those factors that influence the final position of those treated with external fixation, nor is there information available regarding the change in position from the initial postoperative radiographs to the final well-healed state. The purpose of this study was to evaluate these two questions in a large series of unstable distal radius fractures treated with external fixation.

Methods: We evaluated 77 patients with unstable distal radius fractures treated with external fixation. 57 patients (31 M, 26 F), average age of 49 years (range, 22-89) with 59 fractures had complete radiographs available and were followed radiographically for an average of 149 days. All patients had unacceptable initial closed reductions. All external fixation spanned the wrist and was performed by a trauma or hand attending surgeon; accessory pins were standard. We tabulated the following parameters as potential predictors of final alignment: dorsal comminution (defined as having a loss of the dorsal cortex of ≥5 mm by 1/3 of the metaphyseal depth), intra-articular fracture, ulnar styloid fracture, volar cortical alignment, and initial dorsal tilt >20°. In addition to these factors, age, sex, the number of Lafontaine criteria present, and the McQueen equation value were used in the statistical analysis. On the immediate postoperative and final radiographs (at discharge from follow-up) we measured the volar tilt, radial height, radial inclination, and ulnar variance. A PhD statistician performed univariate and multivariate analyses to determine which of the fracture or patient factors were associated with final alignment. The change in each of the radiographic parameters was calculated from the initial postoperative to the final follow-up films.

Results: The results of the univariate analysis demonstrated that the McQueen value predicted final ulnar variance. The total number of Lafontaine criteria met predicted radial inclination. Dorsal comminution predicted radial inclination and height. Age predicted radial height and ulnar variance and sex predicted ulnar variance. Interestingly, no factor correlated with volar tilt. Based on the univariate analysis, a multivariate analysis was performed to isolate which patient and fracture characteristics had the greatest effect on final radiographic position. The findings of the multivariate analysis demonstrated that dorsal comminution, age, and sex were the factors that most influenced the final radiographic alignment (Table 1).

Table 1. Factors That Were Statistically Significant in the Multivariate Analysis ($P < 0.05$)*

	Volar Tilt	Radial Height	Radial Inclination	Ulnar Variance
Final alignment	--	DC, S	DC	DC, S, Age

*S = sex, DC = dorsal comminution.

The difference in radiographic parameters from the immediate postoperative radiographs to those at an average of 145 days demonstrated that the reductions were maintained after frame

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

removal. The overall alignment and the shift over time is seen in Table 2; each difference is within measurement error indicating maintenance of position through the well-healed state.

Table 2. Final Position and Change From Initial Postoperative Films

	Volar Tilt	Radial Height	Radial Inclination	Ulnar Variance
Final alignment	2.4° ± 9°	12.4 ± 3.5 mm	24.6° ± 6.5°	1.0 ± 2 mm
Δ to final follow-up	–1.8°	0.1 mm	–0.5°	–1.1 mm

Conclusion: For patients with unstable distal radius fractures treated with external fixation, dorsal comminution was the most influential factor influencing the final radiographic position. It was associated with radial height, inclination, and ulnar variance. Additionally, we found almost no change in position from the initial postoperative radiographs to the final films (average 145 days). As opposed to fractures treated closed, the initial reduction with external fixation was well maintained over time.

See pages 99 - 147 for financial disclosure information.

Lost Work Productivity in Patients With Distal Radius Fractures

***Gerard Slobogean, MD, MPH, FRCSC**; Peter O'Brien, MD, FRCSC;*
Henry Broekhuyse, MD, FRCSC; Kelly Lefaivre, MD, MSc, FRCSC;
Department of Orthopaedics, University of British Columbia,
Vancouver, British Columbia, Canada

Purpose: Quantifying work productivity losses includes accounting for time missed from work (absenteeism) and time working at a reduced capacity (presenteeism). The primary purpose of the current study is to determine the fracture-related work productivity losses following a distal radius fracture. The secondary objective of the study is to estimate the societal cost of the decreased work productivity.

Methods: Adult patients with an isolated distal radius fracture were prospectively enrolled into this study. Both operative and nonoperative treatments were included. Participants were assessed regularly until 1 year post-injury. At each assessment, participants completed the Work Productivity Impairment Questionnaire – Specific Health Problem (WPAI-SHP), the EuroQol-5 Dimensions (EQ-5D), and the Disabilities of the Arm, Shoulder and Hand Outcome Measure (DASH). The cost of decreased work productivity was estimated using age and gender adjusted median incomes reported by Statistics Canada (2008 Canadian Dollars).

Results: 53 patients were enrolled in this prospective cohort. The mean age of the participants was 48 ± 15 years and 64% of patients were female. The majority of fractures were treated nonoperatively (64%). At baseline, the mean EQ-5D score was 0.95 ± 0.1, indicating near perfect health; similarly, the mean DASH score at baseline was 3.0 ± 11.9. Both scores decreased significantly in the acute post-injury phase but eventually returned to baseline function at 1 year: EQ-5D 0.90 ± 0.2 ($P = 0.42$) and DASH 9.9 ± 13.1 ($P = 0.20$). 38/53 patients were employed during the study (72%), and employed patients were more likely to receive operative fixation than unemployed individuals ($P = 0.05$). The median work productivity loss was 54% at 2 weeks, 20% at 6 weeks, and 0% at 3 months. Although the median work productivity loss at 6 months and 1 year post-injury remained at 0%, approximately one-fourth of the cohort still reported some work productivity loss at these time points (28% and 21%, respectively). The average estimated societal cost due to lost work productivity was $3317 ± $782 per patient, approximately 7% of their annual salary (interquartile range, $1940-$15,369; 4%-32% of annual salary).

Conclusion: This study prospectively measured the work productivity burden of an isolated distal radius fracture. It extends previous research that has only considered time missed from work because work presenteeism has been included in the assessment. The majority of patients regain full work productivity by 3 months; however, a measurable societal cost from lost productivity is incurred during this time and approximately one-fourth of patients continue to work at less than 100% productivity at 1 year.

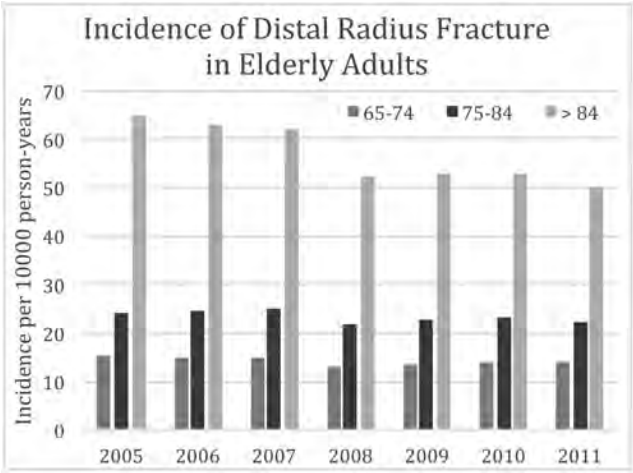
- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Decreasing Incidence and Changing Treatment of Distal Radius Fractures Among Elderly Adults

Benjamin D. Streufert, BS*; Jonathan A. Godin, MD, MBA; Robin N. Kamal, MD; Sendhilnathan Ramilingam, BS; R. Andrew Henderson, MD, MSc; Richard C. Mather III, MD; David S. Ruch, MD;*
Duke University Medical Center, Durham, North Carolina, USA

Background/Purpose: Distal radius fracture (DRF) is the most common upper extremity fracture in the elderly population and a cause of significant morbidity. DRF has been linked to osteoporosis and to subsequent injury, including hip fracture. Several studies in the past two decades have described increases in absolute numbers and incidence of DRF across age groups, including the elderly, but neither recent trends of incidence nor data on treatment in elderly adults in the US are available. It is not well known if recent emphasis on diagnosing and treating bone mineral density changes in elderly adults has impacted the incidence or treatment of DRF.

Methods: US Medicare enrollees who were diagnosed with DRF between 2005 and 2011 were identified by searching ICD-9 diagnosis codes in a comprehensive Medicare hospital claims dataset via the PearlDiver Database (PearlDiver Technologies, Fort Wayne, IN). Treatment of DRF was identified in a 5% Medicare Patient Sample using CPT codes for closed and open fixation. Rates of treatments were compared relative to each other for analysis. Additional procedures and diagnostic testing performed on patients before and after diagnosis of DRF were analyzed. Fractures were stratified according to patient demographics, and comorbidities within this population were examined.



Results: *Incidence of DRF:* Between 2005 and 2011, 571,384 patients diagnosed with DRF were identified in the Medicare population. Total numbers of DRF increased 6.70% from 83,512 in 2005 to 89,107 in 2011, but the incidence fell 7.17% from 19.65 to 18.24 per 10,000 person-years over the same period. The age group with the largest decrease in incidence was patients age 85 years and older, with a 22.93% decrease from 64.67 to 49.84 per 10,000 person-years. Incidence in females was higher than in males, and both groups had decreased incidence of DRF from 2005 to 2011. Incidence in the Northeastern US decreased 9.12% while increasing 4.33% in the Western US. In the year prior to DRF, a diagnosis of osteoporosis was present in 11.0% of patients, low vitamin D in 1.8%, and tobacco use in 4.7%. Dual x-ray absorptiometry scan was performed in 6.73% in the year before DRF and 8.50% in the year after DRF. *Treatment of DRF:* In the 5% Medicare sample, 29,570 patients were treated with closed or open fixation for DRF from 2005 to 2011. Closed

See pages 99 - 147 for financial disclosure information.

treatment represented 79.6% of the total treated, but the proportion treated with open fixation rose from 21.2% in 2007 to 29.4% in 2011. Trends in treatment of various fracture patterns were examined, as were regional and gender variation in treatment.

Conclusion: Despite increases in absolute numbers of DRF from 2005 to 2011 in US elderly adults, the incidence of DRF has decreased over the same period. Treatment trends show increased open fixation in this population. While increasing emphasis on osteoporosis may be affecting trends in DRF in elderly adults, this decreasing incidence and changing surgical management deserve further investigation.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Variation in Treatment Recommendations for Fracture of the Distal Radius: Actual Radiographs Versus Radiographic Measurements

Valentin Neuhaus, MD*; Arjan G. Bot, MD; Thierry G. Guitton, MD;*
David C. Ring, MD, PhD;
Massachusetts General Hospital, Boston, Massachusetts, USA

Purpose: The primary purpose of the study was to compare the interobserver variability of surgeon recommendation for operative treatment of a distal radius fracture when provided with either actual radiographs or just radiographic measurements. Secondarily, factors associated with greater likelihood of recommending operative treatment were evaluated.

Methods: 677 orthopaedic surgeons, members of the Science of Variation group, were invited to evaluate online the case scenarios of 30 consecutive adult patients with a distal radius fracture treated at our emergency department. Surgeons were randomly assigned either to the group receiving actual radiographs or to the group with just the radiographic measurements. Both groups read in addition a paragraph containing all available clinical information. 259 of all invited raters (38%) assessed all 30 cases; 124 were assigned to the group "measurements" and 135 received radiographs. The multirater agreement was calculated with the Fleiss generalized kappa. Factors associated with operative treatment choice were sought in bivariate and multivariable analysis.

Results: Surgeons who received measurements only recommended operative treatment significantly more often, but were less likely to agree than surgeons evaluating actual radiographs. Surgeon factors significantly associated with a greater likelihood of recommending operative treatment was the area (Europe and countries other than US), years of practice (less than 21 years of practice), and the specialty hand and wrist. Patient factors (younger age, female sex, left side, lesser comorbidities, diagnosed osteoporosis, and no known alcohol or drug abuse) and radiographic information (AO Type B or C, fracture of the ulnar styloid, dorsal comminution, and more dorsal tilt) significantly explained nearly 40% of the operative treatment recommendation.

Conclusion: Radiographic deformity and some changes, which were not measured or measureable, provided significant information about the injury and influenced the treatment recommendation beyond the measurements alone.

See pages 99 - 147 for financial disclosure information.

Influence of Surgeon, Patient, and Radiographic Factors on Distal Radius Fracture Treatment

Valentin Neuhaus, MD*; Arjan G. Bot, MD; Thierry G. Guitton, MD;*
David C. Ring, MD, PhD;
Massachusetts General Hospital, Boston, Massachusetts, USA

Purpose: There is a trend to recommend operative treatment for distal radius fractures. The influences of surgeon and patient factors on recommendation for operative treatment are not well studied. The purpose of this study is to evaluate surgeon and patient factors influencing the recommendation for operative treatment in distal radius fractures.

Methods: In a web-based study, 252 orthopaedic surgeons from a variety of countries reviewed 30 consecutive sets of radiographs of patients that presented to our emergency department with a fracture of the distal radius. Surgeons were randomly assigned to receive either "radiographs only" or "radiographs and clinical information". Surgeon and patient factors associated with a recommendation for operative treatment were sought in bivariate and multivariable analysis. Fleiss kappa was used to assess and compare the interobserver agreement.

Results: Surgery was recommended 52% of the time whether or not surgeons received clinical information. Female surgeons, surgeons with less than 21 years of experience, and hand and wrist surgeons were more likely to recommend operative treatment, but these factors explained only 1% of the variation in recommendation of operative treatment. Radiographic criteria (intra-articular fractures, ulnar styloid fractures, dorsal comminution, and dorsal tilt) explained 48% of the variation. The overall agreement on treatment was moderate, and was slightly, but significantly, higher among surgeons who received radiographs alone.

Conclusion: The observation that clinical information lowered agreement among surgeons, but did not influence treatment recommendations, suggests that additional study is merited to determine whether patient preferences and circumstances are adequately considered.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Unstable Metacarpal Fractures Treated with Intramedullary Nail Fixation

Ather Mirza, MD; Justin Mirza; Brian Lee; Shawn Adhya; ***Christopher Healy****;*
St. Catherine of Siena Medical Center and North Shore Surgi-Center,
Smithtown, New York, USA

Background/Purpose: Fractures of the metacarpals account for nearly 36% of all hand fractures. While many metacarpal fractures can be treated through nonsurgical means, unstable metacarpal fractures that are subject to malrotation, displacement, foreshortening, and angulation require reduction and stable fixation. Flexible intramedullary nail (IMN) fixation of fractures has become the cornerstone of treatment of long bone fractures with the medullary cavity. It provides distinct advantages over other methods because it is minimally invasive with minimal soft-tissue dissection, stability of fixation, and enhancing bone healing by preventing distraction of the fracture site. This is a particularly great option for patients presenting multiple metacarpal fractures. This study evaluates outcomes in a case series of unstable metacarpal fractures treated with flexible IMN fixation.

Methods: This study includes 55 cases of fractures healed by clinical and radiographic assessment at an average of 12.7 weeks. The outcomes were assessed via a radiological study of longitudinal and angular collapse, and final functional outcome as measured by the Disabilities of the Arm, Shoulder and Hand (DASH), active wrist range of motion (AROM), and grip and pinch strength tests.

Results: Pins were removed in all cases at an average of 13.9 weeks. Patients regained full finger ROM at final follow-up and were capable of 72.4% of motion at 2 weeks postoperatively. Mean DASH score at final follow-up was 6.5. Complications included three cases of extensor tendon irritation that resolved without functional impairment and two cases of "backing out" that required reoperation to replace the pin. In one case, a bony exostosis formed on the affected metacarpal that led to tendon irritation and required operative excision.

Conclusion: This technique allowed for stabilization of fractures, early range of motion with early resumption of usual activities, reduced immobilization, and minimal complications. A removable orthosis, instead of a cast, allowed for mobilization of the proximal interphalangeal joint.

See pages 99 - 147 for financial disclosure information.

Detection of Pediatric Traumatic Knee Arthrotomy Using the Saline Load Test

***Justin Haller, MD**; James Beckmann, MD; Ashley Kapron, PhD; Stephen Aoki, MD;*
University of Utah Department of Orthopaedics, Salt Lake City, Utah, USA

Background/Purpose: Penetrating joint injuries are important to diagnose early given the risk of septic arthritis. The saline load test (SLT) has been used to detect a traumatic arthrotomy in adults with mixed results. CT scan has also been proposed as a more reliable test than SLT for detecting traumatic arthrotomy. Given the concerns for radiation exposure in children, CT scan may not be an option in the pediatric population. The purpose of this study was to quantify the volume needed for positive diagnosis of arthrotomy in the pediatric knee using SLT.

Methods: After IRB approval, investigators prospectively enrolled patients less than 18 years of age who were scheduled to undergo elective knee arthroscopy. Patients with open injury, active infection, or limited range of motion were excluded. The SLT was performed prior to undergoing planned arthroscopic procedure. The standard superolateral arthroscopic portal was made using 11-blade scalpel, and a 5.0-mm obturator was used to ensure that an arthrotomy had been created. A syringe with 18-gauge needle was inserted into the lateral aspect of the knee and sterile saline was injected at a rate of 5 mL/sec until fluid extravasated from the knee joint. The volume injected was recorded. The 50th, 75th, 90th, and 95th percentiles of saline load volume were identified.

Results: We enrolled 93 patients (50 females, 43 males), with an mean age of 13.5 ± 3.1 years (range, 5-18) and a mean body mass index (BMI) of 21.9 ± 5.6 kg/m^2 (range, 12.9-43.5). Seven patients underwent bilateral surgery, and data were collected on bilateral knees. Mean saline load volume was 26.0 ± 12.5 mL (range, 7.0-72 mL). The 50th, 75th, 90th, and 95th percentiles of saline load volume were 24, 33, 42, and 47 mL, respectively. There was no significant difference in injected volume between males and females (26.3 ± 12.5 vs. 25.5 ± 12.5 mL, $P = 0.686$). Saline load volume was significantly correlated to age, height, weight, and BMI (Table 1).

Conclusion: In order to detect 95% of 1-cm superolateral arthrotomies of the pediatric knee using the SLT, 47 mL must be injected from the lateral aspect of the knee. There is no significant difference between genders. As expected, SLT volume was significantly correlated with child age, height, weight, and BMI.

Table 1. Relationship Between Demographics and Saline Load Volume (Dependent Variable)

Independent Variable	Correlation Coefficient (r)	Regression Equation	Significance (P)
Age (years)	0.35	y = 8.8 + 1.3*x	0.001
Height (cm)	0.33	y = -13.7 + 0.25*x	0.002
Weight (kg)	0.36	y = 14.6 + 0.20*x	0.001
BMI (kg/m^2)	0.28	y = 13.5 + 0.59*x	0.008

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Does Skeletal Maturity Affect Pediatric Pelvic Injury Patterns, Associated Injuries, and Treatment Intervention?

*Christiane G. Kruppa, MD[1,2]; **Debra L. Sietsema, PhD**[3,4]; Justin D. Khoriaty, BS[4]; Marcel Dudda, MD[1]; Clifford B. Jones, MD[3,4];*
[1]Department of Surgery, BG-University Hospital Bergmannsheil, Bochum, Germany;
[2]Grand Rapids Medical Education Partners, Grand Rapids, Michigan, USA;
[3]Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA;
[4]Michigan State University, Grand Rapids, Michigan, USA

Purpose: Pediatric pelvis fractures are rare injuries, most frequently caused by high-energy trauma. Major associated injuries are common. Due to the high elasticity and flexibility of the immature pelvis, pediatric fracture patterns may be different than mature patients. The purpose of this study was to analyze the effect of skeletal maturity on pediatric pelvic fracture pattern and initial treatment.

Methods: 90 pediatric pelvic fractures receiving treatment at a private orthopaedic practice in association with a Level I teaching trauma center between 2002 and 2011 were retrospectively analyzed. Skeletal maturity was determined as closed triradiate cartilage. 41 (46%) were skeletally immature and 49 (54%) skeletally mature. Mean age was 11.5 years (range, 2-16). Fractures were 23 A2, 1 A3, 4 B1, 44 B2, 16 B3, and 2 C2 according to OTA/AO classification. OTA B and C fractures were 26 LC1 (lateral compression), 20 LC2, 10 LC3, 4 APC1 (anterior-posterior compression), 5 APC2, and 1 VS (vertical shear) injury according to Young and Burgess. Treatment of the pelvis fracture was operative in 28 (31%) and nonoperative in 62 (69%) children. Mechanism of injury, ISS, deaths, and associated injuries were recorded.

Results: 71 (79%) injuries were caused by traffic accidents. More complex fractures occurred in skeletally mature versus immature children ($P = 0.014$). 75% (12/16) B3 fractures, 100% (2/2) C2 fractures, 80% LC3 fractures (8/10), and 80% (4/5) APC2 fractures occurred in skeletally mature children. Skeletally mature children had a significantly higher rate of operative intervention ($P = 0.009$). The ISS in skeletally mature children was higher (25; range, 1-66) than in skeletally immature children (17; range, 4-43) ($P = 0.013$). 84% (41) skeletally mature and 78% (32) skeletally immature children sustained associated traumatic brain injuries (32 vs. 41), abdomen (14 vs. 20), thorax (16 vs. 25), spine (2 vs. 5), upper extremity (6 vs. 6), and lower extremity (6 vs. 9). 22% (11) of all skeletally mature children sustained urinary tract injuries, but only 7% (3) of all skeletally immature children ($P = 0.049$). One skeletally mature and one immature child died because of associated extrapelvic injuries.

Conclusion: The majority of pediatric pelvic fractures are caused by traffic accidents. Skeletally mature children are more likely to sustain more complex fracture patterns with a higher rate of operative intervention, similar associated injuries, and higher ISS than immature patients.

See pages 99 - 147 for financial disclosure information.

Complications After Operatively Treated Both-Bone Forearm Fractures with ESIN in Childhood and Adolescence: A Two Center Study

Marcel Dudda, MD[1]*; Pamela Bunge, MD; Clifford B. Jones, MD*[2,3]*;*
Thomas A. Schildhauer, MD[1]*; Christiane Kruppa, MD*[1,4]*;*
[1]*Department of Surgery, University Hospital Bergmannsheil, Ruhr, University of Bochum, Bochum, Germany;*
[2]*Michigan State University/CHM, Grand Rapids, Michigan, USA;*
[3]*Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA;*
[4]*Grand Rapids Medical Education Partners, Grand Rapids, Michigan, USA*

Purpose: Both-bone forearm fractures are frequent injuries in childhood and adolescence. Operative treatment is frequently performed using intramedullary stabilization such as elastic stable intramedullary nails (ESIN). The purpose of this study was to analyze complication rates after intramedullary stabilization of both-bone forearm fractures in childhood and adolescence retrospectively at two Level I teaching trauma centers.

Methods: At both centers operatively treated both-bone forearm fractures with ESIN were retrospectively evaluated over 10 to 12 years, respectively. Patients included had a diaphyseal both-bone forearm fracture until the age of 15 and 17 years, respectively. Complications and necessity of further treatment intervention were analyzed. At Center 1, 59 patients with an average age of 11.0 years (range, 5-15) were included. The study population at Center 2 consisted of 180 patients with 181 fractures. Average age was 9.7 years (range, 3-17). A total of 23 (9.6%) fractures were open. 202 (84.2%) fractures were treated with ESIN radial and ulnar. In 26 (10.8%) both-bone fractures the radius was stabilized isolated, in 8 (3.3%) fractures the ulna. Three (1.3%) fractures were stabilized with intramedullary Kirschner wires (K-wires). One was stabilized (0.4%) with ESIN ulnar and K-wire stabilization radial.

Results: 204 both-bone forearm fractures had a total of 15 complications: 4 superficial wound infections, 4 refractures after early hardware removal, 2 malunions, 2 ruptures of the extensor pollicis longus (EPL) tendon, and 1 compartment syndrome. In 2 cases, reoperation with extramedullary stabilization was performed without further intervention.

