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

Dear OTA Annual Meeting Attendees:

Timothy J. Bray, MD

Welcome to Baltimore!

Baltimore, one of America's greatest and most historic cities, is host to our Annual Meeting this year and we are happy to be here!

Camden Yards, R Adams Cowley Shock Trauma Center, USNS *Comfort* and the beautiful Baltimore Inner Harbor are but a few of this year's meeting attractions. Thanks to local host Andy Pollack, and Program Chair Bill Ricci, this year's program has something for every attendee.

The program will focus on the Basic Science Focus Forum, international trauma care, billing and coding, a young practitioner's forum, case presentations and practical tips on caring for the trauma patient. The memorial and guest lecture series will cover broad topics of historic and current orthopaedic trauma issues for our members and guests alike.

I am honored to address the membership this year by recognizing our hard-working Board of Directors and committee volunteers, as well as our community orthopaedic traumatologists. This year, the OTA Board has committed to making the Association a more 'user-friendly' organization by improving 'member services'. We have worked on changes in the organizational governance, committee structures, website improvement, easier access to assistance with billing and coding, references for community trauma program development and media campaigns to better inform our members of benefit opportunities. Peter Trafton will edit the new *'Tip of the Month'* publication on the website which will include helpful tools for clinical practice, business management and research, as well as personal growth as an orthopaedic trauma surgeon.

OTA members are always available for consultation regarding difficult cases, so feel free to utilize their expertise. Enjoy the few days away from your busy schedule, catch up with old friends, and update your orthopaedic trauma knowledge while visiting beautiful Baltimore.

Respectfully,

Timothy J. Bray

Tim Bray, MD
President OTA

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: http://www.ota.org

OTA Staff

Kathleen A. Caswell, *Executive Director*
Sharon M. Moore, *Society Manager*
Diane Vetrovec, *Manager, Education and Research*
Paul M. Hiller, *Society Coordinator*
Darlene A. Meyer, *Society Assistant*

TABLE OF CONTENTS

SCIENTIFIC POSTERS — *Baltimore Convention Center, Charles Street Lobby*

Open:	Thursday	11:00 am - 5:00 pm
	Friday	6:30 am - 5:00 pm
	Saturday	6:30 am - 5:00 pm

TECHNICAL EXHIBITS — *Baltimore Convention Center, Hall B*

Open:	Thursday	3:00 pm - 5:00 pm
	Friday	9:30 am - 5:00 pm
	Saturday	9:30 am - 1:30 pm

SPEAKER READY ROOM — *Baltimore Convention Center, Charles Street Lobby*

Open 6:30 daily — Wednesday thru Saturday.

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

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

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

ORTHOPAEDIC TRAUMA ASSOCIATION ORGANIZATION

2010 BOARD OF DIRECTORS

President – Timothy J. Bray, MD
President Elect – Andrew N. Pollak, MD
2nd President Elect – Robert A. Probe, MD
CFO – Alan L. Jones, MD
Secretary – James P. Stannard, MD
Immediate Past President – David C. Templeman, MD
2nd Past President – J. Tracy Watson, MD
Member-at-Large – Brendan M. Patterson, MD
Member-at-Large – David J. Stephen, MD
Member-at-Large – Christopher T. Born, MD
Annual Program – William M. Ricci, MD

NOMINATING *(Elected Committee)*
David C. Templeman (Chair)
Dolfi Herscovici, Jr.
Craig S. Roberts
Paul Tornetta, III
Robert A. Winquist

MEMBERSHIP *(Elected Committee)*
David P. Barei (Chair)
Robert P. Dunbar, Jr.
Susan A. Scherl
Michael S. Sirkin
Robert D. Zura

International Members Committee
(Ad Hoc Committee)
Peter V. Giannoudis, (Chair) (UK)
Hans-Christoph Pape (Germany)
Ney Amaral (Brazil)
Thomas A. (Toney) Russell (China focus)
Guenter C. Lob (Germany)
Akira Oizumi (Japan)

ANNUAL MEETING ARRANGEMENTS
Andrew N. Pollak
(Baltimore, MD 2010 Local Host)
Animesh Agarwal
(San Antonio, TX 2011 Local Host)
David C. Templeman & Andrew H. Schmidt
(Minneapolis, MN 2012 Local Hosts)
Alan L. Jones, CFO

ARCHIVES
Robert F. Ostrum (Chair)
Animesh Agarwal
Madhav A. Karunakar

BY-LAWS & HEARINGS
Lawrence X. Webb (Chair)
Mark J. Anders
Alexandra Schwartz

CLASSIFICATION AND OUTCOMES
J. Lawrence Marsh (Chair)
Thomas A. DeCoster
Gregory L. DeSilva
Douglas R. Dirschl
Clifford B. Jones
Douglas W. Lundy
Julie Agel
James F. Kellam (Presidential Consultant)

Open Fracture Work Group
Andrew R. Evans
Milan K. Sen
Debra Sietsema

EDUCATION
David C. Teague (Chair)
Paul J. Dougherty
Matt L. Graves
Thomas F. Higgins
Kenneth J. Koval
Scott P. Ryan (Resident Member)
Paul Tornetta, III
Stephen A. Kottmeier (ex-officio Website education links)

Education Sub Committee

Advanced Trauma Techniques Course – January 14 - 15, 2011
David P. Barei & Christopher Finkemeier,

11th Annual AAOS/OTA Orthopaedic Trauma Update – March 31 - April 2, 2011
Robert F. Ostrum & Daniel Scott Horwitz

Orthopaedic Trauma Fellows Course – April 15 - 17, 2011
Paul Tornetta, III

Comprehensive Fracture Course for Residents – April 28 - 30, 2011
David F. Hubbard & Matt L. Graves

Comprehensive Fracture Course for Residents – October 12 - 15, 2011
Laura J. Prokuski & Michael T. Archdeacon

JOT Editor: Roy Sanders

EVALUATION
Andrew N. Pollak (Pres Elect)
Mohit Bhandari
Mitchel B. Harris
James P. Stannard
Robert A. Probe (2nd Pres Elect, ex officio)
Timothy J. Bray (ex-officio)

FELLOWSHIP & CAREER CHOICES
Mark A. Lee (Chair)
Lisa K. Cannada (Presidential Consultant)
Cory A. Collinge
George J. Haidukewych
John M. Iaquinto
Toni M. McLaurin
Sara Strebe (Resident Member)

Fellowship MATCH Compliance Sub Committee
Robert A. Probe (Chair)
Robert J. Brumback
Gregory J. Schmeling
Robert A. Winquist

FINANCE AND AUDIT
Alan L. Jones, CFO (Chair)
Andrew N. Pollak, Past CFO
Brendan M. Patterson

FUND DEVELOPMENT
Robert A. Probe (Chair)
Peter Althausen
Thomas J. Ellis
John H. Wilber

Vendor Policy (Ad Hoc Committee of Fund Development)
Alan L. Jones, CFO
Timothy J. Bray, President
David C. Templeman, Immediate Past-President
Andrew N. Pollak, President Elect
William M. Ricci, Annual Meeting Program Chair
Laura J. Prokuski, RCFC Chair
Edward J. Harvey, Research Committee Chair

HEALTH POLICY & PLANNING
Michael Suk (Chair)
Samuel G. Agnew
David B. Carmack
Paul J. Duwelius
Theodore Toan Le
J. Spence Reid
Jeffrey Richmond
Heather A. Vallier
Philip R. Wolinsky
Mitchell B. Harris (Presidential Consultant)

Disaster Management Emergency Preparedness (Ad Hoc Committee of Health Policy)
Christopher T. Born (Chair)
Michael J. Bosse
William G. DeLong, Jr.
David W. Lhowe
Mark P. McAndrew
Steven J. Morgan
Andrew N. Pollak
Mark W. Richardson
David C. Teague

MILITARY
LTC Romney C. Andersen (Chair) (Army)
Robert J. Gaines (Navy)
Christopher T. LeBrun (Air Force)
LTC Greg M. Osgood (Air Force)
COL (Ret) Mark W. Richardson (Air Force)

PAST PRESIDENTS LIAISON
David C. Templeman, Immediate Past President (Chair)
All past Presidents are committee members

PRACTICE MANAGEMENT
William R. Creevy (Chair)
J. Scott Broderick
David S. Brokaw
Laura J. Prokuski
Michael S. Sirkin
Bruce H. Ziran
M. Bradford Henley (Presidential Consultant)

PROGRAM ANNUAL MEETING
William M. Ricci (Chair)
James A. Goulet (Co-Chair)
Victor A. de Ridder
Michael J. Gardner
Pierre Guy
Shepard R. Hurwitz
Theodore Miclau, III
William T. Obremskey
John T. Ruth

Program Basic Science Sub Committee
Theodore Miclau, III (Chair)
Joseph Borrelli, Jr.
Mohit Bhandari
Edward J. Harvey
Steven A. Olson
Emil H. Schemitsch

PUBLIC RELATIONS AND BRANDING
Craig S. Roberts (Chair)
Joseph R. Cass
Peter J. Nowotarski
Jeffrey M. Smith (Presidential Consultant)
Lisa K. Cannada (Newsletter)
Stephen A. Kottmeier (Website)

Your Orthopaedic Connection (YOC) and Poster Group Project Team
Brett D. Crist and Steve A. Kottmeier, co-chair liaison with AAOS
Charles M. Blitzer
Christopher T. Born
Joseph R. Cass
Gregory J. Della Rocca
Robert P. Dunbar
George M. Kontakis
Steven J. Morgan
Alberto Padilla
Lori K. Reed
Lisa A. Taitsman

RESEARCH
Edward J. Harvey, (Chair)
Gregory J. Della Rocca
Kenneth A. Egol
Bruce G. French
Kyle J. Jeray
Todd O. McKinley
Brian H. Mullis
Steven A. Olson
Hans-Christoph Pape
George V. Russell
Andrew H. Schmidt
Walter W. Virkus

STRATEGIC PLANNING AND BOARD DEVELOPMENT
J. Tracy Watson, Chair - 2nd Past President
David C. Templeman - Immediate Past President
Timothy J. Bray - President
Andrew N. Pollak - President Elect
Robert A. Probe - 2nd President Elect
Alan L. Jones - CFO

OTA PROJECT TEAMS

International Relationships
William G. DeLong, Jr. (Chair)
Jeffrey O. Anglen
Peter V. Giannoudis
Steven J. Morgan
Saqib Rehman
Andrew H. Schmidt
Wade R. Smith
Dave C. Templeman
Lewis G. Zirkle, Jr.

Evidence Based Outcomes
William T. Obremskey (Chair)
Mohit Bhandari
Michael J. Bosse
Cory A. Collinge
Douglas R. Dirschl
Steven A. Olson
H. Claude Sagi
Paul Tornetta, III

LIAISONS

AAOS BOS (American Academy of Orthopaedic Surgeons Board of Specialty Societies)
David C. Templeman - Presidential Line Rep
Jeffrey M. Smith - Communications
Michael Suk - Health Policy
David C. Teague - Education
Edward J. Harvey – Research
Kathleen Caswell - Executive Director
M. Bradford Henley – BOS, Chair
Jeffrey O. Anglen – BOS, Chair-Elect
Lisa K. Cannada – BOS Match Oversight Committee Chair
Mark A. Lee – BOS Match Oversight Committee OTA Rep

ACS COT (American College of Surgeons Committee on Trauma)
Jeffrey O. Anglen (2011)
William G. DeLong, Jr. (2013)
Gregory Georgiadis (2016)
Douglas W. Lundy (2014)
Wade R. Smith (2014)
David C. Teague (2012)
Clifford H. Turen (2013)
Philip R. Wolinsky (2016)

ACS (American College of Surgeons) Orthopaedic Advisory Council
Steven A. Olson

OTA DISTINGUISHED VISITING SCHOLAR PROGRAM

The AAOS/OTA gratefully acknowledges the *Foundation of Orthopaedic Trauma* and the following companies for their support of this program:

Kinectic Concepts, Inc. | Smith + Nephew | Synthes

OTA expresses gratitude to the following OTA/AAOS Members who have been chosen as Distinguished Visiting Scholars by a civilian/military panel to spend at least two weeks assisting the Military Orthopaedic Surgeons in Landstuhl who treat the soldiers injured from Iraq prior to their return to the states:

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
Langdon A. Hartsock, MD
Thomas F. Higgins, MD
James J. Hutson, Jr., MD
Clifford B. Jones, MD
Jonathan P. Keeve, MD
James C. Krieg, 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
Steven A. Olson, MD
Brendan M. Patterson, MD
Laura J. Prokuski, MD
John T. Ruth, MD
H. Claude Sagi, MD
Bruce J. Sangeorzan, MD
Andrew H. Schmidt, MD
R. Bruce Simpson, Jr., MD
Marc F. Swiontkowski, MD
David C. Teague, MD
Peter G. Trafton, MD
Bruce H. Ziran, MD
Robert D. Zura, MD

Landstuhl Distinguished Visiting Scholars Program: <u>Ongoing Need for Volunteers!!</u>

- Over 30 Active OTA members have participated since program inception in August 2007
- Conflict is ongoing with Landstuhl performing over 1000 cases in the last 12 months particularly with surge in Afghanistan.
- Landstuhl, Germany is a critical stop over in the evacuation of casualties from the theater providing interim care but also provides definitive trauma care for certain coalition partners and contractors.
- Scholars have the opportunity to provide valuable teaching and support to military orthopaedic surgeons while gaining a unique insight to these highly complex war injuries performing about 30 cases during their 2 week stay.
- Suggested scholar criteria:
    - o Demonstrated commitment to teaching and leadership
    - o 10 years of trauma experience

If interested please contact the OTA Business Office, and include your CV: ota@aaos.org

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

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

Maurice Müeller, MD (2009)
Bern, Switzerland

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

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

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

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 5 in memory of their commitment to education, research and patient care.

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 Board of Directors, approved granting two scholarships annually for SIGN members to attend the OTA annual meeting. Information regarding SIGN can be found on http://www.sign-post.org.

Congratulations to the following OTA/SIGN Scholarship Winners:
2007 – ***Thwit Lwin, MD****, Yangon, Myanmar* and
Kibor Leilei, MD*, Eldoret, Kenya*

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

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

2010 – ***COL M. Ismail Wardak, MD, MS****, Kabul, Afghanistan* and
Edmund Ndalama Eliezer, MD*, Dar es Salaam, Tanzania*

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.

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, MD

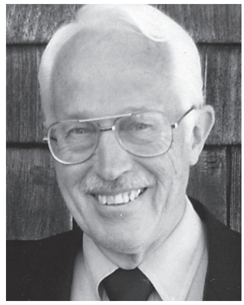
1997 – Trauma Care in Europe before and after John Border: The Evolution of Trauma Management at the University of Hannover
Professor Harald Tscherne, MD

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

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.)

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*

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*

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, individuals and companies for their generous financial support received through OTA and through OREF to fund OTA reviewed research grants and educational programs.

2010 FOUNDATION DONORS - RESEARCH/EDUCATION

(as of August 1, 2010)

Silver Award ($50,000 - $74,999)
Foundation for Orthopaedic Trauma

2010 CORPORATE DONORS - RESEARCH/EDUCATION

(as of September 1, 2010)

Diamond Award ($150,000 and above)
Smith & Nephew, Inc.
Stryker Orthopaedics
Synthes, USA

Platinum Award ($125,000 - $149,999)
Zimmer

Gold Award ($100,000 - $124,999)
Medtronic

Silver Award ($75,000 - $99,999)
DePuy, A Johnson & Johnson Company

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

Sponsors Award ($5,000 - $24,999)
KCI
Orthopaedic Trauma Service (Florida Orthopaedic Institute, Tampa, Florida)
Osteotech, Inc.

Members Award ($1,000 - $4,999)
Timothy Bray, Bruce Buhr, Janos Ertl, Joseph Lane, Simon Mears, Brian Mullis, Jorge Orbay, Edward Paxton, Andrew Pollak, Robert Probe, James Ross, Thomas (Toney) Russell, Brian Sears, David Teague, David Templeman, J. Tracy Watson, Sharese White

Friends Awards ($250 - $999)
Jeffrey Anglen, Joseph Cass, Clifford Jones, Fred Kolb, Douglas Lundy, Randall Marcus, William Obremskey, James Pape, Brendan Patterson, Michael Prayson, Andrew Saterbak, Andrew Schmidt, Robert Schultz, John Schwappach, William & Karla Shopoff, Scott Smith, Peter Trafton, Matthew Weresh, Ryan Will, Lewis Zirkle

2010 OREF/OTA ENDOWMENT FUND CONTRIBUTORS

Joseph Cass, Fred Kolb, James Nepola, David Weisman, Bruce Ziran

MEMORIAL DONATIONS

ABOS (Dan Horwitz)

Acknowledgments

2009 FOUNDATION DONORS - RESEARCH/EDUCATION

Platinum Award ($100,000 - $124,999)
AONA

Silver Award ($50,000 - $74,999)
Foundation for Orthopaedic Trauma

Copper Award ($10,000 - $24,999)
Team Ortho Foundation

2009 CORPORATE DONORS - RESEARCH/EDUCATION

Diamond Award ($125,000 and above)
DePuy, A Johnson & Johnson Company
Medtronic
Smith & Nephew, Inc.
Stryker Orthopaedics
Zimmer

Platinum Award ($100,000 - $124,999)
Synthes, USA

Silver Award ($50,000 - $74,999)
Biomet Trauma

Sponsors Award ($5,000 - $9,999)
Synthes Spine

Members Award ($1,000 - $4,999)
James Binski, Peter Cole, William Creevy, Robert DeTroye, Kyle Jeray, Orthopaedic Surgeons Network of Arizona, Brian Sears, Dave Templeman, Paul Tornetta, III, Bruce Ziran

Friends Awards ($250 - $999)
A. Herbert Alexander, Sarah Anderson, Paul Appleton, Robert Blotter, Brett Bolhofner, Timothy Bonatus, Christopher Born, Timothy Bray, Brian Buck, Bruce Buhr, Joseph Cass, Michael Chapman, Curt Comstock, Brett Crist, Gregory Della Rocca, Mark Dodson, Christopher Doro, Paul Duwelius, Rajeev Garapati, Michael Gardner, John Gorczyca, James Goulet, Gerald Greenfield, Jr., Justin Greisberg, Jonathan Gross, Sigvard Hansen, Jr., Langdon Hartsock, Roman Hayda, David Helfet, Thomas Higgins, Catherine Humphrey, Shepard Hurwitz, Utku Kandemir, Alan Kawaguchi, Fred Kolb, Paul Kosmatka, Gerald Lang, Richard Lange, David Laverty, Ross Leighton, Paul Levin, Frank Liporace, Dean Lorich, Steven Louis, Thaun Ly, John Lyden, Frank Maletz, J. Lawrence Marsh, Scott Martson, Amir Matityahu, R. Trigg McClellan, Todd McKinley, Theodore Miclau, III, Michael Miller, Matthew Mormino, Sam Morshed, Yvonne Murtha, James Nepola, Mark Olson, Steven Olson, Glen Oren, Michael Patzakis, Murat Pekmezci, Michael Prayson, Matthew Putnam, Mark Reilly, William Ricci, Craig Roberts, Gary Roberts, Edward Rodriguez, Melvin Rosenwasser, George Russell, Thomas Russell, Bruce Sangeorzan, Andrew Saterbak, Susan Scherl, Robert Schultz, John Schwappach, Daniel Sheerin, William & Karla Shopoff, Robert Simpson, Michael Sirkin, Jeffrey Smith, R. Malcolm Smith, Scott Smith, James Stannard, Marc Swiontkowski, Julie Switzer, Charles Versteeg, Gregory Vrabec, Mark Vrahas, J. Tracy Watson, Lawrence Webb, Matthew Weresh, Thomas Wuest, Edward Yang, Harris Yett

2009 OREF/OTA ENDOWMENT FUND CONTRIBUTIONS
Joseph Cass, Fred Kolb, Bruce Ziran

EDUCATION SCHOLARSHIP GRANT $500 FOR KUMASI GUEST
Jeff Anglen, Dave Templeman

OTA 2010 RESEARCH GRANT AWARD RECIPIENTS

OTA DIRECTED TOPIC CLINICAL STUDY

Title: **Decreasing Long Term Complications and Cost Following Hip Fracture Using a Medical Home Concept (MHC)**
Principal Investigator: **Wade Smith, MD**
Co-Principal Investigator: **Jove Graham, MD**
Grant Funded by: **AONA/OTA**

CLINICAL GRANT APPLICATIONS

Title: **Multidisciplinary Care of the Geriatric Patient with Fractures Below the Hip**
Principal Investigator: **Gregory J. Della Rocca, MD, PhD, FACS**
Co-Principal Investigator: **Yvonne Murtha, MD**
Grant Funded by: **DePuy/OTA**

Title**: Prevalence of Abuse with an Intimate Partner Violence Surgical Evaluation (P.R.A.I.S.E.)**
Principal Investigator: **Brad Petrisor, MD**
Co-Principal Investigator: **Mohit Bhandari, MD**
Grant Funded by: **Zimmer/OTA**

Title: **Effects of the Presence of Microbial Biofilms on the Healing of Osseous Fractures Treated with Internal Fixation**
Principal Investigator: **Daniel Altman, MD**
Co-Principal Investigator: **Greg Altman, MD**
Grant Funded by**: Medtronic/OTA**

BASIC RESEARCH GRANTS

Title: **Heterotopic Ossification in an Animal Extremity Blast Model**
Principal Investigator: **Robert O'Toole, MD**
Co-Principal Investigator: **Vincent Pellegrini, MD**
Grant Funded by: **AONA/OTA**

Title: **The Synergistic Effects of VEGF on BMP-Induced Osteogenic Differentiation of Bone Marrow Stem Cells**
Principal Investigator: **Quanjun Cui, MD**
Co-Principal Investigator: **Gary Balian, PhD**
Grant Funded by**: Synthes/OTA**

Title: **Engineering the Bioactivity of Absorbable Magnesium Implants for Fracture Fixation and Bone Defect Scaffolds: The Effect of Calcium Phosphate Coatings on In-Vitro Biocorrosion and Osteogenic Differentiation of Mesenchymal Stem Cells**
Principal Investigator: **Lawrence Bone, MD**
Co-Principal Investigator: **Shuying Yang, MD, PhD**
Grant Funded by: **DePuy/OTA**

Title: **Endothelial Progenitor Cells for Healing and Angiogenesis in a Segmental Bone Defect Model: A Comparison with Mesenchymal Stem Cells**
Principal Investigator: **Aaron Nauth, MD**
Co-Principal Investigator: **Emil Schemitsch, MD**
Grant Funded by: **Smith & Nephew/Zimmer/OTA**

Title: **Preferential Peroneal Nerve Palsy after Posterior Hip Dislocation and Acetabular Surgery: A Cadaveric Study**
Principal Investigator: **Ivan Tarkin, MD**
Co-Principal Investigator: **Hans-Christoph Pape, MD**
Grant Funded by: **Zimmer/OTA**

OTA 2010 RESIDENT GRANT AWARD RECIPIENTS

(January 1 - December 31, 2010 Grant Cycle)

Principal Investigator: **Alberto Carli, MD**
Co-Investigator: **Edward Harvey, MD**
Grant Title: **Chitosan-Mediated FGF18 Delivery for Assisted Bone Repair**
Grant Funded by: **Foundation for Orthopaedic Trauma/OTA**

Principal Investigator: **Jesse Shantz, MD, MBA**
Co-Investigator: **David Sanders, MD**
Grant Title: **The Efficacy and Cost Effectiveness of Pre-operative and Post-operative Cryotherapy in Proximal Tibia Fractures**
Grant Funded by: **Medtronic/OTA**

Principal Investigator: **Eric Henderson, MD**
Co-Investigator: **Claude Sagi, MD**
Grant Title: **Tension Band Wiring of Patella Fractures: Separating Fact from Fiction - A Biomechanical Study**
Grant Funded by: **Foundation for Orthopaedic Trauma/OTA**

Principal Investigator: **Vikram Sathyendra, MD**
Co-Investigator: **John Reid, MD**
Grant Title: **Expression of Single Nucleotide Polymorphisms in Delayed Fracture Healing**
Grant Funded by: **AO North America/OTA**

Principal Investigator: **Roshan Shah, MD, JD**
Co-Investigator: **Samir Mehta, MD**
Grant Title: **The Effect of Low Magnitude Mechanical Signals on Tibial Shaft Fracture Healing**
Grant Funded by: **Foundation for Orthopaedic Trauma/OTA**

Principal Investigator: **Brandon Steen, MD**
Co-Investigator: **Thomas Einhorn, MD**
Grant Title: **The Comparison of the Therapeutic Potential of Isolated BMP-2 Producing Progenitor Cells, Bone Marrow Aspirates and Recombinant BMP-2 in Rodent Models of Bone Formation**
Grant Funded by: **AO North America/OTA**

Principal Investigator: **Ty Fowler, MD**
Co-Investigator: **Kevin Pugh, MD**
Grant Title: **Tension Band Fixation of the Medial Malleous using Fiberwire. Suture: A Biomechanical Study**
Grant Funded by: **Foundation for Orthopaedic Trauma/OTA**

Principal Investigator: **Kristine Banks, MD**
Co-Investigator: **Milan Sen, MD**
Grant Title: **Locking Plate Fixation of Patella Fractures: A Biomechanical Study**
Grant Funded by: **OTA**

OTA 2010 RESIDENT GRANT AWARD RECIPIENTS

(June 1, 2010 - May 31, 2011 Grant Cycle)

Principal Investigator: **Mitchell Bernstein, MD**
Co-Investigator: **Edward Harvey, MD**
Grant Title: **The Use of Contrast Media in Detecting Traumatic Knee Arthrotomy**
Grant Funded by: **Foundation for Orthopaedic Trauma/OTA**

Principal Investigator: **Paul Chin, MD, PhD**
Co-Investigator: **Joseph Borrelli, Jr, MD**
Grant Title: **Effect of BMP-7 on Articular Cartilage Following an Impact Load**
Grant Funded by: **AO North America/OTA**

Principal Investigator: **Niloofar Dehghan, MD**
Co-Investigator: **Hans Kreder, MD, MPH, FRCS(C)**
Grant Title: **A Pilot Study of a Prospective Randomized Trial Comparing Early Post-Operative Motion and Weight-Bearing to Immobilization after Surgical Fixation of Bimalleolar Ankle Fractures**
Grant Funded by: **Foundation for Orthopaedic Trauma/OTA**

Principal Investigator: **E. Stephan Garcia, MD**
Co-Investigator: **Amr Abdelgawad, MD**
Grant Title: **Use of Local Free Antibiotic Powder in the Treatment of Osteomyelitis**
Grant Funded by: **AO North America/OTA**

Principal Investigator: **Rachel Goldstein, MD, MPH**
Co-Investigator: **Nirmal Tejwani, MD**
Grant Title: **Efficacy of Popliteal Block in Post-operative Pain Management for Ankle Fractures. A Prospective Randomized Study**
Grant Funded by: **Foundation for Orthopaedic Trauma/OTA**

Principal Investigator: **William Graham, MD**
Co-Investigator: **Thomas Ellis, MD**
Grant Title: **Acetabular Fracture after Total Hip Replacement**
Grant Funded by: **AO North America/OTA**

Principal Investigator: **Jason Hsu, MD**
Co-Investigator: **Samir Mehta, MD**
Grant Title: **Oxygen Partial Pressure Monitoring in Impending Compartment Syndrome Associated with Diaphyseal Tibia Fractures**
Grant Funded by: **Foundation for Orthopaedic Trauma/OTA**

Principal Investigator: **Lukas Nystrom, MD**
Co-Investigator: **Todd McKinley, MD**
Grant Title: **Accurate Radiographic Assessment of Pelvic Ring Fracture Deformity**
Grant Funded by: **AO North America/OTA**

Principal Investigator: **Kevin O'Neill, MD, MS**
Co-Investigator: **William Obremskey, MD, MPH**
Grant Title: **Quantitative Axial Micro-CT as a Surrogate for Biomechanics in a Mouse Fracture Model**
Grant Funded by: **Foundation for Orthopaedic Trauma/OTA**

Principal Investigator: **Jaron Sullivan, MD**
Co-Investigator: **J. Lawrence Marsh, MD**
Grant Title: **Accurate Screw Placement for Calcaneus Fixation**
Grant Funded by: **OTA**

OTA 2010 RESIDENT GRANT AWARD RECIPIENTS, *continued*

(June 1, 2010 - May 31, 2011 Grant Cycle)

Principal Investigator: **John Tidwell, MD**
Co-Investigator: **David Hubbard, MD**
Grant Title: **The Effects of Melatonin on Fracture Healing in a Traumatic Femur Fracture Model**
Grant Funded by: **Foundation for Orthopaedic Trauma/OTA**

Principal Investigator: **Lindley Wall, MD**
Co-Investigator: **Michael Gardner, MD**
Grant Title: **Volar Locking Plates for Extra-Articular Distal Radius Fractures: Is Unicortical Fixation Sufficient?**
Grant Funded by: **AO North America/OTA**

Principal Investigator: **Akira Yamamoto, MD**
Co-Investigator: **Amir Matityahu, MD**
Grant Title: **Comparison of Long versus Short Intramedullary Hip Nails for Fixation of Unstable Intertrochanteric Hip Fractures: A Cadaveric Study**
Grant Funded by: **Medtronic/OTA**

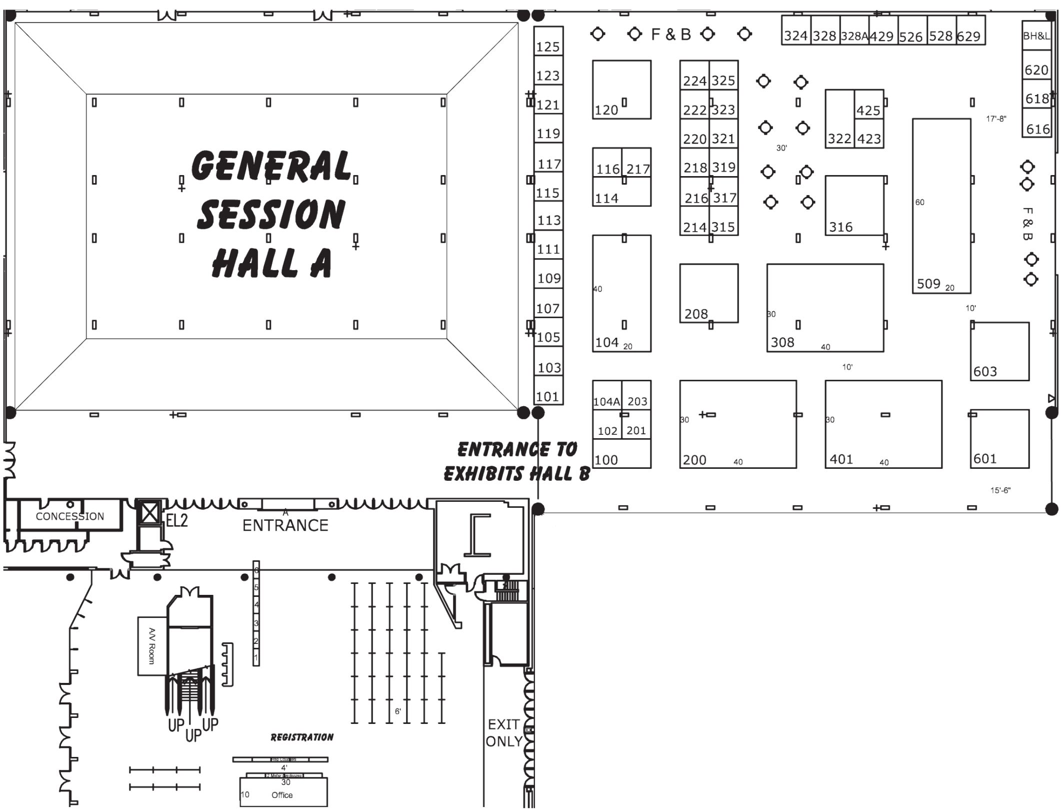
OTA GRATEFULLY ACKNOWLEDGES THE FOLLOWING EXHIBITORS FOR THEIR SUPPORT OF THE 26TH ANNUAL MEETING:

Booth #	Company Names	City, State
601	Acumed	Hillsboro, OR
123	Advanced Orthopaedic Solutions	Torrance, CA
100	AO North America	Paoli, PA
105	Aspen Medical Products	Irvine, CA
117	Baxter Healthcare Corporation	Deerfield, IL
528	Bio Access, Inc.	Baltimore, MD
425	Biocomposites, Inc.	Wilmington, NC
208	Biomet Trauma	Parsippany, NJ
315	Biomet	Warsaw, IN
328A	BioMimetic Therapeutics, Inc.	Franklin, TN
325	Bone Foam/Excel Medical Solutions, Inc.	Plymouth, MN
125	BrainLAB, Inc.	Westchester, IL
101	Contour Fabricators, Inc.	Fenton, MI
218	Delphi Healthcare Partners, Inc.	Morrisville, NC
509	DePuy Orthopaedics	Warsaw, IN
222	DeRoyal	Powell, TN
616	DGIMed Ortho Inc.	Minnetonka, MN
2	Elsevier (Saunders/Mosby)	Gaithersburg, MD
107	Exactech, Inc.	Gainesville, FL
119	Extra Ortho, Inc.	Memphis, TN
316	FX Devices	Boca Raton, FL
113	HRA Research	Parsippany, NJ
120	I.T.S. USA	Oviedo, FL
620	Innomed Inc.	Savannah, GA
220	Kinetic Concepts, Inc. (KCI)	San Antonio, TX
3	Lippincott Williams & Wilkins - A Wolters Kluwer Company	Philadelphia, PA
116	Medartis	Kennett Square, PA
104	Medtronic Spinal and Biologics	Memphis, TN
114	Mizuho, OSI	Union City, CA
103	Mylad Orthopedics Solutions	Mc Lean, VA
322	Orthofix Italy	Bussolengo, Italy
121	Orthohelix Surgical Designs Inc	Akron, OH
104A	Orthopedic Designs North America, Inc.	Tampa, FL
115	OsteoMed	Addison, TX
201	Osteotech, Inc.	Eatontown, NJ
214	PFS Med, Inc	Eugene, OR
224	Quintus Composites	Camp Verde, AZ
321	RTI Biologics, Inc.	Alachua, FL
319	Salient Surgical Technologies, Inc.	Portsmouth, NH
317	Sawbones/Pacific Research Labs	Vashon, WA
423	Shukla Medical	Piscataway, NJ

EXHIBITORS LISTING, continued

Booth #	Company Names	City, State
102	Skeletal Dynamics	Miami, FL
6	SLACK, Inc.	Thorofare, NJ
200	Smith and Nephew Orthopaedics	Memphis, TN
526	Sonoma Orthopedic Products, Inc.	Santa Rosa, CA
217	Starr Frame LLC	Richardson, TX
401	Stryker	Mahwah, NJ
603	Synthes USA	West Chester, PA
1	Thieme Medical Publishers	New York, NY
109	Toby Orthopaedics LLC	Coral Gables, FL
324	Tornier	Minneapolis, MN
323	Tri-Medics-Intell-Ortho	Lincoln, RI
328	Trimed Inc	Santa Clarita, CA
429	Twin Star Medical, Inc.	Minneapolis, MN
111	UCSF/SFGH Orthopaedics Trauma Institute	San Francisco, CA
216	Z-Medica Corporation	Wallingford, CT
308	Zimmer	Warsaw, IN

Orthopaedic Trauma Association
October 14 - 16, 2010
Baltimore Convention Center - Baltimore, MD
Hall B



2010 BASIC SCIENCE FOCUS FORUM
WEDNESDAY, OCTOBER 13, 2010

6:30 AM	Registration
7:25 AM	**Introduction:** *Theodore Miclau, III, MD, Program Chair* *(Hilton Baltimore Hotel, Holiday Ballroom 6-Level 2)*
7:30 – 8:50 AM (Notes p. 105)	**SYMPOSIUM I: BIOMECHANICS: CHOOSING THE RIGHT MODEL** Moderators: *Steven A. Olson, MD* *Loren L. Latta, MD, PhD*
7:30 AM	**Introduction** *Steven A. Olson, MD*
7:35 AM	**Choosing the Right Specimen** *Steven A. Olson, MD*
7:45 AM	**Plate Fixation – A Clinician's Perspective** *Philip J. Kregor, MD*
8:00 AM	**Plate Fixation – An Engineer's Perspective** *Michael Bushelow, MS*
8:10 AM	**IM Nail Fixation – A Clinician's Perspective** *Thomas (Toney) A. Russell, MD*
8:20 AM	**IM Nail Fixation – An Engineer's Perspective** *Loren L. Latta, MD, PhD*
8:30 AM	Discussion *Symposium Panel*
8:50 – 10:12 AM	**PAPER SESSION I: BIOMECHANICS** Moderators: *Steven A. Olson, MD* *Loren L. Latta, MD, PhD*
8:50 AM	**Overview:** *Steven A. Olson, MD*

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

See pages 75 - 103 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 413.

9:00 AM (p. 106) Paper #1

Can We Trust Ex Vivo Mechanical Testing of Fresh Frozen Cadaveric Specimens? The Effect of Post-Freezing Delays

*Paul Tornetta, III, MD[1]; **Jacob L. Cartner, PhD**[2]; Zane Hartsell, PhD[2]; William M. Ricci, MD[2];*
[1]Boston University Medical Center, Boston, Massachusetts, USA;
[2]Smith and Nephew, Inc, Memphis, Tennessee, USA

9:06 AM (p. 107) Paper #2

A Biomechanical Comparison of Standard Screw and Hybrid Fixation of Unstable Humeral Shaft Fractures

***Robert F. Ostrum, MD**[1]; Jason Nydick, DO[2]; Matthew Boardman, DO[2];*
[1]Cooper University Hospital, Camden, New Jersey, USA;
[2]Philadelphia College of Osteopathic Medicine, Philadelphia, Pennsylvania, USA

9:12 AM (p. 109) Paper #3

Biomechanics of Distal Radioulnar Repair: Ligament Reconstruction versus Capsulorraphy

*Christopher Dy, MD[1]; Elizabeth Anne Ouellette, MD[2]; Anna-Lena Makowski[2]; Dena Mohnani[3]; Ali Malik [4]; Edward L. Milne, BS[5]; **Loren L. Latta, MD, PhD**[4,5];*
[1]Hospital for Special Surgery, New York, New York, USA;
[2]Miami International Hand Surgery Service, North Miami Beach, Florida, USA;
[3]University of Florida, School of Medicine, Gainesville, Florida, USA;
[4]University of Miami, Department of Orthopaedics, Miami Beach, Florida, USA;
[5]Max Biedermann Institute for Biomechanics, Miami Beach, Florida, USA

9:18 AM Discussion

9:24 AM (p. 111) Paper #4

Δ Biomechanical Evaluation of Transsacral, Transalar, and Iliosacral Screw Fixation for Comminuted Transforaminal Sacral Fractures

***Brett D. Crist, MD**; Ferris Pfeiffer, PhD; Michael Khazzam, MD; Yvonne M. Murtha, MD; Gregory J. Della Rocca, MD, PhD, FACS; William Carson, PhD;*
University of Missouri, Columbia, Missouri, USA

9:30 AM (p. 113) Paper #5

Quantifying the Load Sharing Capabilities of Distal Femur Plating through Strain Analyses in Healthy and Osteoporotic Bone in Different Fracture Types

*Jacob L. Cartner, PhD; Zane Hartsell, BS; **Bob Jones, III, BS**; William M. Ricci, MD;*
Smith & Nephew, Memphis, Tennessee, USA

9:36 AM (p. 114) Paper #6

Does Screw Orientation Influence Construct Stiffness in Vertical Shear Fractures of the Medial Malleolus?