Conclusion: Intramedullary nailing of unstable both-bone forearm fractures is the method of choice in case operative treatment is required. The complication rate in our study population of 240 included fractures is low; therefore, ESIN can be considered as a safe procedure. Some complications such as EPL tendon rupture and refracture could be avoided by improvement of the operation technique and careful consideration of the time of hardware removal.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Fractures of the Acetabulum in Childhood and Adolescence

*Christiane G. Kruppa, MD[1,2]; **Debra L. Sietsema, PhD**[3,4]; Justin D. Khoriaty, BS[3]; Marcel Dudda, MD[1]; Clifford B. Jones, MD[3,4];*
[1]Department of Surgery, BG-University Hospital Bergmannsheil, Bochum, Germany;
[2]Grand Rapids Medical Education Partners, Grand Rapids, Michigan, USA;
[3]Michigan State University, Grand Rapids, Michigan, USA;
[4]Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA

Purpose: Acetabular fractures in childhood and adolescence are rare. Because of the triradiate cartilage in immature patients, growth disturbance or arrest can result from injury. The purpose of this study was to evaluate acetabular fractures in childhood and adolescence concerning mechanism of injury, fracture pattern, associated injuries, and clinical and radiographic outcome.

Methods: Between 2002 and 2011, 32 consecutive pediatric patients with 37 acetabular fractures were retrospectively analyzed at a Level I teaching trauma center. Fractures were classified according to OTA classification as 9 A1 (one-column posterior wall), 21 A3 (one-column anterior wall), 3 B1 (transverse), 3 B2 (transverse T-type), and 1 B3 (transverse posterior, hemitransverse anterior column) fractures. 12 (32.4%) fractures were isolated (group 1). 25 (67.6%) fractures had an associated pelvis fracture (group 2). The triradiate cartilage was involved in 12 (32.4%) fractures. Mechanism of injury, fracture pattern, fracture displacement, and treatment of the acetabular fracture were recorded. ISS and length of hospital stay were determined and differences between group 1 and 2 were evaluated. 18 children with 22 acetabular fractures with follow-up >6 months were included for further evaluation. Follow up averaged 33.3 months (range, 6-84). Union, nonunion, leg-length discrepancy (LLD), hip dysplasia, pain, and hip range of motion (ROM) were evaluated on final follow-up.

Results: Age averaged 12.8 years (range, 4-16). The main fracture pattern in group 1 (9, 75%) was a posterior wall fracture (A1); 6 were the consequence of a hip dislocation. The majority in group 2 (21, 84%) had anterior wall/column (A3) fractures, caused by traffic accidents in 88% (22). Average fracture displacement in group 1 was significantly higher than in group 2 (3.8 mm vs. 0.8 mm; $P = 0.0003$). Nine (24.3%) fractures were operatively treated, which was significantly higher in group 1 (8/12) than group 2 (1/25) ($P < 0.001$). Group 2 had a higher ISS ($P < 0.001$) (30 vs. 7) and a longer average hospital stay ($P = 0.041$) (2 vs. 6 days). All fractures healed by 11 weeks without delayed or nonunion. Three (13.6%) children had complications of LLD of 1.5 cm (2) or hip dysplasia (2). One (4.5%) child required a varus derotational proximal femoral osteotomy for increasing hip dysplasia and subluxation. None had hip-related pain on their final follow-up. Eight (36.4%) patients complained about low back/sacroiliac joint pain; all were in Group 2. One child (4.5%) had limited hip ROM.

Conclusion: In the pediatric population, high-energy acetabular fractures with an associated pelvic ring injury have different characteristics than isolated acetabular fractures. Combined injuries have less fracture displacement and are less likely to require operative treatment. Due to growth disturbance with injuries of the triradiate cartilage, leg-length discrepancy and hip dysplasia can occur and may require operative intervention.

See pages 99 - 147 for financial disclosure information.

Sacral Fractures in Pediatric Patients

*Christiane G. Kruppa, MD[1,2]; **Debra L. Sietsema, PhD**[3,4]; Justin D. Khoriaty, BS[3]; Marcel Dudda, MD[1]; Clifford B. Jones, MD[3,4];*
[1]Department of Surgery, BG-University Hospital Bergmannsheil, Bochum, Germany;
[2]Grand Rapids Medical Education Partners, Grand Rapids, Michigan, USA;
[3]Michigan State University, Grand Rapids, Michigan, USA;
[4]Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA

Purpose: Sacral fractures in pediatric patients are rare and described in less than 0.2% of pediatric trauma cases. Misdiagnosis and underestimation of sacral fractures are frequently seen in adults. The purpose of this study was to analyze pediatric sacral fractures concerning injury and fracture pattern, treatment and outcome.

Methods: Between March 2002 and June 2011, 52 children (<16 years) presented with a sacral fracture with (51) or without (1) other associated pelvic ring injuries. Electronic records and imaging were retrospectively reviewed at a Level I teaching trauma center. Sacral fracture patterns were analyzed and classified by Denis and pelvic ring injury patterns were classified by OTA/AO classification. Patient age, demographics and mechanism of injury were recorded. Associated injuries, ISS, GCS (Glasgow Coma Scale), and length of hospital stay as well as initial treatment and neurologic symptoms were determined. Clinical and radiographic outcome was evaluated.

Results: There were 22 (42.3%) boys and 30 (57.7%) girls with 25 (48.1%) right, 15 (28.8%) left, and 12 (23.1%) bilateral sacral fractures. Age averaged 12.2 years (range, 3.0-16.0). 39 (75.0%) fractures involved Zone 1 and were crush injuries to the anterior sacral ala, 11 (21.2%) were Zone 2, and 2 (3.8%) were Zone 3. Both Zone 3 fractures were transverse sacral fractures, one below S3 and one lambda-shaped above. 20 (38.5%) children were skeletally immature, and 32 (61.5%) mature. The most frequent mechanism of injury in 42 (80.8%) children was a traffic accident including car occupant (28) or pedestrian versus car (14). Operative stabilization was performed in 9 (17.3%) children with sacroiliac (SI) screw fixation. Four (7.7%) children had neurologic symptoms. One child with a lambda-shaped transverse sacral fracture had decreased sensation of the proximal thigh, another child with a Zone 2 sacral fracture had a sciatic nerve paresthesia, another one with a Zone 2 sacral fracture had a lumbar plexus injury demonstrated with pelvic floor dyssynergia and partial fecal incontinence, and one child with a Zone 1 sacral fracture had a lumbar 5 nerve root paresthesia. All four children had a pelvic ring injury OTA B3 or B2 without injury of extremities. All fractures healed and had an average time to weight bearing as tolerated at 1.8 months (range, 0.1-3.6). One child died because of associated injuries. 11 (45.8%) children had low back or SI joint pain in final follow-up. Seven (29.2%) had a superior sacral displacement of 5-10 mm in their final radiographic outlet view, and nine (37.5%) had a posterior sacral displacement of 5-10 mm in their final inlet view. Four of the 7 malunited fractures had pain while 3 did not have pain. All children returned to normal activities without gait or limp problems. All paresthesias resolved, but the one child with lumbar plexus injury had persistent neurologic symptoms with incontinence.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Conclusion: Most pediatric sacral fractures occur in the sacral alar region. More complex and unstable sacral fractures with neurologic symptoms occur and potentially benefit from stabilization. Persistent pelvic pain and deformity in this pediatric sample are present, do not remodel, and do not correlate.

See pages 99 - 147 for financial disclosure information.

Is "Delayed" Early Total Care Dangerous When Nailing Femur Fractures?

Daphne Beingessner, MD; David P. Barei, MD; ***Jonah Hebert-Davies, MD****;*
Harborview Medical Center, Seattle Washington, USA

Background/Purpose: Timing of definitive fixation of femur fractures in the polytraumatized patient remains an area of certain controversy. The concept of damage control orthopaedics (DCO) was designed to treat unstable patients with temporary stabilization using external fixation. Recently, improved resuscitative methods have allowed for the return of early appropriate total care. Recent studies have shown that definitive fixation within 24 hours of injury resulted in lower complication rates then delayed treatment. The purposes of this study were first to review the tendencies at our Level I trauma center, and second to evaluate complications associated with timing of femoral nailing.

Methods: All femoral shaft fractures amenable to intramedullary nail fixation over a 5-year period were identified retrospectively from a trauma database. Patients who died prior to fixation, underwent damage control, and those with periprosthetic fractures were excluded. Complications collected were mortality, pulmonary embolism, fat embolism, pneumonia, acute respiratory distress syndrome (ARDS), deep vein thrombosis (DVT), and respiratory arrest. Patients were divided into four groups (<24 hours, 24-48 hours, 48-120 hours, >120 hours) based on timing from injury to operative fixation.

Results: A total of 822 patients presenting with femur fractures were identified over a 5-year period. Of these patients, 610 were treated with intramedullary statically locked nailing. Nine patients died in the immediate postoperative period. The average age was 33.6 years and mean ISS was 22.3. The mean time from admission to operation was 23.1 hours, with 70.9 % being treated <24 hours, 15.2% between 24 and 48 hours, 9.3% between 48 and 120 hours, and 4.6% >120 hours. The total rate of complications was 22%. ARDS and pneumonia were statistically more likely in patients nailed within 24 hours ($P > 0.05$). ARDS was also significantly increased in patients undergoing fixation after 120 hours. All other complications were not different among the groups.

Conclusion: Early total care for femur fractures is safe although not without complications. Modern resuscitation has likely allowed for earlier fixation time; however, it does not eliminate complications. Current literature supports primary definitive fixation and this is reflected in our practice. Special attention should be given to patients at risk for respiratory complications. When there is a delay, intramedullary nailing can still be safely undertaken between injury days 2 and 4 without increased complications.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

A Day Late and a Fracture Missed: Delayed Diagnosis of Orthopaedic Injuries in Severely Injured Trauma Patients

Ronald T. Auer, MD*; Shane J. Kibbe, MD; John T. Riehl, MD;*
University of Louisville, Louisville, Kentucky, USA

Background/Purpose: Critically injured patients maybe at a higher risk for missed or delayed diagnosis for musculoskeletal conditions. Extremity and spine fractures and dislocations are can be overlooked when a patient has life-threatening injuries according to some reports. The goal of our study was to identify risk factors associated with missed orthopaedic injuries in patients with ISS 25 and higher.

Methods: A retrospective chart review using the database at a Level I trauma center was used to find patients who (1) sustained an orthopaedic injury of the spine, pelvis, or extremity; (2) had an ISS ≥25; and (3) met criteria for Level I or Level II activation by our emergency department (ED). 390 consecutive patients were identified and charts reviewed. A "missed injury" was defined as an injury that was not identified on initial radiographs, CT scan, or initial examination in the ED. Any injuries without imaging were considered missed after 24 hours. Injuries were categorized into body regions, severity, and treatment (surgery, closed reduction, or conservative). The missed injury group and the group without missed injuries were compared using c^2 testing and Student *t*-test for statistical significance of risk factors.

Results: Of the 390 patients evaluated, 62 (16%) were found to have 97 orthopaedic injury locations that were missed or had a delay in diagnosis. There were significant differences between the two groups in length of stay ($P < 0.005$), ICU days ($P < 0.005$), ventilator days ($P < 0.005$), and ISS ($P < 0.02$). There was no significant difference between the groups in male:female ratio, discharge outcome (alive or dead), or trauma activation level (I or II). The average time to diagnosis for missed injuries was 5 days (range, 1-38). 19 of these injuries required surgical intervention and 3 were managed with closed reduction or manipulation. The distribution of injuries was disproportionately in the lower extremities (50 lower extremity, 11 spine, 2 pelvis, 34 upper extremity). The most common reasons for a missed injury were lack of physical examination findings, late radiographs, and injury not seen on radiographs but found on CT imaging.

Conclusion: Severely injured patients are at a particular risk for a missed or delayed diagnosis because of their inability to communicate the location of pain, and therefore rely heavily on physical examinations and imaging studies. The risk factors for a missed or delayed diagnosis in our patient population were an increased ISS, ICU stay, and overall length of hospital admission and ventilator time. Our study shows an increased risk of missed or delayed diagnosis in distal extremity injuries especially the foot and ankle region. The incidence of missed or delayed diagnosis of spinal fractures has been significantly reduced compared to previous studies with the routine use of the pan CT scan (head, chest, abdomen, pelvis, and spinal reconstructions).

See pages 99 - 147 for financial disclosure information.

Definition of the Borderline Condition in Multiple Trauma Patients: Role of Conventional Parameters

Frank Hildebrand, MD[1,2]*; Rolf Lefering, PhD*[3]*; Richard Sellei, MD*[1]*;*
Hagen Andruszkow, MD[1,2]*; Boris A. Zelle, MD*[4]*; Hans-Christoph Pape, MD, FACS*[1]*;*
[1]*Department of Orthopaedic Trauma at Aachen University, Aachen, Germany;*
[2]*Harald Tscherne Research Laboratory for Orthopaedic Trauma at Aachen University, Aachen, Germany;*
[3]*Institute for Research in Operative Medicine (IFOM), Cologne, Germany;*
[4]*The University of Texas Health Science Center, San Antonio, Texas, USA*

Background/Purpose: Several recommendations for the classification of multiple trauma patients exist. In order to define the multiple trauma patient in the "borderline situation" we performed a database analysis to indentify threshold levels of clinical parameters that are easily available in the early posttraumatic course.

Methods: A population-based trauma registry was used (TraumaRegister DGU). All patients were documented between January 1, 2002 and December 31, 2012. Inclusion criteria were age >16 years combined with significant isolated injury (defined as Abbreviated Injury Score [AIS] >3 points) and treated in the ICU, or polytrauma with an ISS >16 points. Patients were graded for their risk of death according to their true mortality rates: low risk (5%), intermediate risk (15%), and high risk (40%). Patients in extremis were excluded. Parameters recommended in previous publications were assessed. Threshold levels were established according to their associated mortality and their ability to determine low risk, intermediate risk, and high risk pathological changes. The primary end point was in-hospital mortality.

Results: 11,436 patients met the inclusion criteria. The mean ISS was 22.7 ± 11.2 points. 73% of the patients were male. 95.6% sustained blunt injuries. Five clinical parameters were used to describe the risk situation as low, intermediate, or high. The intermediate risk threshold levels were as follows: systolic blood pressure on admission (76-90 mmHg), INR (international normalized ratio) (1.4-2.0), base deficit (8-10), NISS (New Injury Severity Score) (35-49), and pRBCs (packed red blood cells) administered (3-14). More aggravated alterations were considered as high risk pathological changes. Borderline patients were defined as having two or more intermediate risk pathological changes and no more than one high risk pathological change. Patients with more than one high risk pathological change were classified as "unstable".

Conclusion: Borderline patients can be defined based on five conventionally used parameters: admission systolic blood pressure, base deficit, INR, NISS, and number of transfused units of red blood cells administered. These parameters can easily be determined and can be used interchangeably to identify a borderline situation in multiple trauma patients.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

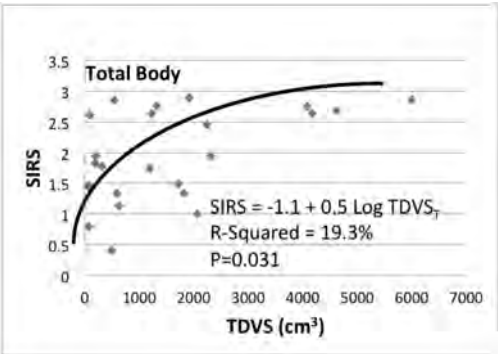
Tissue Damage Volume Predicts Systemic Inflammation in Multiply Injured Patients with Fractures

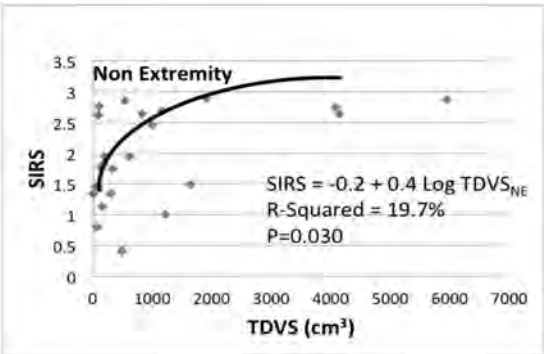
Travis L. Frantz, MS; Greg E. Gaski, MD; Scott Steenburg, MD; Timothy Pohlman, MD;
Todd O. McKinley, MD;
Indiana University School of Medicine, Methodist Hospital, Indianapolis, Indiana, USA

Background/Purpose: The Systemic Inflammatory Response Syndrome (SIRS) occurs in multiply injured patients (MIPs) and can lead to organ failure and death. Evidence has accumulated showing that SIRS results from an immune response to endogenous molecules, damage-associated molecular patterns (DAMPs), which are liberated from damaged tissue secondary to trauma. However, it is not known how the magnitude of tissue damage or the types of tissues that are damaged translate into an inflammatory response. The purpose of this study was to quantify how the magnitude of tissue damage affected inflammation in MIPs. Additionally, we explored the differences in inflammation resulting from extremity versus non-extremity tissue damage.

Methods: Data from 23 MIPs (ISS ≥18) ages 18 to 65 years were collected. Daily SIRS scores (0 to 4) were calculated from vital sign data and white blood cell count, and averaged for the entire ICU length of stay. A novel radiographic index, the Tissue Damage Volume Score (TDVS), was calculated by measuring every injury sustained by each patient as detected on all CT scans and plain radiographs. A characteristic radius (r) of each injury was determined by two reviewers, and the TDVS was calculated assuming each injury was spherical ($V_i = 4/3Pr^3$). Individual injuries were summed into three damage volume values representing the total body ($TDVS_T$), extremities ($TDVS_E$), and non-extremities ($TDVS_{NE}$). Linear and nonlinear regression analyses were used to assess relationships between $TDVS_T$, $TDVS_E$, and $TDVS_{NE}$, and average SIRS scores.

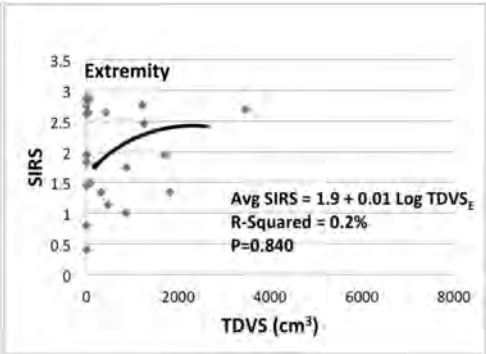
Results: $TDVS_T$ and $TDVS_{NE}$ demonstrated statistically significant relationships to average SIRS scores. $TDVS_E$ did not correlate to average SIRS scores.





Conclusion: The magnitude of inflammation correlated to $TDVS_T$ and to $TDVS_{NE}$. In contrast, inflammation showed no correlation to $TDVS_E$. $TDVS_E$ calculations did not include spine and pelvis fractures. Patients with $TDVS_T$ >2500 cm^3 or $TDVS_{NE}$ >2000 cm^3 uniformly had average SIRS scores ≥2.5, which correlated closely with organ failure and death in this set

See pages 99 - 147 for financial disclosure information.



of patients. These data show that the magnitude of inflammation is a function of the volume of injury. The bridge between tissue damage volume and inflammation needs subsequent investigation to determine pathomechanistic pathways that cause SIRS and organ failure.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Early Appropriate Care of Orthopaedic Injuries in Elderly Multiple-Trauma Patients

Michael S. Reich, MD; Andrea J. Dolenc, BS; Timothy A. Moore, MD; ***Heather A. Vallier, MD****; MetroHealth Medical Center, Cleveland, Ohio, USA*

Background/Purpose: This study was designed to evaluate clinical predictors of complications in multiply injured elderly trauma patients with orthopaedic injuries. Previous work from our institution has established resuscitation parameters that minimize complications with early fracture management. Protocol recommendations included definitive management of mechanically unstable fractures of the pelvis, acetabulum, spine, and femur within 36 hours, provided the patient demonstrated a positive response to resuscitative efforts, including lactate <4.0, pH ≥7.25, or base excess (BE) ≥–5.5 mmol/L. This protocol has been applied to all skeletally mature patients, but patients with advanced age or preexisting medical issues may require unique parameters to mitigate risk of complications and mortality.

Methods: Between October 2010 and March 2013, 376 skeletally mature patients with 426 unstable fractures of the pelvis (n = 73), acetabulum (n = 58), spine (n = 112), and/or proximal or diaphyseal femur fractures (n = 183) were treated at a Level I trauma center and were prospectively studied. Subgroups of patients age ≤30 years (n = 114) and ≥60 years (n = 37), treated within 36 hours of injury, were compared. Low-energy fractures were excluded. The ISS, Glasgow Coma Score (GCS), and American Society of Anesthesiologists (ASA) classification were determined. Lactate, pH, and BE were measured at 8-hour intervals and perioperatively. Complications included pneumonia, pulmonary embolism (PE), acute renal failure (ARF), acute respiratory distress syndrome (ARDS), multiple organ failure (MOF), deep vein thrombosis (DVT), infection, sepsis, and death.

Results: Patients ≤30 years old (y/o) were more likely to sustain gunshot wounds (P = 0.039), while those ≥60 y/o were more likely to fall from a height (P = 0.002). There were no differences in the frequency of pelvis, acetabulum, spine, or femur fractures. In patients who underwent definitive fixation within 36 hours of injury, younger patients had lower GCS (12.3 ± 4.32 vs. 14.2 ± 2.77, P = 0.003), and lower ASA (2.58 ± 0.86 vs. 3.03 ± 0.76, P = 0.004), with no difference in ISS (25.0 ± 9.64 vs. 24.6 ± 8.99). At least one complication occurred at similar rates for patients ≤30 y/o (15.8%) and ≥60 y/o (16.2%), but younger patients were more likely to develop PE or ARDS (both, 3.5% vs. 0.0%, P = 0.045). At the time of fixation for patients ≤30 y/o and ≥60 y/o, there were no differences in lactate (2.09 ± 0.95 vs. 1.86 ± 0.81), pH (7.32 ± 0.07 vs. 7.32 ± 0.09), or BE (–3.79 ± 3.73 vs. –3.42 ± 4.30). Subgroup analysis evaluating the severity of acidosis incrementally within patients ≤30 y/o showed more overall complications if pH was <7.30 (P = 0.042) or BE <–6.0 (P =0.049); there were trends toward more pulmonary complications with lower BE and more pneumonia with lower pH. Patients ≥60 y/o demonstrated more sepsis if BE was <–6.0 (P = 0.046); they trended toward more overall complications with lower BE and more MOF and death with lower pH. The older cohort trended toward being more prone to sepsis than the younger cohort with lower BE. Higher ASA was associated with a greater incidence of any complication, pulmonary complication, pneumonia, ARDS, MOF, sepsis, and death, irrespective of patient age.

Conclusion: Early appropriate care aims to definitively manage major skeletal injuries by treating patients once they have been adequately resuscitated in order to minimize

See pages 99 - 147 for financial disclosure information.

complications. ASA score has important implications in predicting complications. Further study is needed in a larger sample to determine whether previous resuscitation parameters guiding timing of definitive fixation in elderly patients should be more conservative to decrease their risk of complications.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Fracture Healing Complications in Patients Presenting with High-Energy Trauma Fractures and Bone Health Intervention

Debra L. Sietsema, PhD[1,2]*; Michael D. Koets, BS*[3]*; Clifford B. Jones, MD*[1,2]*;*
[1]*Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA;*
[2]*Michigan State University, Grand Rapids, Michigan, USA;*
[3]*Wayne State University School of Medicine, Detroit, Michigan, USA*

Purpose: Approximately 5%-10% of fractures will have healing complications of nonunion or malunion. Altered bone metabolism is one of many contributing factors to abnormal bone healing. Trauma patients may have many of the risk factors for osteoporosis which when combined with a high-impact injury can lead to poor fracture healing. The purpose of this study was to determine fracture healing complications following high-energy trauma in those who have had bone health follow-up.