*Safdar N. Khan, MD; **Derek Amanatullah, MD**; Shane Curtiss, AS; Philip R. Wolinsky, MD;*
University of California at Davis Medical Center, Sacramento, California, USA

9:42 AM Discussion

Δ OTA Grant
See pages 75 - 103 for financial disclosure information.

9:48 AM (p. 115) Paper #7 — **The Mechanical Effect of Targeted Blocking Screws in Distal Femur Fractures**
Sagar J. Desai, MD; *David W. Sanders, MD; Louis Ferreira, MD; Josh Giles, BESc; James Johnson, PhD;*
University of Western Ontario, London, Ontario, Canada

9:54 AM (p. 116) Paper #8 — **•Does Insertion Torque Affect the Mechanics of Locking Hole Inserts and Fatigue Performance of Bridge Plate Constructs?**
Jacob L. Cartner, PhD[1]; Adam Messina, BS[1]; Charlie Baker[1]; Thomas (Toney) A. Russell, MD[2]; **Paul Tornetta III, MD[3]**; *William M. Ricci, MD[1];*
[1]Smith & Nephew, Memphis, Tennessee, USA;
[2]Regional Medical Center, Memphis, Tennessee, USA;
[3]Boston University Medical School, Boston, Massachusetts, USA

10:00 AM (p. 117) Paper #9 — **Biomechanical Investigation of Plate Working Length on Fatigue Characteristics of Locking Plate Constructs in Cadaveric Distal Metaphyseal Femoral Fracture Models**
William M. Ricci, MD[1]; *Paul Tornetta, III, MD[2]; Yanming Zheng, PhD[1]; Ramona Soileau[1]; Jacob L. Cartner, PhD[1];*
[1]Smith and Nephew, Inc., Memphis, Tenneessee, USA;
[2]Boston University Medical School, Boston, Massachusetts, USA

10:06 AM — Discussion

10:12 AM — **Break**

10:30 – 11:40 AM (Notes p. 119)

SYMPOSIUM II: BONE DEFECT REPAIR

Moderators: *Emil H. Schemitsch, MD*
Thomas A. Einhorn, MD

10:30 AM — **Selecting the Right Autograft**
Aaron Nauth, MD

10:40 AM — **Induced Membranes (Masquelet Technique): What Is the Evidence?**
Hans-Christoph Pape, MD

10:50 AM — **Subchondral Defects: What Is the Best Bone Void Filler?**
William G. DeLong, Jr., MD

11:00 AM — **The Use of Osteobiologics in Bone Defects**
J. Tracy Watson, MD

11:10 AM — **Large Diaphyseal Defects: What Is the Best Treatment?**
Michael D. McKee, MD

11:20 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 413.

11:40 AM – 12:38 PM	**PAPER SESSION II: BONE DEFECT REPAIR** Moderators: *Emil H. Schemitsch, MD* *Thomas A. Einhorn, MD*
11:40 AM	**Overview:** *Thomas A. Einhorn, MD*
11:50 AM (p. 120) Paper #10	**Δ Endothelial Progenitor Cells for Healing of Segmental Bone Defects** *Ru Li, PhD[1]; Kivanc Atesok, MD[1]; Aaron Nauth, MD[1]; **Erion Qamirani, MD**[1]; David Wright, BS[2]; Cari M. Whyne, PhD[2]; Emil H. Schemitsch, MD[1]* *[1]St Michael's Hospital, University of Toronto, Toronto, Ontario, Canada;* *[2]University of Toronto, Toronto, Ontario, Canada*
11:56 AM (p. 121) Paper #11	**Increasing Vascularity to Improve Healing of a Segmental Defect of the Rat Femur** ***Rena L. Stewart, MD[1]***; *Jessica B. Goldstein, RN[1]; Eddie L. Hyatt, BS[1]; T. Gabriel Chu, PhD[2]; Shawn R. Gilbert, MD[1];* *[1]University of Alabama at Birmingham, Birmingham, Alabama, USA;* *[2]Indiana University, Indianapolis, Indiana, USA*
12:02 PM (p. 123) Paper #12	**Δ Endothelial Progenitor Cells for Healing and Angiogenesis in a Segmental Bone Defect Model: A Comparison with Mesenchymal Stem Cells** ***Aaron Nauth, MD***; *Ru Li, MD; Emil H. Schemitsch, MD;* *St. Michael's Hospital, Toronto, Ontario, Canada*
12:08 PM	Discussion
12:14 PM (p. 125) Paper #13	**Decreasing Complications in Open Fractures with a Novel Bone Graft** ***Kate V. Brown, MD***[1]; *Bing Li, PhD[2]; Teja Guda, PhD[1]; Daniel Perrien, PhD[2]; Scott Guelcher, PhD[2]; Josh C. Wenke, PhD[1];* *[1]United States Army Institute of Surgical Research, San Antonio, Texas, USA;* *[2]Vanderbilt University Medical Center, Nashville, Tennessee, USA*
12:20 PM (p. 126) Paper #14	**Xenograft Bone Inclusion Improves Incorporation of Hydroxyapatite Cement into Cancellous Defects** ***Michael J. Voor, PhD***; *Eric M. Yoder, BS; Robert L. Burden, Jr., MEng;* *University of Louisville, Orthopaedic Bioengineering Laboratory, Louisville, Kentucky, USA*
12:26 PM (p. 128) Paper #15	**Evaluation of Histological and Mechanical Properties of Plexur M. Bone/Polymer Biocomposite in a Rabbit Defect Model** *Christophe Nich, MD[1]; Bertrand David, PhD[2]; Karim Oudina, BS[1]; Valentin Myrtil, BS[1]; Herve Petite, PhD[1];* ***Moussa Hamadouche, MD[3]***; *[1]Orthopaedic Research Laboratory, Paris, France;* *[2]Ecole Central, Paris, France;* *[3]Department of Orthopaedics, Hopital Cochin, Paris, France*
12:32 PM	Discussion
12:38 – 1:45 PM	**Lunch** *(Hilton Baltimore Hotel, Holiday Ballroom 4-5, Level 2)*

Δ OTA Grant

See pages 75 - 103 for financial disclosure information.

1:45 – 3:05 PM (Notes p. 129)

SYMPOSIUM III: CHOOSING A PRE-CLINICAL MODEL IN ORTHOPAEDIC TRAUMA

Moderators: *Edward J. Harvey, MD*
R. Geoff Richards, PhD

1:45 PM **Osteoporotic Fractures**
Peter V. Giannoudis, MD

2:00 PM **Bone Defects**
Jennifer Lansdowne, AVCS

2:15 PM **Articular Injury**
Paul A. Martineau, MD

2:30 PM **Osteomyelitis**
R. Geoff Richards, PhD

2:45 PM Discussion

3:05 – 4:03 PM

PAPER SESSION III: PRE-CLINICAL ANIMAL MODELS

Moderators: *Edward J. Harvey, MD*
Peter V. Giannoudis, MD

3:05 PM **Overview:** *Edward J. Harvey, MD*

3:15 PM (p. 130) Paper #16
Mesenchymal Stem Cell Transplantation to Promote Fixation of Orthopaedic Hardware
Chan Gao, MD[1,2]*; Ailian Li, BMed*[1]*; Huifen Wang, BMed*[1]*; Alison Butler, BSc*[1,3]*; Geetanjali Nayak, MSc*[2]*; Bilal Elcharaani, BSc*[2]*; Jan Seuntjens, PhD*[4]*; Edward J. Harvey, MD, MSc*[1,5]*; Janet E. Henderson, PhD*[1,2,5]*;*
[1]*JTN Wong Laboratories for Bone Engineering, Research Institute, McGill University Health Centre, Montreal, Quebec, Canada;*
[2]*Department of Medicine, McGill University, Montreal, Quebec, Canada;*
[3]*Department of Microbiology and Immunology, University of British Columbia, Vancouver, British Columbia, Canada;*
[4]*Department of Oncology, McGill University, Montreal, Quebec, Canada;*
[5]*Department of Surgery, McGill University, Montreal, Quebec, Canada*

3:21 PM (p. 132) Paper #17
Mechanical Stability Affects Angiogenesis during Fracture Healing
Chuanyong Lu, MD*; Xiaodong Wang, PhD; Zhiqing Xing, MD; Ralph Marcucio, PhD; Theodore Miclau, III, MD;*
University of California at San Francisco, Department of Orthopaedic Surgery, 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 413.

3:27 PM (p. 134) Paper #18	**Murine Model of Oligotrophic Tibial Nonunion** ***Calvin T. Hu, MD***; *Sarah C. Offley, MD; Catherine A. Humphrey, MD; Regis J. O'Keefe, MD;* *Department of Orthopaedics, University of Rochester School of Medicine, Rochester, New York, USA*
3:33 PM	Discussion
3:39 PM (p. 135) Paper #19	**Δ Heterotopic Ossification following Extremity Blast Amputation: An Animal Model in the Sprague-Dawley Rat** ***Oliver O. Tannous, MD[1]***; *Cullen K. Griffith, MD[1]; Robert V. O'Toole, MD[2]; Vincent D. Pellegrini, Jr., MD[1];* *[1]University of Maryland School of Medicine, Baltimore, Maryland, USA;* *[2]University of Maryland School of Medicine, R Adams Cowley Shock Trauma Center, Baltimore, Maryland, USA*
3:45 PM (p. 136) Paper #20	**Androstendiol Exerts Protective Effects in a Murine Two-Hit Model** ***Christian Zeckey, MD***; *Philipp Mommsen, MD; Michael Frink, MD; Ulf Brunnemer, MD; Christian Krettek, MD; Tanja Barkhausen, MD; Frank Hildebrand, MD;* *Trauma Department, Hannover Medical School, Hannover, Germany*
3:51 PM (p. 137) Paper #21	**Effects of Binge Alcohol Consumption and Anti-Oxidant Therapy on Healing of Femur Fractures in a Rat Model** ***Dustin Volkmer, MD***; *Benjamin Sears, MD; Ryan Himes, BS; Kristen Lauing, BS; Michael Stover, MD; Sherri Yong, MD; John Callaci, PhD;* *Loyola University Medical Center, Maywood, Illinois, USA*
3:57 PM	Discussion
4:03 PM	Adjourn Evening on your own

Basic Science Focus Forum resumes tomorrow:
7:00 am – Continental Breakfast
(Hilton Baltimore Hotel, Holiday Ballroom 6)

7:25 am – Forum Reconvenes

Δ OTA Grant
See pages 75 - 103 for financial disclosure information.

2010 BASIC SCIENCE FOCUS FORUM
THURSDAY, OCTOBER 14, 2010

6:30 AM — Registration

7:25 AM — **Introduction:**
Theodore Miclau, III, MD, Program Chair

7:30 – 8:50 AM (Notes p. 138)

SYMPOSIUM IV: ADVANCES IN IMAGING: ARTICULAR CARTILAGE

Moderators: *Joseph Borrelli, Jr., MD*
Todd O. McKinley, MD

7:30 AM — **Can Non-Destructive MRI Provide a Measurement of Cartilage Function? The Role of Delayed Gadolinium-Enhanced MRI of Cartilage (dGEMRIC)**
Deborah Burstein, PhD

7:45 AM — **T2 and Ultra-Short T2 Weighted Imaging: Research and Clinical Applications**
Constance R. Chu, MD

8:00 AM — **Imaging of the Acutely Injured Joint: What Do the Findings Mean?**
Hollis G. Potter, MD

8:15 AM — **Limiting Metallic Implant Artifacts**
Laura Fayad, MD

8:30 AM — Discussion

8:50 – 9:19 AM

PAPER SESSION IV: IMAGING

Moderators: *Joseph Borrelli, Jr., MD*
Todd O. McKinley, MD

8:50 AM — **Overview:** *Todd O. McKinley, MD*

8:55 AM (p. 139) Paper #22 — **Quantitative Micro-CT Compared to Biomechanics in a Mouse Fracture Model**
Kevin R. O'Neill, MD; *Christopher Stutz, MD; Nicholas A. Mignemi, BS; Jeffry S. Nyman, PhD; Jonathan Schoenecker, MD; William T. Obremskey, MD; Vanderbilt University Medical Center, Nashville, Tennessee, USA*

9:01 AM (p. 141) Paper #23 — **Use of Two 3-Dimensional Fluoroscopic Systems for the Assessment of Articular Reduction: A Cadaveric Study**
Yoram A. Weil, MD[1]; *Meir Liebergall, MD[1]; Rami Mosheiff, MD[1]; Syndie Singer, MD[2]; Amal Khoury, MD[1];*
[1]Hadassah Hebrew University Medical Center, Jerusalem, Israel;
[2]University of Toronto, Toronto, Ontario, Canada

- 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 413.

9:07 AM (p. 143) Paper #24
Comparative Biomechanical and MicroCT Analysis of Osseointegration: Biodegradable Magnesium Alloy versus Titanium Control
Richard A. Lindtner, MD[1,2]*; Christoph Castellani, MD*[2]*; Elmar Tschegg, PhD*[3]*; Annelie-Martina Weinberg, MD*[2]*;*
[1]*Department of Trauma Surgery and Sports Medicine, Innsbruck Medical University, Innsbruck, Austria;*
[2]*Department of Pediatric Surgery, Medical University of Graz, Graz, Austria;*
[3]*Institute of Solid State Physics, Vienna University of Technology, Vienna, Austria*

9:13 AM Discussion

9:19 AM Break

9:30 – 10:50 AM — SYMPOSIUM V: FUNDING ORTHOPAEDIC TRAUMA RESEARCH

(Notes p. 144)
Moderators: *Theodore Miclau, III, MD*
Michael J. Bosse, MD

9:30 AM **Update from the National Institute of Arthritis and Musculoskeletal and Skin Diseases/National Institutes of Health**
James S. Panagis, MD, MPH

9:50 AM **Opportunities through the Department of Defense: Basic Research**
Joseph C. Wenke, PhD

10:05 AM **Opportunities through the Department of Defense: Clinical Research**
James R. Ficke, COL, MD

10:20 AM **Other Funding Opportunities: Getting Started**
Theodore Miclau, III, MD

10:30 AM Discussion

10:50 AM – 12:10 PM — SYMPOSIUM VI: BRINGING PRODUCTS TO MARKET

(Notes p. 145)
Moderators: *Emil H. Schemitsch, MD*
Barbara D. Buch, MD

10:50 AM **Re-thinking the 510K Mechanism for Devices: What Does the Future Hold?**
Barbara D. Buch, MD

11:05 AM **Getting Fracture Healing Biologics Approved: What Are the New Standards for Industry?**
Ricardo Dent, MD

11:20 AM **Surgeon-Industry Collaborations in Implant Design: Are the Roadblocks Worth the Hassle?**
Thomas (Toney) A. Russell, MD

See pages 75 - 103 for financial disclosure information.

11:35 AM **Designing the Right Fracture Healing: If We Only Knew?**
Thomas A. Einhorn, MD

11:50 AM Discussion

12:10 PM **Basic Science Focus Forum Adjourns**

Lunch (on your own)

26th ANNUAL MEETING BEGINS at 1:00 pm
(*Baltimore Convention Center, Hall A)*

A special thank you from the Members of the OTA,
the OTA Board of Directors, and the Pre-Meeting Faculty
to the generous contributors listed below
for supporting the October 13 - 14, 2010 pre-meeting events:

BASIC SCIENCE FOCUS FORUM
Theodore Miclau, III, MD, Forum Director

INTERNATIONAL ORTHOPAEDIC TRAUMA CARE FORUM
William G. DeLong, Jr., MD,
Andrew H. Schmidt, MD *and* ***Wade R. Smith, MD***, Co-Chairs

YOUNG PRACTITIONERS FORUM
Lisa K. Cannada, MD, Chair

DePuy
a Johnson & Johnson company

smith&nephew

stryker®

SYNTHES®

zimmer

2010 OTA ANNUAL MEETING
THURSDAY, OCTOBER 14, 2010

6:30 AM	**Registration** (*Baltimore Convention Center, Charles Street Lobby)*
1:00 PM	**WELCOME** (*Baltimore Convention Center, Hall A)* Timothy J. Bray, MD – *President* William M. Ricci, MD – *Program Chair* James A. Goulet, MD – *Program Co-Chair* Andrew N. Pollak, MD – *Local Host*
1:10 PM – 1:20 PM	**RESEARCH AWARD PRESENTATIONS** Edward J. Harvey, MD, *OTA Research Committee Chair*

1:20 – 2:45 PM SYMPOSIUM I: CONTROVERSIES IN EVERYDAY ORTHOPAEDIC CARE

(Notes p. 149) **Moderator:** *Paul Tornetta, III, MD* (*Baltimore Convention Center, Hall A)*
Faculty: *Michael D. McKee, MD*
Robert F. Ostrum, MD
Robert A. Probe, MD

1:20 pm	**Distal Radius Fractures: Cast, Ex Fix or Plate?** *Michael D. McKee, MD*
1:35 pm	**Intertrochanteric Hip Fractures: Nail or Plate?** *Robert A. Probe, MD*
1:50 pm	**Discussion/Questions** *Faculty*
2:00 pm	**Proximal Tibia Fractures: Nail or Plate?** *Robert F. Ostrum, MD*
2:15 pm	**Syndesmotic Fixation: When and How?** *Paul Tornetta, III, MD*
2:30 pm	**Discussion**

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

See pages 75 - 103 for financial disclosure information.

SESSION I
UPPER EXTREMITY

2:45 – 3:42 PM Moderators - William T. Obremskey, MD & Margaret M. McQueen, MD

2:45 PM
(p. 150)
Paper #25

What Is the Outcome of a Protocol of Non-Operative Treatment of All Displaced Scapula Fractures?

Brent J. Bauer, MD; *Robert V. O'Toole, MD; Andrew N. Pollak, MD; Mary Zadnik Newell, OT; W. Andrew Eglseder, MD;*
R Adams Cowley Shock Trauma, Department of Orthopaedics, University of Maryland Medical School, Baltimore, Maryland, USA

2:51 PM
(p. 151)
Paper #26

Surgical and Functional Outcomes after Operative Management of Extra-Articular Glenoid Neck and Scapula Body Fractures

Erich M. Gauger, MD; *Peter A. Cole, MD;*
Division of Orthopaedic Trauma, Department of Orthopaedic Surgery, University of Minnesota, Regions Hospital, St. Paul, Minnesota, USA

2:57 PM Discussion

3:02 PM
(p. 152)
Paper #27

Electrophysiological Assessment after Minimally Invasive Fracture Treatment of the Proximal Humerus Using a Minimal Anterolateral Acromial Approach

Götz Röderer, MD[1]; *Philipp Hansen[2]; Anne-Dorte Sperfeld, MD[2]; Lothar Kinzl; Florian Gebhard, MD[1]; Jan Kassubek, MD[2];*
[1]University of Ulm, Orthopaedic Trauma, Ulm, Germany;
[2]University of Ulm, Neurology, Ulm, Germany

3:08 PM
(p. 153)
Paper #28

Fracture-Site Augmentation with Calcium Phosphate Cement Prevents Screw Penetration following Open Reduction and Internal Fixation (ORIF) of Proximal Humerus Fractures

Kenneth A. Egol, MD; ***Michelle Sugi, BS***; *Crispin Ong, MD; Roy I. Davidovitch, MD; Joseph D. Zuckerman, MD;*
NYU Hospital for Joint Diseases, New York, New York, USA

3:14 PM Discussion

3:19 PM
(p. 154)
Paper #29

Results of 70 Consecutive Ulnar Nightstick Fractures

Marlon O. Coulibaly, MD[1]; ***Clifford B. Jones, MD[2]***; *Debra L. Sietsema, PhD[2]; James R. Ringler, MD[2]; Terrence J. Endres, MD[2];*
[1]Grand Rapids Medical Education and Research Center, Grand Rapids, Michigan, USA;
[2]Orthopaedic Associates of Michigan, Michigan State University, Grand Rapids, Michigan, 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 413.