Methods: From 2011 through 2012, 522 consecutive adults with high-energy trauma fractures received treatment in a Level I trauma center, were seen in an outpatient clinic for bone health, and retrospectively evaluated. 96 patients were excluded due to insufficient chart data, resulting in 426 patients in the study. Patients had a full workup consisting of mechanism of traumatic fracture(s), radiologic determination of healing, health and medication history, physical examination, bone health laboratory values drawn inpatient, and dual x-ray absorptiometry (DXA) outpatient when physically feasible. Vitamin D 50,000 IU was given following trauma presentation prior to initial laboratory draw and continued maintenance dose was dependent on laboratory results. Individualized bone health lifestyle behavioral counseling, treatment and prescription were provided as indicated. Both inpatient and outpatient electronic medical records were accessed to assess mechanism of trauma, medications, laboratory values, DXA scan values, open versus closed fracture, surgical intervention, and the occurrence of malunion or nonunion.

Results: There were 231 (54%) males and 195 (46%) females with a mean age of 54 years (range, 18-90), body mass index (BMI) of 27.7 kg/m^2 (range, 15.3-70.6), and predominance of Caucasians (405, 95%). Mechanism of injury was motor vehicle accident (MVA) (149, 35%), fall from height (106, 25%), motorcycle accident (MCA) (53, 12%), and other (118, 28%). 42/426 (10%) were open fractures. 19/426 (5%) had previous fracture(s) after age 50 years. Comorbidities included diabetes (45, 11%), hypothyroidism (45, 11%), chronic obstructive pulmonary disease (COPD) (23, 5%), and rheumatoid arthritis (RA) (17, 4%). 92/426 (22%) were smokers and 67 (16%) were past smokers. Medication history included bisphosphonate (10, 2%), PPIs (proton pump inhibitors) (64, 15%), estrogen (52, 12%), and glucocorticoids (7, 2%). Laboratory values included calcium 8.9 (range, 6.5-11.1), vitamin D 25 (OH) 27.5 (range, 3-65), with 262 (62%) less than 30 ng/mL. Bone turnover markers were: P1NP 52 (range, 1-231) and CTX 0.5 (range, 0.09-1.77). DXA T-score was –1.7 (range, 0.4 to –4.8). Decreased T-score was related to increased age ($r = -0.318$, $P < 0.001$). 34/426 (8%) and 6/426 (1.4%) resulted in nonunions and malunions, respectively. Nonunions occurred more frequently in open fractures (8/42 vs. 26/384, $P = 0.005$).

See pages 99 - 147 for financial disclosure information.

	Ca	Vitamin D	iPTH	CTX	P1NP	T-Score
Healed	8.9 (6.5-10.7)	27 (3-65)	51 (4-303)	0.5 (0.09-1.8)	52 (1-231)	–1.7 (0.4 to –4.8)
Nonunion	9.0 (8.0-11.1)	26 (14-42)	49 (15-104)	0.4 (0.2-0.9)	51 (9-164)	–1.6 (0.2 to –3.2)
Malunion	9.1 (8.0-10.1)	24 (14-32)	45 (18-85)	0.7 (0.5-1.0)	68 (28-187)	–1.7 (–0.7 to –2.9)

Conclusion: Despite presenting with high-energy trauma, initial bone metabolic laboratory values and DXA indicators were poor and did not vary between patients who healed their fractures and those with fracture-healing complications. Open fractures continue to be associated with nonunions. Vigilance in maximizing bone health in all patients may have been a contributing factor in keeping the nonunion and malunion rate relatively low.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Are the Fractures We Treat Becoming More Complex? Trends in Orthopaedic Fracture and Injury Severity—A Level-I Trauma Center Experience

Neil Tarabadkar, MD*; Timothy Alton, MD; Jacob Gorbaty, BA; Lisa Taitsman, MD; Sean Nork, MD; Conor Kleweno, MD;*
University of Washington, Harborview Medical Center, Seattle, Washington, USA

Purpose: Our objective was to define the trends in fracture complexity and overall injury severity of orthopaedic trauma patients at a tertiary Level I trauma center. We hypothesize that patients presenting to this center in the late 2000s will be more severely injured and have increasingly complex fractures compared to a cohort of patients in the 1990s as determined by the ISS and the AO/OTA fracture classification.

Methods: We conducted a retrospective review of a prospectively collected trauma database to determine the ISS and AO/OTA classification of the most common fractures at this institution from 1995-1999 and from 2008-2012. Inclusion criteria included lower extremity fractures of the femur, tibia, and pelvis (AO/OTA 31-33 A-C, 41-43 A-C, 61-62 A-C) within the years of interest. Exclusion criteria were age <18 years, pathologic fracture, and insufficient medical record to determine ISS or AO/OTA classification.

Results: The total number of fractures increased from 4869 to 5902 between the two cohorts. There was an increase in the percentage of lower extremity periarticular fractures (20.7% to 23.4%, $P < 0.001$), an increase in the percentage of pelvic and acetabular fractures (32.7% to 39.9%, $P < 0.001$), and a decrease in the percentage of lower extremity extra-articular fractures (46.6% to 36.7%, $P < 0.001$). The overall complexity of fractures based on the AO/OTA classification significantly increased between the two time periods (A-type fractures compared to B and C types, ie, extra- vs. intra-articular) ($P = 0.041$). Specifically, the ratio of intra-articular tibial pilon fractures relative to extra-articular tibial fractures increased from 0.29 to 0.60 ($P < 0.001$). The ratio of intra-articular tibial plateau fractures relative to extra-articular tibial fractures increased from 0.49 to 0.81 ($P < 0.001$). Thus, for each extra-articular tibia fracture, there were 0.79 intra-articular tibial fractures in the earlier cohort compared to 1.4 intra-articular tibia fractures in the later cohort. The ratio of intra-articular distal femur fractures to femoral shaft fractures remained unchanged (0.26 to 0.22, $P = 0.14$). However, the proportion of femoral shaft fractures decreased from 17.1% to 13.2% ($P < 0.001$) of the total fractures, and extra-articular tibia fractures decreased from 19.4% to 13.9% ($P < 0.001$). Acetabular and unstable pelvis fractures significantly increased from 26.9% to 34.4% of the total fractures ($P < 0.001$). The average ISS from 2008-2012 increased compared to 1995-1999 (ISS = 19.2 vs. 15.1), being significantly greater for each 10-point stratification of the ISS data (Pearson c^2 $P < 0.001$).

Conclusion: Health-care economics continue to change in the US, with provider and hospital reimbursements shifting toward being based on patient outcomes with potential penalties for complications and readmissions. In this evolving reimbursement environment, accurate determination of case mix index and patient risk stratification based on anticipated outcomes is increasingly important. These data demonstrate that the complexity of certain lower extremity fractures and the severity of injury of patients treated at this referral institution are high and continue to increase. In the setting of increasing injury severity, we

See pages 99 - 147 for financial disclosure information.

observed proportionally fewer diaphyseal fractures and increased periarticular, acetabular, and unstable pelvic fractures. This information should be considered as new reimbursement algorithms are developed.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Thromboelastography Demonstrates Less Hyperfibrinolysis in Multiply Injured Trauma Patients with Pelvic Fractures

Christiaan N. Mamczak, DO[1,2]*; Bryan Boyer, MD*[1,2]*; Scott Thomas, MD*[2,3]*;*
Braxton Fritz, BS[4]*; Ed Evans, BA, CCP*[2]*; Benjamin Speicher, BA*[2]*; Mark Walsh, MD*[2,4]*;*
[1]*Beacon Orthopaedic Trauma Surgery, South Bend, Indiana, USA;*
[2]*Memorial Hospital of South Bend, South Bend, Indiana, USA;*
[3]*General & Vascular Surgery PC, South Bend, Indiana, USA;*
[4]*Indiana University School of Medicine, South Bend, Indiana, USA*

Background/Purpose: Hyperfibrinolysis is an abnormal physiologic response and marker of trauma severity in multiply injured patients (MIPs). Tranexamic acid (TXA), an antifibrinolytic used in two landmark studies, demonstrated improved survival rates and fewer transfusion requirements when given as an adjunct to hemostatic resuscitation in bleeding trauma patients (CRASH-2 trial and MATTERs study). Despite these potential benefits, there are thromboembolic risks that have raised concern about its use in acute orthoapedic trauma fracture cases when compared to TXA use in elective arthroplasty procedures. Differences in hyperfibrinolysis between trauma MIPs receiving massive transfusions may account for the increased thrombosis. Using a pilot study, we hypothesized that MIPs with acute pelvic fractures have less hyperfibrinolysis than MIPs without pelvic fractures, leaving them at greater risk for thromboembolic events if TXA were added to the resuscitation protocol.

Methods: A cohort of MIPs at a Level II trauma center were retrospectively reviewed for the presence or absence of hyperfibrinolysis. Inclusion criteria included: trauma activation, ISS >9, age >15 years old, and an available perfusionist. Whole blood samples taken from each patient during the index resuscitation were analyzed for real-time clotting using thromboelastography (TEG). Standard TEG parameters were measured: R, α-angle, maximum amplitude, and incipient plateau LY30% (% clot lysis at 30 minutes). The termination of clot and existence of fibrinolysis was based on LY30 values. Based on previous research, hyperfibrinolysis was classified as an LY30% value ≥3%. Massive transfusion (MT) was defined as ≥10 units of blood components transfused within 24 hours. Subgroup analysis was performed between four groups: MIP with MT, MIP without MT, pelvic MIP with MT, and pelvic MIP without MT.

Results: 89 MIPs met criteria for review: 15 MIPs with MT, 48 MIPs without MT, 7 pelvic MIPs with MT, and 19 pelvic MIPs without MT. The mean LY30% values were: 15.5 for MIP with MT, 1.2 for pelvic MIP with MT, 3.12 for MIP without MT, and 1.7 for pelvic MIP without MT. When comparing only patients who demonstrate fibrinolysis (LY30% >0), there was a significant difference in the amount of measureable fibrinolysis between the MIP with MT (mean 38.63) and both pelvic MIP with MT (mean 2.67, $P = 0.036$) and pelvic MIP without MT (mean 3.36, $P = 0.042$). There was no significant difference between MIP without MT (7.19) and pelvic MIP without MT (3.36, $P = 0.33$) or between MIP groups ($P = 0.56$).

Conclusion: Index TEG evaluation suggests the incidence of hyperfibrinolysis is significantly less in MIPs with pelvic fractures. Although trauma studies have advocated benefits of TXA dosing early in the resuscitation protocol, this pilot study raises concerns for its use in MIPs with pelvic fractures. Because of the increased concern for thromboembolic events

See pages 99 - 147 for financial disclosure information.

in orthopaedic trauma patients, we suggest that TXA be given cautiously by restricting its use to patients demonstrating hyperfibrinolysis defined by TEG LY30 levels ≥3%.

• The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Phonomyography as a Noninvasive Continuous Monitoring Technique to Diagnose Acute Compartment Syndrome

Adriana P. Martinez Gomez, MD; *Thomas Hemmerling, MD, DEAA, PhD; Neil Saran, MD, MSc, FRCSC; Marylene Paquet, DMV, MSc, D'ACVP; Gregory K. Berry, MDCM, FRCSC;*
McGill University, Montreal General Hospital, Orthopaedic Surgery Department, Montreal, Quebec, Canada

Background/Purpose: In acute compartment syndrome (ACS), clinicians have difficulty diagnosing soft-tissue hypoperfusion in a timely and noninvasive manner. Once identified, immediate surgical intervention is required to relieve the pressure; left untreated, it may cause loss of limb function. Phonomyography, which detects acoustic signals of muscle contraction, is currently used by anesthesiologists to evaluate neuromuscular blockade in general anesthesia. We hypothesize that alterations in muscle contraction caused by hypoperfusion in ACS and ischemia can be detected with phonomyography.

Methods: An established ischemic model of limb injury in Sprague-Dawley rats was used. 15 rats were tested, with standard duration of injuryof 30 minutes, and 1, 2, 4, and 6 hours. The right leg served as control, and the left common iliac artery was clamped for the ischemic model. Transcutaneous nerve stimulators near the sciatic nerve and phonomyography microphones over the posterior calf of both limbs were used. Nerve stimulation at 10-minute intervals provoked muscle contraction, evaluated using a patented phonomyography device. Routine histology evaluated nerve and muscle damage, correlated with the duration of injury and phonomyography output.

Results: In all ischemic time points there was a statistically significant decrease of the phonomyography signal. In 1 hour of ischemia the signal decreased 55% (n = 12; $P = 0.005$), 5%-10% muscle necrosis. In 2 hours of ischemia the signal decreased 76% (n = 9; $P = 0.015$), 100% muscle necrosis and nerve damage. In 4 hours of ischemia the signal decreased 86% (n = 6; $P = 0.028$), corresponding to 100% of muscle necrosis and nerve damage. In 6 hours of ischemia the phonomyography signal decreased 95% (n = 3; $P = 0.109$), 100% of muscle damage and nerve damage.

Conclusion: Phonomyography, a promising noninvasive technique, detects early changes in muscle physiology that occur as a result of acute compartment syndrome. Further testing is planned to evaluate its potential use in humans.

See pages 99 - 147 for financial disclosure information.

Infection After Internal Fixation: Alternatives in Treatment

Salvatore Frangiamore, MD; Ajinkya Rane, BS; ***Heather A. Vallier, MD****;*
MetroHealth Medical Center, Cleveland, Ohio, USA

Background/Purpose: Infection is a serious complication after internal fixation, characterized by bacterial adherence to implants and facilitated by dampened immune response after local trauma and inherent properties of metal implants. Treatment includes surgical debridement and irrigation, followed by antibiotics with or without implant retention. Currently, standard of care consists of debridement followed by 4-8 weeks of intravenous (IV) antibiotics. Risks of prolonged IV therapy include line sepsis or phlebitis, drug abuse, thrombosis, and mechanical failure, as well as adverse reactions to medications. Outpatient therapy is associated with considerable health-care utilization and cost due to drug acquisition, nursing time, and supplies required for administrating IV antibiotics. To our knowledge, there are no studies regarding efficacy of oral antibiotics for infection after internal fixation. The aim of our study is to assess the efficacy of oral antibiotics in combination with debridement, with or without plate retention, for treatment of infection. We hypothesize that oral antibiotics will effectively treat infection, with fewer adverse events and lower costs. A secondary aim is to determine the frequency of positive culture during treatment of nonunion, and to determine the risk of subsequent clinical infection.

Methods: We retrospectively reviewed a single-surgeon series of 54 patients over 72 months who underwent secondary surgery for infected implants or for nonunion of fracture. This cohort was broken into subgroups based on presentation. 14 patients (25.9%) were treated for a presumed infection and plate colonization, having preoperative indicators including elevated serum inflammatory markers and/or clinical infection (erythema, drainage, etc) and a colonized plate. Each of these patients underwent plate removal when the fracture was clinically and radiographically united. They received a 10-14 day course of oral antibiotics. One patient with iliac plate colonization had a chronic open wound, and plates were not removed during debridement. The second group was composed of 33 patients without any clinical indication of infection who had treatment of nonunion with internal fixation. These were treated with implant revision, with or without bone grafting, and no long-term antibiotics. The third group of 7 patients presented with chronic osteomyelitis, chronic draining wounds, and diffuse bone involvement, and they were excluded from further study.

Results: A total of 27 patients grew positive cultures postoperatively. Mean follow-up was 10.2 (3.1/6.0/15.0 [25th/50th/75th percentile]) months. Of the 33 patients treated for nonunion, 14 (42.4%) grew positive cultures all in broth only postoperatively and had no perioperative indicators of infection. None of them were treated with long-term antibiotics postoperatively, and there were no patients with recurrent infection at latest follow-up. The 13 patients with colonized plates who had plate removal had no recurrence of clinical infection. One patient with a chronic open iliac wound and retained hardware did undergo further treatment for infection, consisting of later debridement and implant removal. Thus, one patient (1/14, 7.1%) had clinical evidence of recurrent infection.

Conclusion: After standard 24-hour perioperative IV antibiotics, oral antibiotics appear effective in preventing recurrent infection after initial debridement of infected plates.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Removal of metal implants and debridement of surrounding infection and necrotic tissue likely eliminate much of the bacterial load. This should be considered an alternative to prolonged IV therapy. It is likely associated with lower patient risks and less expense. Broth-positive cultures occur commonly at our hospital in patients undergoing treatment of nonunion with no prior history of infection. In the presence of no clinical or laboratory indicators of active infection, patient observation without administration of antibiotics may be a reasonable course of care.

See pages 99 - 147 for financial disclosure information.

Treatment of Complex Posttraumatic Wounds Without Free Flap Coverage: Are Stem Cells the Orthopaedic Surgeon's New Free Flap?

Bruce A. Kraemer, MD; Scott Geiger, MD; ***J. Tracy Watson, MD****;*
Departments of Orthopaedic and Plastic Surgery, St. Louis University School of Medicine, St. Louis, Missouri, USA

Background/Purpose: Free flap coverage is often the treatment of choice for complex posttraumatic orthopaedic wounds. Exposed hardware, bone, and tendon can further complicate the ability to achieve competent and timely wound coverage especially in a compromised host. Patients with multiple medical comorbidities are noted poor flap candidates with high rates of flap failure and complications. The purpose of this study reviewed the results of treatment using a porcine extracellular matrix to achieve stable/durable wound coverage for patients presenting with complex posttraumatic wounds that were deemed poor free flap candidates.

Methods: We prospectively applied Extracellular Matrix MatriStem (ACell) to complex posttraumatic orthopaedic lower extremity wounds. This xenograft extracellular matrix is applied as a powder or single or multilayer sheet formulations that is placed directly into the open wounds. Inclusion criteria included patients with complex lower extremity wounds as a result of trauma/surgical intervention. All wounds potentially required free flap coverage but were deemed poor free flap candidates by the consulting plastic surgery service. Conditions precluding flaps included obesity (body mass index >35 kg/m^2), prior leg trauma with inadequate vasculature, severe venous stasis disease, vascular occlusive disease, uncontrolled diabetes, renal dialysis, uncontrolled wound infection, recent myocardial infarction and other chronic medical comorbidities. MatriStem was applied following serial debridements to achieve a stable wound. Exposed hardware, tendon or bone was *not* routinely removed unless grossly infected. Following application, wounds were sealed with occlusive dressings to maintain local biology. Dressings were changed at weekly intervals until regenerate tissue was present. Time to complete wound and skeletal healing was noted. Residual infection, secondary procedures, and functional outcomes were recorded.

Results: 55 patients were treated with the material overall including 15 with orthopaedic conditions. Of these patients screened, and material applied, 12 patients had adequate follow-up for review (>1 year). Pathology consisted of ankle/pilon fractures (4), open tibial shaft fractures (4), and Achilles tendon repair (4). Six patients required secondary application, but all wounds healed with durable wound coverage, (average 14 weeks) with no additional intervention other than split-thickness skin graft (6 patients). All patients healed their orthopaedic pathology without residual infection. Five of 6 patients presenting with retained hardware had total wound healing with hardware in place. The remaining patient achieved subtotal coverage over a large plate that was subsequently removed following fracture healing, allowing complete healing.

Conclusion: With this early experience, we advocate this material for complex orthopaedic wounds in patients that are not flap candidates, even in patients with exposed hardware provided the wound is not grossly infected. This material facilitates closure with simple dressings and avoids the need for advanced plastic surgical wound closure techniques or prolonged negative pressure wound therapy.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

WITHDRAWN

See pages 99 - 147 for financial disclosure information.

Manipulation Under Anesthesia: A Safe and Effective Treatment for Posttraumatic Arthrofibrosis of the Knee

Adam A. Sassoon, MD*; Obinna O. Adigweme, MD; Joshua Langford, MD;*
Kenneth J. Koval, MD; George J. Haidukewych, MD;
Orlando Regional Medical Center, Orlando, Florida, USA

Purpose: Manipulation under anesthesia (MUA) has been shown to improve range of motion (ROM) following elective total knee arthroplasty; however, there is a paucity of data regarding its role in a posttraumatic setting. This study seeks to investigate the results of a consecutive series of closed knee manipulations performed under anesthesia after high-energy trauma to evaluate if this treatment modality is an effective means to treat posttraumatic arthrofibrosis.

Methods: Patients undergoing a closed knee MUA for the treatment of arthrofibrosis, which developed subsequent to surgical treatment after high-energy periarticular knee injury, were retrospectively reviewed. Knee ROM was determined prior to MUA and the ROM at the most recent follow-up was recorded. Patient and injury characteristics including patient age, body mass index, tobacco use, medical comorbidities, injury type, and location were assessed and correlated with manipulation success using a 2-sample *t*-test. A delay in manipulation of 90 days or greater was also evaluated in this fashion with regard to its role in predicting the benefit of MUA.

Results: 22 patients with a mean age of 40 years (range, 21-78), consisting of 11 women and 11 men, were included. Injuries included distal femur fracture (7), tibial plateau fracture (5), patellar fracture (3), multiligamentous knee injury (2), femoral shaft fracture (1), traumatic arthrotomy (1), combined distal femur and patella fracture (1), combined tibial plateau and patella fracture (1), and combined femoral shaft and patella fracture (1). Nine fractures were open and 13 injuries presented in the setting of polytrauma. The mean time from definitive treatment to manipulation was 90 days (range, 42-188 days). Mean follow-up after manipulation was 7 months. The mean premanipulation ROM arc was 59° (range, 10°-110°). The mean intraoperative arc of motion, achieved at the time of the manipulation, was 123° (range, 90°-145°). The average intraoperative improvement was 67° (range, 25°-120°). No complications occurred during the MUA procedure. At the most recent follow-up, the mean ROM arc was 108° (range, 75°-145°). The average improvement from premanipulation to the most recent follow-up was 49° (range, 5°-115°). An average of 18° was lost between intraoperative ROM and that at most recent follow-up (range, loss of 50° to gain of 30°). Interestingly, manipulations performed 90 days or more following initial surgical treatment provided a benefit equaling those performed more acutely ($P = 0.12$).

Conclusion: Manipulation under anesthesia is a safe and effective method to improve postoperative knee ROM in the setting of trauma-induced arthrofibrosis. Improvement in ROM was noted following manipulation in every patient in our series. Surgeons should anticipate that while some patients may show improvement beyond intraoperative achievements, the majority of patients fall short of reproducing this range at final follow-up. A 90-day window between fracture fixation and manipulation did not negatively impact ROM at final follow-up and may prevent fracture displacement during the MUA.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

•Safety of Osseointegrated Prosthesis for Transfemoral Amputees

*Munjed Al Muderis, MB ChB, FRACS, FAOrthA[1]; Guy Raz, MD[1]; Michael Edwards[2]; Henk van de Meent, MD, PhD[2]; **Jan Paul Frölke, MD, PhD**[2];*
[1]School of Medicine, University of Notre Dame Australia, Sydney, New South Wales, Australia;
[2]Radboud University Nijmegen Medical Center, Nijmegen, The Netherlands

Purpose: Osseointegration is a known concept to avoid problems related to the socket-body interface for transfemoral amputees. With this technique the prosthesis is transcutaneously attached to the distal femoral shaft by osseointegration using a retrograde intramedullary implant. Although osseointegration has been proven to significantly increase walking ability and prosthesis-related quality of life, the risk of potential complications prevents further introduction to a larger scale, so far. In this study we report on complications to determine potential risk factors in the first 2 years after implantation.

Methods: After IRB approval, two university hospitals in Australia and the Netherlands conducted a prospective clinical cohort study to analyze all consecutive subjects with transfemoral amputation (3 bilateral) who underwent implantation of osseointegrated femoral prosthesis (ILP Ortho Dynamics GmbH, Lubeck, Germany) with 2 years follow-up. All complications were prospectively registered and classified. Potential risk factors for complications were determined including gender, age, duration after amputation, cause of amputation, comorbidity including body mass index, smoking behavior, and length of stoma.

Results: Complications occurred in 26 of 47 subjects (55%) during the first 2 years after osseointegrated femoral prosthesis. 26 patients had 101 events. 88 events were graded as a minor event not requiring surgery. 11 patients had major complications requiring surgical

N=47	No/Mild complications n=36 (77%)	Adverse Effects which required surgery n=11 (23%)	P
Gender m/f	30/6	6/5	0.0484
Mean age (years)	46.94	45.86	0.83
Mean duration after amputation (years)	17.06	15.00	0.77
Cause trauma/neoplasia/other	27/6/3	8/0/3	0.074
Mean follow-up (months)	24.81	25.71	0.71
Smoking status no/yes	34/2	7/4	0.0074
Length of stoma (cm)	4.66	4.29	0.50
Prosthetic use (hrs per week)	104.25	93.43	0.026
6 min walking test (m)	413.38	434.86	0.93

See pages 99 - 147 for financial disclosure information.

intervention (23%): 2 patients underwent exchange of intramedullary implant and 9 other patients underwent surgical corrections for recurrent peri-implant soft-tissue irritation with pain. No septic loosening of implant was identified. Risk factors that might have contributed to these complications included smoking, and female gender (see table).

Conclusion: Complications related to the osseointegrated leg prosthesis do occur but the suffering and disabilities are relatively mild. Infectious events are superficial and can be managed with intensive local irrigation and antibiotics. Strict patient selection and adherence to exclusion criteria may reduce complication rate.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

The Treatment of Atrophic, Recalcitrant Long-Bone Nonunion with Human Recombinant Bone Morphogenetic Protein-7 (rhBMP-7): A Retrospective Cohort Review

Zachary Morison, MSc; *Milena Vicente, RN; Emil H. Schemitsch, MD, FRCS(C); Michael D. McKee, MD, FRCS(C);*
St. Michael's Hospital, University of Toronto, Toronto, Ontario, Canada

Purpose: Recombinant human bone morphogenetic protein-7 (rhBMP-7) has been shown to enhance bone formation and promote fracture healing in a number of clinical and basic science settings. However, there is little information from large-scale studies of its use for human nonunion. We sought to determine the safety and efficacy of rhBMP-7 in the treatment of atrophic human long-bone nonunions.

Methods: This was a single-center, retrospective, longitudinal cohort study of patients treated with the application of rhBMP-7 to a nonunion of the femur, tibia, fibula, clavicle, humerus, radius, or ulna. Patients were identified through a prospectively gathered clinical database. Patients were followed at 2 weeks, 6 weeks, 3 months, 6 months, and 1 year post surgical procedure. Data from each of these clinical visits was collected for this study. To be considered eligible for inclusion in this study, patients were required to be over 16 years old and present with an atrophic, aseptic nonunion of a long-bone or clavicle. The rhBMP-7 must have been used in isolation when performing the open reduction internal fixation of the nonunion, although the use of available local autogenous bone graft was acceptable.

Results: We identified 95 eligible patients who were treated with rhBMP-7 for a long-bone nonunion between July 1997 and April 2012. The mean age of the patients at the time of treatment with rhBMP-7 was 50.5 years (range, 20-92). 47 of the patients had a history of smoking for a mean of 17.9 pack-years and 64 of the patients had significant comorbidities. 22 patients had received at least one failed surgical treatment for their nonunion with a mean of 1.8 procedures per person. Of these 22 patients, 14 had received a bone graft or an osteobiologic as a part of their treatment prior to receiving rhBMP-7. The primary mechanisms of injury for this cohort were falls (n = 37) and motor vehicle accidents (n = 21). During the 1-year postoperative period, 78 patients had achieved union as a result of their treatment. Five patients were lost to follow-up prior to definitive clinical or radiographic union, three patients had early hardware failure not related to the rhBMP-7 treatment, two patients developed a stable fibrous union, and seven patients went on to nonunion. Six of the seven nonunion patients went on to heal following revision ORIF (open reduction and internal fixation).

Conclusion: To our knowledge this is the largest report of rhBMP-7 used for the treatment of long-bone nonunions in North America. We found that the application of rhBMP-7 to long-bone nonunions was an effective way (86% union rate) of treating this challenging pathology and not associated with any increase in adverse events.

See pages 99 - 147 for financial disclosure information.

Osseointegrated Prosthetic Limb for Amputees: Over 10 Years' Experience with More Than 100 Cases

***Guy Raz, MD**; Aditya Khemka, MD; Munjed Al Muderis, MB ChB, FRACS, FAOrthA;*
School of Medicine, University of Notre Dame Australia, Sydney, New South Wales, Australia

Purpose: The Osseointegrated Prosthetic Limb (OPL) was introduced in 1999. Prior to its advent all prostheses consisted of stump and socket mechanisms, which did not change dramatically since Ambroise Paré introduced lower limb prostheses in 1529. These socket prostheses failed to address a few major requirements of normal gait. Our hypothesis was that using an osseointegrated prosthetic limb will result in superior function of daily activities, without compromising patients' safety.

Methods: This is a prospective cohort study, of our first 100 OPL cases operated between 1999 and 2013 in two centers: Lübeck, Germany and Sydney, NSW, Australia, by the two principal surgeons acquainted with this technology. Both centers used similar strict exclusion criteria, and followed equivalent surgical technique. We collected demographic as well as surgical details, and postoperative complications. In addition, patients' outcome measurement included: Objective functional, as well as subjective surgeon assessment, and Short Form-36 and Q-TFAs (Questionnaires for Persons with a Transfemoral Amputation). The results were statistically analyzed to compare socket versus OPL outcome.

Results: 78 amputees were operated on by the German center, and 37 in the Australian center, totaling 115 patients. Eight patients (six German, two Australian) had a bilateral implantation. Average age at amputation for both centers was 33 years (range, 3-76), at implantation 44.3 years (range, 17-76). Average period from amputation to implantation was 13 years (range, 0-46). Traumatic amputations occurred in 61 patients (78%) in Germany, and 28 (76%) in Australia. Infection was the second most common cause for amputation consisting of 10% of cases in Germany and 12% in Australia. Neoplasia was the cause for amputation in similar rates in both centers (10%). In addition 4% in Germany had a vascular etiology, and 2% congenital malformation in Australia. Both K scores, and Timed Up and Go tests have shown improved results for OPL compared to socket prostheses, with high significance ($P = 0.0006$, and $P = 0.0149$, respectively). Six-minute walking tests did not show significant improvement. Patients' questionnaire scores have improved as well with statistically significance.

Conclusion: This study shows favorable results for OPL treatment for above-knee as well as below-knee amputees, compared to socket prostheses. Our experience with over 100 patients has revealed encouraging results with a major improvement in patient functionality and quality of life, and a low rate of complications.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Function After Traumatic Amputation of the Lower Extremity: What Are the Predictors of Better Outcome?

Douglas A. Smith, DO; Meredith Grogan; ***Heather A. Vallier, MD****;*
MetroHealth Medical Center, Cleveland, Ohio, USA

Purpose: Prior studies have described dysfunction and poor functional outcomes following lower extremity amputation. The purpose of this study was to identify risk factors associated with postoperative complications and poor functional outcomes and to characterize narcotic medication usage, employment status, and mental illness.

Methods: A retrospective review was conducted at a single Level I trauma center of adults who were treated acutely with lower extremity amputations for injury (TFA [transfemoral amputation], TTA [transtibial amputation]). Medical records from a 10-year period (2003 to 2013) were evaluated and yielded 588 lower extremity amputation patients. Of these, 411 patients were excluded as non–trauma-related. 33 of the remaining 147 patients were excluded (11 died during hospitalization, 13 had amputation prior to period of study, 9 had no clinical follow-up). Charts and radiographs were reviewed. Postoperative complications included infections, wound dehiscence, deep vein thrombosis, and pulmonary embolus. Patients were contacted by a trained investigator not involved in their care to complete a Musculoskeletal Function Assessment (MFA) questionnaire and other survey questions regarding social and mental health characteristics.

Results: 114 patients underwent 116 lower extremity amputations with mean clinical follow-up of 42.5 months. Mean age was 43.4 years and 83% were male. Amputations included 74 TTAs (1 bilateral), 38 TFAs (1 bilateral), and 2 knee disarticulations. 116 complications occurred in 76 patients (67%), and 38 patients (33%) underwent 62 secondary procedures. Complications were more common after TFA (78% vs. 38% after TTA, $P = 0.001$). Deep infection occurred in 46% after TFA and 25% after TTA, $P < 0.0001$. 92% of patients used prostheses to ambulate, but 74% reported persistent phantom limb pain, and 67% were using chronic pain medication (more than 3 months after injury), with 42% on narcotics, and 69% on narcotics and other prescription analgesics. Tobacco smokers were more likely to use chronic narcotic medication than nonsmokers ($P = 0.016$). At most recent follow-up only 28% were employed, and 50% of all previously employed patients were either unemployed or working at a reduced level due to injury. Prior to injury 15% reported history of mental illness, while 61% had documented mental illness afterward, most commonly depression (86% of all patients with post-injury mental illness). Mean MFA score for all patients was 37.7 (range, 5 to 68) after mean 58.5 months follow up. Worse MFA scores were noted in patients with diagnosed mental illness (43.2 vs. 26.0, $P < 0.0001$).

Conclusion: The majority of amputees following trauma experience postoperative complications, more common after TFA versus TTA. Deep infections occur frequently. Most patients developed mental illness or experienced worsening thereof after injury, which was associated with poor MFA scores. A majority of amputees required chronic narcotics, and only 28% were employed. This information may help to identify individuals at risk for poor outcomes to develop individualized treatment plans and system resources to mitigate complications, and to address pain management and mental illness in order to optimize recovery.

See pages 99 - 147 for financial disclosure information.

First Clinical Use of a Novel Plasma-Based Biomaterial to Augment the Healing of Open Tibia Fractures

Brian Bernstein, MD*; Sithombo Maqungo, MD; Marc Nortje, MD; David North, MD;*
University of Cape Town, Cape Town, South Africa

Purpose: This study was designed to examine the performance of a novel blood plasma-based bone putty for augmenting the treatment of open tibia fractures (Gustilo types II, IIIA, IIIB). The putty was manufactured from pooled blood plasma (Carmell Therapeutics, Pittsburgh, PA) and contains a concentration of both plasma and platelet-derived regenerative factors. Based on clinical reports of the use of autologous platelet-rich plasma (PRP) to treat injuries, we anticipated that the putty would accelerate the healing of both the bone fractures as well as surrounding soft tissues.

Methods: This was a two-arm, randomized controlled study including 20 treatment patients and 10 controls. Follow-up examinations, including radiographs and clinical assessments, occurred at 14, 30, 60, 90, 180, and 365 days. The product was provided in a delivery syringe containing 3 cm^3 of putty contained in a double-pouched, sterile box that was stored at room temperature. The putty was placed at the site of the fracture during open fracture reduction and mechanical stabilization.

Results: Both treatment and control groups were well balanced with a mean age of 35 years. 79% were type IIIA and IIIB injuries, 67% were active smokers, and 70% received external fixation. No adverse events related to the use of the putty were noted. The use of the putty significantly reduced infections through the first 90 days ($P = 0.002$), accelerated bone bridging at 90 and 180 days, and provided more rapid wound closure at 30 days. In the subset of patients with IIIA/IIIB injuries, the putty group demonstrated more significantly reduced infections ($P = 0.0007$), with accelerated bone healing and wound closure approaching statistical significance. There were also statistically fewer adverse events with the putty (42.1%) compared to controls (80.0%).

Conclusion: The study was a challenging one to demonstrate efficacy given the small sample size, the majority of type IIIA/IIIB injuries, the use of external fixation known to have a relatively high incidence of pin tract infection, and the relatively high percentage of smokers. The putty performed as expected, promoting the more rapid healing of the bone fractures and wounds. The rather dramatic reduction in infections, however, was unanticipated and is most likely related to the recruitment of the innate immune system to the site of the injury over several weeks as these plasma-based materials degrade. A larger, statistically powered study is planned. The potential for using a concentration of natural plasma and platelet-derived regenerative factors to augment the healing of traumatic injuries, however, makes this first-in-human study particularly relevant and exciting.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Depression in Orthopaedic Trauma Patients: A Prospective Cohort

Stephen Becher, MD*; Michele Smith, PhD; Bruce Ziran, MD;*
Atlanta Medical Center, Atlanta, Georgia, USA

Background/Purpose: Orthopaedic trauma patients often have psychiatric comorbidities that are either not diagnosed or under treated. Depression may affect the outcome of a patient's recovery in a variety of ways but longitudinal effects in orthopaedic trauma are yet fully described. This study prospectively followed a cohort of orthopaedic trauma patients with the purpose of building a predictive model to identify risk factors contributing to depression in patients with skeletal injuries. We hypothesized that more severe injuries would correlate with higher levels of depression.

Methods: After IRB approval, orthopaedic trauma patients underwent both a PHQ-9 (Patient Health Questionnaire) for depression and the Duke Social Support and Stress Scale (DUSOCS). Demographic data, history of psychiatric conditions, and injury patterns were obtained from the medical record. Patients were called at 9 months to follow their PHQ-9 score, DUSOCS score, any psychiatric treatment, and work and insurance status. c^2 tests were used to determine any risk factors for depression at injury and 9-month follow-up. A Pearson correlation coefficient was calculated between DUSOCS and PHQ-9 scores. Analysis of variance was used to compare the mean change of PHQ-9 score between the initial injury and follow-up. Predictive models for PHQ-9 score at injury were built withholding a subset of patients to test the model on.

Results: 110 patients were enrolled at injury, of whom 22 had moderate to major depression and 36 had mild depression. 47 patients were able to complete the required surveys at an average of 9 months follow-up. Factors with significance for mild depression (PHQ-9 >4) at the time of injury were a history of illegal drug use ($P = 0.037$) and DUSOCS support score ($P = 0.002$), which had a negative Pearson correlation coefficient with PHQ-9 (n = –0.18, $P = 0.03$). Factors with significance for moderate to major depression (PHQ-9 >9) at time of injury were a history of a psychiatric diagnosis ($P = 0.0009$) and work status at injury ($P = 0.039$). Both a history of psychiatric diagnosis and an elevated PHQ-9 score were predictors of having depression at 9 months ($P = 0.02$ and $P = 0.0005$ respectively). Having Medicaid insurance was significant for an increase in depression score at 9 months ($P = 0.02$). The most successful predictive model built was as follows:

Predicted PHQ-9 score = $5.69 + 3.63(P_H) - 1.24(W_S) + 0.95(G_S)$
P_H is 1 if the psychiatric history is positive and 0 if negative.
W_S is 1 if the patient is employed at time of injury and 0 if unemployed.
G_S is 1 if the patient required a general surgical procedure and 0 if not.

Conclusion: Depression was quite prevalent in our patient cohort. A prior psychiatric diagnosis predisposed patients to depression. Socioeconomic status is also a predictive factor for increased depression scores at 9 months. A higher feeling of support from friends and family has an inverse correlation with depression. Employment appears to have a protective effect. The severity of injury did not affect depression. The predictive model identified the existence of a psychiatric, unemployment, and a general surgical procedure as risk factors for the longitudinal perseverance or worsening of depression. To our knowledge it is the first study to longitudinally study and build a predictive model for the evolution of depression in orthopaedic trauma patients.

See pages 99 - 147 for financial disclosure information.

Evaluation of Appropriate Chemical and Mechanical Prophylaxis for Deep Vein Thrombosis and Pulmonary Emboli in Orthopaedic Trauma Patients

***Christopher M. Domes, MD, ATC**; Anneliese M. Schleyer, MD; Daphne M. Beingessner, MD; Harborview Medical Center, Seattle, Washington, USA*

Purpose: Deep vein thrombosis (DVT) and pulmonary emboli (PE) occur frequently in patients who sustain traumatic orthopaedic injuries or undergo orthopaedic operations. Both chemical and mechanical means are used to attempt to decrease the incidence of these in the inpatient setting. The purpose of this study is to determine the incidence of DVT and PE in patients with traumatic orthopaedic injuries in the setting of guideline-directed DVT prophylaxis.

Methods: We conducted a retrospective review of patients treated by orthopaedic traumatologists and spinal traumatologists over a 72-month period who had vascular or radiographic studies looking for DVTs or PE. The electronic medical records were interrogated using a technical tool that electronically captures thrombotic event data from vascular and radiologic imaging studies using natural language processing. Information about application of mechanical prophylaxis was electronically pulled from nursing documentation in the medial record.

Results: 663 patients underwent vascular or radiographic studies after orthopaedic surgical procedures. 100 patients (age 52.3 years, SD 18.3; 70% male) had positive studies that met inclusion criteria for further review. 24 patients sustained upper extremity injuries, 40 single lower extremity traumas, 20 bilateral lower extremity traumas, 27 spinal injury, 35 pelvic fractures, and 41 patients had combinations of the above. Of the 100 patients with DVTs or PE, 63 DVTs (39 occlusive, 24 nonocclusive) and 49 PE were found. Appropriate chemical DVT prophylaxis as deemed by the hospital protocol/evidence-based guideline was given to 54% of patients while 46 missed doses due to operative procedures, comorbid conditions, or direct contraindication to chemical prophylaxis. Mechanical prophylaxis was applied appropriately to both or unaffected lower extremities >75% of the time in 40% of patients.

Conclusion: This study shows that despite appropriate use of chemical prophylaxis and near ideal use of mechanical DVT prophylaxis, DVTs and PE still occur in this high-risk orthopaedic trauma population.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Timing, Incidence, and Risk Factors Associated with Unplanned Postoperative Hospital Readmissions in the Orthopaedic Trauma Patient Population

Rishin J. Kadakia, MD*; Harrison F. Kay, BSc; Jesse Ehrenfeld, MD, MPH;*
Sunil Kripalani, MD, MSc; Kamran Idrees, MD; Amanda M. McDougald Scott, MS;
Kristin R. Archer, PhD, DPT; Hassan R. Mir, MD, MBA;
Vanderbilt University Medical Center, Nashville, Tennessee, USA

Background/Purpose: The Hospital Readmissions Reduction Program (HRRP), a provision within the Affordable Care Act, has started to enforce financial sanctions on hospitals with increased readmission rates for patients with certain medical conditions. Although recent policy initiatives have led to a dramatic increase in research on hospital readmissions, there are little data on this topic within the orthopaedic trauma patient population. The purpose of this study is to evaluate the timing, incidence, and risk factors associated with unplanned postoperative hospital readmissions in this patient population.

Methods: All patients who underwent operative treatment for orthopaedic injuries at a Level I trauma center over a 2-year period were retrospectively reviewed. A minimum 3-month postoperative follow-up was required for study inclusion. Patient demographics, primary insurance status, American Society of Anesthesiologists (ASA) physical status class, Charlson Comorbidity Index (CCI), Elixhauser Comorbidity Index, ISS, and a validated health literacy screening assessment were extracted from electronic medical records. In addition, specifics regarding the hospitalization such as ICU and ventilator status, incidence of multiple operative procedures, emergency department Glasgow Coma Scale, presence of a work-related injury, disposition, and the Surgical Apgar Score (SAS) were also collected. Records were reviewed for unplanned hospital readmissions within 1 year of surgery. Multivariable logistic regression analyses were used to examine associations between collected variables and hospital readmission.

Results: 2434 patients were eligible for the study and 1714 patients (70.4%) had at least 3-month follow-up. 458 patients (458/1714 = 26.2%) had unplanned readmissions at least once within a year following surgery, and 121 patients of these patients were readmitted multiple times in 1 year. Over a quarter of the readmissions (26.2%) occurred within the first 30 days (120 patients), and over 60% (284 patients) were readmitted within 90 days of discharge. Patients with multiple operative procedures (odds ratio [OR] = 1.6; $P < 0.001$), a lower SAS (OR = 0.85; $P < 0.001$), ASA class 3 (OR = 2.4; $P = 0.02$), ASA 4/5 (OR = 2.7; p = 0.02), and increased CCI (OR = 1.21, $P = 0.002$) were associated with readmission within 90 days. Risk factors for readmissions within 6 months were similar with the addition of patients with public insurance associated with readmission (OR = 1.35, $P = 0.02$).

Conclusion: The unplanned readmission rate within the orthopaedic trauma patient population is alarmingly high, with over a quarter (26.2%) occurring within 30 days, and the majority of readmissions (62.0%) occurring within 90 days of discharge. Identification of patients at increased risk is the first step in the development of targeted interventions that could reduce unplanned hospital readmissions within this population.

See pages 99 - 147 for financial disclosure information.

Is the Digital Divide in Orthopaedic Trauma Patients a Myth?
A Prospective Cohort Study of the Usage of a Custom Internet Site

Paul E. Matuszewski, MD[1]*; Samir Mehta, MD*[2]*; Andrew N. Pollak, MD*[1]*;*
Robert V. O'Toole, MD[1]*;*
[1]*R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA;*
[2]*Hospital of the University of Pennsylvania, Department of Orthopaedics, Philadelphia, Pennsylvania, USA*

Purpose: Musculoskeletal trauma is often associated with individuals of lower socioeconomic status, suggesting that this may translate to limited access to technology and the Internet. Some have proposed a "digital divide" in this patient population, limiting the clinical usefulness of the Internet in this subset of patients. No evidence exists regarding this "digital divide" phenomenon in orthopaedic trauma patients. The hypotheses of this study are that (1) a large percentage of trauma patients have access to the Internet and (2) patients will access a custom Internet site tailored to their trauma.

Methods: A customized orthopaedic trauma website was designed for the study and contained information about injury, institution, surgeons, and frequently asked questions. Patients 18 years or older sustaining an acute operative fracture at our institution, a Level I regional trauma center, were considered eligible. Those lacking Internet access were not excluded. Patients were consented within 24-48 hours of planned discharge/transfer. Participants underwent a brief survey to elicit demographics, Internet usage habits, device type, e-health literacy, and their intent to use the website. Participants were given a light-up keychain containing a web address and a unique access code. Participants, as well as family members and friends, were encouraged to utilize the website. Participants' device type, frequency, time spent, click flow, and choice of pages visited were recorded. Multiple logistic regression was performed to assess relationships.

Results: 52 patients were approached for participation; 40 enrolled in the prospective study. In support of our first hypothesis, 87% (n = 46/52, 95% confidence interval [CI] 0.738-0.936) of patients reported access to the Internet ($P < 0.001$) compared with historical controls from literature. 66% of those participants utilized the Internet at least daily (82% at least weekly). Age, education, race, profession, employment status, and income did not predict access to the Internet nor e-health literacy ($P > 0.20$). Most (93%) felt it important to access health resources on the Internet, while 78% thought the Internet was useful in helping make health decisions. Laptop was most frequently used (50%), followed by desktop (25%) and mobile device (18%). Nearly all enrolled patients (95%), stated they would utilize our website. However, only five (13%, $P < 0.001$) visited our website. Patients most frequently accessed information about their injury first. Surgeon information was accessed infrequently.