3:25 PM (p. 155) Paper #30	**Hand Stiffness following Distal Radius Fractures: Who Gets It and Is It a Functional Problem?** *Steve K. Lee, MD[1]; Nader Paksima, DO[1]; Nikola Lekic, BA[2]; Allissa Zingman, BA[3]; Michael Walsh, PhD[4];* ***Kenneth A. Egol, MD[1]****;* *[1]NYU Hospital for Joint Diseases, New York, New York, USA;* *[2]Georgetown University, Washington, District of Columbia, USA;* *[3]University of Maryland, College Park, Maryland, USA;* *[4]SUNY Downstate, Brooklyn, New York, USA*
3:31 PM (p. 156) Paper #31	**Corrective Osteotomy for Malunited Fractures of the Distal Radius: Do We Need to Use Bone Graft?** ***Kagan Ozer, MD****; Ayhan Kilic, MD; Kyros Ipaktchi, MD;* *University of Colorado, Denver Health Medical Center, Department of Orthopaedics, Denver, Colorado, USA*
3:37 PM	Discussion
3:42 PM	Break Visit Scientific Posters *(Baltimore Convention Center, Charles Street Lobby)* & Technical Exhibits *(Baltimore Convention Center, Hall B)*

See pages 75 - 103 for financial disclosure information.

SESSION II
BASIC SCIENCE

4:05 – 5:00 PM **Moderators - Theodore Miclau, III, MD & Victor A. de Ridder, MD**

4:05 PM
(p. 158)
Paper #32

Immediate Weight Bearing after Fixation of Humeral Shaft Fractures with Small-Fragment Hybrid Plating: A Clinical and Biomechanical Study

***Lisa K. Cannada, MD*[1]**; *J. Tracy Watson, MD[1]; Courtney B. Farnhorst, BA[2]; Sean Owen, MD[1]; James Bucheit, MS[2]; J. Gary Bledsoe, PhD[2];*
[1]St. Louis University Hospital, St. Louis, Missouri, USA;
[2]St. Louis University Medical School, St. Louis, Missouri, USA

4:11 PM
(p. 160)
Paper #33

Biomechanical Test Load Discrepancies in the Medical Literature

***Jacob L. Cartner, PhD*[1]**; *Andy Whitten[1]; Michael Day, BS[2]; William M. Ricci, MD[1];*
[1]Smith & Nephew, Memphis, Tennessee, USA;
[2]University of Tennessee, Knoxville, Tennessee, USA

4:17 PM
(p. 161)
Paper #34

A Comparison between the Use of Unicortical versus Bicortical Medial Malleolar Fixation with Lag Screws

Robert O. Crous, MD; *Matthew P. Willis, MD; Timothy B. Ervin, BS; Peter J. Nowotarski, MD;*
University of Tennessee, College of Medicine Chattanooga, Dept. of Orthopaedic Surgery, Chattanooga, Tennessee, USA

4:23 PM Discussion

4:28 PM
(p. 162)
Paper #35

The Effect of Pulsed Electromagnetic Field (PEMF) upon Diabetic Fracture Healing

Elan Goldwaser, BS; Ravi Verma, MD; David Paglia, PhD; ***Eric A. Breitbart, MD***; *Sharonda Meade, PhD; Siddhant Mehta, MD; Christopher Ojeda, BS; Anne Marie Simon, PhD; Ankur Gandhi, PhD; Sheldon S. Lin, MD;*
UMDNJ: New Jersey Medical School, Newark, New Jersey, USA

4:34 PM
(p. 163)
Paper #36

•Unfocused Extracorporeal Shock Waves Induce Anabolic Responses in Osteoporotic Bone

***Olav P. van der Jagt, MD*[1]**; *J.H. Waarsing, PhD[1]; Nicole Kops, BS[1]; Wolfgang Schaden, MD[2]; Victor A. De Ridder, MD[3]; Jan Verhaar, MD[1]; Harrie Weinans, PhD[1];*
[1]Erasmus MC, Rotterdam, The Netherlands;
[2]Traumacenter Meidling, Vienna, Austria;
[3]Sint Franciscus Hospital, Rotterdam, The Netherlands

• 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 413.

4:40 PM (p. 165) Paper #37	**Comparison of Osteogenic Potential of Different Bone Morphogenetic Proteins** ***Jessica D. Cross, MD[1,2]***; *Christopher R. Rathbone, PhD[2]; Joseph C. Wenke, PhD[2];* *[1]United State Army Institute of Surgical Research and Brooke Army Medical Center, San Antonio, Texas, USA;* *[2]United States Army Institute of Surgical Research, Fort Sam Houston, Texas, USA*
4:46 PM (p. 166) Paper #38	**Altered Bone Quality in Bisphosphonate-Related Femoral Fractures of Postmenopausal Women** ***Brian J. Rebolledo, BA[1]***; *Eve Donnelly, PhD[2]; Dean G. Lorich, MD[2]; Brian P. Gladnick, BA[1]; Aasis Unnanuntana, MD[2]; Adele L. Boskey, PhD[2]; Joseph M. Lane, MD[2];* *[1]Weill Cornell Medical College, New York, New York, USA;* *[2]Hospital for Special Surgery, New York, New York, USA*
4:52 PM	Discussion
5:00 – 6:00 PM	**Member Business Meeting for Members Only**
6:30 – 8:30 PM	**Welcome Reception** *Join the OTA for cocktails and a generous assortment of hors d'oeuvres at Oriole Park at Camden Yards.*

See pages 75 - 103 for financial disclosure information.

2010 OTA ANNUAL MEETING
FRIDAY, OCTOBER 15, 2010

6:30 AM	**Attendee Registration** (*Baltimore Convention Center, Charles Street Lobby)*
	Scientific Posters *(Baltimore Convention Center, Charles Street Lobby)*
	Speaker Ready Room *(Baltimore Convention Center, Charles Street Lobby)*
6:45 - 7:45 AM (Notes p. 168)	**Case Presentations–*Tickets Required*** **Continental Breakfast** *(6:15—Available at Case Discussion Rooms)*

6:45 – 7:45 AM **CASE PRESENTATIONS**

Proximal Humerus Fractures *(#F-1)* *(Convention Center 307)*
Moderator: *Michael J. Gardner, MD*
Faculty: *Clifford B. Jones, MD* and *Samir Mehta, MD*

Nonunions and Malunions *(#F-2)* *(Convention Center 302/303)*
Moderator: *Stuart M. Gold, MD*
Faculty: *Mark C. Reilly, MD; William M. Ricci, MD* and *J. Tracy Watson, MD*

The Not-So-Straightforward Ankle Fracture *(#F-3)* *(Convention Center 308)*
Moderator: *Justin K. Greisberg, MD*
Faculty: *Stephen K. Benirschke, MD; Kenneth A. Egol, MD* and *David W. Sanders, MD*

Nailing Difficult Femur and Tibia Fractures *(#F-4)* *(Convention Center 309)*
Moderator: *Robert F. Ostrum, MD*
Faculty: *Dolfi Herscovici, Jr., DO; Wade R. Smith, MD* and *Paul Tornetta, III, MD*

Fractures About the Knee *(#F-5)* *(Convention Center 310)*
Moderator: *David P. Barei, MD*
Faculty: *Matt L. Graves, MD* and *Thomas F. Higgins, 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 413.

SYMPOSIUM II: DISASTER PREPAREDNESS: WHAT WE LEARNED FROM HAITI

8:00 – 9:30 AM

(Notes p. 169) **Moderator:** *Christopher T. Born, MD* (*Convention Center Hall A)*

Faculty: *Andrew N. Pollak, MD*
Mark P. McAndrew, MD
William G. DeLong, Jr., MD
Michael J. Bosse, MD
Capt. Daniel V. Unger, MD

Introduction / Goals and Objectives
Christopher T. Born, MD
(Co-Chair, AAOS/OTA Haiti Relief: Disaster Preparedness Project Team)

8:00 am **Personal Safety and Medical Ethics in the Disaster Response Setting**
Andrew N. Pollak, MD

8:15 am **Orthopaedic Care in the Austere, Mass Casualty Medical Environment**
Mark P. McAndrew, MD

8:30 am **Humanitarian Response: Future Directions for the Academy and the OTA**
William G. DeLong, Jr., MD
(Co-Chair, AAOS/OTA Haiti Relief: Disaster Preparedness Project Team)

8:40 am **Question/Answer Session**
Faculty

8:50 am **Civilian/Military Collaboration: Expanded Disaster Surge Capacity**
Michael J. Bosse, MD

9:05 am **OTA Surgeons on the Comfort: What Worked and What Did Not**
Capt. Daniel V. Unger, MD (Orthopaedic Specialty Advisor to the US Navy, Chief of Orthopaedic Surgery on the Comfort for the Haiti deployment)

9:20 am **Question/Answer Session**
Faculty

9:30 AM Break
Visit Scientific Posters
(Baltimore Convention Center, Charles Street Lobby)
& Technical Exhibits
(Baltimore Convention Center, Hall B)

See pages 75 - 103 for financial disclosure information.

SESSION III
GERIATRICS

10:00 – 11:14 am **Moderators - Michael J. Gardner, MD & Kenneth A. Egol, MD**

10:00 AM
(p. 170)
Paper #39

Radiographic Evaluation of Intertrochanteric Hip Fractures Treated With or Without Distal Interlocking in a Cephalomedullary Construct

George Karl Van Osten, III, MD[1]; *Mark A. Lee, MD[2];*
[1]North Mississippi Medical Center, Tupelo, Mississippi, USA
[2]University of California, Davis, Sacramento, California, USA

10:06 AM
(p. 171)
Paper #40

Risk of Complications following Treatment of Intertrochanteric Hip Fractures with Intramedullary Nails and Plate Fixation in the Medicare Population

Arthur L. Malkani, MD[1]; Colin Carroll[1]; ***Craig S. Roberts, MD, MBA[1]****; David Seligson, MD[1]; Edmund Lau, PhD[2]; Steven Kurtz, PhD[2]; Kevin Ong, PhD[2];*
[1]University of Louisville, Louisville, Kentucky, USA;
[2]Exponent Inc, Philadelphia, Pennsylvania, USA

10:12 AM
(p. 172)
Paper #41

The Orthopaedic Traumatologist and the Peritrochanteric Hip Fracture: Does Experience Matter?

Paul Tornetta, III, MD; ***T. William Axelrad, MD****; Alex Dehaan, MD; William R. Creevy, MD;*
Boston University Medical Center, Boston, Massachusetts, USA

10:18 AM Discussion

10:23 AM
(p. 174)
Paper #42

Bipolar Hemiarthroplasty Compared with Total Hip Arthroplasty in Patients with Displaced Femoral Neck Fractures: A Four-Year Follow-Up of a Randomized Controlled Trial

Carl Johan Hedbeck, MD[1]*; Anders Enocson, MD, PhD[1]; Gunilla Lapidus, MD[2]; Richard Blomfeldt, MD, PhD[1]; Hans Törnkvist, MD, PhD[1]; Sari Ponzer, PhD[1]; Jan Tidermark, MD, PhD[1];*
[1]Karolinska Institutet, Dept. of Clinical Science and Education, Sodersjukhuset, Stockholm, Sweden;
[2]Unilabs St. Goran Radiology, Capio St. Goran Hospital, Stockholm, Sweden

10:29 AM
(p. 175)
Paper #43

Functional Status, Morbidity and Mortality in Cemented versus Press-Fit Hemiarthroplasty for Displaced Femoral Neck Fractures: A Prospective Randomized Trial

Joseph P. DeAngelis, MD[1]*; Arben Ademi, BA[2]; Courtland G. Lewis, MD[2];*
[1]Beth Israel Deaconess Medical Center/Harvard Medical School - Orthopaedics, Boston, Massachusetts, USA;
[2]Hartford Hospital, University of Connecticut, Hartford, Connecticut, USA

10:35 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 413.

10:40 AM (p. 176) Paper #44	**Functional and Cardiac Outcomes Comparing Symptomatic versus 10 g/dL Transfusion Threshold: A Randomized Trial in over 2000 Patients with Hip Fracture** ***David W. Sanders, MD[1]***; *Jeffrey L. Carson, MD[2]; Michael L. Terrin, MD[3]; Jay L. Magaziner, MD[3]; Courtland G. Lewis, MD[1]; Lauren Beaupre, MD[4]; William McAuley, MD[5]; Kevin Hildebrand, MD[6]; FOCUS Investigators;* *[1]University of Western Ontario, London, Ontario, Canada;* *[2]UMDNJ: New Jersey Medical School, Newark, New Jersey, USA;* *[3]University of Maryland, College Park, Maryland, USA;* *[4]University of Alberta, Edmonton, Alberta, Canada;* *[5]Columbia University, Columbia, New York, USA;* *[6]University of Calgary, Calgary, Alberta, Canada*
10:46 AM (p. 178) Paper #45	**Operative Outcomes and Treatment Difficulties for Fractures of the Proximal Femur Associated with Bisphosphonate Therapy** ***Jaimo Ahn, MD[1]***; *Omesh Paul, MD[2]; Paul Matuszewski, MD[1]; Mark L. Prasarn, MD[3]; Andrew S. Neviaser, MD[2]; Timothy S. Achor, MD[4]; David L. Helfet, MD[2]; Joseph M. Lane, MD[2]; Dean G. Lorich, MD[2];* *[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA;* *[2]Hospital for Special Surgery, New York, New York, USA;* *[3]University of Rochester, Rochester, Minnesota, USA;* *[4]University of Texas, Houston, Houston, Texas, USA*
10:52 AM	Discussion
10:57 AM (p. 179) Paper #46	**Mortality after Distal Femur Fractures in Elderly Patients** ***Philipp N. Streubel, MD***; *William M. Ricci, MD; Ambrose Wong, BS; Michael J. Gardner, MD;* *Washington University School of Medicine, St. Louis, Missouri, USA*
11:03 AM (p. 180) Paper #47	**Changes in Hip Fracture Rates in British Columbia Canada, 1990-2004** ***Kelly A. Lefaivre, MD***; *Adrian R. Levy, PhD; Boris Sobolev, PhD; Stephanie Y. Cheng, BS; Lisa Kuramoto; Pierre Guy, MD;* *University of British Columbia, Department of Orthopaedic Surgery Vancouver, British Columbia, Canada*
11:09 AM	Discussion

See pages 75 - 103 for financial disclosure information.

SESSION IV
FOOT and ANKLE

11:14 AM – 12:05 PM **Moderators - Shepard R. Hurwitz, MD & Roy Sanders, MD**

11:14 AM (p. 182) Paper #48	**Operative versus Nonoperative Treatment of Unstable Lateral Malleolar Fractures: A Randomized, Multicenter Trial** ***David W. Sanders, MD***; *Christina A. Tieszer;* *Canadian Orthopedic Trauma Society;* *University of Western Ontario, London, Ontario, Canada*
11:20 AM (p. 183) Paper #49	**Treatment of the Stress-Positive Ligamentous SE4 Ankle Fracture: Incidence of Syndesmotic Injury and Clinical Decision Making** *Paul Tornetta, III, MD;* ***T. William Axelrad, MD***; *William R. Creevy, MD;* *Boston University Medical Center, Boston, Massachusetts, USA*
11:26 AM	Discussion
11:31 AM (p. 185) Paper #50	**Prospective Intraoperative Syndesmotic Evaluation during Treatment of Ankle Fractures: Stress External Rotation versus Lateral Fibular Stress** ***Derek G. Dombroski, MD***; *Paul E. Matuszewski, MD; J. Todd Lawrence, MD; John Esterhai, MD; Samir Mehta, MD* *University of Pennsylvania, Department of Orthopaedic Surgery, Philadelphia, Pennsylvania, USA*
11:37 AM (p. 186) Paper #51	**Staged Posterior Tibial Plating for the Treatment of OTA 43C2 & 43C3 Tibial Pilon Fractures** ***John Ketz, MD***; *Roy Sanders, MD;* *Florida Orthopaedic Institute, Tampa, Florida, USA*
11:43 AM	Discussion
11:48 AM (p. 187) Paper #52	**Intraoperative Stress Examination of the Lateral Midfoot for Lisfranc Injuries** ***Chris Steyn, MBChB, CCFP***; *David W. Sanders, MD, MSc, FRCSC;* *University of Western Ontario, London, Ontario, Canada*
11:54 AM (p. 188) Paper #53	**Summed Scores for Hindfoot and Ankle Trauma: What Do They Really Tell Us and How Many Do We Need?** ***Paul Tornetta, III, MD[1]***; *Rabah Qadir, MD[1]; Roy Sanders, MD[2];* *[1]Boston University Medical Center, Boston, Massachusetts, USA;* *[2]Tampa General Hospital, Tampa, Florida, USA*
12:00 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 413.

12:05 – 1:00 PM | **Lunch**
Visit Scientific Posters
(Baltimore Convention Center, Charles Street Lobby)
& Technical Exhibits
(Baltimore Convention Center, Hall B)

12:05 – 1:00 PM | ***Kathy Cramer, MD Memorial***
Women in Orthopaedic Trauma
Luncheon/Meeting
(Baltimore Convention Center,
Room 302/303 - Level 300)

Co-Chairs: *Jacqueline J. Krumrey, MD*
Laura S. Phieffer, MD

Pre-Registration is required.

1:00 –
2:30 PM
(Notes pgs. 190 - 191)

Concurrent Sessions
(Skills Labs and Mini Symposia run concurrently.)
Tickets Required

1:00 – 2:30 PM — **SKILLS LABS**

IM Nailing of Proximal Tibia Fractures with *(#F-6)* *(Convention Center 310)*
Semi-Extended Nailing Technique
Moderator: *Thomas (Toney) A. Russell, MD*
Faculty: *Massimo Max Morandi, MD; Gilbert R. Ortega, MD, MPH; H. Claude Sagi, MD; Paul Tornetta, III, MD; J. Tracy Watson, MD* and *David P. Zamorano, MD*

ORIF Distal Humerus Fractures *(#F-7)* *(Convention Center 318/319)*
Moderator: *Michael D. McKee, MD*
Faculty: *Paul Duffy, MD; Kyle J. Jeray, MD; Utku Kandemir, MD* and *David C. Ring, MD*

ORIF Calcaneus *(#F-8)* *(Convention Center 315)*
Moderator: *Roy Sanders, MD*
Faculty: *Daniel S. Chan, MD; Joshua Langford, MD; Frank A. Liporace, MD; Michael S. Sirkin, MD* and *Jeff Yach, MD*

See pages 75 - 103 for financial disclosure information.

1:00 – 2:30 PM	MINI SYMPOSIA

Management of Blast Injuries for Civilian Surgeons *(#F-9)* *(Convention Center 307)*
Moderator: *LTC Romney C. Andersen, MD*
Faculty: *MAJ Wade T. Gordon, MD; MAJ Joseph R. Hsu, MD; MAJ B. Kyle Potter, MD* and *CDR Timothy Whitman, MD*

Bone Graft Options *(#F-10)* *(Convention Center 308)*
Moderator: *Craig S. Roberts, MD, MBA*
Faculty: *William G. DeLong, Jr., MD; Peter V. Giannoudis, MD; Roman Hayda, COL(Ret), MD* and *Michael J. Voor, PhD*

Periprosthetic Fractures: Current Concepts *(#F-11)* *(Convention Center 309)*
Moderator: *Emil H. Schemitsch, MD*
Faculty: *Jeremy A. Hall, MD; Richard J. Jenkinson, MD; Hans J. Kreder, MD; Markku Nousiainen, MD* and *David J. Stephen, MD*

2:30 PM

Break
Visit Scientific Posters
(Baltimore Convention Center, Charles Street Lobby)
& Technical Exhibits
(Baltimore Convention Center, Hall B)

3:00 –
3:30 PM
(Notes p. 192)

PRESIDENT'S MESSAGE
(Convention Center Hall A)

Timothy J. Bray, MD

"The Community Orthopaedic Traumatologist"

• 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 413.