Conclusion: Our results suggest that the so-called "digital divide" may be a myth in our modern orthopaedic trauma population, as Internet access is common. Surprisingly, despite this access and overwhelming enthusiasm for our website (95%), only a small fraction of patients visited our site (13%, $P < 0.001$). Reasons for this are unclear, and warrant further

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

study. Regardless, data from our prospective study caution against the allocation of resources for patient specific web sites in orthopaedic trauma patients, until feasibility can be better demonstrated.

See pages 99 - 147 for financial disclosure information.

Surgical Apgar Score (SAS) is Associated with Postoperative Complications in the Orthopaedic Trauma Patient Population

Rishin J. Kadakia, MD*; Harrison F. Kay, BSc; Jesse Ehrenfeld, MD, MPH;*
Sunil Kripalani, MD, MSc; Kamran Idrees, MD; Amanda M. McDougald Scott, MS;
Kristin R. Archer, PhD, DPT; Hassan R. Mir, MD, MBA;
Vanderbilt University Medical Center, Nashville, Tennessee, USA

Background/Purpose: Postoperative complications in orthopaedics can negatively impact patient outcomes, burden the health-care system with unplanned readmissions and increased hospital stays, and place further strain on our economy. The 10-point Surgical Apgar Score (SAS) is based on various intraoperative measures and has been shown to predict mortality and morbidity in several surgical subspecialties. However, the application of this novel and validated scoring system has not been examined in the orthopaedic trauma patient population. The aim of this study is to determine if the SAS is associated with postoperative complications in this patient population.

Methods: All patients who underwent operative treatment for orthopaedic injuries at a Level I trauma center over a 2-year period were retrospectively reviewed. A minimum 3-month postoperative follow-up was required for study inclusion. SASs were extracted from electronic records along with several other patient variables: patient demographics, primary insurance status, American Society of Anesthesiologists (ASA) physical status class, Charlson Comorbidity Index (CCI) , Elixhauser Comorbidity Index, ISS, and a validated health literacy screening assessment. In addition, specifics regarding the hospitalization such as ICU and ventilator status, incidence of multiple operative procedures, emergency department Glasgow Coma Scale, presence of a work-related injury, and disposition were also collected. Electronic records were reviewed for any surgical site infections, hardware failures, or DVT/PE (deep vein thromboses/pulmonary emboli) occurring within 1 year following surgery. Multivariable logistic regression analyses were used to examine the association between the SAS and postoperative complications controlling for patient demographic and clinical characteristics. The level of significance was set at $\alpha = 0.05$.

Results: 2434 patients were eligible for the study and 1714 patients (70.4%) had at least a 3-month follow-up. 247 (247/1714 = 14.4%) patients suffered a postoperative complication within 1 year and over 50% of these complications were surgical site infections (149 cases). Increased SAS scores were associated with decreased postoperative complications (odds ratio [OR] = 0.88; $P = 0.03$). Patients with multiple operative procedures (OR = 1.8, $P = 0.001$) and ASA class 2 (OR = 3.0, $P = 0.04$), ASA 3 (OR = 3.0, $P = 0.04$), and ASA 4/5 (OR = 3.3, $P = 0.04$) were more likely to suffer a postoperative complication. Furthermore, increased education by years in school was associated with decreased complication rate (OR = 0.94; $P = 0.007$).

Conclusion: This study supports the use of the SAS to identify patients at-risk for postoperative complications in the orthopaedic trauma population. While many complications are multifactorial and sometimes unavoidable, steps taken to decrease preventable adverse events must begin with identifying those at increased risk. The use of risk factors such as the SAS can help identify these targets for intervention.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

The Value of a Dedicated Saturday Orthopaedic Trauma OR

Robert P. Runner, MD; Thomas J. Moore Jr, MD; ***William M. Reisman, MD****;*
Grady Memorial Hospital, Emory University Orthopaedic and Fracture Care,
Atlanta, Georgia, USA

Background/Purpose: Hospital administrations constantly face cost-benefit decisions when balancing financial and patient care interests. These pressures are magnified at a large academic Level I trauma center with recurring financial hardships. Providing quality care for patients in an efficient delivery model is imperative. One way to increase efficiency within the orthopaedic department is to clear cases by operating more often, which could potentially reduce costs by reducing patient length of stay (LOS). Beginning November 1, 2010, the orthopaedics and anesthesia departments implemented a new policy to have a dedicated Saturday orthopaedic operating room (OR) to provide more continuous care for patients and efficiently work through a large caseload. The aim of this study is to assess the efficacy of this additional operative day by analyzing the primary outcomes of LOS and surgical waiting time. Trauma patients admitted with femur or tibia fractures 1 year prior to the implementation of this dedicated orthopaedic trauma OR were compared to patients admitted in the year after this policy change.

Methods: In this retrospective chart review of the trauma registry for patients admitted with operative femur or tibia fractures from November 1, 2009-October 31, 2011, 455 patients were identified and analyzed. 167 were direct orthopaedic admissions; 308 were admitted to general surgery with orthopaedic consultation. Our outcome measures were the LOS based on weekday of admission, the distribution of caseload between weekdays, and the wait time to surgery

Results: After the addition of a dedicated Saturday orthopaedic operating room, the overall LOS for all trauma patients admitted with femur or tibia fractures was significantly reduced by 2.7 days from a mean of 14.0 days to 11.3 days ($P = 0.018$). Additionally, there was a trend toward shorter waiting time to surgery (average reduction of 25.1 hours) for patients admitted on a Friday (48.6 hours vs. 23.5 hours, $P = 0.06$). Furthermore, there was an increase in the number of cases performed on Saturdays by 59% (6.2% of the total caseload) while the originally disproportionally high number of cases on Mondays was appropriately reduced by 33% (6.7% of the total caseload).

Conclusion: Overall, these findings support the continuation of a dedicated Saturday orthopaedic trauma OR and can provide the foundation for other departments with similar circumstances to negotiate for more operative time on weekends to improve efficiency.

See pages 99 - 147 for financial disclosure information.

The ASA Score as a Predictive Tool for Perioperative Transfusion in Trauma

Dagoberto Estevez-Ordonez, BS; Rachel V. Thakore, BS; Vasanth Sathiyakumar, BA; Rivka C. Ihejirika, BS; Anna E. Garcia, BSPH; Gerald Onuoha II, BS; Jesse M. Ehrenfeld, MD, MPH; Young M. Lee, BS; William T. Obremskey, MD, MPH; ***Manish K. Sethi, MD****;*
Vanderbilt University, Nashville, Tennessee, USA

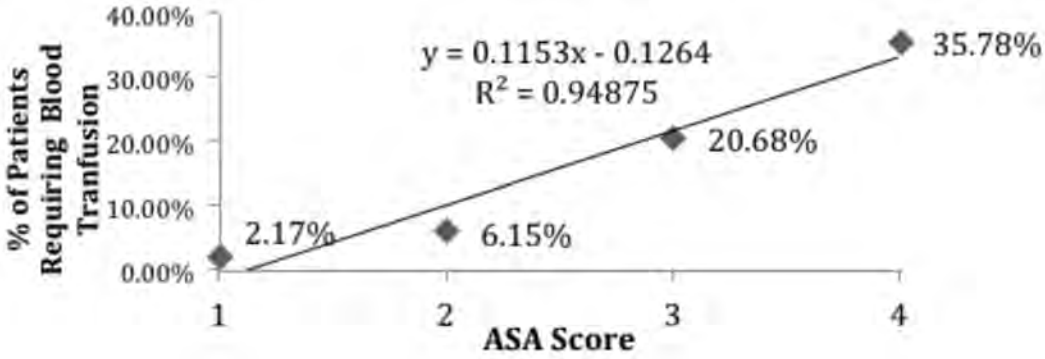
Purpose: The number of blood transfusion units required during orthopaedic trauma surgery is very difficult to predict. Identifying patient-specific risk factors that predict the amount of blood units required during surgery can help ensure an adequate supply of blood while reducing wastage. In this study, we determined whether individual patient factors, including comorbid conditions, are correlated to blood transfusion requirements during orthopaedic trauma surgery and can be utilized in current maximum blood-ordering schedules (MSBOS).

Methods: All patients who presented to a Level I trauma center with an orthopaedic trauma injury from January 1, 2005 to December 31, 2010 were identified using CPT code searches. A total of 7338 patients were identified. Medical records were reviewed to gather demographic information such as age, gender, race, American Society of Anesthesiologists (ASA) score and type of fracture. Perioperative data such as red blood cell (RBC) transfusion and 21 individual comorbidities (ie, presence of heart disease or diabetes, substance abuse, etc) were gathered from the institution's operative warehouse. Patients without isolated fractures (ie, no other injuries other than fracture) and patients without complete medical records were eliminated from analysis. A stepwise linear regression was conducted to identify significant predictive associations between individual patient factors and blood transfusion. Results were further stratified by upper extremity, lower extremity, and pelvic fractures.

Results: A total of 1819 patients with isolated fractures met inclusion criteria for analysis. 485 patients had pelvis, acetabular, or hip fractures; 1162 patients had lower extremity fractures; and 172 had upper extremity fractures. After running a stepwise linear regression with basic demographics and 21 individual comorbidities, ASA score was found to have a significant relationship ($P < 0.001$) with blood transfusion after controlling for age, gender, race, and type of fracture. Compared to patients with an ASA score of 1, patients with an ASA score of 2 were 2.45 times as likely to receive a RBC transfusion, patients with an ASA score of 3 were 6.00 times as likely to receive RBCs, and patients with an ASA score of 4 were 14.71 times as likely to receive a RBC transfusion. The percentage of patients receiving transfusion increased significantly as ASA score increased (figure). A significant association was also found when grouping by lower extremity, upper extremity, and pelvic fractures ($P < 0.001$).

Conclusion: Our results demonstrate that patients' ASA scores are strong predictors of the number of blood units required for transfusion during orthopaedic trauma surgery even after controlling for type of surgery. The inclusion of ASA scores in institution-specific blood-ordering procedures may minimize wastage due to outdating while ensuring adequate cross-matching of blood units among the orthopaedic trauma population.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.



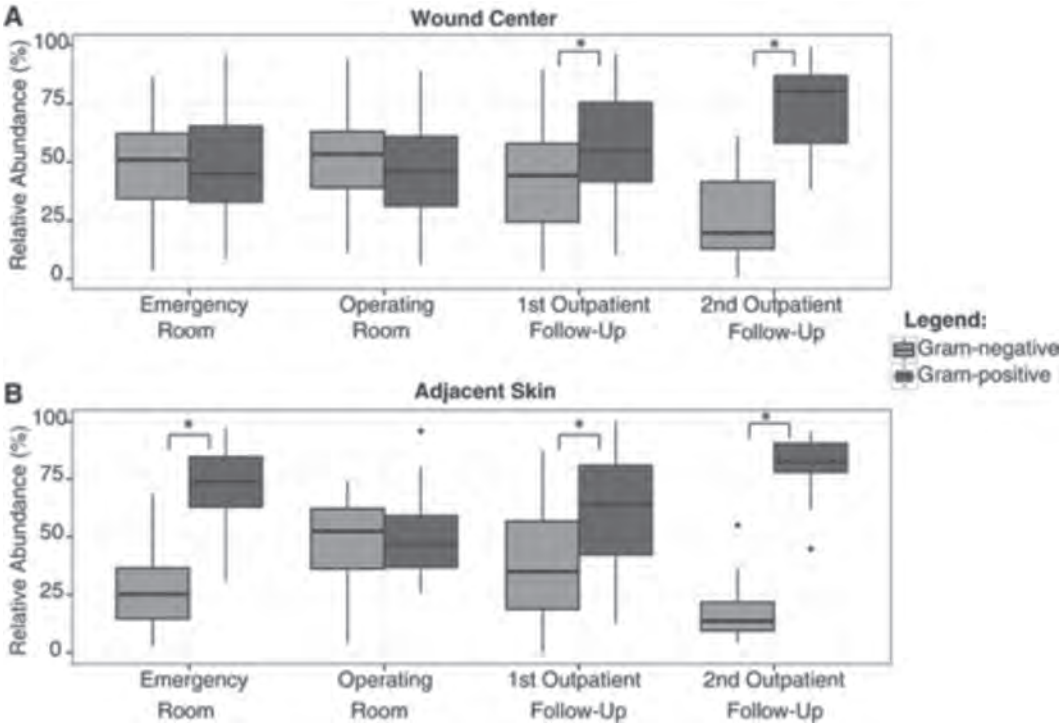
See pages 99 - 147 for financial disclosure information.

ΔCulture-Independent Pilot Study of Microbiota Colonizing Open Fractures and Association with Severity, Mechanism, Location, and Complication From Presentation to Early Outpatient Follow-up

Geoffrey D. Hannigan; Brendan P. Hodkinson; Kelly McGinnis; Jason B. Anari, MD; Annamarie D. Horan, Elizabeth A. Grice, PhD; ***Samir Mehta, MD****;*
University of Pennsylvania, Philadelphia, Pennsylvania, USA

Purpose: Precise identification of bacteria associated with post-injury infection, comorbidities, and outcomes could have a tremendous impact in the management and treatment of open fractures.

Methods: We characterized microbiota colonizing open fractures using culture-independent, high-throughput DNA sequencing of bacterial 16S ribosomal RNA genes, and analyzed those communities with respect to injury mechanism, severity, anatomical site, and infectious complications.



Gram-positive and gram-negative bacteria in the open fracture wound and on the adjacent skin. Open fracture wound relative abundance is shown in (A) and adjacent skin relative abundance is shown in (B). The upper and lower box hinges correspond to the first and third quartiles. Lines within the box depict median, and the whiskers extend to the highest and lowest values within 1.5 times the IQR (interquartile range). Outliers of the IQR are depicted with black dots above or below the whiskers. $^*p<0.05$ (Wilcoxon rank-sum test).

Δ OTA Grant

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Results: 30 subjects presenting to our Level I trauma center for acute care of open fractures were enrolled in a prospective cohort study. Microbiota was collected from wound center and adjacent skin upon presentation to the emergency department, intraoperatively, and at two outpatient follow-up visits at approximately 25 and 50 days following initial presentation. Bacterial community composition and diversity colonizing open fracture wounds became increasingly similar to adjacent skin microbiota with healing. Mechanism of injury, severity, complication, and location were all associated with various aspects of microbiota diversity and composition.

Conclusion: The study demonstrates the diversity and dynamism of the open fracture microbiota, and their relationship to clinical variables. Validation of these preliminary findings in larger cohorts may lead to the identification of microbiome-based biomarkers of complication risk and/or to aid in management and treatment of open fractures.

See pages 99 - 147 for financial disclosure information.

Physical and Biological Properties of a New Antibiotic-Eluting Resorbable Bone Void Filler

Kristofer D. Sinclair, PhD[1]*; Amanda E. Brooks, PhD*[1,2]*; David W. Grainger, PhD*[2]*;*
[1]*Elute, Inc, Salt Lake City, Utah, USA;*
[2]*University of Utah, Salt Lake City, Utah, USA*

Purpose: A resorbable composite antibiotic-eluting bone void filler was developed to address the growing problem of orthopaedic device-related infection. Prior studies demonstrate the efficacy of local antibiotic delivery in the context of osteomyelitis, but current methods lack degradable, osteoconductive materials. We hypothesized that a polymer/ceramic composite could restore bone volume while addressing periprosthetic infections using a controlled release antimicrobial.

Methods: Prior to device fabrication, polymers were characterized to ensure thermostability. Three groups of devices were fabricated using commercial synthetic calcium-based bone graft granules and varying combinations of biodegradable polymers. Differential scanning calorimetry analyzed polymer blend stability. Polymer device aqueous degradation was assessed qualitatively using scanning electron microscopy (SEM). Antibiotic (tobramycin) release used Kirby-Bauer (KB) sensitivity testing and liquid chromatography tandem mass spectrometry (LC-MS/MS). An IACUC (Institutional Animal Care and Use Committee)-approved rabbit radial window defect model was used to assess healing and antimicrobial efficacy in vivo with *Staphylococcus aureus* inocula. Bone remodeling was assessed with micro-CT, backscatter electron microscopy (BSE), fluorescence, and light microscopic imaging.

Results: No adverse effects of processing temperatures used for device fabrication were noted. SEM device surface inspection showed considerable in vitro device degradation after 90 days in phosphate-buffered saline at 37°C. KB analysis showed bacterial growth inhibition for up to 9 weeks. LC-MS/MS validated KB testing, as antibiotic concentrations exceeded the minimum bactericidal concentration (MBC) for ~8 weeks (Figure 1). In vivo rabbit implant outcomes of the antibiotic-eluting bone void filler supported osteoconductivity and strong antimicrobial properties in a lethal infection model with *S. aureus*. Micro-CT showed restoration of the medullary canal after 12 weeks in situ (Figure 2). These results were corroborated by BSE, showing new bone bridging the implant surgical defect. Fluorescent microscopy revealed up to 50.36% mineralizing bone surface and 3.36 ± 0.23 μm of new bone formation per day.

Conclusion: The antibiotic-eluting composite bone void filler demonstrated the ability to release broad-spectrum tobramycin above the MBC for up to 8 weeks in vitro. In vivo implants demonstrated substantial device degradation, restoration of the medullary canal, an accelerated rate of bone remodeling, and rescue from lethal *S. aureus* infections at high CFU (colony-forming units) inocula.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

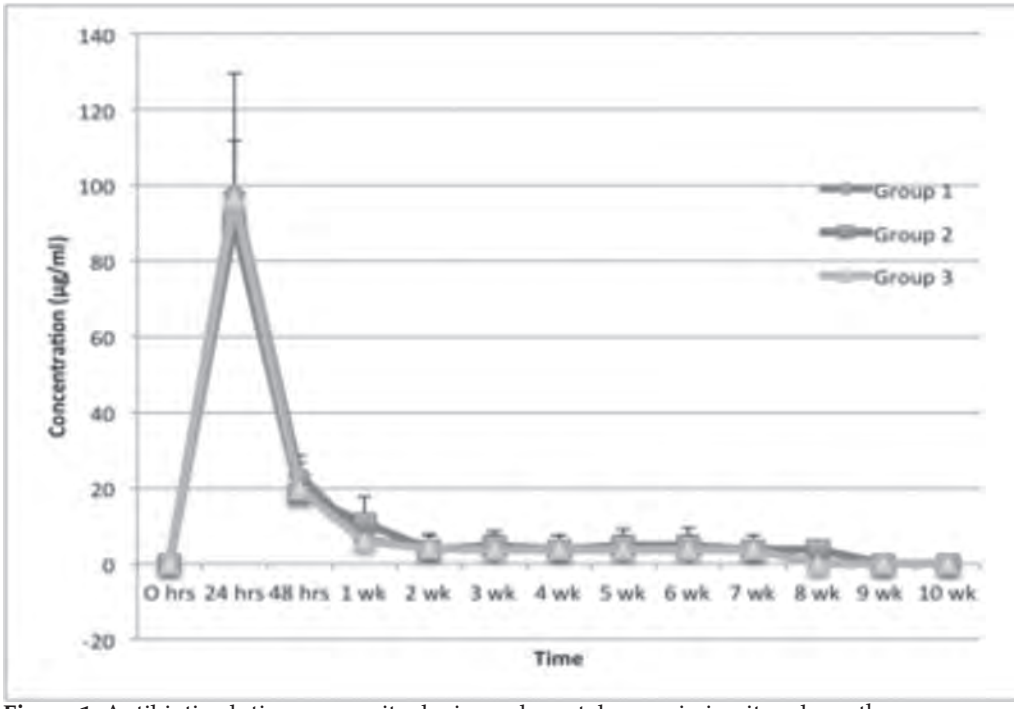


Figure 1. Antibiotic-eluting composite devices release tobramycin in vitro above the tobramycin MBC for *S. aureus* up to 8 weeks.

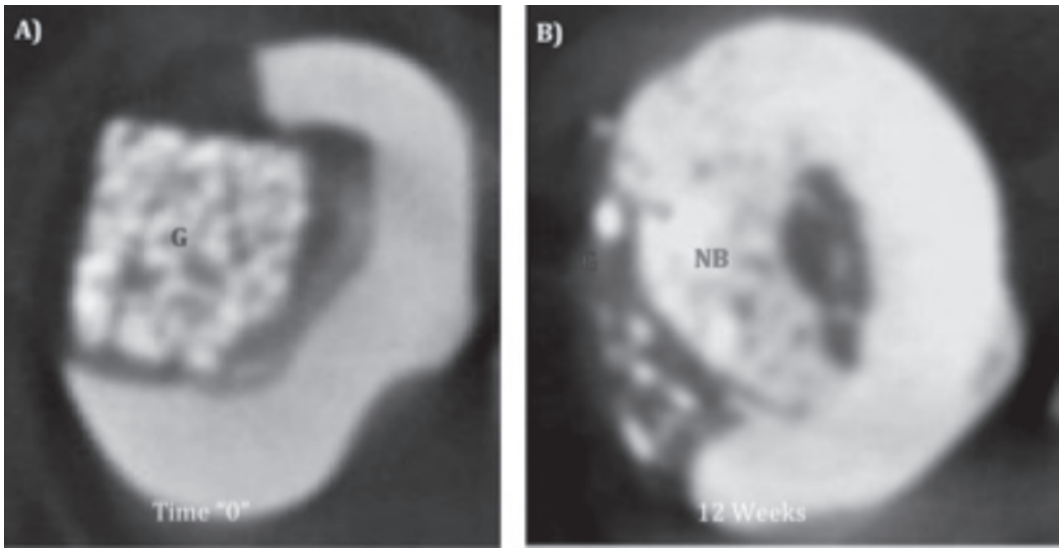


Figure 2. A, Time "0" micro-CT image of ElutiBone implants (G). Note the breach of the medullary canal. B, 12-week postoperative micro-CT image of implanted bone void filler. Note the new bone (NB) and restoration of the medullary canal.

See pages 99 - 147 for financial disclosure information.

Prospective Study Investigating the Prevalence and Evolution of Malnourishment in the Acute Orthopaedic Trauma Patient

***Reza Firoozabadi, MD**; Benjamin Hamilton, MS; Courtney O'Donnell, MD; Julie Agel, MA; Patricia Kramer, PhD; Stephen Benirschke, MD; M. Bradford Henley, MD;*
Harborview Medical Center/University of Washington, Seattle, Washington, USA

Purpose: Malnutrition is present in 20%-50% of all patients in acute hospital settings in developed countries. In surgical patients, undernutrition is associated with poor clinical outcomes, including higher infection rates, impaired wound healing, depression of the immune response, longer length of stay, increased muscle loss, increased recovery time, and increased mortality. The primary aim of this study was to investigate the prevalence and progression of malnourishment in orthopaedic trauma patients admitted acutely.

Methods: We prospectively studied orthopaedic trauma patients admitted to the Orthopaedic Trauma Service at a Level I regional trauma center. Serum laboratory markers were obtained on admission, hospital day 3, hospital day 7, and at 6 weeks post surgery. Nutritional markers included albumin, prealbumin, transferrin, C-reactive protein (CRP), and vitamin D. Nutritional status was determined using the Rainey MacDonald nutritional index (RMNI). Patient demographics, ISS, and surgical treatment were also recorded prospectively.

Results: 101 patients were enrolled, but 30 patients were excluded because either they were discharged before and/or appropriate laboratory tests were not drawn on hospital day 3. As a result, 71 orthopaedic trauma patients (36 men and 35 women) with an average age of 51 years were included in the final analysis. 17 patients required more than one surgery for their injuries. On admission, 70%, 40%, and 43% of patients were malnourished based on albumin, prealbumin, and RMNI values, respectively, with 74% in an acute-phase response (APR) as determined by CRP. By day 3, a significant increase in the percent of malnourished patients based on the laboratory markers was noted—97%, 88%, and 91%, respectively, with 100% in APR. On day 7, values stabilized at 96%, 88%, 78%, with 95% in APR. At 6 weeks, malnourishment persisted in 25%, 25%, and 20% of patients, with 31% in APR. Vitamin D levels were low in 80% of patients on admission and 60% continued to have deficiency at 6 weeks.

Conclusion: The prevalence of malnourishment, based on serum values of albumin and prealbumin and the RMNI, in the presence of acute orthopaedic injury, is substantial, and it continues to rise during the initial hospital stay. We found a pronounced decrease in nutritional status during the acute phase, which may indicate the importance of nutritional support immediately following orthopaedic injury. Further studies are required to determine if supplementation will correct malnourishment in the acute setting and whether these parameters result in a greater incidence of complications in our patient population.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

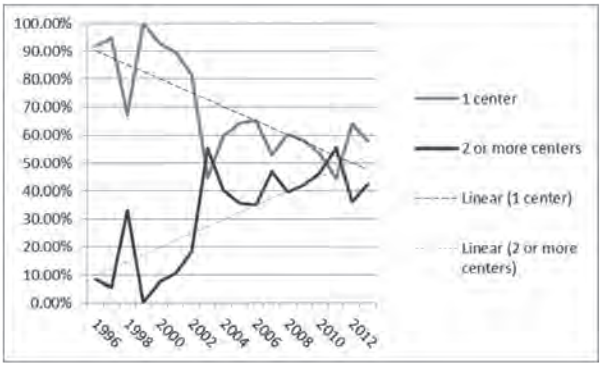
Multicentered Studies in the OTA: Has the Increased Ability to Share Information Translated to More Multicentered Studies at the OTA Annual Meetings?

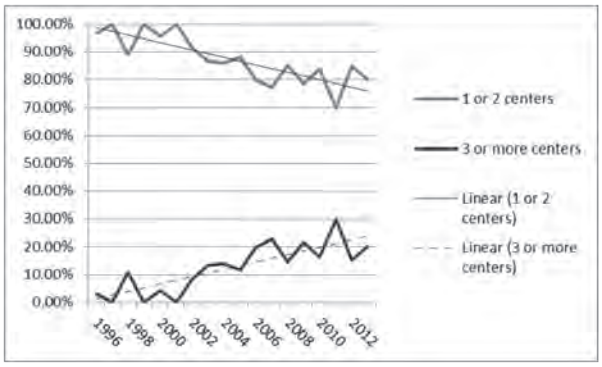
Alaa Kalloub, MD; Rumeal Whaley; ***John Riehl, MD****;*
University of Louisville Hospital, Louisville, Kentucky, USA

Background/Purpose: Original scientific studies presented at the OTA annual meeting every year are a source of cutting edge clinical information for orthopaedic surgeons. There has always been an emphasis on high-quality, well-powered studies that can show statistical significance and direct clinical practice. Often, this requires multiple center involvement in order to include appropriate numbers of patients in these studies. With computers and the Internet we believe that the feasibility of performing multicenter studies should be greater over the past several years than it was for years prior. The purpose of this study was to compare the presentations at the OTA annual meeting based on the number of centers involved over a period of 18 years (1996-2013), and whether or not there is a tendency over time toward more multicenter trials being presented at this meeting.

Methods: OTA podium presentations were reviewed over a period from 1996-2013. A total of 1400 presentations were given during this time period. Data pertaining to the number of institutions involved based on authorship was recorded for each presentation and trended over time.

Results: Single-center studies occurred more commonly for the years 1996-2002 (88%), with few studies performed with 2 centers (8%), 3 centers (1.96%), and 4 or more centers (1.92%). For the period 2003-2013, multicenter studies became increasingly more common than in the years prior. Over this time period single-center studies were presented on average 56% of the time (range, 44%-65%), while the occurrence of 2, 3, and 4 or more center studies increased significantly (25.04%, 10.3%, and 7.83%, respectively).





Conclusion: Over the past 18 years the number of multicenter studies presented at the OTA annual meeting has increased. This is likely due in part to improved communication and improved ability to share data across multiple sites. This has, and will in the future, allow researchers to combine data across sites that are geographically remote in order to produce high-quality, meaningful research.

See pages 99 - 147 for financial disclosure information.

Sleep Disturbances After Orthopaedic Trauma

Robert D. Russell, MD[1]*; William R. Hotchkiss, MD*[1]*; Jose Santoyo, BA*[1]*; Jeffrey Howard, MA*[2]*; Adam J Starr, MD*[1]*;*
[1]*University of Texas Southwestern Medical Center, Dallas, Texas, USA;*
[2]*University of Texas at San Antonio, San Antonio, Texas, USA*

Purpose: Musculoskeletal trauma can have a tremendous effect on patients' quality of life. However, the effect of orthopaedic trauma on patients' sleep quality has not been investigated. The purpose of this study was to examine the quality of sleep in a cohort of patients who have sustained musculoskeletal injuries, and to determine if sleep quality correlates with patient-perceived outcome.

Methods: We distributed questionnaires to all patients in the outpatient trauma clinic of a Level I trauma center during a 1-month period. The questionnaire given to assess sleep quality was the Pittsburgh Sleep Quality Index (PSQI). We also distributed the Short Form 36 (SF-36) to quantify patients' perceived outcome after their injury. Demographic data and injury type was also recorded for each patient. Statistical analysis was performed to determine any correlation between the PSQI score and the SF-36 score, and also to reveal any predictive factors for poor sleep quality.

Results: 267 patients completed the questionnaires properly and were included in the study. 19 (6.6%) questionnaires were excluded due to incomplete information. The overall prevalence of sleep disturbance (defined as global PSQI > 5) was 80.5%. 120 patients (44.9%) had a PSQI global score >10, which is similar to the level of sleep disturbance experienced by patients with clinical depression. 41 patients (15.4%) had a PSQI global score >15, which is a severe sleep disturbance. Females who sustained orthopaedic trauma had a greater sleep disturbance than males with a mean PSQI global score of 10.7 and 9.7, respectively ($P = 0.047$). Age was not statistically correlated with sleep disturbance. Every subscale of the SF-36, as well as the physical and mental composite scores, were negatively correlated with PSQI global score ($P < 0.001$). The subscale with the greatest negative correlation with PSQI global score was Bodily Pain

Conclusion: Sleep disturbance is an extremely common problem after orthopaedic trauma. Females who sustain orthopaedic trauma experience greater sleep disturbance than males. Patient sleep quality after orthopaedic trauma does correlate with patient-perceived outcome.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

PROMIS Physical Function CAT Correlates with PTSD But Not Anxiety and Depression in Orthopaedic Trauma Patients

Ami R. Stuart, PhD; David L. Rothberg, MD; Erik N. Kubiak, MD; ***Thomas F Higgins, MD****;*
University of Utah, Salt Lake City, Utah, USA

Purpose: The relationship between traumatic injury and physical disability is well established in the literature. More recent data would suggest that pain, depression, and anxiety may have an equally powerful influence on long-term function as the severity of physical injury. The purpose of this study is to establish the correlation between patients' postoperative anxiety and depression, PTSD (posttraumatic stress disorder) as determined by validated measures and PROMIS (Patient Reported Outcomes Measurement Information System) physical function computer adaptive test (PF CAT) scores.

Methods: With IRB approval, orthopaedic trauma patients were administered PROMIS PF CAT, Hospital Anxiety and Depression Score (HADS), and PTSD Checklist (PCL) score. Descriptive statistics were used to analyze demographic data. Mean and standard deviation (SD) and median and interquartile range (IQR), were used to analyze questionnaire responses. Pairwise correlations between the three questionnaires were assessed using Spearman's correlation coefficient (r). P values <0.05 were taken to be statistically significant.

Results: 69 patients had complete data sets. A score greater than 50 on the PCL represents clinically significant PTSD. Scores on the PF CAT are compared to the general population mean of 50 with a standard deviation of 10; a score of 38.7 suggests the patient functions at a level greater than 1 SD below population means. The HADS has separate depression and anxiety subscales with a score on either subscale of greater than 11 representing clinical presence of disease. Descriptive statistics are reported in Table 1. Correlation between the PCL and PF CAT, HADS-Anxiety, and PCL were statistically significant (Table 2).

Conclusion: The orthopaedic trauma population in this sample showed evidence of depression more than anxiety or PTSD. However, physical function impairment correlated most closely with presence of PTSD, and PTSD correlated with anxiety. The PTSD correlation confirms prior findings, but interestingly, the dissociation between physical function and depression/anxiety runs contrary to previous research on the topic.

Table1. Descriptive Summary

	N	Mean (SD)	Median (IQR)
HADS-Anxiety	69	7.8 (2.4)	7.0 (6.0, 9.0)
HADS-Depression	69	12.8 (1.5)	13.0 (12.0, 14.0)
PF CAT	69	38.7 (11.1)	35.6 (30.6, 47.7)
PTSD	69	25.9 (9.1)	23.0 (20.0, 31.0)

See pages 99 - 147 for financial disclosure information.

Table 2. Estimate of Spearman's Correlation Between Variables

Variables	Sample Correlation	95% CI	*P* Value for H0:Rho = 0
PF CAT*PTSD	–0.462	(–0.628, –0.25)	<0.0001
PF CAT*HADS-Anxiety	–0.126	(–0.351, 0.115)	0.3050
PF CAT*HADS-Depression	–0.166	(–0.386, 0.075)	0.1734
PTSD*HADS-Anxiety	0.546	(0.352, 0.691)	<0.0001
PTSD*HADS-Depression	0.055	(–0.184,0.288)	0.6540
HADS-Anxiety*HADS-Depression	0.066	(–0.174, 0.298)	0.5896

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Appropriate Use of the 22-Modifier Does Not Improve Payment in Orthopaedic Trauma and Fracture Care

Matthew P. Sullivan, MD*; Doug Nestorovski, BS; Annamarie D. Horan, PhD; Derek J. Donegan, MD; Jaimo Ahn, MD, PhD; Samir Mehta, MD; Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania, USA*

Purpose: The 22-modifier in surgical billing allows the surgeon to request increased payment for a given procedure due to increased complexity. The purpose of this analysis was to critically evaluate the effects on payment related to the use of the 22-modifier in complex periarticular trauma. We chose four complex surgical procedures including open treatment of acetabular, elbow, tibial plateau, and pilon fractures and hypothesized that the 22-modifier is an effective method for receiving higher payment in a timely and cost-effective manner.

Methods: All operative procedures billed by the orthopaedic trauma service at an urban, Level I trauma center were evaluated from September 2007 to November 2011. Billing data for the following CPT codes were extracted: open treatment acetabular fracture, open treatment elbow fracture, open treatment pilon fracture, and open treatment tibial plateau fracture. Data were then stratified based on the application of the 22-modifier. Procedures with no payment were excluded. 396 submissions were included in the final analysis. For each procedure group the following variables were assessed: payment to surgeon, days to payment, operative dictation word count, and explanation for requesting higher payment. Correlation of payment amount by payer and number of reasons for use of the 22-modifier was also determined.

Results: Utilization of the 22-modifier was associated with $331 lower payment for open treatment acetabulum fracture (27226, 27227, 27228), $330 lower payment for open treatment elbow fracture (24545, 24546, 24586, 24635), and $72 lower payment for open treatment pilon fracture (27826, 27827, 27828). Open treatment anterior or posterior wall fracture was the only specific code for which there was a significant benefit to applying the 22-modifier ($479.40, $P < 0.05$). For all procedure groups, a significantly greater operative dictation word count was noted and there was a 14.4% increase in time to payment when the 22-modifier was applied. There was no payment benefit to dictating additional reasons for requesting a greater payment. Payer type statistically significantly affected payment amount using the 22-modifier in the following order from greatest to least: Workers' Compensation, private insurance, Medicare, and Medicaid.

Conclusion: Utilization of the 22-modifier is associated with decreased payment for complex periarticular fracture procedures. Furthermore, it greatly increased the administrative aspects of fracture care such as increased time to payment for many procedures and dramatically increased operative dictation length by word count. Application of the 22-modifier in patients insured through Workers' Compensation may result in increased payment. Routine use of the 22-modifier for complex procedures is not recommended in orthopaedic trauma and fracture care.

See pages 99 - 147 for financial disclosure information.

The Morbidity of Alcohol Withdrawal Among Orthopaedic Trauma Patients

***Gavin Hart, MD**; Rachel Seymour, PhD; Michael J. Bosse, MD;*
Carolinas Medical Center, Charlotte, North Carolina, USA

Purpose: The goals of this study were to examine the incidence of alcohol withdrawal symptoms (AWS) and delirium tremens (DTs) among trauma patients with alcohol-associated diagnoses treated symptomatically with a benzodiazepine-based regimen at our institution. We sought to quantify their hospital length of stay (LOS), ICU LOS, and overall cost of hospitalization. We hypothesized that trauma patients with and without orthopaedic injuries at our institution develop AWS and DTs at a higher rate than the national average.

Methods: After IRB approval, we retrospectively reviewed our Level I trauma center's trauma database for trauma patients over the age of 21 who presented with injury or trauma between January 1, 2008 and December 31, 2011 and were discharged with a secondary diagnosis of alcohol abuse, alcohol withdrawal/delirium, and/or alcoholic psychosis. Patients were excluded if they presented without a traumatic injury. Investigators recorded demographics (age, sex, ethnicity), mechanism of injury, primary and secondary diagnoses, hospital LOS, ICU LOS, hospital disposition, implementation of CMC (Carolinas Medical Center) Adult Alcohol Withdrawal Protocol (AAWP), the development of AWS, and the development of DTs.

Results: We retrospectively reviewed the charts of 921 patients (770 males, 151 females) with an average age of 44.8 years. The overall implementation rate of the AAWP was 44.7%. Of the patients placed on the AAWP, 167 (40.5%) of them developed AWS and 38 (9.2%) developed DTs. Of patients not on the AAWP, 25 (4.9%) developed withdrawal symptoms and 13 (2.5%) developed DTs. Overall, patients who developed DTs were significantly older than patients who did not (55.4 years vs. 44.1 years, $P < 0.0001$). Furthermore, 24 (47%) of the patients who developed DTs required admission to the ICU for treatment of their withdrawal-related symptoms with an average ICU LOS of 8.09 days. Average hospital LOS was significantly longer for patients who developed DTs than for those who did not (15.5 days vs. 7.8 days, $P < 0.0001$).

Conclusion: Even when placed on the AAWP, a relatively high number of trauma patients with and without orthopaedic injuries developed DTs at a rate almost double that of the national average of approximately 5%. Almost half of the patients who developed DTs required an ICU stay unrelated to their traumatic injuries. Furthermore, patients who developed DTs required a hospital LOS twice that of the rest of the patient cohort. The questionable efficacy of the AAWP at our institution and the increased cost associated with the development of DTs has led the authors to advocate for an alcoholic beverage with meals regimen to combat AWS and DTs in high-risk patients.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Decisional Balance and Smoking: Are Orthopaedic Trauma Patients More Willing to Quit?

Paul E. Matuszewski, MD*; Christina L. Boulton, MD; Robert V. O'Toole, MD;*
R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA

Background/Purpose: Smoking is associated with increased complications in fracture care, including increased infection rate, wound healing difficulties, nonunion, and perioperative morbidity. Recent data also demonstrate that smoking cessation may have a positive impact on fracture care. The psychological effects of trauma may influence a patient's desire to quit smoking. It is unknown if orthopaedic trauma patients represent a group that can be targeted for smoking cessation programs. Our hypothesis is that orthopaedic trauma patients are more apt to quit smoking than expected in a typical population of smokers.

Methods: The study group included all patients having sustained a new extremity or pelvis fracture presenting to our orthopaedic trauma clinic within 8 weeks of injury who consented to participation (n = 112, 68 nonsmokers and 44 smokers, 66 males). Nonsmokers were defined as those patients who have never smoked or have not smoked in the last 6 months. A 24-question survey administered to each patient included opinion questions assessing "decisional balance" in smoking (6 questions, a short-form validated psychometric tool), a question asking if injury influenced desire to quit, and knowledge questions about the effects of smoking. Additionally, the survey addressed the smoking patients' willingness to quit by measuring the previously defined transtheoretical model (TTM) stage of change. TTM is a well-known biopsychological model designed to conceptualize the process of intentional behavior of change. It consists of 5 stages associated with increasing success in behavior change: Precontemplation, Contemplation, Preparation, Action, and Maintenance. Ordinal logistic regression was performed to assess the primary outcome, the TTM stage of change.

Results: 73% of smokers were in the 3 most favorable stages of change ($P < 0.001$ vs. historical control, [95% CI (confidence interval) 0.596-0.859], 16% Action, 18% Preparation, 34% Contemplation), consistent with higher likelihood of smoking cessation. 48% (95% CI 0.330-0.628) stated their injury made them more likely to quit. Higher scoring on smoking knowledge questions successfully predicted increasingly favorable stages of change ($P = 0.004$). Likewise, smokers reporting increased desire to quit secondary to injury were likely to be in a favorable stage of change ($P < 0.0001$). Smokers with decisional balance favoring smoking correlated with the lowest stage of change (precontemplation), but no others ($P < 0.05$).

Conclusion: A significant number of smokers after orthopaedic trauma are within a stage of change favoring cessation interventions (73%, $P < 0.001$), which is in stark contrast to values expected in nonorthopaedic trauma populations. Increased knowledge about the effects of smoking makes patients more receptive to quitting. Our data suggest that patients with new orthopaedic injuries may represent a population uniquely receptive to smoking cessation and education programs. Decisional balance may be a clinically useful screening tool and further prospective studies will help elucidate the most effective smoking cessation modalities for the orthopaedic trauma population.

See pages 99 - 147 for financial disclosure information.

The Electronic Medical Record: Does It Accurately Reflect the Trauma Patient?

Wesley Winn, BS; Heidi Israel, PhD; ***Lisa K. Canada, MD;***
Saint Louis University, St. Louis, Missouri, USA

Background/Purpose: The Electronic Medical Record (EMR) has mandatory widespread use. The use of EMR for clinical notes carries with it the ease of using cut-and paste functions. The purpose of this study is evaluate the use of copy-and-paste functions in daily progress notes of patients, treated in a single institution, with injuries at a high risk for complications: bicondylar tibial plateau fractures and type I and II open tibial shaft fractures. We hypothesize that the daily progress notes by the orthopaedic residents will have less than 4 new points from the previous day and that the progress notes will not accurately portray an accurate picture of the patient.

Methods: A retrospective medical record review was carried out on orthopaedic trauma patients aged 18 years and older who received surgical intervention for bicondylar tibial plateau fractures and open tibial shaft fractures (types I and II) treated at a Level I trauma center. Daily progress notes were compared manually to the previous day's note for changes in subjective, objective, and plan portions of the notes during the patient's index hospitalization for the injury. Descriptive statistics and a nonparametric McNemar test were used to compare discrepancies on notes for key areas.

Results: There were 38 patients whose charts were reviewed during a 10-month (July 2012 to April 2013) period. 28 had tibial plateau fractures and 10 had open tibia fractures. The average length of stay for patients was 12 days (range, 2-35) There were 418 total notes compared. The overall average of copied data was 85% on a daily basis. Vital signs were auto-updated, so they are not included in the overall copied material. In the subjective portion of the notes, 85%-97% of the data was copied on a daily basis and 71%-92% of the data was copied within the objective portion of the notes on a daily basis. Medical complications (15) necessitating intervention included 8 cases of anemia requiring transfusion, 2 urinary tract infections, mental status changes and cardiac issues (4), and a fall delaying discharge. Of these medical complications, the note the day after the complication reflected the event in 10 of the complications. Thus 5 (30%) of patients did not have notes reflecting the complication ($P < 0.05$). There were 7 complications related to the injuries: 4 cases of compartment syndrome, 1 case of a change in neurovascular status, an amputation, and a wound infection treated with antibiotics. Four of the 7 complications (57%) were not reflected in the notes the day following the complication ($P < 0.05$). There were 54 planned returns to the operating room for procedures, yet 30 of the 54 notes (56%) regarding planned surgical procedures notes did not accurately report the plan for surgery($P < 0.05$). There were 4 patients with unplanned trips to the operating room and 3 of 4 notes (75%) did not reflect this ($P <0.05$). Twelve patients (32%) did not have notes accurately reflecting discharge plans and/or destination ($P < 0.05$).

Conclusion: The EMR is now standard in most institutions. While there is not concern for legibility of the notes and access to the chart there is an ease of copy and paste for daily notes. This may not lead to accurate portrayal of the patient. Our results demonstrated widespread use of the copy and paste function in a large academic Level I trauma center.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

We encourage evaluation of the charts by comparing notes to check for this function being used and a plan to minimize this practice at all institutions. This will decrease the inaccuracies in the chart and provide a clear picture of the patient, their injuries and current status.

See pages 99 - 147 for financial disclosure information.

Decreasing the Occurrence of Intraoperative Technical Errors Through Periodic Simple Show, Tell, and Learn Method

Ely L. Steinberg, MD*; Eyal Amar, MD; Assaf Albagli, MD; Ehud Rath, MD; Moshe Salai, MD; Department of Orthopaedic Surgery, Tel-Aviv Sourasky Medical Center, Sackler Faculty of Medicine, Tel-Aviv University, Tel-Aviv, Israel*

Background/Purpose: Technical errors (TEs) that occur during surgery for treating fractures are considered as being preventable by good preoperative planning and surgeon education. This prospective study evaluated a new instructional method for improving surgical outcomes that involved assessing surgeons' own recent performances in a seminar setting.

Methods: Postoperative radiographs from two groups of patients were assessed during consecutive 4-month periods. 350 operations were included in the early group and 411 operations in the late group. All the TEd that occurred during the first period were reviewed and discussed among the residents and the consultant surgeons who had performed those operations in a scheduled, seminar-type presentation. The same procedure was followed 4 months later. The TEs were classified as minor, moderate, and major.

Results: The two groups included the same 41 surgeons. The most common surgical sites were: proximal femur (21.4%), radius (17%), ankle (12.88%), and tibia (11.43%). The most common TEs were insufficient reduction, varus and valgus malalignment, and prominent hardware. The total number of errors dropped significantly, from 52 (14.7%) during the first period to 25 (6.3%) during the second period ($P = 0.0003$). The TE score for the severity classifications dropped from 81 to 38, respectively ($P = 0.0001$). The seven major events that occurred in both periods were reoperated with satisfactory results. The consultants performed statistically better than the residents in the first period (12% vs. 20%, $P = 0.036$), but almost similar to the residents in the second period (5.3% vs. 9%, $P = 0.164$). A TE index was calculated by dividing the accumulated sum by the number of operations and it dropped in both groups from 0.2 and 0.3 to 0.09 and 0.09, respectively.