SESSION V
KNEE, TIBIA and PEDIATRICS

3:30 – 4:55 PM **Moderators - Pierre Guy, MD & Steven L. Frick, MD**

3:30 PM (p. 193) Paper #54

Sagittal Plane Deformity in Bicondylar Tibial Plateau Fractures
Philipp N. Streubel, MD[1]; *Donald Glasgow, MD*[2]; *Ambrose Wong, BS*[1]; *David P. Barei, MD*[2]; *William M. Ricci, MD*[1]; *Michael J. Gardner, MD*[1];
[1]*Washington University School of Medicine, St. Louis, Missouri, USA;*
[2]*Harborview Medical Center, Seattle, Washington, USA*

3:36 PM (p. 194) Paper #55

A Prospective Functional Analysis of Proximal Tibia Fractures Using a Calcium Sulfate/Calcium Phosphate Composite Graft with an Early Weight Bearing Protocol
J. Tracy Watson, MD[1]; *Joseph Borrelli, Jr., MD*[2]; *Timothy G. Weber, MD*[3]; *Robert H. Choplin, MD, FACR*[4]; *Scott A. Persohn, RT*[4]; *Rena White, BS*[5]; *Emily M. Haglund, MD*[5];
[1]*St. Louis University, St. Louis, Missouri, USA;*
[2]*University of Texas Southwestern, Dallas, Texas, USA;*
[3]*OrthoIndy, Indianapolis, Indiana, USA;*
[4]*Indiana University, Indianapolis, Indiana, USA;*
[5]*Wright Medical Technology, Arlington, Tennessee, USA*

3:42 PM Discussion

3:47 PM (p. 195) Paper #56

The Critical-Sized Defect in the Tibia: Is It Critical? Results from the SPRINT Trial
David W. Sanders, MD[1], *on behalf of the SPRINT (Study to Prospectively Evaluate Reamed Intramedullary Nails in Tibial Fractures) Investigators;*
[1]*Department of Surgery, Division of Orthopaedic Surgery, University of Western Ontario, London, Ontario, Canada*

3:53 PM (p. 196) Paper #57

Factors Influencing Functional Outcomes after Distal Tibia Shaft Fractures
Heather A. Vallier, MD; *Beth Ann Cureton, BS; Brendan M. Patterson, MD;*
MetroHealth Medical Center, Cleveland, Ohio, USA

3:59 PM Discussion

4:04 PM (p. 198) Paper #58

Semi-Extended Nailing: Is the Patellofemoral Joint Safe?
David P. Zamorano, MD; *Grant W. Robicheaux, MD;*
Janessa Law, BS; Jeff Mercer, MD;
University of California Irvine Medical Center, Orange, California, USA

See pages 75 - 103 for financial disclosure information.

4:10 PM (p. 199) Paper #59	**A Multicenter Prospective Randomized Trial Comparing the Less Invasive Stabilization System (LISS) and Mini-Invasive Dynamic Condylar System (DCS)** ***Abdullah A. Hawsawi, MD***[1]; *Ross K. Leighton, MD*[1]; *Richard A. Preiss, MD*[1]; *COTS Group*[2]; *Kelly Trask, PhD, RC*[1]; [1]*Queen Elizabeth II & Health Science Center, Dalhousie University, Halifax, Nova Scotia, Canada;* [2]*Multiple Canadian Orthopaedic Trauma Society Centers in Canada: Toronto and London, Ontario; Calgary, Alberta; Vancouver, British Columbia*
4:16 PM	Discussion
4:21 PM (p. 200) Paper #60	**A Comparison of Locked versus Non-Locked Enders Rods for Length-Unstable Pediatric Femoral Shaft Fractures** *Henry B. Ellis, MD*[1]; *Christine A. Ho, MD*[2]; ***David A. Podeszwa, MD***[2]; *Philip L. Wilson, MD*[2]; [1]*University of Texas Southwestern, Dallas, Texas, USA;* [2]*Texas Scottish Rite Hospital, Dallas, Texas, USA*
4:27 PM (p. 201) Paper #61	**Isolated Pediatric Tibial Shaft Fractures Do Not Need to be Treated in Above-Knee Cast** ***Joshua W.B. Klatt, MD***; *Alan K. Stotts, MD; John T. Smith, MD* *University of Utah, Primary Children's Medical Center, Salt Lake City, Utah, USA*
4:33 PM	Discussion
4:38 PM (p. 202) Paper #62	**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*
4:44 PM (p. 203) Paper #63	**Delay in Surgery for Displaced Supracondylar Humeral Fracture: Does It Matter?** ***Gunasekaran Kumar, FRCS***; *Antoni Otto, MBBS; Alfie Bass, FRCS;* *Royal Liverpool Children's Hospital, Alder Hey Children's NHS Foundation Trust, Liverpool, United Kingdom*
4:50 PM	Discussion
4:55 PM	Adjourn

- 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 413.

2010 OTA ANNUAL MEETING
SATURDAY, OCTOBER 16, 2010

6:30 AM	**Attendee Registration** (*Baltimore Convention Center, Charles Street Lobby)* **Scientific Posters** *(Baltimore Convention Center, Charles Street Lobby)* **Speaker Ready Room** *(Baltimore Convention Center, Charles Street Lobby)*
6:45 - 7:45 AM (Notes p. 204)	**Case Presentations–*Tickets Required*** **Continental Breakfast** *(6:15—Available at Case Discussion Rooms)*

6:45 – 7:45 AM **CASE PRESENTATIONS**

Pelvis and Acetabulum *(#S-1)* *(Convention Center 307)*
Moderator: *Paul Tornetta, III, MD*
Faculty: *Tania A. Ferguson, MD; Charles M. Reinert, MD; Wade R. Smith, MD* and *David C. Templeman, MD*

The Difficult Proximal Femur Fracture *(#S-2)* *(Convention Center 308)*
Moderator: *Lisa K. Cannada, MD*
Faculty: *George J. Haidukewych, MD; Frank A. Liporace, MD* and *Simon C. Mears, MD, PhD*

Cases from the Haiti Disaster *(#S-3)* *(Convention Center 309)*
Moderator: *Andrew N. Pollak, MD*
Faculty: *Michael J. Bosse, MD; John E. Herzenberg, MD; James C. Krieg, MD; LCDR Christiaan N. Mamczak, DO; Marcus F. Sciadini, MD* and *R. Malcolm Smith, MD*

Elbow Trauma *(#S-4)* *(Convention Center 310)*
Moderator: *Michael D. McKee, MD*
Faculty: *Jeremy A. Hall, FRCSC; Steven R. Papp, MD; Brad A. Petrisor, MD* and *Emil H. Schemitsch, MD*

Grantsmanship 101: Writing an Effective Proposal *(#S-5)* *(Convention Center 301)*
Moderator: *Theodore Miclau, III, MD*
Faculty: *Joseph Borrelli, Jr., MD; Edward J. Harvey, MD* and *Ellen J. MacKenzie, PhD*

See pages 75 - 103 for financial disclosure information.

8:00 – 9:30 AM

SYMPOSIUM III: ORTHOPAEDIC TRAUMA CALL: OPPORTUNITY OR OBLIGATION?

(Notes p. 205) **Moderator:** *Heather A. Vallier, MD* (*Convention Center Hall A)*

Faculty: *Timothy J. Bray, MD*
Timothy G. Weber, MD
Brendan M. Patterson, MD
Wade R. Smith, MD

8:00 am **Introduction: The Call Crisis, Does It Exist?**
Heather A. Vallier, MD

8:10 am **Challenges and Realities of Call**
Timothy G. Weber, MD

8:20 am **Finances of a Trauma Center**
Timothy J. Bray, MD

8:35 am **Acute Care Surgery: Is There a Market?**
Wade R. Smith, MD

8:45 am **Development of Regionalized Trauma Systems**
Brendan M. Patterson, MD

9:00 am **Question/Answer Session**
Faculty

9:30 AM Break
Visit Scientific Posters
(Baltimore Convention Center, Charles Street Lobby)
& Technical Exhibits
(Baltimore Convention Center, Hall B)

- 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 413.

SESSION VI
POLYTRAUMA and FEMUR

10:10 – 11:50 AM **Moderators - John T. Ruth, MD & Joseph Borrelli, Jr., MD**

10:00 AM (p. 206) Paper #64	**Δ Early Appropriate Care: Definitive Stabilization of Femoral Fractures within 24 Hours of Injury Is Safe in Most Multiply-Injured Patients** ***Nickolas J. Nahm, BS***; *John J. Como, MD; John H. Wilber, MD; Heather A. Vallier, MD;* *MetroHealth Medical Center, Cleveland, Ohio, USA*
10:06 AM (p. 207) Paper #65	**The Effect of Intramedullary Nailing on Cognitive Impairment following Multiple Trauma without Intracranial Hemorrhage** ***Justin E. Richards, MD***; *Oscar D. Guillamondegui, MD; E. Wesley Ely, MD; James C. Jackson, PsyD; Kristin Archer-Swygert, PhD; William T. Obremskey, MD, MPH;* *Vanderbilt University Medical Center, Nashville, Tennessee, USA*
10:12 AM (p. 208) Paper #66	**Δ Do Patients with Multiple System Injury Benefit from Early Fixation of Unstable Axial Fractures? The Effects of Timing of Surgery on Initial Hospital Course** ***Heather A. Vallier, MD***; *Dennis M. Super, MD, MPH; Timothy A. Moor, MD; John H. Wilber, MD;* *MetroHealth Medical Center, Cleveland, Ohio, USA*
10:18 AM	Discussion
10:23 AM (p. 210) Paper #67	**Surgical Stabilization of Flail Chest with Locked Plate Fixation** ***Peter L. Althausen, MD[1]***; *Daniel Coll, PAC[2]; Timothy O'Mara, MD[1]; Timothy J. Bray, MD[1];* *[1]Reno Orthopaedic Clinic, Reno, Nevada, USA;* *[2]Renown Regional Medical Center, Reno, Nevada, USA*
10:29 AM (p. 211) Paper #68	**A High Ratio of Fresh Frozen Plasma to Packed Red Blood Cells Significantly Decreases Mortality in Femur Fracture Patients Requiring Massive Transfusion** ***Justin Michael Broyles, BS***; *Gavin Wagenheim, BBA; Sartaj Alam, MS; Catherine Ambrose, PhD; Milan Sen, MD;* *The University of Texas Health Science Center at Houston, Houston, Texas, USA*
10:35 AM (p. 212) Paper #69	**Is Septicemia a Contraindication to Internal Fixation in the Multiply Traumatized Patient?** ***Robert F. Ostrum, MD[1]***; *Julieanne P. Sees, DO[2]; Patrick Kane, MD[3]; Robert Marburger, RN[1];* *[1]Cooper University Hospital, Camden, New Jersey, USA;* *[2]UMNDJ- School of Osteopathic Medicine, Newark, New Jersey, USA;* *[3]Brown University Medical School, Providence, Rhode Island, USA*
10:41 AM	Discussion

Δ OTA Grant
See pages 75 - 103 for financial disclosure information.

10:46 AM
(p. 214)
Paper #70

•Negative Pressure Wound Therapy (NPWT) Reduces Effectiveness of Antibiotic Beads

CPT Daniel J. Stinner, MD*; MAJ(P) Joseph R. Hsu, MD; Joseph C. Wenke, MD;*
United States Army Institute of Surgical Research, Fort Sam Houston, Texas, USA

10:52 AM
(p. 215)
Paper #71

Is Time to Flap Coverage an Independent Predictor of Flap Complication

Jean-Claude G. D'Alleyrand, MD[1]*; Lindsay Dancy, BS[1]; Renan Castillo, PhD[2]; J.B. Bertumen, BS[1]; Theodore T. Manson, MD[1]; Robert V. O'Toole, MD[1]; Tom Meskey, BS[2];*
[1]R Adams Cowley Shock Trauma, Dept of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA;
[2]Center for Injury Research and Policy, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA

10:58 AM
(p. 216)
Paper #72

The Military Extremity Trauma Amputation/Limb Salvage (METALS) Study: Comparing Outcomes for Amputation versus Limb Salvage following Major Lower Extremity Trauma

Ellen J. MacKenzie, PhD[1]; **William C. Doukas COL(Ret.), MD[2]***; Romney C. Andersen, LTC, MD[3]; James R. Ficke, COL, MD[4]; Roman Hayda, COL(Ret), MD[5]; John J. Keeling, CDR, MD[3]; Anthony Carlini[6];*
[1]Center for Injury Research & Policy, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA;
[2]UHC Orthopaedics, Clarksburg, West Virginia, USA;
[3]Walter Reed National Military Medical Center, Washington, District of Columbia, USA;
[4]San Antonio Military Medical Center, San Antonio, Texas, USA;
[5]Brown University Medical School, Providence, Rhode Island, USA;
[6]Johns Hopkins University, Baltimore, Maryland, USA

11:04 AM Discussion

11:09 AM
(p. 218)
Paper #73

The Fate of Patients with a 'Surprise' Positive Culture after Nonunion Surgery

Paul Tornetta, III, MD[1]; Dana Olszewski, MD[1]; Clifford B. Jones, MD[2]; Martin Hoffmann, MD[2]; Debra L. Sietsema, PhD[2]; **Charlton Stucken, MD[1]***; William R. Creevy, MD[1]; William M. Ricci, MD[3]; Michael J. Gardner, MD[3]; Phillipp N. Streubel, MD[3];*
[1]Boston University Medical Center, Boston, Massachusetts, USA;
[2]Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA;
[3]Washington University Medical Center, St. Louis, Missouri, USA

11:15 AM
(p. 220)
Paper #74

Does Long Term Donor Site Morbidity after Anterior Iliac Crest Bone Graft Harvesting Exist?

Sangmin Ryan Shin, MD*; Paul Tornetta, III, MD;*
Boston University Medical Center, Boston, Massachusetts, USA

11:21 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 413.

11:26 AM (p. 221) Paper #75	**CT Scans Have a High Rate of Missed Femoral Neck Fractures** ***Robert V. O'Toole, MD***[1]; *Lindsay Dancy, BS*[1]; *Adam R. Dietz, MD*[1]; *Aaron J. Johnson, MD, MS*[1]; *Andrew N. Pollak, MD*[1]; *Gregory M. Osgood, MD*[1]; *Jason W. Nascone, MD*[1]; *Marcus F. Sciadini, MD*[1]; *Renan C. Castillo, PhD*[2] [1]*R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland Medical School, Baltimore, Maryland, USA;* [2]*Center for Injury Research and Policy, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA*
11:32 AM (p. 222) Paper #76	**Radiation Exposure Has Increased in Trauma Patients over Time** ***Kasra Ahmadinia, MD***; *Ben Smucker, MD; Clyde L. Nash, MD; Heather A. Vallier, MD;* *MetroHealth Medical Center, Cleveland, Ohio, USA*
11:38 AM	Discussion
11:43 AM – 12:50 PM	**Lunch** Visit Scientific Posters *(Baltimore Convention Center, Charles Street Lobby)* LAST OPPORTUNITY TO VISIT Technical Exhibits *(Baltimore Convention Center, Hall B)*
1:00 – 2:30 PM (Notes pgs. 223 - 224)	**Concurrent Sessions** ***(Skills Labs and Mini Symposia run concurrently.)*** ***Tickets Required***

1:00 – 2:30 PM

SKILLS LABS

ORIF Distal Radius *(#S-6)* *(Convention Center 316)*
Moderator: *David C. Ring, MD*
Faculty: *Gregory T. Altman, MD; Cory A. Collinge, MD; Scott G. Edwards, MD; Kenneth A. Egol, MD; Michael D. McKee, MD; Milan K. Sen, MD* and *R. Malcolm Smith, MD*

IM Nailing Trochanteric Fractures *(#S-7)* *(Convention Center 314)*
Moderator: *Richard F. Kyle, MD*
Faculty: *Clifford B. Jones, MD; Laura S. Phieffer, MD; S. Andrew Sems, MD;* and *Thomas F. Varecka, MD*

SIGN Nailing *(#S-8)* *(Convention Center 317)*
Moderator: *Lewis G. Zirkle, Jr., MD*
Faculty: *Kyle F. Dickson, MD; Edmund Eliazar, MD; Robert V. O'Toole, MD; Bhaskar Pant, MD; Robert S. Schultz, MD; Swap Shah, MD; John W. Staeheli, MD; David C. Templeman, MD* and *Ishmayal Wardak, MD*

See pages 75 - 103 for financial disclosure information.

1:00 – 2:30 PM **MINI SYMPOSIA**

2 Minutes/ 2 Slides: Technical Tips and Tricks *(#S-9)* *(Convention Center 308)*
(Rapid Fire Cases)
Moderator: *Pierre Guy, MD*
Faculty: *Richard E. Buckley, MD; Kelly A. Lefaivre, MD; Mark C. Reilly, MD; Emil H. Schemitsch, MD; Stephen H. Sims, MD* and *Paul Tornetta, III, MD*

Infection Following Internal Fixation – What's New? *(#S-10)* *(Convention Center 309)*
Moderator: *Andrew H. Schmidt, MD*
Faculty: *Jeffrey O. Anglen, MD, William T. Obremskey, MD; Robert V. O'Toole, MD* and *Mark E. Shirtliff, PhD*

Soft Tissue Coverage for the Non-Microsurgeon *(#S-11)* *(Convention Center 310)*
Moderator: *Gregory L. DeSilva, MD*
Faculty: *Michael T. Archdeacon, MD* and *Stephen D. DeSilva, MD*

2:30 PM

Break
Visit Scientific Posters
(Baltimore Convention Center, Charles Street Lobby)

3:00 – 3:30 PM
(Notes pgs. 225)

JOHN BORDER MEMORIAL LECTURE
(*Convention Center Hall A)*

Sigvard T. Hansen, Jr., MD
Professor, Director of the Sigvard T. Hansen, Jr., MD Foot and Ankle Institute, University of Washington, Seattle, Washington, USA

Introduction: *John H. Wilber, MD, AONA President*
Lecture Co-sponsored by AONA

- 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 413.

SESSION VII
PELVIS and SPINE

3:30 – 4:49 PM **Moderators - James A. Goulet, MD & Clifford B. Jones, MD**

3:30 PM (p. 226) Paper #77

Defining the Role of Examination Under Anesthetic in Determining the Need for Surgical Stabilization after Traumatic Pelvic Ring Injuries
__H. Claude Sagi, MD__; Franco M. Coniglione, DO; Jason H. Stanford, DO;
Orthopedic Trauma Service, Tampa General Hospital, Tampa, Florida, USA

3:36 PM (p. 227) Paper #78

Outcome of Posterior Wall Fractures of the Acetabulum Treated Nonoperatively after Diagnostic Screening by Dynamic Stress Examination under Anesthesia
__Charles S. Grimshaw, MD__; Berton R. Moed, MD;
St. Louis University School of Medicine, St. Louis, Missouri, USA

3:42 PM (p. 228) Paper #79

Operative Fixation versus Reconstruction with THA for Acute Acetabular Fractures in the Elderly Population
__Michael J. Weaver, MD__[1,2]; Micah Miller, BS[2]; David Lhowe, MD[2];
Malcolm Smith, MD[2]; Mark S. Vrahas, MD[1,2];
[1]Brigham and Women's Hospital and Massachusetts General Hospital, Boston, Massachusetts, USA;
[2]Massachusetts General Hospital, Boston, Massachusetts, USA

3:48 PM Discussion

3:53 PM (p. 229) Paper #80

Sequential Duplex Ultrasound Screening for Deep Venous Thrombosis in Asymptomatic Patients with Acetabular and Pelvic Fractures Treated Operatively
__Berton R. Moed, MD__; John R. Miller, BS;
St. Louis University School of Medicine, St. Louis, Missouri, USA

3:59 PM (p. 230) Paper #81

Use of Temporary Partial Intrailiac Balloon Occlusion for Decreasing Blood Loss during Open Reduction and Internal Fixation of Acetabular and Pelvic Fractures
__Justin C. Siebler, MD__; Thomas DiPasquale, MD; H. Claude Sagi, MD;
Florida Orthopaedic Institute, University of South Florida, Tampa, Florida, USA

4:05 PM (p. 231) Paper #82

Adaptive Prophylaxis Against Heterotopic Ossification Based on Body Habitus
__Waleed F. Mourad, MD__[1]; Satya Packianathan, MD[1]; Walid Waked, MD[2];
Rania A. Shourbaji, BS[3]; Zhen Zhang, MS[1]; Majid A. Khan, MD[1];
Matt L. Graves, MD[1]; George V. Russell, MD[1];
[1]University of Mississippi Medical Center, Jackson, Mississippi, USA;
[2]Yale University School of Medicine, New Haven, Connecticut, USA
[3]Jackson State University, Jackson, Mississippi, USA

4:11 PM Discussion

See pages 75 - 103 for financial disclosure information.