Conclusion: Intraoperative TEs can be significantly reduced by periodic performance evaluations in a seminar setting during which groups of surgeons can review the TEs that they and their colleagues had made during recent orthopaedic surgical procedures.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Implant Choice, Spending, and Postoperative Complications: Exploring the Variability in an Orthopaedic Trauma Group

Thomas J. An, BA; Vasanth Sathiyakumar, BA; Harrison F. Kay, BS; Michael Gerasimopoulos, MBA; Young M. Lee, BS; Rachel V. Thakore, BS; William T. Obremskey, MD, MPH, MMHC; ***Manish K. Sethi, MD****; Vanderbilt University, Nashville, Tennessee, USA*

Purpose: The future of health-care reform will potentially involve bundled payment, where physicians and hospitals are paid a single amount for orthopaedic trauma injuries. It is therefore critical for surgeons to evaluate their utilization of implants and seek ways to reduce cost. Furthermore, it is important to explore the relationship between implant spending and complications. The purpose of our study is to determine if locking plate utilization, and in turn increased implant spending, leads to reduced complication rates.

Methods: We reviewed isolated bicondylar tibial plateau (BTP) fractures, bimalleolar ankle (BA), and trimalleolar ankle (TA) fractures for six orthopaedic trauma surgeons for 1 year at a single Level I trauma center. Reoperations for wound infection, hardware failure, and nonunion were recorded. We reviewed implant records, radiographs, and operating notes to determine if locking (L) versus non-locking (NL) implants were utilized. Implant cost information was given from financial services. Fisher's exact c^2 analysis and Mann-Whitney *U* tests of means were used to compare complication rates.

Results: We reviewed 77 patients with isolated fractures (26 with BTP fractures, 33 with BA fractures, and 18 with TA fractures) for six surgeons. There was a significant difference in costs between locking and non-locking plates (Figure 1). There was no significant relationship between implant choice and complication rates (Table 1). There was a wide variability in utilization of locking implants (ranging from 0% to 100% of cases) and in turn average total implant spending per case ranged from $1998 to $4856 among the six surgeons for BTA; for BA fractures, surgeon use of locking constructs ranged from 29% to 50% of cases, reflecting a range in average cost of case per physician from $1392 to $2144. For TA fractures, surgeon use of locking constructs ranged from 33% to 67% of cases, reflecting an average cost per case per physician from $823 to $1843.

See pages 99 - 147 for financial disclosure information.

Figure 1. Implant costs.

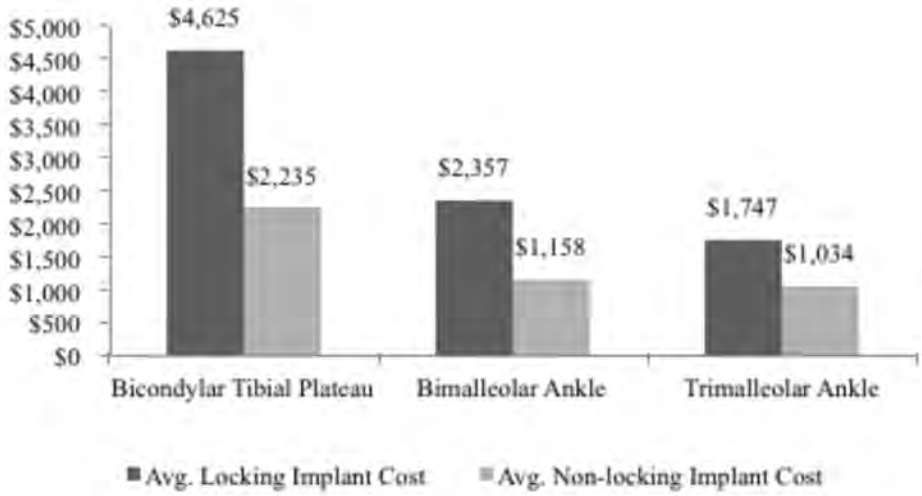


Table 1. Complication Rates

Fracture	Locking Complication Rate	Non-Locking Complication Rate	*P*
Bicondylar tibial plateau (n = 26)	31% (n = 5)	20% (n = 2)	0.55
Bimalleolar ankle (n = 30)	21% (n = 3)	16% (n = 3)	0.69
Trimalleolar ankle (n = 18)	33% (n = 3)	0% (n = 0)	0.06

Conclusion: This study is the first to investigate the relationships between utilization of locking/non-locking plates and complications. Our results demonstrate that while surgeon implant choice and, in turn, spending varies greatly, there is no relationship to complications.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Health-Care Reimbursement Models and Orthopaedic Trauma: Will There Be Change in Management?

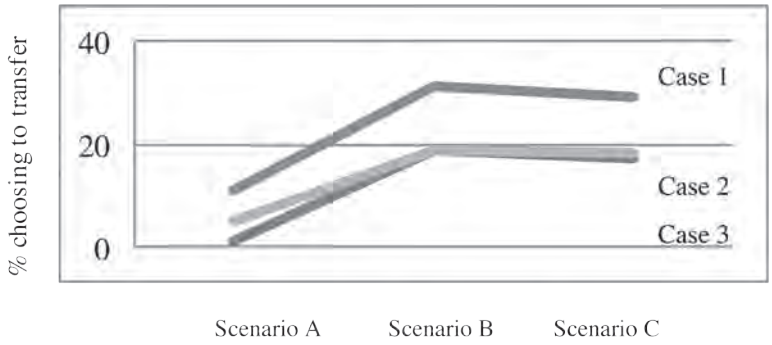
Rivka C. Ihejirika, BS; Vasanth Sathiyakumar, BA; A. Alex Jahangir, MD, MMHC; William T. Obremskey, MD, MPH, MMHC; Hassan R. Mir, MD, MBA; Daniel J. Stinner, MD; Rachel V. Thakore, BS; ***Manish K. Sethi, MD****;*
Vanderbilt University, Nashville, Tennessee, USA

Purpose: Health-care reimbursement models are changing. Fee-for-service may be replaced by pay-for-performance or capitated care. Medicare and Medicaid will alter payment schedules and tighten policy surrounding hospital readmission, and hospitals will face the potential creation of different reimbursement models including bundled payment and capitation. Some propose that given these changes the management of higher risk patients may occur predominantly at larger medical centers. The purpose of this study is to examine the possible changes in future management of orthopaedic trauma and general orthopaedic injuries based on potential shifts in policy surrounding readmission and reimbursement.

Methods: An e-mail survey was sent to 375 orthopaedic surgeons across the state of Tennessee via REDCAP. Surveys consisted of 3 case-based scenarios presented 3 separate times under different health-care settings for a total of 9 cases (table). Five options for management of each case were provided, with one choice involving transfer to a tertiary care center. Fisher's exact tests were conducted to compare the distribution of answers among the three scenarios.

Table Cases	Health-Care Environments
(1) 44-year-old type 3 open tibia fracture	(A) Current fee-for-service health-care setting
(2) 36-year-old, comorbidities, closed trimalleolar fracture	(B) 90-day reoperation/admission not reimbursed
(3) 65-year-old, comorbidities, hip osteoarthritis	(C) Capitated structure w/fixed payment per patient

Results: The response rate was 40.3% with 151 surgeons completing the survey. 71% of respondents were in private practice settings, while 28% were in academic centers. Respondents came from all orthopaedic subspecialties. In each case, there was a significant shift towards transferring patients to tertiary care centers under the capitated and penalized systems compared to the current fee-for-service model (figure). For Case 1, a significant increase in patient transfers occurred with 31% and 29% of respondents respectively choosing to transfer under health-care environments B and C ($P < 0.005$). In



See pages 99 - 147 for financial disclosure information.

Case 2, 19% and 17% of respondents chose to transfer the patient in scenarios B and C ($P < 0.005$), respectively. With Case 3, 19% and 18% of respondents respectively chose to transfer care in scenarios B and C ($P < 0.005$).

Conclusion: This survey is the first of its kind to confirm through case-based scenarios that a health-care system with readmission penalties and capitated reimbursement models may lead to a significant increase in transfer of orthopaedic injuries to tertiary care centers. Tertiary care centers must prepare for this influx from both a resource and financial perspective.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Thromboelastography Predictive of Death in Trauma Patients

Ian Kane, BS[1,2]*; Alvin Ong, MD*[2]*; Fabio R. Orozco, MD*[2]*; Zachary D. Post, MD*[2]*;*
Luke S. Austin, MD[2]*; Kris E. Radcliff, MD*[2]*;*
[1]*New York Medical College, Valhalla, New York, USA*
[2]*Rothman Institute of Orthopedics at Jefferson University Hospital,*
Philadelphia, Pennsylvania, USA

Purpose: Coagulopathy following trauma is a common condition. The purpose of this study was to determine if thromboelastography (TEG) was predictive of patient outcomes following a traumatic injury.

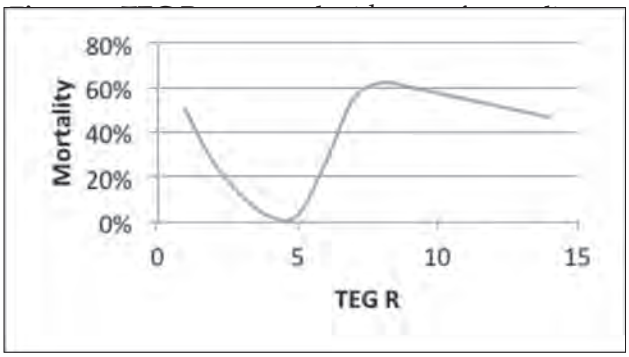
Methods: This was a retrospective review of a consecutive series of 131 patients with pelvic trauma admitted to a Level II trauma center over a 4-year period. TEG and traditional clotting parameters were recorded on patients who were admitted with orthopaedic trauma. Medical records were reviewed for specific complications, including death (n = 18), resuscitation effort (n = 19), pulmonary embolism (n = 5), and pelvic hematoma (n = 84).

Results: Evaluating the TEG data, there were 41 patients with abnormal clotting time (TEG R). TEG R >6 was an independent risk factor for death (odds ratio 16, 95% confidence interval 5.4-53, $P = 0.0001$). The death rate was 52% in patients with TEG R values equal to and above 6 (n = 13/25). There was no significant association between traditional clotting markers and death rate.

Conclusion: TEG reaction time value, representing the time of initial clot formation, was the only hematologic marker predictive of mortality in patients with trauma. Delay in reaction time was associated with a significantly increased death rate, independent of injury severity. The death rate association was not observed with traditional markers of clotting. Based on these data, we recommend that patients with pelvic trauma undergo screening TEG to evaluate for coagulopathy.

Table 1.
Mortality Rate Compared with TEG R Values

	Total	Death	Percent
R <6	106	5	4.72%
R ≥6	25	13	52%
R <3.8	36	4	11.10%



See pages 99 - 147 for financial disclosure information.

Is It Ever Too Hot or Too Cold for Trauma?

Gregg M. Ebersole, MD; Melissa Meister, BS; ***Lisa K. Cannada, MD****; J. Tracy Watson, MD; Saint Louis University Hospital, St. Louis, Missouri, USA*

Background/Purpose: It is commonly believed weather conditions have a direct effect on trauma volumes. We hypothesize that the rate of orthopaedic trauma will be altered by extreme deviations (Tdev) from normal: daily temperature maximums (Tmax) that exceed 90°F, and minimums (Tmin) below 32°C will affect trauma volumes.

Methods: Data were obtained from the trauma databases of two major metropolitan Level I trauma centers, with seasonal weather variability over a 4-year time period collated. Our study criteria included adult patients >18 years of age and an orthopaedic trauma injury determined by an AIS (abbreviated injury scale)-extremity >1. The National Weather Service–local international airport data collected were: Tmax, Tmin, Tdev, and precipitation. The total data were evaluated then divided by season and month. Data analysis included descriptives, analysis of variance, and logistic regression. Nominal variables were analyzed using χ^2. The alpha was 0.05 for significance.

Results: There were 5879 trauma admissions during the study period of 48 months, (1461 days) with an average of 4.03 traumas per day. There was a total of 583 days without trauma admissions between the 2 hospitals. Admission demographics consisted of 3900 (66%) males versus 1979 (34%) females. Mechanism of injury included motor vehicle collision 2062 (35%), motorcycle collision 631 (11%), pedestrian versus auto 276 (5%), fall 1845 (31%), gunshot wound 412 (7%), and other 653 (11%). 1901 traumas occurred during 488 days with precipitation. Total traumas that occurred with a Tmax of 80°-89°F numbered 1399 (over 295 days), with an average of 4.74 traumas per day. When the Tmax was 90°-99°F there were 949 traumas (over 193 days), with an average of 4.92 traumas per day. When Tmax was >100°F the rate dropped to 3.9 traumas per day with 156 traumas (occurring over 40 days). The trauma rate with a Tmin <32°F was 3.21 per day with 1030 traumas seen (occurring over 321 days).

Conclusion: The occurrence of orthopaedic trauma does increase during warmer seasons/months with the peak number occurring in August. Precipitation leads to a decrease in overall rate of traumas. The rate of trauma did increase as temperatures increased from 80-89°F to 90-99°F but once the Tmax exceeded 100°F the rate dropped. It appears from the data that High temperatures are "too hot for trauma" once extreme temperatures of Tmax >100°F are reached. The overall trend of orthopaedic trauma decreases in the winter time which is evident with the associated drop in Tmin<32°F.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Season (days)	Total # Traumas	Average Traumas/ day	Trauma + Precipitation	Trauma + No Precip	Days With No Trauma	No Trauma + Precip	No trauma + No Precip
Winter (356)	1180	3.3	375 (32%)	805 (68%)	170	52 (31%)	118 (69%)
Spring (372)	1624	4.4	660 (41%)	964 (59%)	127	63 (50%)	64 (50%)
Summer (376)	1704	4.5	473 (28%)	1231 (72%)	126	38 (30%)	88 (70%)
Fall (357)	1371	3.9	376 (25%)	995 (75%)	161	54 (34%)	107 (66%)

See pages 99 - 147 for financial disclosure information.

Implementing Recovery Resources in Trauma Care: Impact and Implications

Sarah B. Hendrickson, Med; Mary A. Breslin, BA; ***Heather A. Vallier, MD****;*
Department of Orthopaedic Surgery, MetroHealth Medical Center, Cleveland, Ohio, USA

Purpose: The purpose of this project was to identify resources that patients perceive as potentially helpful to their recovery and to characterize the impact of Trauma Survivor Network (TSN) services. The TSN is a community of patients, their support systems, and trauma providers committed to education and engaged recovery. We hypothesized that patients exposed to TSN resources would be more likely to be satisfied with their hospital course and would be more likely to feel that they would recover from their injuries.

Methods: Over a 5-month period after implementation of TSN programming, 177 adult patients admitted to a Level I trauma center for musculoskeletal injuries were exposed to TSN services (Group 1). Services included TSN coordinator and peer survivor visits in the hospital, printed educational materials, and referral to online services and support group meetings. During that same period a group of patients admitted for musculoskeletal injuries with no recorded exposure to TSN was identified from a registry, matched to Group 1 by fracture type (Group 2, n = 92). A second control group of patients treated 1 to 3 months prior to any implementation of TSN programs, also matched to Group 1 by fracture type, was identified (Group 3, n = 83). 114 patients (32%) completed a survey regarding their hospital experience and the perceptions of TSN services and resources potentially helpful to their recovery.

Results: On a Likert scale from 0 to 5, patients were overall highly satisfied with their hospital stay, mean 4.25, with no differences among the three groups. Patients exposed to TSN services were more likely to believe they were likely or very likely to recover from their injuries: mean 3.73 versus 3.02, Group 1 versus Group 2 ($P = 0.026$). Group 1 patients were also over twice as likely to perceive peer support relationships (59% vs. 28%) and support groups (31% vs. 11%) to be helpful to their recovery (both $P < 0.0001$). Patients who recalled utilization of TSN services were overall highly satisfied with these services, mean 4.46. The majority of Group 3 patients, treated prior to implementation of TSN services, identified one or more resources they would have benefited from during their hospitalization and recovery. These included counseling services (44%), support groups (55%), peer visitation/relationship (44%), printed educational materials (44%), and an online community (22%).

Conclusion: Patients were overall highly satisfied with their hospital stay, with those exposed to TSN services more likely to believe they were going to recover fully. Development of nontraditional services, including peer visitation and support groups, is perceived to be helpful in recovery. This project will not only provide insight into the current effectiveness of the TSN program and areas to improve upon, through feedback from patients, but will also serve as a baseline to revisit in the future. As the program continues to grow in awareness, expertise of peer visitors, and meaningful patient interaction, this data will be used as a tangible gauge of the progress and evolution of the program.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

Early Complications and Outcomes in Combat Injury-Related Invasive Fungal Infections: A Case-Control Analysis

LT Louis Lewandowski, MD[1,2]*; Amy C. Weintrob, MD*[1,3]*; David R. Tribble, MD*[3]*;*
CDR Carlos J. Rodriguez, DO[1,2]*; CPT Joseph Petfield, MD*[4]*; COL Bradley A. Lloyd, DO*[4,5]*;*
COL Clinton K. Murray, MD[4]*; MAJ Daniel Stinner, MD*[4]*; Deepak Aggarwal, MSE, MSPH*[3]*;*
Faraz Shaikh, MS[3]*; LTC Benjamin K. Potter, MD*[1,2]*;*
Infectious Disease Clinical Research Program Trauma Infectious Disease Outcomes Study Group
[1]*Department of Orthopaedics, Walter Reed National Military Medical Center, America Bethesda, Maryland, USA;*
[2]*Department of Surgery, Uniformed Services University of the Health Sciences, Bethesda, Maryland, USA;*
[3]*Infectious Disease Clinical Research Program, Uniformed Services University of the Health Sciences, Bethesda, Maryland, USA;*
[4]*San Antonio Military Medical Center, Fort Sam Houston, Texas, USA;*
[5]*Landstuhl Regional Medical Center, Landstuhl, Germany*

Background/Purpose: Invasive fungal infections (IFIs) have become increasingly prevalent in combat trauma populations. In addition to increased mortality, clinicians have anecdotally noted that IFIs lead to residual limb shortening, additional days and operative procedures prior to initial wound closure, and a high early complication rate. Our objective was to evaluate the validity of these observations and identify risk factors that may impact the time to initial wound closure in a case-control analysis.

Methods: The study population included United States military personnel injured during combat operations (June 2009-August 2011). The IFI cases were identified based upon the presence of recurrent, necrotic extremity wounds with mold growth in culture and/or histopathology demonstrating invasive fungal elements. The non-IFI controls were matched on the basis of injury pattern and severity. Information regarding surgical history, time to initial wound closure, complications, amputation level changes, and loss of femur length were analyzed. Data are expressed as multivariate hazard ratios (HR; 95% confidence interval [CI]).

Results: 71 IFI cases (112 fungal-infected extremity wounds) were identified and matched to 160 control patients (315 extremity wounds without fungal infections). Wounds with fungal infections resulted in a significantly ($P < 0.001$) higher number of operative procedures and longer duration to initial wound closure, along with a greater rate of early complications requiring additional surgery. Additionally, a significantly increased amount of residual limb shortening ($P = 0.009$) and changes in amputation level ($P < 0.001$) were observed among the IFI cases compared to controls. The IFI case wounds also demonstrated a higher rate of secondary or concurrent bacterial skin and soft-tissue infections (SSTIs; $P < 0.001$). A shorter duration to initial wound closure was significantly associated with wounds lacking IFIs (HR: 1.53; CI: 1.17, 2.01) and SSTIs (HR: 2.89; CI: 2.02, 4.11).

Conclusion: Our analysis indicates that IFIs adversely impact wound healing and patient recover,y leading to more frequent proximal amputation revisions and higher early complication rates. Concurrent/secondary bacterial SSTIs also add to the complexity of IFI wounds and may further affect wound healing.

See pages 99 - 147 for financial disclosure information.

The Relationship Between Preinjury Functional Status and 12-Month Functional Outcomes Varies by Fracture Site

*Deirdre Regan, BA[1]; Arthur Manoli III, BS[1]; **Kenneth Egol, MD**[1,2];*
[1]NYU Hospital for Joint Diseases, New York, New York, USA;
[2]Jamaica Medical Center, Jamaica, New York, USA

Purpose: It is unclear to what extent preinjury functional status relates to clinical outcomes in patients sustaining traumatic fractures. The purpose of this study is to investigate three common traumatic fractures and evaluate how baseline functional status relates to functional recovery at 1 year.

Methods: Prospectively collected data from 668 patients sustaining either an ankle fracture (n = 281, mean age 44 years), tibial plateau fracture (n = 108, mean age 49 years), or distal radius fracture (n = 279, mean age 54 years) were retrospectively reviewed. In all cases, baseline functional status was obtained and each patient was followed for a minimum of one year with the use of standard functional outcome measures including the Short Musculoskeletal Function Assessment (SMFA), and Disabilities of the Arm, Shoulder and Hand (DASH) score. Linear regression analysis was used to examine the relationship between functional status at baseline and 1 year following injury.

Results: Mean length of follow-up for the ankle fracture cohort was 12 months. Baseline total standardized SMFA scores were found to be significant predictors of total SMFA scores at 1 year (Table 1). Every 10-point increase in baseline total SMFA scores increased expected 1-year SMFA scores by 2.4 points. Considered independently, baseline SMFA scores were able to explain 6.2% of the variability in functional scores at 1 year for patients sustaining ankle fractures. In the cohort of distal radius fracture patients, baseline DASH scores were found to be significant predictors of total DASH scores at 1 year. Every 10-point increase in baseline DASH scores increased expected 1-year DASH scores by 1.5 points. Baseline DASH scores were only able to explain 1.5% of the variability in 1-year functional scores. Baseline SMFA scores for tibial plateau fracture patients were not found to be predictive of total SMFA scores at 1 year.

Table 1.
Relationship Between Baseline Functional Status and 12-Month Outcomes

Fracture Site	β Coefficient	95% Confidence Interval for Odds Ratio		Significance
Ankle	0.241	0.130	0.351	< 0.001
Distal radius	0.147	0.006	0.288	0.041
Tibial plateau	0.448	–0.151	1.047	0.141

Conclusion: The effect of preinjury functional status on 1-year outcomes varies by fracture site. In patients who sustain an ankle fracture, baseline functional status has a statistically

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

significant, and likely clinical significant, effect on outcomes at 1 year. The effect of baseline functional status on 12-month functional outcomes for patients sustaining distal radius fractures is statistically significant, but unlikely to be clinically significant. For patients sustaining tibial plateau fractures, the relationship is both clinically and statistically insignificant. Patients with limited functional status at baseline who require fracture repair should be advised accordingly.

See pages 99 - 147 for financial disclosure information.

Comparing Weight Bearing and Patient Satisfaction Between the Ertl Transtibial Amputation and the Traditional Below Knee Amputation

***Anthony W. Feher, MD**; Kreigh A. Kamman, BA; Melissa A. Kacena, PhD; Janos P. Ertl, MD*
Department of Orthopaedic Surgery, Indiana University School of Medicine, Indianapolis, Indiana, USA

Background: High energy or blast injuries have contributed to the dramatic increase in the number of amputations performed on military personnel in the past several years. A large percentage of civilian amputations occur secondary to diabetes and subsequent osteomyelitis. Unfortunately, there is significant functional loss and morbidity associated with lower extremity amputations. In an effort to mitigate potential long-term complications and improve patient satisfaction, we are evaluating different surgical options. The Ertl osteomyoplastic transtibial amputation (Ertl) creates a synostosis between the tibia and the fibula. The medullary canal is also closed to help restore endosteal blood supply gradients. The traditional posterior myofascialcutaneous amputation does not address bony stability. The null hypothesis of our study is there is no difference between patient satisfaction and end weight bearing capacity between the two procedures.