4:16 PM (p. 232) Paper #83	**Minimally Invasive Surgery (MIS) Reduction and Stabilization with Percutaneous Pedicle Screw and Rod Fixation without Arthrodesis for Unstable Spinal Fractures: Early Experience and Results** ***Sean Owen, MD***; *Dirk Alander, MD;* *St. Louis University Hospital, St. Louis, Missouri, USA*
4:22 PM (p. 234) Paper #84	**Percutaneous Posterior Instrumentation after Unstable Thoracolumbar Fractures: Prospective Analysis of Two Systems** ***Oliver Gonschorek, MD***; *Stefan Hauck, MD; Thomas Weiß, MD; Volker Bühren, MD;* *Department of Spine Surgery, BGU Murnau, Murnau, Germany*
4:28 PM (p. 235) Paper #85	**Spine Damage Control: A Safe and Effective Treatment Modality for Unstable Spine Fractures in Multiply Injured Patients** ***Philip F. Stahel, MD***; *Michael A. Flierl, MD; Ernest E. Moore, MD; Kathryn M. Beauchamp, MD;* *Denver Health Medical Center, Denver, Colorado, USA*
4:34 PM	Discussion
4:49 PM	Closing Remarks and Adjourn

- 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 413.

See pages 75 - 103 for financial disclosure information.

OTA ANNUAL MEETING
SCIENTIFIC POSTERS

Baltimore Convention Center Hall A/B Foyer will be open:

Thursday	11:00 am – 5:00 pm
Friday	6:30 am – 5:00 pm
Saturday	6:30 am – 5:00 pm

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

UPPER EXTREMITY EXCLUDING WRIST AND HAND

Poster #1
(p. 237)
Custom Fixed-Angle Plating of Complex Olecranon Fractures: A Preliminary Report of Efficacy of a New Technique
***Bruce H. Ziran, MD*[1]**; *B. Hileman, MD*[2]; *M. K. Barrette-Grishow, MD*[2];
[1]*Atlanta Medical Center, Atlanta, Georgia, USA;*
[2]*St. Elizabeth Health Center, Youngstown, Ohio, USA*

Poster #2
(p. 238)
Attitude Toward Exercising Through Pain After Radial Head Fracture
Thierry G. Guitton, MSc; ***David C. Ring, MD, PhD****;*
Harvard Medical School, Orthopaedic Hand and Upper Extremity Service, Massachusetts General Hospital, Boston, Massachusetts, USA

Poster #3
(p. 239)
Simple Olecranon Fractures: What Determines Long-Term Outcome?
Hendrik Jan Flinterman, MSc[1]; *Job N. Doornberg, MD, PhD*[1,2];
Thierry G. Guitton, MSc[1]; *J.Carel Goslings, MD, PhD*[3];
David C. Ring, MD, PhD[4]; *Peter Kloen, MD, PhD*[2];
[1]*Orthotrauma Research Center Amsterdam (ORCA), Academisch Medisch Centrum, Amsterdam, The Netherlands;*
[2]*Afdeling Orthopedie, Academisch Medisch Centrum, Amsterdam, The Netherlands;*
[3]*Afdeling Heelkunde, Academisch Medisch Centrum, Amsterdam, The Netherlands;*
[4]*Orthopaedic Hand and Upper Extremity Service, Massachusetts General Hospital and Harvard Medical School, Boston, Massachusetts, USA*

Poster #4
(p. 241)
Prevention of Iatrogenic Damage of the Axillary Nerve in Proximal Humeral Surgery by Defining a Radiographic Safe Zone Preoperatively
Hilco P. Theeuwes, MD[1]; *Jan-Willem Potters*[1]; *Victor A. de Ridder, MD*[2];
Gert Bessems, MD[1]; *Bert Kerver, MD*[2]; *Gert J. Kleinrensink, MD*[1];
[1]*Erasmus Medical Center, Rotterdam, The Netherlands;*
[2]*Sint Franciscus Hospital, Rotterdam, The Netherlands*

- 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 413.

SCIENTIFIC POSTERS

Poster #5
(p. 242)

Do Traction Views of Distal Radius Fractures Influence Fracture Characterization and Treatment?

Elan Goldwyn, MD; *Robert V. O'Toole, MD; Raymond Pensy, MD; Jordan Hoolachan, BS; Renan C. Castillo, PhD; Christopher LeBrun, MD; Theodore T. Manson, MD; Jason W. Nascone, MD; Marcus F. Sciadini, MD; W. Andrew Eglseder, MD;*
R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland Medical School, Baltimore, Maryland, USA

Poster #6
(p. 243)

Results of a New Multidirectional Intramedullary Implant Treating Transverse and Comminuted Olecranon Fractures and Nonunions

Scott G. Edwards, MD[1]; *Evan Argintar, MD*[1]; *Thomas F. Varecka, MD*[2];
[1]*Georgetown University Hospital, Washington, DC, USA;*
[2]*University of Minnesota, Minneapolis, Minnesota, USA*

Poster #7
(p. 244)

Surgeon Perceptions of Patient Outcomes Regarding Proximal Ulna Internal Fixation

Scott G. Edwards, MD[1]; *Thomas F. Varecka, MD*[2]; *Mark S. Cohen, MD*[3];
[1]*Georgetown University Hospital, Washington, DC, USA;*
[2]*University of Minnesota, Minneapolis, Minnesota, USA;*
[3]*Rush Medical Center, Chicago, Illinois, USA*

WRIST AND HAND

Poster #8
(p. 245)

Latent Class Analysis to Determine the Accuracy of Diagnostic Tests for Suspected Scaphoid Fractures

Geert A. Buijze, MD[1] *(Netherlands Organisation for Scientific Research); Wouter H. Mallee, MD*[2]; *Frank J.P. Beeres, MD, PhD*[3]; *Steven J. Rhemrev, MD*[3]; *Tim Hanson, PhD*[4]; *Wesley O. Johnson, PhD*[4]; *C. Niek van Dijk, MD, PhD*[2]; ***David C. Ring, MD, PhD***[1];
[1]*Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts, USA*
[2]*Orthopaedic Research Center Amsterdam, Amsterdam, Netherlands*
[3]*Medical Center Haaglanden, The Hague, Netherlands*
[4]*University of California, Davis, California, USA*

Poster #9
(p. 246)

Articular Cartilage Skiving: The Concept Defined

Richelle Takemoto, MD; Mark Gage, BS; Leon Rybak, MD;
Kenneth A. Egol, MD
NYU Hospital for Joint Diseases, New York, New York, USA

Poster #10
(p. 247)

Accuracy of Detecting Screw Penetration of the Radiocarpal Joint following Volar Plating Utilizing Plain Radiographs versus Computed Tomography

Richelle Takemoto, MD; Mark Gage, BS; Leon Rybak, MD;
Kenneth A. Egol, MD
NYU Hospital for Joint Diseases, New York, New York, USA

See pages 75 - 103 for financial disclosure information.

Poster #11 (p. 248)

Increased Dorsal Flexor Pollicis Longus Pressure by Volar Plating of the Distal Radius: Effect of Plate Position and Profile
__Meir Marmor, MD__; Amir Matityahu, MD; Suleiman Lapalme, BA; Hyun Kyu Han, MD; Jennifer M. Buckley, PhD; Lisa Lattanza, MD; University of California San Francisco, San Francisco, California, USA

BASIC SCIENCE AND BIOMECHANICS

Poster #12 (p. 249)

Bacterial Adherence on Suture Materials
__Brendan D. Masini, MD__; Daniel J. Stinner, MD; Scott M. Waterman, MD; Joseph C. Wenke, PhD; US Army Institute of Surgical Research, Fort Sam Houston, Texas, USA

Poster #13 (p. 251)

Bacterial Contaminant on Lead Garments in the Operating Suite
__Brian F. Grogan, MD__; William C. Cranston, PA-C, MEd; Donna M. Lopez, RN; Christopher Furbee, PA-C; Clinton K. Murray, MD; Joseph R. Hsu, MD; Skeletal Trauma Research Consortium (STReC); Brooke Army Medical Center, San Antonio Uniformed Services Health Education Consortium, Fort Sam Houston, Texas, USA

Poster #14 (p. 252)

Δ The Effects of Hypothermia and Mediators on Skeletal Muscle Function in Ischemia-Reperfusion Injury
__Daniel Stahl, MD__; Nicholas Souder, MD; Binu Tharakan, PhD; Robert Probe, MD; Russell Ward, MD; Scott & White Hospital/Texas A&M Health Sciences Center, Temple, Texas, USA

Poster #15 (p. 253)

Preliminary Evaluation of Blood Serum Levels of Procollagen Type I N-Terminal Propeptide (PINP) as an Indicator of Fracture Healing
__Travis A. Burgers, PhD[1]__; Marlon O. Coulibaly, MD[2]; James Mason, PhD[1]; Debra L. Sietsema, PhD[1,3,4]; Bart Williams, PhD[1]; Clifford B. Jones, MD, FACS[1,3,4]; [1]Van Andel Research Institute, Grand Rapids, Michigan, USA; [2]Grand Rapids Medical Education and Research Center, Grand Rapids, Michigan, USA; [3]Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA; [4]Michigan State University, Grand Rapids, Michigan, USA

Poster #16 (p. 254)

Real-Time Monitoring of BMP Signaling during Weight Sharing of Tibia and Fibula with an External Fixator
__Job N. Doornberg, MD, PhD[1]__; Rutger van Bezooijen, PhD[2]; Ivo Que, MSc[2]; Erik Kaijzel, PhD[2]; Clemens W.G.M. Löwik, PhD[2]; Peter Kloen, MD, PhD[1]; [1]Orthotrauma Research Center, Amsterdam, The Netherlands; [2]Leids Universitair Medisch Centrum, Leiden, The Netherlands

Poster #17 (p. 256)

Atorvastatin Is Beneficial for Muscle Reinnervation after a Complete Sciatic Nerve Section in Rats
__Jonah Hebert-Davies, MD__; Fredric-Charles Cloutier, MD; Dominique Rouleau, MD; Pierre Beaumont, MD; Eric Beaumont, PhD; Université of Montréal, Division Chirurgie Orthopédique, Hôpital du Sacré Cœur, Montréal, Québec, 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 413.

Poster #18 (p. 257)

Multiplanar Fixation of a Locking Plate in the Diaphysis Improves Construct Strength

Patrick J Denard, MD[1]; Josef Doornink, MS[2]; Steven M. Madey, MD[2]; Daniel C. Fitzpatrick, MD, MS[3]; ***Michael Bottlang, PhD[2]****;*
[1]Department of Orthopaedics and Rehabilitation, Oregon Health & Science University, Portland, Oregon, USA;
[2]Legacy Biomechanics Laboratory, Portland, Oregon, USA;
[3]Slocum Center for Orthopaedics, Eugene, Oregon, USA

Poster #19 (p. 258)

Increased Expression of Bone Sialoprotein is Associated with Early, Increased Mineralization by Young, but not Aged, Adipose-Derived Multipotential Progenitor Cells

Patrick W. Whitlock, MD[1]*; Thorsten M. Seyler, MD[1]; David R. Marker, BS[2]; Casey L. Northam, BS[1]; Thomas L. Smith, PhD[1]; Lawrence X. Webb, MD[3];*
[1]Wake Forest University Health Sciences, Winston-Salem, North Carolina, USA;
[2]Johns Hopkins University, Baltimore, Maryland, USA;
[3]MCMG/Mercer University, Macon, Georgia, USA

Poster #20 (p. 259)

An Analysis of Strategies to Increase External Fixator Stiffness: Is Double Stacking Really Worth the Money?

Sara Strebe, MD[1]*; Robert V. O'Toole, MD[1,2]; Hyunchul Kim, MS[2]; Adam H. Hsieh, PhD[2];*
[1]R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland Medical School, Baltimore, Maryland, USA
[2]Orthopaedic Mechanobiology Lab, Department of Bioengineering, University of Maryland, College Park, Maryland, USA

Poster #21 (p. 260)

•In Vitro Antibiotic Elution Profile: Adhesive Polyurethane Bone Cement Compounded with Tobramycin/Vancomycin

Josh Murphy, MD[1]*; Eric Kolb, MS[2]; Naresh Akkarapaka, MS[2]; Martin Franzus, MS[1]; Thomas Moore, MD[3]; Timothy Ganey[1];*
[1]Atlanta Medical Center, Atlanta, Georgia, USA;
[2]Doctors Research Group, Southbury, Connecticut, USA;
[3]Emory University, Atlanta, Georgia, USA

GERIATRIC FRACTURES

Poster #22 (p. 262)

The Influence of Rotation on Femoral Neck-Shaft Angle Measurements in the Anatomic, Varus Malreduced, and Shortened Proximal Femur

Amir Matityahu, MD*; R. Trigg McClellan, MD; Meir Marmor, MD;*
University of California San Francisco, San Francisco General Hospital, Orthopaedic Trauma Institute, San Francisco, California, USA

Poster #23 (p. 264)

A New Effective Surgical Treatment for Displaced Femoral Neck Fractures

Antonio Moroni, MD*; Martha Hoque, PhD; Giovanni Micera, MD; Riccardo Orsini, MD; Fabrizio Sinapi, MD; Lucia Calbucci, MD; Elena Maccagnan, MD; Sandro Giannini, MD;*
Bologna University, Rizzoli Orthopaedic Institute, Bologna, Italy

See pages 75 - 103 for financial disclosure information.

Poster #24 (p. 265)

The Rate of Contralateral Proximal Femur Fracture Following Closed Reduction Percutaneous Pinning (CRPP) versus Arthroplasty in Treatment of Femoral Neck Fractures

Christopher D. Souder, MD; *Michael L. Brennan, MD; Kindyle Brennan, PhD; Christopher Chaput, MD; Johnathan Williams, BS;*
Scott & White Memorial Hospital, Temple, Texas, USA

Poster #25 (p. 266)

Assessment of Local Bone Quality and Implant Anchorage in the Humerus: Correlation Between High-Resolution CT Data and Mechanical Measurements

Damiano Schiuma[1]; Stefano Brianza, PhD[1]; Andrea Tami, PhD[1]; Karsten Schwieger, PhD[1]; ***Götz Röderer, MD[2]***; *Alexander Scola, MD[2]; Florian Gebhard, PhD[2];*
[1]AO Research Institute, Davos, Switzerland;
[2]Ulm University, Department of Orthopaedic Trauma, Ulm, Germany

Poster #26 (p. 268)

Comanagement of Geriatric Patients with Hip Fractures: A Retrospective, Controlled, Cohort Study

Gregory J. Della Rocca, MD, PhD, FACS; *Kyle C. Moylan, MD; Brett D. Crist, MD, FACS; Yvonne M. Murtha, MD; David C. Mehr, MD;*
University of Missouri, Columbia, Missouri, USA

Poster #27 (p. 269)

Intramedullary Nailing Is Superior in Pertrochanteric Hip Fractures with a Detached Greater Trochanter

Henrik Palm, MD; *Michael Krasheninnikoff, MD; Steffen Jacobsen, MD; Kim Holck, MD; Charlotte Lysén, MD; Peter Gebuhr, MD;*
Copenhagen University Hospital of Hvidovre, Hvidovre, Denmark

Poster #28 (p. 270)

The "Wedge Effect" after Intramedullary Hip Screw Fixation for Osteoporotic Intertrochanteric Fractures

Emil Azer, MD[1]; *Steven S. Sands, DO[1]; Peter A. Siska, MD[1]; Gary S. Gruen, MD[1]; Hans-Christoph Pape, MD[2]; Ivan S. Tarkin, MD[1];*
[1]University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA;
[2]RWTH Aachen University, Aachen, Germany

Poster #29 (p. 271)

•The Effect of Intramedullary Bone-Graft Harvesting on Torsional Strength in Normal and Osteoporotic Femurs

Jason Lowe, MD; *William Carson, PhD; Ferris Pfeiffer, PhD; Gregory J. Della Rocca, MD, PhD, FACS; Yvonne M. Murtha, MD; Brett D. Crist, MD;*
University of Missouri, Columbia, Missouri, USA

Poster #30 (p. 272)

Impact of Guideline Implementation by a Fracture Nurse on Subsequent Fractures and Mortality in Patients Presenting with Nonvertebral Fractures

Kirsten M.B. Huntjens, MD; *Tineke van Geel, MSc, PhD; Piet P. Geusens, MD, PhD; Joop van den Bergh, MD, PhD; P.R.G. Brink, MD, PhD; B. Winkens, MSc, PhD; P. Willems, MD; S.H. van Helden, MD, PhD;*
Maastricht University Medical Centre, Maastricht, The Netherlands

- 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 413.

Poster #31
(p. 273)

High-Energy Trauma and Clavicle Fractures: A Marker for Death in the Elderly?

Julie M. Keller, MD; *Marcus F. Sciadini, MD; Robert V. O'Toole, MD;*
RA Cowley Shock Trauma Center, Department of Orthopaedics,
University of Maryland School of Medicine, Baltimore, Maryland, USA

Poster #32
(p. 274)

Functional Outcomes Following Intramedullary Nailing of Trochanteric Hip Fractures: A Pilot Multicenter, Randomized Controlled Trial

Mohit Bhandari, MSc, MD, FRCSC[1]; Alicja Bojan, MD[2];
Carl Ekholm, MD, PhD[2]; Ole Brink, MD, PhD, MPA[3]; Anthony Adili, MD[4];
Sheila Sprague, MSc[1]; Nasir Hussain[1]; Anders Joensson, MD, PhD[5];
on behalf of the REGAIN Investigators; ***Emil H. Schemitsch, MD****;*
[1]McMaster University, Hamilton, Ontario, Canada;
[2]Sahlgrenska University Hospital, Mölndal, Sweden;
[3]Aarhus University Hospital, Aarhus, Denmark;
[4]St. Joseph's Hospital, McMaster University, Hamilton, Ontario, Canada;
[5]Stryker Osteosynthesis, Schönkirchen, Germany

Poster #33
(p. 275)

Total Knee Arthroplasty for the Treatment of Complex Fractures of the Tibial Plateau in the Elderly

Panayiotis Christofilopoulos, MD; *Constantinos Roussos, MD;*
Florence Unno-Veith, MD; Alexandre Lädermann, MD; Richard Stern, MD;
Robin Peter, MD;
Division of Orthopaedics and Trauma Surgery, University Hospitals of Geneva,
Geneva, Switzerland

Poster #34
(p. 276)

Implant Standardization for Hemiarthroplasty: Implementation of a Pricing Matrix System at a Level 2 Community-Based Trauma System

Peter L. Althausen, MD, MBA[1]; *Daniel Coll, MHS, PA-C[2];*
Eric M. Boyden, MD[1]; Timothy J. O'Mara, MD[1]; Timothy J. Bray, MD[1];
[1]Reno Orthopaedic Clinc, Reno, Nevada, USA;
[2]Renown Regional Medical Center, Reno, Nevada, USA

Poster #35
(p. 277)

Osteosynthesis of AO/OTA 44-B (Danis-Weber B) Fractures in Older Patients: A New Technique Allowing Early Weight Bearing

Mathieu Assal, MD; ***Panayiotis Christofilopoulos, MD****;*
Anne Lübbeke, MD, DSc; Richard Stern, MD;
Division of Orthopaedics and Trauma Surgery, University Hospitals of Geneva,
Geneva, Switzerland

See pages 75 - 103 for financial disclosure information.

FOOT, ANKLE AND PILON

Poster #36 (p. 279)

Quantitative Assessment of the Vascularity of the Talus Using Gadolinium-Enhanced MRI

Anna N. Miller, MD[1]; *Mark L. Prasarn, MD[2]; Jonathan P. Dyke, PhD[3]; David L. Helfet, MD[1]; Dean G. Lorich, MD[1];*
[1]Orthopaedic Trauma Service, Hospital for Special Surgery, New York, New York, USA;
[2]Orthopaedic Trauma Department, University of Rochester, Rochester, New York, USA;
[3]Citigroup Biomedical Imaging Center, Weill Cornell Medical College; New York, New York, USA

Poster #37 (p. 280)

A New Ankle-Spanning Fixator Construct for Distal Tibia Fractures: Optimizing Visualization, Minimizing Pin Problems, and Protecting the Heel

Bruce H. Ziran, MD[1]; *T. Morrison, MD[2]; R. C. Kinney, MD[1];*
[1]Atlanta Medical Center, Atlanta, Georgia, USA;
[2]St. Joseph Hospital, Warren, Ohio, USA

Poster #38 (p. 281)

22-Year Follow-up of Pronation-Eversion Type III-IV (AO/OTA Type C) Ankle Fractures: A Retrospective Cohort Study

Christian Donken, MD[1]; *Michael Verhofstad, PhD[2]; Kees van Laarhoven, PhD[1];*
[1]Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands;
[2]St. Elisabeth Hospital, Tilburg, The Netherlands

Poster #39 (p. 283)

High-Energy Navicular Body Fractures: Results of Open Reduction and Internal Fixation Using Minifragment Plate Fixation

Jason M. Evans, MD[1]; Daphne M. Beingessner, MSc, MD, FRCSC[2]; ***Julie Agel, MA[2]***; *Stephen Benirschke, MD[2];*
[1]University of Texas Health Science Center, San Antonio, Texas, USA;
[2]Harborview Medical Center, University of Washington, Seattle, Washington, USA

Poster #40 (p. 284)

Socioeconomic Sequelae of Orthopaedic Trauma

David A. Volgas, MD; *Rena L. Stewart, MD;*
University of Alabama at Birmingham, Birmingham, Alabama, USA

Poster #41 (p. 285)

The Incidence of Wound Complications following Open Reduction and Internal Fixation of Calcaneal Fractures: A Comparison of Static versus Dynamic Retraction

Megan Brady, MD; *David Brokaw, MD;*
OrthoIndy, Indianapolis, Indiana, USA

Poster #42 (p. 286)

Do Educational Handouts Work after Ankle Fracture? Results of a Randomized Controlled Trial

Joshua Mayich, MD[1]; William McCormick, MD[2]; Christina A. Tieszer, MSc[3]; Abdel Lawendy, MD, FRCSC[3]; ***David W. Sanders, MD, MSc, FRCSC[3]***;
[1]Queen's University, Kingston, Ontario, Canada;
[2]University of Ottawa, Ottawa, Ontario, Canada;
[3]London Health Sciences Centre, London, Ontario, Canada

- 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 413.

Poster #43
(p. 287)

Fixing the Almost-Healed Ankle Fracture: Is the Surgery, Reduction, and Complication Different from Acute Open Reduction and Internal Fixation?
Serdar Toker, MD*; Steven J. Morgan, MD;* ***David J. Hak, MD****;*
Denver Health, Denver, Colorado, USA

Poster #44
(p. 288)

Adjunctive Spanning Fixation Treatment of Displaced Cuboid Fractures: Results and Complications
Marlon O. Coulibaly, MD[1]; ***Clifford B. Jones, MD, FACS[2]****;*
Debra L. Sietsema, PhD[2]; Donald R. Bohay, MD[2]; John G. Anderson, MD[2];
James R. Ringler, MD[2];
[1]Grand Rapids Medical Education and Research Center,
Grand Rapids, Michigan, USA;
[2]Orthopaedic Associates of Michigan, Michigan State University,
Grand Rapids, Michigan, USA

Poster #45
(p. 289)

Is Surgeon's Training More Important than Injury Pattern in Determining Operative versus Nonoperative Treatment of Calcaneal Fractures?
John Y. Kwon, MD; Amna Diwan, MD; Aron T. Chacko, BS;
Paul T. Appleton, MD; ***Edward K. Rodriguez, MD****;*
Beth Israel Deaconess Medical Center. Harvard Medical School,
Boston, Massachusetts, USA

Poster #46
(p. 290)

When Is Plate Fixation for Unstable Isolated Fibular Fractures Cost-Effective? Results from a Multicenter Randomized Control Trial
Gerard P. Slobogean, MD, MPH[1]*; David W. Sanders, MD, MSc, FRCSC[2];*
Canadian Orthopaedic Trauma Society;
[1]University of British Columbia, Department of Orthopaedics,
Vancouver, British Columbia, Canada;
[2]University of Western Ontario, Division of Orthopaedic Surgery,
London, Ontario, Canada

Poster #47
(p. 291)

A Primary Report of the Supercutaneous Calcaneal Locking Plate to Treat Calcaneal Fracture
Guo-zhu Zhang, MD*; Xie-yuan Jiang, MD; Man-yi Wang;*
Department of Orthopaedic Trauma, Beijing Jishuitan Hospital, Beijing, China

Poster #48
(p. 292)

The Impact of CT Scans on the Treatment of Lisfranc Injuries
Lance E. LeClere, MD, LT MC USN*; Michael T. Mazurek, MD, CDR MC USN;*
Anthony I. Riccio, MD, LCDR MC USN;
Nelson S. Saldua, MD, LCDR MC USN; Ryan P. Ponton, MD, LT MC USN;
Naval Medical Center San Diego, San Diego, California, USA

Poster #49
(p. 293)

Surgeon Practices Regarding Operative Treatment of Posterior Malleolus Fractures
Michael J. Gardner, MD*; Philipp N. Streubel, MD; Jeremy McCormick, MD;*
Sandra Klein, MD; Jeffrey E. Johnson, MD; William M. Ricci, MD;
Washington University School of Medicine, St Louis, Missouri, USA

See pages 75 - 103 for financial disclosure information.

Poster #50 (p. 295)

Impact of Location of Osteochondral Lesion of Talus on Outcomes in Ankle Fractures

***Omesh Paul, MD*[1]**; *Sreevathsa Boraiah, MD[2]; Keith Hentel, MD[3]; Robert J. Parker, BS[1]; Elizabeth M. Morris, BA[1]; David L. Helfet, MD[1]; Dean G. Lorich, MD[1];*
[1]Hospital for Special Surgery, New York, New York, USA;
[2]Westchester Medical Center, Valhalla, New York, USA;
[3]New York Presbyterian Hospital, Weill Cornell Medical Center, New York, New York

Poster #51 (p. 296)

Plain Radiographs versus CT after Open Reduction and Internal Fixation of Tibial Pilon Fractures: What Are We Missing?

***Justin Knight, MD*[1]**; *Lauren Hinojosa, MD[1]; Florian Nickisch, MD[2]; Rahul Banerjee, MD[1];*
[1]University of Texas Southwestern Medical Center, Dallas, Texas, USA;
[2]University of Utah, Salt Lake City, Utah, USA

Poster #52 (p. 297)

Does Supplemental Perioperative Oxygen Decrease Surgical-Site Infection in At-Risk Fractures? Results of a Double-Blind Randomized Controlled Trial

***Alec Stall, MD*[1]**; *Rishi Gupta, MD[1]; Mary Zadnik Newell, OT[1]; Emily Hui, MPH[1]; Renan C. Castillo, PhD[2]; Robert V. O'Toole, MD[1];*
[1]R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland Medical School, Baltimore, Maryland, USA;
[2]Johns Hopkins Bloomberg School of Public Health, Department of Health Policy and Management, Baltimore, Maryland, USA

Poster #53 (p. 298)

Syndesmotic Reduction: Can Accuracy Be Improved with Intraoperative 3D Imaging?

***Roy I. Davidovitch, MD*[1]**; *Kenneth A. Egol, MD[1]; Meir Liebergall, MD[2]; Amal Khoury, MD[2]; Rami Mosheiff, MD[2]; Yoram A. Weil, MD[2];*
[1]NYU Hospital for Joint Diseases, New York, New York, USA;
[2]Hadassah Hebrew University Hospital, Jerusalem, Israel

Poster #54 (p. 299)

Prospective Comparison of Locked Plates versus Nonlocked Plates for the Treatment of High-Energy Pilon Fractures

Theodore T. Le, MD*; *Namdar Kazemi, MD; *Gene Lee, BS; Michael T. Archdeacon, MD, MSE; John D. Wyrick, MD;*
University of Cincinnati Academic Health Center, Cincinnati, Ohio, USA

KNEE AND TIBIAL PLATEAU

Poster #55 (p. 300)

An Investigation of Multiligamentous Knee Injury Patterns and Associated Morbidities from a Level 1 Trauma Referral Center

Jeffrey D. Watson, MD; *Edward H. Becker, MD; James C. Dreese, MD;*
University of Maryland, R Adams Cowley Shock Trauma Center, Baltimore, Maryland, 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 413.

Poster #56 (p. 301)

Δ Posteromedial Tibial Plateau Fracture Stability May Depend on its Morphology and Knee Flexion Angle

Igor Immerman, MD; *Christopher Bechtel, BS; Yildirim Gokce, MS; Yonah Heller, BS; Peter S. Walker, PhD; Kenneth A. Egol, MD;*
NYU Hospital for Joint Diseases, New York, New York, USA

Poster #57 (p. 302)

Knee Joint Extensor Mechanism Disruption: Better to Fracture the Patella or Rupture the Tendon?

Nirmal C. Tejwani, MD; *Nicole Montero, BS; Christopher Bechtel, BS; Michael Walsh, PhD; Kenneth A. Egol, MD;*
NYU Hospital for Joint Diseases, New York, New York, USA

Poster #58 (p. 303)

Functional Outcomes of Operative Fixation of Patella Fractures

Omesh Paul, MD[1]; *Sreevathsa Boraiah, MD[2]; Gina Sauro, DPT[3]; Elizabeth M. Morris, BA[1]; Robert J. Parker, BS[1]; David L. Helfet, MD[1]; Dean G. Lorich, MD[1];*
[1]Hospital for Special Surgery, New York, New York, USA;
[2]Westchester Medical Center, Valhalla, New York, USA
[3]New York Presbyterian Hospital–Weill Cornell Medical Center, New York, New York, USA

Poster #59 (p. 304)

•Rationale for Tissue Ultrafiltration as a Potential Treatment for Impending Acute Compartment Syndrome: Increased Fluid Removal Is Associated with Lower Intramuscular Pressure

Andrew H. Schmidt, MD; *Rick Odland, MD, PhD;*
Hennepin County Medical Center, Minneapolis, Minnesota, USA

TIBIA

Poster #60 (p. 305)

Fibular Head Osteotomy: A New Approach for the Treatment of Lateral or Posterolateral Tibial Plateau Fractures

Baoqing Yu, MD[1]; *Kaiwei Han, MD;*
Department of Orthopaedics, Changhai Hospital, The Second Military Medical University, Shanghai, China

Poster #61 (p. 306)

Retrospective Study of Type III Open Fractures: Do Negative Pressure Dressings Safely Allow for Delayed Flap Coverage?

Jason Halvorson, MD[1]; *Eben A. Carroll, MD[1]; Lisa K. Cannada, MD[2]; William T. Obremskey, MD[3]; Steven A. Olson, MD[4]; Langdon Hartsock, MD[5]; Brenda Kulp, RN[1]; Lawrence X. Webb, MD[6]; Southeastern Fracture Consortium;*
[1]Wake Forest Baptist Hospital, Winston-Salem, North Carolina, USA;
[2]Saint Louis University, St. Louis, Missouri, USA;
[3]Vanderbilt University Medical Center, Nashville, Tennessee, USA;
[4]Duke University Medical Center, Durham, North Carolina;
[5]Medical University of South Carolina, Charleston, South Carolina, USA;
[6]Medical Center of Central Georgia, Macon, Georgia, USA

Δ OTA Grant
See pages 75 - 103 for financial disclosure information.

Poster #62
(p. 307)

A Novel Technique for Reduction and Immobilization of Tibial Shaft Fractures: The Hammock

Sanjit R. Konda, MD; *Charles J. Jordan, MD; Roy I. Davidovitch, MD; Kenneth A. Egol, MD;*
NYU Hospital for Joint Diseases, New York, New York, USA

Poster #63
(p. 308)

The Somatic Pre-Occupation and Coping (SPOC) Questionnaire Predicts Functional Recovery in Tibial Fracture Patients

The SPRINT (Study to Prospectively Evaluate Reamed Intramedullary Nails in Tibial Fractures) Investigators and the Medically Unexplained Syndromes Study Group[1]
The writing group (Jason Busse, PhD [chair]; Mohit Bhandari, MD; Gordon H. Guyatt, MD; Diane Heels-Ansdell, MSc; Abhaya V. Kulkarni, MD; Scott Mandel, MD; David W. Sanders, MD; ***Emil H. Schemitsch, MD****; Marc Swiontkowski, MD; Paul Tornetta, III, MD; Eugene Wai, MD; and Stephen D. Walter, PhD) assumes responsibility for the overall content and integrity of the manuscript. Drs Bhandari and Guyatt, as Principal Investigators, had full access to the study data and take responsibility for its integrity.*
[1]*McMaster University, Hamilton, Ontario, Canada*

Poster #64
(p. 309)

Do Surgeon and Center Volumes Impact the Outcomes of Closed Tibia Fractures?

Marc Swiontkowski, MD[1]*, for the SPRINT (Study to Prospectively Evaluate Reamed Intramedullary Nails in Patients with Tibial Fractures) Investigators;*
[1]*Department of Orthopedics, University of Minnesota, Minneapolis, Minnesota, USA*

Poster #65
(p. 310)

Round Peg in a Triangular Hole: Is Preoperative Radiographic Determination of Tibial Isthmal Diameter Accurate?

Brandon Steen, MD; Michael Kindya, BS; ***Paul Tornetta, III, MD****;*
Boston University Medical Center, Boston, Massachusetts, USA

Poster #66
(p. 312)

Distal Tibial Fractures Treated by Intramedullary Nailing Are at Increased Risk of Malunion and Complication When Compared with Diaphyseal Tibial Fractures

Barton Simon, MD; Martin Marsh, MD; Paul Harwood, MD; ***Peter V. Giannoudis, MD****;*
Academic Department Orthopaedic Trauma Surgery, Leeds University, Leeds, United Kingdom

Poster #67
(p. 314)

Gait Parameter Differences Between Standard and Ertl Transtibial Amputees

Todd Fellars, LT MC USN; *Anthony I. Riccio, LCDR MC USN; Joseph Carney, LCDR MC USN; Michael T. Mazurek, CDR MC USN; Marilynn Wyatt, PT;*
Naval Medical Center San Diego, San Diego, 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 413.

Poster #68 (p. 315)

Does the Wound Vacuum-Assisted Closure Affect Free Flap Survival in Lower Extremity Trauma?

William M. Reisman, MD; *Patrick M. Osborn, MD; John D. Carew, PhD; Michael J. Bosse, MD; Stanley B. Getz, MD;*
Carolinas Medical Center, Charlotte, North Carolina, USA

Poster #69 (p. 317)

Incremental Cost of Fracture Non-Union in Patients with Tibia Fracture and Internal Fixation Surgery

Xue Song, PhD[1]; Nianwen Shi, PhD[1]; Nicole Yurgin, PhD[2]; Alan Oglesby[2]; ***Ricardo Dent, MD[2]***; *Mohit Bhandari, MD[3];*
[1]Thomson Reuters, Cambridge, Massachusetts, USA;
[2]Amgen Inc, Thousand Oaks, California, USA;
[3]Department of Clinical Epidemiology and Biostatistics, McMaster University, Hamilton, Ontario, Canada

PEDIATRIC

Poster #70 (p. 319)

Age-Related Patterns of Spine Injury following All-Terrain Vehicle Accidents in Children and Adolescents

Jeffrey R. Sawyer, MD; *Michael J. Beebe, MD; Norfleet Thompson, MD; Aaron T. Creek, MD; Matthew G. Yantis, MD; Derek M. Kelly, MD; William C. Warner, Jr, MD;*
Campbell Clinic, Memphis, Tennessee, USA

Poster #71 (p. 320)

Pediatric Cubitus Varus Correction by Computer-Guided Circular External Fixation

John E. Herzenberg, MD[1]; *Mohan V. Belthur, MD[2]; Christopher Iobst, MD[3]; Gaurav Jindal, MD[4]; Noam Bor, MD[5];*
[1]Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore, Baltimore, Maryland, USA;
[2]Texas Children's Hospital and Shriners Hospital for Children, Houston, Texas, USA;
[3]Miami Children's Hospital, Miami, Florida, USA;
[4]Pushpanjali Crosslay Hospital, Ghaziabad, India;
[5]Emek Medical Center, Afula, Israel

Poster #72 (p. 321)

Composite Playground Safety Measure to Correlate the Rate of Supracondylar Humerus Fractures with Safety: An Ecologic Study

Min Jung Park, MD, MMSc[1]; ***Keith Baldwin, MD, MPH, MSPT[1]***; *Nomi Weiss-Laxer, MA[2]; Jennifer Christian, Pharm D[2]; Julia Katarincic, MD[3]; Craig Eberson, MD[3]; Michael J. Mello, MD, MPH[2,4]; David A. Spiegel, MD[5]*
[1]Department of Orthopaedic Surgery, Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania, USA;
[2]The Injury Prevention Center at Rhode Island Hospital, Department of Emergency Medicine, Warren Alpert Medical School of Brown University, Providence, Rhode Island, USA;
[3]Department of Orthopedic Surgery, Warren Alpert Medical School of Brown University, Rhode Island Hospital, Providence, Rhode Island, USA;
[4]Department of Community Health, Brown University, Rhode Island Hospital, Providence, Rhode Island, USA;
[5]Department of Orthopedic Surgery, Children's Hospital of Philadelphia, Philadelphia, Pennsylvania, USA

See pages 75 - 103 for financial disclosure information.