Methods: Our study was conducted on patients with a transtibial amputation. Each patient completed the Short Musculoskeletal Function Assessment Injury and Arthritis Survey (SMFA). Measurements of the patients' weight-bearing pressure were recorded three times using the X-Sensor© pressure mapping system. The average pressure and stump surface area were recorded. Pain was documented during testing with the visual analog scale (VAS). Knee range of motion and limb circumference was measured prior to weight bearing testing. A two-sample t-test was utilized to detect significant differences ($p<0.05$).

Results: 43 patients have been enrolled (24 Ertl and 19 standard) and were matched according to BMI. Ertl amputees could bear more average pressure over their residual limb, as compared to those having standard amputations ($p<0.05$). The surface area of the residual limb was significantly increased in the Ertl amputees ($p<0.05$). The limb circumference trended larger in the Ertl amputees as well. Ertl amputees had more range of motion of the residual limb with a significant improvement in flexion ($p<0.05$). There was a significant reduction in pain scores for participants having an Ertl over a standard amputation ($p<0.05$). Ertl patients scored better on both the bothersome and function SMFA scores ($p<0.05$).

Discussion: The Ertl amputation procedure allows patients to bear more weight comfortably on their residual limb. Our results illustrate that the Ertl procedure results in significantly larger weight-bearing pressures being tolerated in the amputated limb with significantly lower VAS pain scores. Ertl patients demonstrate better range of motion with their amputated limb. Ertl patients also have more function and feel less hindered by their amputation. Thus, patients receiving an Ertl amputation better tolerate weight bearing on their residual limb, which may facilitate: prosthetic use, perceived comfort, increased functionality, and subsequently more reliable return to pre-amputation level of activity.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.

This may be attributed to the greater surface area, slightly larger limb circumference, diminished motion between the tibia and fibula with weight bearing, or increased intramedullary pressures recorded in yet unpublished data. We believe that the Ertl amputation is a viable alternative to the traditional below knee amputation.

See pages 99 - 147 for financial disclosure information.


THERE ARE SMARTER WAYS TO GUARD AGAINST FALLS.
Preventing hip fractures from falls is critical for senior home safety. A few common sense precautions can make homes safer and extend independence. A public service message from the American Academy of Orthopaedic Surgeons and the Orthopaedic Trauma Association. For home safety tips, visit orthoinfo.org/falls and ota.org.
HOME SAFETY IS BONE SAFETY.
OTA ORTHOPAEDIC TRAUMA ASSOCIATION
AAOS AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS

PSA

Dear Colleagues,

I am reaching out to ask for your support of the OTA Research Grant Program through a research donation. As you know, the OTA Research Grant program is key to the success of our mission, and without support from BOTH industry and our members, this program cannot continue to exist. I am pleased to let you know that each member of the OTA Board of Directors has pledged a donation to this year's campaign – we hope we can count on your contribution too. I would like to thank those who have already contributed this year – your support is greatly appreciated!

And, I would like to extend a special thank you to our OTA Legacy Society members, which include those who have contributed $10,000 and greater during their lifetime giving:

James C. Binski, MD
Thomas (Toney) A. Russell, MD
Christopher T. Born, MD
Andrew H. Schmidt, MD
William R. Creevy, MD
Jeffrey M. Smith, MD
Ramon B. Gustilo, MD
Marc F. Swiontkowski, MD
Ross K. Leighton, MD
David C. Templeman, MD
Theodore Miclau, III, MD
Paul Tornetta, III
Florida Orthopaedic Institute, Tampa, Florida
Orthopaedic Specialists of North America, Phoenix, AZ
UCSF/SFGH Orthopaedic Trauma Institute

My personal goal is to see the Legacy Society double this year! Please note: new this year, the OTA will accept donor pledges (up to 3 years), which will count towards the Legacy Society total donor level.

If you'd like to know your donor level, please contact the OTA Office at ota@aaos.org or (847) 698-1631. *** 100% of OTA member research fund donations will go towards funding 2015 OTA-approved research studies ***

Donate to the OTA - Ways to Donate

1. Login to your Member Account to Donate directly to the OTA.
2. Call the OTA office and speak to a staff member: 847-698-1631
3. OTA Donation Form - Print and fax (847-823-0536) or mail to the staff office.
4. OREF Donation Form

Why contribute? Your help is needed to continue to fund the numerous outstanding OTA research efforts. The OTA continues to fund nearly $600,000 annually to OTA peer-reviewed studies…and the success of this program has been illustrated in the following *JBJS* article:

Volume 95, Issue 19 | The Orthopaedic Forum | October 02, 2013
A Ten-Year Analysis of the Research Funding Program of the Orthopaedic Trauma Association
Mitchell Bernstein, MD, FRCSC[1]; Nicholas M. Desy, MD[2]; Bogdan A. Matache, MD[3]; Todd O. McKinley, MD[4]; Edward J. Harvey, MD, MSc, FRCSC[2]

The OTA has always been a leader in the advancement of orthopaedic trauma care through high quality research, which has been funded since 1990. Because of the importance of this activity, and the success we as a society have had, we urge you to consider making a contribution. This ongoing effort will allow us to maximize the funding directed to trauma related research.

Sincerely,

Ross K. Leighton, MD

ORTHOPAEDIC TRAUMA ASSOCIATION

RESEARCH FUND DONATIONS

Contribution Levels:

- ❑ $ _____ **Sponsors Award** $5,000 - $24,999
- ❑ $ _____ **Members Award** $1,000 - $4,999
- ❑ $ _____ **Friends Award** $250 - $999

Name: _____

Address: _____

_____
City State Zip Code

Phone: _____ E-mail address: _____

❑ Check Enclosed ***(Checks may be made payable to: Orthopaedic Trauma Association)***

❑ MasterCard ❑ Visa ❑ AMEX

Cardholder Name: _____

Card Number: _____

Expiration: _____ Signature: _____

Total Amount: _____

OTA Memorial Fund

Memorial donations will be credited to the OTA "Best Resident/Fellow Podium Presentation/ Poster Award."

❑ $ _____ In memory of _____.

Please return to:

Orthopaedic Trauma Association
Attn: OTA Research Fund
6300 N. River Road, Suite 727
Rosemont, IL 60018-4226 USA

Phone: 847-698-1631

Mission Statement

The mission of the Orthopaedic Trauma Association (OTA) is to promote excellence in care for the injured patient, through provision of scientific forums and support of musculoskeletal research and education of orthopaedic surgeons and the public.

Vision Statement

The OTA will be the authoritative source for the optimum treatment and prevention of musculoskeletal injury, will effectively communicate this information to the orthopaedic and medical community and will seek to influence health care policy that effect care and prevention of injury.

Value Statement

The OTA is adaptable, forward thinking and fiscally responsible and is composed of a diverse worldwide membership who provide care and improve the knowledge base for the treatment of injured patients. OTA members provide worldwide leadership through education, research and patient advocacy.

Scientific Meeting Objectives

The OTA is an organization dedicated to the discovery and dissemination of knowledge and information regarding the prevention, diagnosis, and treatment of musculoskeletal injuries. This 30th Anniversary Annual Meeting of the OTA will provide all registrants the opportunity to witness presentations of peer-reviewed original basic science and clinical research papers, posters and symposia that present current concepts for topics of general interest. A multitude of mini-symposia, bio-skills labs, informal case presentations, and technical exhibits, each with specific focus, will enable a customized educational experience. Ample opportunity will be available for expression of common concerns, sharing of relevant experiences, and discussion of alternative treatment approaches.

Research sessions will include: original paper presentations dedicated to specific anatomic injury and original basic science papers.

Educational objectives will be fulfilled through the presentation of scientific presentations and symposia with subsequent discussions in an open forum. Ample opportunity will be available to express common concern, share relevant experiences and provide alternative treatment approaches.

General themes of orthopaedic trauma care will also be presented by topic focused symposia, motor skills laboratories, case presentations, scientific poster presentations and technical exhibits.

The American Academy of Orthopaedic Surgeons designates this live activityfor a maximum of **21** ***AMA PRA Category 1 Credits***™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

ACCREDITATION – CME INFORMATION

This 30th Annual Meeting of the Orthopaedic Trauma Association has been planned and implemented in accordance with the Essential Areas and policies of the Accreditation Council for Continuing Medical Education through the joint sponsorship of the American Academy of Orthopaedic Surgeons and the Orthopaedic Trauma Association. The American Academy of Orthopaedic Surgeons is accredited by the ACCME to provide continuing medical education for physicians.

The American Academy of Orthopaedic Surgeons designates this live activity for a maximum of **21** ***AMA PRA Category 1 Credits***™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

FDA STATEMENT

Some drugs or medical devices demonstrated at this 30th Annual Meeting may not have been cleared by the FDA or have been cleared by the FDA for specific purposes only. The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or medical device he or she wishes to use in clinical practice.

Academy policy provides that "off label" uses of a drug or medical device may be described in the Academy's CME activities so long as the "off label" use of the drug or medical device is also specifically disclosed (i.e., it must be disclosed that the FDA has not cleared the drug or device for the described purpose). Any drug or medical device is being used "off label" if the described use is not set forth on the product's approval label.

- Indicates those faculty presentations in which the FDA has not cleared the drug and/or medical device for the use described (i.e., the drug or medical device is being discussed for an "off label" use).

DISCLAIMER

The material presented at the 30th Annual Meeting has been made available by the *Orthopaedic Trauma Association* for educational purposes only. The material is not intended to represent the only, nor necessarily best, method or procedure appropriate for the medical situations discussed, but rather is intended to present an approach, view, statement or opinion of the faculty which may be helpful to others who face similar situations.

The Orthopaedic Trauma Association disclaims any and all liability for injury or other damages resulting to any individual attending the Annual Meeting and for all claims which may arise out of the use of the techniques demonstrated therein by such individuals, whether these claims shall be asserted by physician or any other person.

DISCLOSURE

The names of authors presenting the papers at the 30th Annual Meeting are printed in **boldface**.

As an accredited provider of continuing medical education CME, the Academy and OTA are required by the Accreditation Council for Continuing Medical Education (ACCME) to obtain and share with participants of an OTA CME activity any potential conflicts of interest by faculty, program developers and CME planners.

The ACCME Standards of Commercial Support, Standard 2 states the requirements:

2.1 The provider must be able to show that everyone who is in a position to control the content of an education activity has disclosed all relevant financial relationships with any commercial interest to the provider.

2.2 An individual who refuses to disclose relevant financial relationship will be disqualified from being a planning committee member, a teacher, or an author of CME, and cannot have control of, or responsibility for the development, management, presentation or evaluation of the CME activity.

The AAOS disclosure policy requires that faculty submit all financial relationships occurring within the past 12 months that create a potential conflict.

Each participant in the Annual Meeting has been asked to disclose if he or she has received something of value from a commercial company or institution, which relates directly or indirectly to the subject of their presentations.

Authors who completed their financial disclosures have identified the options to disclose as follows:

n. Respondent answered 'No' to all items indicating no conflicts;
1. Royalties from a company or supplier;
2. Speakers bureau/paid presentations for a company or supplier;
3A. Paid employee for a company or supplier;
3B. Paid consultant for a company or supplier;
3C. Unpaid consultant for a company or supplier;
4. Stock or stock options in a company or supplier;
5. Research support from a company or supplier as a PI;
6. Other financial or material support from a company or supplier;
7. Royalties, financial or material support from publishers;
8. Medical/orthopaedic publications editorial/governing board;
9. Board member/committee appointments for a society.

An indication of the participant's disclosure appears after his/her name in the alphabetical listing along with the commercial company or institution that provided the support.

The Academy and OTA do not view the existence of these disclosed interests or commitments as necessarily implying bias or decreasing the value of the author's participation in the meeting.

Δ Indicates presentation was funded by a grant from the Orthopaedic Trauma Association.

Cameras or video cameras may not be used in any portion of the meeting.

OTA MANDATORY DISCLOSURE POLICY FOR GOVERNANCE GROUPS AND CONTINUING MEDICAL EDUCATION CONTRIBUTORS

PHILOSOPHY

In order to promote transparency and confidence in the educational programs and in the decisions of the Orthopaedic Trauma Association (hereinafter collectively referred to as "OTA"), the OTA Board of Directors has adopted this mandatory disclosure policy.

The actions and expressions of Fellows, Members, and Others providing education of the highest quality, or in shaping OTA policy, must be as free of outside influence as possible, and any relevant potentially conflicting interests or commercial relationships must be disclosed. Because the OTA depends upon voluntary service by Fellows, Members, and Others to conduct its educational programs and achieve its organizational goals, this disclosure policy has been designed to be realistic and workable.

The OTA does not view the existence of these interests or relationships as necessarily implying bias or decreasing the value of your participation in the OTA.

OBLIGATION TO DISCLOSE

Each participant in an OTA CME program or author of enduring materials, and members of the OTA Board of Directors, Committees, Project Teams or other official OTA groups (collectively "OTA governance groups"), has the obligation to disclose all potentially conflicting interests.

Using a uniform form approved by the OTA Board of Directors, participants are responsible for providing information to the OTA (the OTA will accept either disclosure forms submitted directly to the OTA, or disclosure information submitted through the AAOS on-line Disclosure Program). Participants are responsible for the accuracy and completeness of their information. In addition, participants who disclose via the AAOS on-line Disclosure Program have an obligation to review and update their personal information in the AAOS Orthopaedic Disclosure Program at least semiannually (usually April and October). It is recommended that participants note any changes to the AAOS Orthopaedic Disclosure Program as soon as possible after they occur.

Failure of a required participant to disclosure will result in the participant being asked not to participate in the OTA CME program and OTA governance groups.

A list of all participants in OTA CME programs and OTA governance groups, along with their disclosures, will be included in all meeting materials.

Participants in OTA governance groups have an obligation to indicate any potential conflicts they may have during discussions affecting their personal interests during the meeting of the OTA governance group. At each meeting of the OTA governance group, members of the group will be reminded that full disclosure must be made of any potential conflict of interest when a matter involving that interest is discussed.

The chair of the governance group shall also have the prerogative of requesting a participant to provide further information or an explanation if the chair identifies a potential

conflict of interest regarding that participant. Based on the information provided in the OTA Orthopaedic Disclosure Program and/or upon a further review, the chair of the OTA governance group may determine that the participant shall:

Disclose the conflict and continue to participate fully in the OTA governance group's deliberations

Disclose the conflict, but abstain from discussing and voting on the matter; or

Disclose the conflict and leave the room until the matter has been fully discussed and acted upon.

If one of the latter two actions is taken, it should be reflected in the minutes of the OTA governance group's meeting.

Orthopaedic Trauma Association
ANTITRUST POLICY
(Adopted July 2012)

Discussions at OTA meetings often cover a broad range of topics pertinent to the interests or concerns of orthopaedic surgeons. As a general rule, except as noted below, discussions at OTA meetings can address virtually any topic without raising antitrust concerns if the discussions are kept scrupulously free of even the suggestion of private regulation of the profession. However, a number of topics that might be (and have been) discussed at OTA meetings may raise significant complex antitrust concerns. These include:

- Membership admissions, rejections, restrictions, and terminations;
- Method of provision and sale of OTA products and services to non-members;
- Restrictions in the selection and requirements for exhibitors at the OTA Annual Meeting or in CME activities;
- Establishment of the professional compliance program and adoption of Standards of Professionalism;
- Collecting and distributing certain orthopaedic practice information, particularly involving practice charges and costs;
- Obtaining and distributing orthopaedic industry price and cost information;
- Professional certification programs;
- Group buying and selling; and
- Inclusions or exclusion of other medical societies in organizational activities or offerings.

When these and related topics are discussed, the convener or members of the OTA group should seek counsel from Legal Counsel.

OTA urges its Board, committees and other groups not to participate in discussions that may give the appearance of or constitute an agreement that would violate the antitrust laws.

Notwithstanding this reliance, it is the responsibility of each OTA Board or committee member to avoid raising improper subjects for discussion. This reminder has been prepared to ensure that OTA members and other participants in OTA meetings are aware of this obligation.

The "Do Not's" and "Do's" presented below highlight only the most basic antitrust principles. OTA members and others participating in OTA meetings should consult with the OTA Presidential Line and/or General Counsel in all cases involving specific questions, interpretations or advice regarding antitrust matters.

Do Nots

1. Do not, in fact or appearance, discuss or exchange information regarding:
   a. Individual company prices, price changes, price differentials, mark-ups, discounts, allowances, credit terms, etc. or any other data that may bear on price, such as costs, production, capacity, inventories, sales, etc.
   b. Raising, lowering or "stabilizing" orthopaedic prices or fees;
   c. What constitutes a fair profit or margin level;
   d. The availability of products or services;
   e. The allocation of markets, territories or patients.

2. Do not suggest or imply that OTA members should or should not deal with certain other persons or firms.
3. Do not foster unfair practices regarding advertising, standardization, certification or accreditation.
4. Do not discuss or exchange information regarding the above matters during social gatherings, incidental to OTA-sponsored meetings.
5. Do not make oral or written statements on important issues on behalf of OTA without appropriate authority to do so.

Do

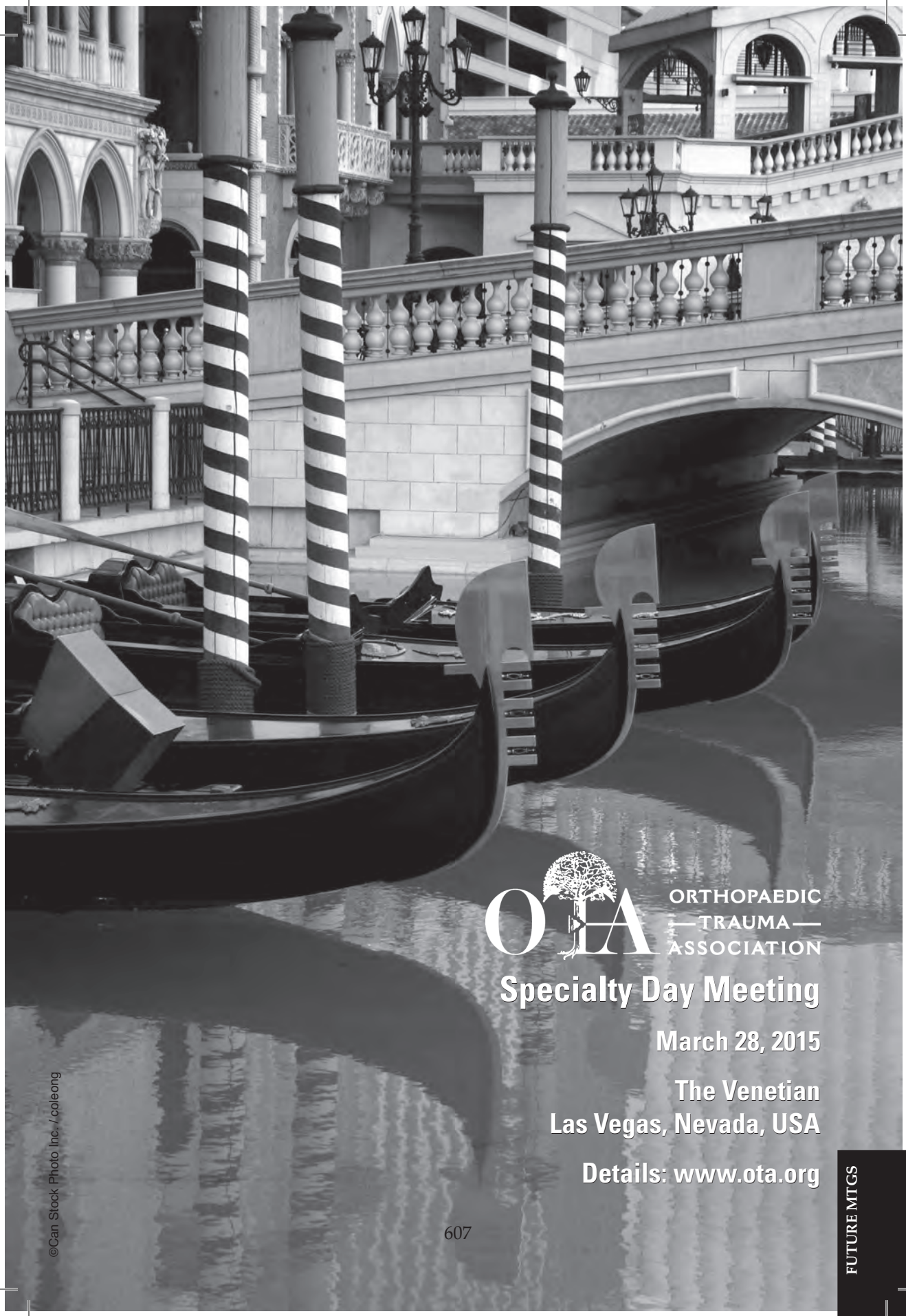
1. Do adhere to prepared agenda for all OTA meetings. It is generally permissible for agendas to include discussions of such varied topics as professional economic trends, advances and problems in relevant technology or research, various aspects of the science and art of management, and relationships with local, state or federal governments.
2. Do object whenever meeting summaries do not accurately reflect the matters that occurred.
3. Do consult with OTA counsel on all antitrust questions relating to discussions at OTA meetings.
4. Do object to and do not participate in any discussions or meeting activities that you believe violate the antitrust laws; dissociate yourself from any such discussions or activities and leave any meeting in which they continue.

Special Guidelines for Collecting and Distributing Information

The collection and distribution of information regarding business practices is a traditional function of associations and is well-recognized under the law as appropriate, legal and consistent with the antitrust laws. However, if conducted improperly, such information gathering and distributing activities might be viewed as facilitating an express or implied agreement among association members to adhere to the same business practices. For this reason, special general guidelines have developed over time regarding association's reporting on information collected from and disseminated to members. Any exceptions to these general guidelines should be made only after discussion with the Office of General Counsel. These general guidelines include:

1. Member participation in the statistical reporting program is voluntary. The statistical reporting program should be conducted without coercion or penalty. Non-members should be allowed to participate in the statistical reporting program if eligible; however, if there is a fee involved, they may be charged a reasonably higher fee than members.
2. Information should be collected via a written instrument that clearly sets forth what is being requested.
3. The data that is collected should be about past transactions or activities; particularly if the survey deals with prices and price terms (including charges, costs, wages, benefits, discounts, etc,), it should be historic, i.e., more than three months old.
4. The data should be collected by either the OTA or an independent third party not connected with any one member.
5. Data on individual orthopaedic surgeons should be kept confidential.

6. There should be a sufficient number of participants to prevent specific responses or data from being attributable to any one respondent. As a general rule, there should be at least five respondents reporting data upon which any statistic or item is based, and no individual's data should represent more than 25% on a weighted average of that statistic or item.
7. Composite/aggregate data should be available to all participants – both members and nonmembers. The data may be categorized, e.g., geographically, and ranges and averages may be used. No member should be given access to the raw data. Disclosure of individual data could serve to promote uniformity and reduce competition.
8. As a general rule, there should be no discussion or agreement as to how members should adjust, plan or carry out their practices based on the results of the survey. Each member should analyze the data and make business decisions independently.


ORTHOPAEDIC
TRAUMA
ASSOCIATION
Specialty Day Meeting
March 28, 2015
The Venetian
Las Vegas, Nevada, USA
Details: www.ota.org
©Can Stock Photo Inc. / coleong

SAN DIEGO, CALIFORNIA

ORTHOPAEDIC TRAUMA ASSOCIATION

SAVE THE DATE

31st Annual Meeting

October 7-10, 2015