Poster #73 (p. 323)

Nonoperative Treatment of Both-Bone Forearm Shaft Fractures in Children: Predictors of Early Radiographic Failure

Eric N. Bowman, MPH[1]; *Charles T. Mehlman, DO, MPH*[2]; *Christopher J. Lindsell, PhD*[1]; *Junichi Tamai, MD*[2];
[1]*University of Cincinnati, College of Medicine, Cincinnati, Ohio, USA;*
[2]*Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio, USA*

Poster #74 (p. 324)

Nerve Injuries Associated with Pediatric Supracondylar Humeral Fractures: A Meta-Analysis

Jessica C. Babal, BS[1]; *Charles T. Mehlman, DO, MPH*[2]; *Guy Klein, BS*[3];
[1]*University of Cincinnati, College of Medicine, Cincinnati, Ohio, USA;*
[2]*Cincinnati Children's Hospital, Cincinnati, Ohio, USA;*
[3]*Ohio University, College of Osteopathic Medicine, Athens, Ohio, USA*

POLYTRAUMA

Poster #75 (p. 325)

Combat Extremity Trauma: Resource Utilization Beyond Initial Hospitalization

Brendan D. Masini, MD; *Brett D. Owens, MD; Joseph C. Wenke, PhD; Joseph R. Hsu, MD;*
US Army Institute of Surgical Research, Fort Sam Houston, Texas, USA

Poster #76 (p. 326)

An Analysis of the Transition in Orthopaedic Trauma Fellowships from 2000 to 2010

Gilbert R. Ortega, MD, MPH; *Karl Bergmann, MD;*
Sonoran Orthopaedic Trauma Surgeons, Scottsdale Osborn Trauma Center, Scottsdale, Arizona, USA

Poster #77 (p. 327)

Battlefield Orthopaedic Injuries Cause the Majority of Long-Term Disabilities

CPT Jessica D. Cross, MD[1,2]; *COL James R. Ficke, MD*[2]; *MAJ (P) Joseph R. Hsu*[1,2]*, MD; CPT Brendan D. Masini, MD*[2]; *Joseph C. Wenke, PhD*[1];
[1]*US Army Institute of Surgical Research, Fort Sam Houston, Texas, USA;*
[2]*Brooke Army Medical Center, Fort Sam Houston, Texas, USA*

Poster #78 (p. 328)

Analysis of Radiation Exposure to the Orthopaedic Trauma Patient during their Inpatient Hospitalization

Mark L. Prasarn, MD; *Elizabeth Martin, MD; Michael Schreck, BA; John Wright, MS; Per-Lennart Westesson, MD; Thomas Morgan, PhD; Mark Gestring, MD; Mark Rechtine, MD;*
University of Rochester/Strong Memorial Hospital, Rochester, New York, USA

Poster #79 (p. 329)

Fluid Lavage of Open Fracture Wounds (FLOW): A Randomized Blinded, Multicenter Pilot Trial

Brad Petrisor, MD, *for the FLOW Pilot Study Investigators;*
Department of Surgery, Division of Orthopaedic Surgery, McMaster University, Hamilton, Ontario, Canada

- 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 413.

SCIENTIFIC POSTERS

Poster #80 (p. 330)

The Evaluation of a New Measure for Assessing Healing in Lower Extremity Fractures

Mohit Bhandari, MD[1]; Scott M. Wasserman[2]; Nicole Yurgin, PhD[2]; Ricardo Dent, MD[2], Sheila Sprague, MSc[1]; ***Brad Petrisor, MD[1]****;*
[1]McMaster University, Hamilton, Ontario, Canada;
[2]Amgen Inc, Thousand Oaks, California, USA

Poster #81 (p. 332)

Outcomes of Treatment of Traumatic Morel-Lavallée Lesions with Negative Pressure Wound Therapy (NPWT)

Robert N. Reddix, Jr, MD[1,2]*; Rajesh R. Gandhi, MD, PhD, FACS[2];*
[1]University of North Texas Health Science, Fort Worth, Texas, USA;
[2]John Peter Smith Hospital, Fort Worth, Texas, USA

Poster #82 (p. 333)

The Influence of Hemorrhagic Anemia on Fracture Healing

Thomas F. Varecka, MD[1]*; Lindsay Wiesner, MD[2];*
[1]Hennepin County Medical Center, Minneapolis, Minnesota, USA;
[2]Creighton University School of Medicine, Omaha, Nebraska, USA

Poster #83 (p. 335)

Self-Efficacy and Coping following Limb Trauma

Elizabeth Sinclair, MA[1]; ***Mary Zadnik Newell, OTR/L, MEd[1]****; Nathan M. Parmer, PsyD[2]; Renan C. Castillo PhD[3]; Stephen T. Wegener, PhD[2,3]; Ellen J. MacKenzie, PhD[3]; Andrew N. Pollak, MD[1];*
[1]R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland Medical School, Baltimore, Maryland, USA;
[2]Department of Physical Medicine and Rehabilitation, Johns Hopkins School of Medicine, Baltimore, Maryland, USA;
[3]Center for Injury Research & Policy, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA

POST TRAUMATIC RECONSTRUCTION

Poster #84 (p. 336)

Clinical Management of Radial Nerve Palsy (RNP) Associated with Humeral Shaft Fracture

Bo-song Zhang, MD*; He Liang, MD; Man-yi Wang, MD;*
Department of Orthopaedic Trauma, Beijing Jishuitan Hospital, Beijing, China

Poster #85 (p. 337)

Treatment of Lower Extremity Segmental-Defect Nonunions with Reamer-Irrigator-Aspirator Bone Graft

Robert Garrison, MD*; Ryan Butterworth, BS; Paul Stafford, MD; Brent Norris, MD;*
University of Oklahoma School of Medicine, Tulsa, Oklahoma, USA

Poster #86 (p. 338)

Morbidity at the Donor Site After Anterior Iliac Crest Bone Graft for Fracture Nonunion

Bryan J. Loeffler, MD; James F. Kellam, MD; Stephen H. Sims, MD; ***Michael J. Bosse, MD****;*
Department of Orthopaedic Surgery, Carolinas Medical Center, Charlotte, North Carolina, USA

See pages 75 - 103 for financial disclosure information.

Poster #87 (p. 340)

BMP-7 versus BMP-2 for the Treatment of Nonunion
Janet D. Conway, MD; *Stacy C. Specht, MPA; Alexandra Bauernschub;*
Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore, Baltimore, Maryland, USA

Poster #88 (p. 341)

Intramedullary Skeletal Kinetic Distractor (ISKD) for Posttraumatic Limb-Length Discrepancy
John E. Herzenberg, MD[1]; *Gaurav Jindal, MD*[2]; *Mohan V. Belthur, MD*[3]; *Dror Paley, MD*[4]; *Stacy C. Specht, MPA*[1];
[1]*Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore, Baltimore, Maryland, USA;*
[2]*Pushpanjali Crosslay Hospital, Ghaziabad, India;*
[3]*Texas Children's Hospital and Shriners Hospital for Children, Houston, Texas, USA;*
[4]*Paley Advanced Limb Lengthening Institute, St. Mary's Hospital, West Palm Beach, Florida, USA*

Poster #89 (p. 342)

Bilateral Transfemoral/Transtibial Amputations Due to Battle Injuries
Paul J. Dougherty, MD[1]; *Lynne V. McFarland, PhD*[2]; *Douglas G. Smith, MD*[3]; *Gayle Reiber, PhD*[2,3];
[1]*University of Michigan, Ann Arbor, Michigan, USA;*
[2]*Veteran's Administration Puget Sound Health Care System, Seattle, Washington, USA;*
[3]*University of Washington, Seattle, Washington, USA*

Poster #90 (p. 343)

•Comparison of Bone-Grafting Modalities for Surgical Revision of Fracture-Nonunions in Long Bones: A Retrospective Analysis of 152 Consecutive Patients
Michael A. Flierl, MD[1]; ***Philip F. Stahel, MD***[1]; *Allison E. Williams, ND, PhD*[2]; *Gabrielle Peacher, BA*[1]; *Erin E. Ross, BS*[1]; *Andrea J. Baron, MS*[1]; *Steven J. Morgan, MD*[1]; *Wade R. Smith, MD*[3];
[1]*Denver Health Medical Center, University of Colorado Denver, School of Medicine, Denver, Colorado, USA;*
[2]*Department of Veterans Affairs Eastern Colorado Health Care System, University of Colorado Denver, School of Medicine, University of Colorado College of Nursing, Denver, Colorado, USA;*
[3]*Geisinger Medical Center, Danville, Pennsylvania, USA*

Poster #91 (p. 345)

Single-Incision versus Dual-Incision Fasciotomy for Tibial Compartment Syndrome
Scott W. Zehnder, MD; *Michael R. Berry, MD; J. Tracy Watson, MD;*
Saint Louis University School of Medicine, Department of Orthopaedics, St. Louis, Missouri, USA

Poster #92 (p. 346)

Periosteal Fibular Bone Bridging (a Modified Ertl Procedure) for Transtibial Amputation
Steven J. Morgan, MD; *Chengla Yi, MD; Justin Newman, MD; Andrea J. Baron, MS;*
Denver Health Medical Center, Denver, Colorado, 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 413.

HIP AND FEMUR

Poster #93 (p. 347)

Cost Effectiveness Analysis of Implant Selection in the Treatment of Extracapsular Hip Fractures

Adam M. Kaufman, MD; *Richard C. Mather, MD; Lori Orlando, MD; Michael P. Bolognesi, MD; Steven A. Olson, MD; Robert D. Zura, MD;*
Duke University Hospital, Durham, North Carolina, USA

Poster #94 (p. 348)

Hip Fracture Fixation in Young Patients: Risk Factors for Failure

Joseph Aderinto, MD; ***Andrew D. Duckworth****; Simon J. Bennet; John F. Keating, MD;*
Edinburgh Orthopaedic Trauma Unit, Royal Infirmary of Edinburgh, Edinburgh, Scotland, United Kingdom

Poster #95 (p. 349)

Limb-Length Discrepancy in Comminuted Femoral Shaft Fractures following Intramedullary Nailing

Brent Anderson, DO; Anil Sethi, MD; Ashraf Elbanna, BS; Michael Liston, MD; Daniel Hoard, MD; ***Rahul Vaidya, MD****;*
Detroit Receiving Hospital, Detroit, Michigan, USA

Poster #96 (p. 350)

Complication Risk Following Treatment of Intracapsular and Extracapsular Hip Fractures in the Medicare Population

Arthur Malkani, MD[1]*; Colin Carroll[1]; [1]Craig S. Roberts, MD, MBA[1]; David Seligson, MD[1]; Edmund Lau, MS[2]; Judd Day, PhD[2]; Steven Kurtz, PhD[2]; Kevin Ong, PhD[2]*
[1]University of Louisville, Louisville, Kentucky, USA;
[2]Exponent, Inc, Philadelphia, Pennsylvania, USA

Poster #97 (p. 351)

Does Time and Type of Fixation Matter in Femoral Shaft Fractures?

Brandon T. Bruce, MD[1]*; Michael J. Bosse, MD[2]; Ron Sing, DO[2]; Andrea Maslow, BS[2];*
[1]University of Kentucky, Lexington, Kentucky, USA;
[2]Carolinas Medical Center, Charlotte, North Carolina, USA

Poster #98 (p. 353)

Transfer Patients Have Worse Observed and Expected Outcomes Compared to Nontransfer Patients After Treatment for Hip Fracture at a Regional Referral Center

Jimme K. Wiggers, MSc; Thierry G. Guitton, MSc; R. Malcolm Smith, MD; Mark S. Vrahas, MD; ***David C. Ring, MD, PhD****;*
Harvard Medical School, Orthopaedic Hand and Upper Extremity Service, Massachusetts General Hospital, Boston, Massachusetts, USA

Poster #99 (p. 354)

Does Late-Night Hip Surgery Affect Outcome?

Miguel A. Ramirez, MD; ***Edward K. Rodriguez, MD****; Lars C. Richardson, MD; Aron T. Chacko, BS; Paul T. Appleton, MD; Arun J. Ramappa, MD;*
Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts, USA

See pages 75 - 103 for financial disclosure information.

Poster #100 (p. 355)

Primary Determinants of Intraoperative Radiation Exposure during Proximal Femur Fracture Fixation

Michael Baratz, MD; Yue Yung Hu, MD; Aron T. Chacko, BS; Paul T. Appleton, MD; ***Edward K. Rodriguez, MD, PhD****;*
Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA

Poster #101 (p. 357)

Financial Sustainability of Orthopaedic Traumatology: Effects of Patient Complexity on Payer Mix and Reimbursement Rates for Femoral Fractures

Nickolas J. Nahm, BS; Brendan M. Patterson, MD; ***Heather A. Vallier, MD****;*
MetroHealth Medical Center, Cleveland, Ohio, USA

Poster #102 (p. 359)

Modifiable Postoperative Factors May Increase the Risk of Nonunion in Distal Femur Fractures Treated with Plate Fixation

Jonathan M. Gross, MD*; Fernando Serna, MD; Kyle Lybrand, BS; Xing Qiu, PhD; Catherine A. Humphrey, MD; John T. Gorczyca, MD;*
University of Rochester Medical Center, Rochester, New York, USA

Poster #103 (p. 360)

Help versus Harm? The Effect of Training Femoral Neck Screw Insertion Skills to Surgical Trainees with Computer-Assisted Surgery: Comparison to Conventional Fluoroscopic Technique

Markku T. Nousiainen, MS, MEd, MD, FRCS(C)[1]*; Patrick Zingg, MD[1]; Daniel Omoto, MD[1]; Heather Carnahan, PhD[2]; Yoram A. Weil, MD[3]; Hans J. Kreder, MPH, MD[1]; David L. Helfet, MD[4];*
[1]Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada;
[2]University of Toronto, Toronto, Ontario, Canada;
[3]Hadassah University Hospital, Jerusalem, Israel
[4]Hospital for Special Surgery, New York, New York, USA

Poster #104 (p. 361)

The Value of Washers in Internal Fixation of Femoral Neck Fractures with Cancellous Screws: A Biomechanical Evaluation

Michael Zlowodzki, MD[1]*; Coen A. Wijdicks, MSc[1]; Bryan M. Armitage, MD[2]; Peter A. Cole, MD[1];*
[1]University of Minnesota, Minneapolis, Minnesota, USA;
[2]University of Hawaii, Honolulu, Hawaii, USA

Poster #105 (p. 362)

Role of Blocking Screws in the Management of Aseptic Femoral Shaft Hypertrophic Nonunion: A Primary Report of 15 Cases

Qiugen Wang, MD; ***Jian Lin, MD****; Qiulin Zhang, MD; Xiaopeng Hu, MD; Peng Li, MD;*
The First People's Hospital Affiliated to Shanghai Jiaotong University, Shanghai, China

- 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 413.

Poster #106 (p. 363)

Does a Trochanteric Lag Screw Improve Fixation of Vertically Oriented Femoral Neck Fractures?

Michael A. Hawks, MD[1]; *Hyunchul Kim, MS*[2]; *Joseph E. Strauss, DO*[1]; *Bryant W. Oliphant, MD*[1]; *Robert D. Golden, MD*[1]; *Adam H. Hsieh, PhD*[2]; *Jason W. Nascone, 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]*Orthopaedic Mechanobiology Laboratory, Fischell Department of Bioengineering, University of Maryland, College Park, Maryland, USA*

Poster #107 (p. 364)

Does the Location of a Ballistic Femur Fracture Predict the Presence of Arterial Injury?

Leah Gitajn, BS; *Paul Perdue, BS; John Hardcastle, MD; Robert V. O'Toole, MD;*
R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland Medical School, Baltimore, Maryland, USA

INJURY PREVENTION

Poster #108 (p. 365)

Testing Tourniquet Application, Efficacy, and Failure

Claire F. Beimesch, MD; *Michelle Bramer, MD; David Hubbard, MD;*
West Virginia University Department of Orthopaedic Surgery, Morgantown, West Virginia, USA

Poster #109 (p. 366)

Effects of Computerized Physician Order Entry (CPOE) on Postoperative Antibiotic Administration Errors in Patients with Open and Closed Fractures

Michael J. Beltran, MD[1]; ***Cory A. Collinge, MD***[2];
[1]*US Army Institute of Surgical Research, San Antonio, Texas, USA;*
[2]*Harris Methodist Fort Worth Hospital, Fort Worth, Texas, USA*

Poster #110 (p. 367)

Δ Prevalence of Abuse and Intimate Partner Violence Surgical Evaluation (PRAISE): A Cross-Sectional Study at Two Fracture Clinics in Ontario

Mohit Bhandari,[1] *MD, for the PRAISE Investigators;* ***Emil H. Schemitsch, MD***;
[1]*McMaster University, Hamilton, Ontario, Canada*

Poster #111 (p. 368)

Are Certain Fractures at Increased Risk for Compartment Syndrome after Civilian Ballistic Injury?

Thomas Meskey, BS; *John Hardcastle, MD; Robert V. O'Toole, MD;*
R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland Medical School, Baltimore, Maryland, USA

Poster #112 (p. 369)

A Predictive Model for Surgical-Site Infection Risk after Surgery for High-Energy Lower Extremity Fractures

Ebrahim Paryavi, MD[1]; *Alec Stall, MD, MPH*[1]; *Rishi Gupta, MD*[1]; *Mary Zadnik Newell, OT*[1]; *Emily Hui, MPH*[1]; *Renan C. Castillo, PhD*[2]; *Daniel O. Scharfstein, ScD*[2]; *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]*Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA*

Δ OTA Grant

See pages 75 - 103 for financial disclosure information.

Poster #113 (p. 370)

Modern Perspective on the Epidemiology and Patterns of Musculoskeletal Motorcycle Injuries

Sean Burns, MD*; Zbigniew Gugala, MD, PhD; Carlos Jimenez, MD; William Mileski, MD; Ronald W. Lindsey, MD;*
University of Texas Medical Branch, Galveston, Texas, USA

PELVIS AND ACETABULUM

Poster #114 (p. 372)

Propensity for Hip Dislocation in Gait Loading versus Sit-to-Stand Maneuvers: Implications for Redefining the Functional Weight-Bearing Dome of the Acetabulum during Activities of Daily Living

Amir Matityahu, MD*; Erik McDonald; Jennifer M. Buckley, PhD; Meir Marmor, MD;*
University of California, San Francisco, San Francisco General Hospital, Orthopaedic Trauma Institute, San Francisco, California, USA

Poster #115 (p. 374)

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*; Michael Khazzam, MD; Gregory J. Della Rocca, MD, PhD, FACS; Yvonne M. Murtha, MD; James P. Stannard, MD;*
University of Missouri, Columbia, Missouri, USA

Poster #116 (p. 375)

Relationship of the Anterosuperior Aspect of the Sacroiliac Joint to S1 and Resultant Placement of Iliosacral Screws

Brian M. Tonne, MD*; John H. Wilber, MD;*
Metrohealth Medical Center, Cleveland, Ohio, USA

Poster #117 (p. 376)

Evaluation of the Use of C-Arm–Based Flat-Panel Technology in 3D Navigation in Comparison to 2D Navigation and Conventional Technique in Transiliosacral Screw Placement

Daniel Behrendt, MD[1]*; Joerg Boehme, MD[1]; Maria Mütze, MD[1]; Martin Koestler[2]; Hanno Steinke, PhD[3]; Christoph Josten, PhD[3];*
[1]Department of Trauma, Reconstructive and Plastic Surgery, University of Leipzig, Leipzig, Germany;
[2]BrainLAB AG, Feldkirchen, Germany;
[3]Institut of Anatomy, University of Leipzig, Leipzig, Germany

Poster #118 (p. 377)

Randomized Clinical Trial Comparing Pressure Characteristics of Pelvic Circumferential Compression Devices

Simon P. Knops, MSc*; Esther M.M. van Lieshout, PhD; W. Richard Spanjersberg, MD; Peter Patka, MD, PhD; Inger B. Schipper, MD, PhD;*
Department of Surgery-Traumatology, Erasmus MC, University Medical Center Rotterdam, Rotterdam, The Netherlands

- 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 413.

Poster #119
(p. 379)

Risk Factors Predisposing to Postoperative Infection after Pelvic/Acetabular Surgery

Daniel R. Dziadosz, MD*; Hassan R. Mir, MD; Cody Olson, DO; M. Principe; Henry Claude Sagi, MD;*
Orthopaedic Trauma Service, Tampa General Hospital, Tampa, Florida, USA

Poster #120
(p. 380)

Does Pain Correlate with Patient-Based Functional Outcome Scores after Pelvic and Acetabular Fractures?

Paul Tornetta, III, MD[1]*; Gillian L. Sembler Soles, MD[1]; Clifford B. Jones, MD[2]; Debra L. Sietsema, PhD, RN;*
[1]Boston University Medical Center, Boston, Massachusetts, USA;
[2]Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA

Poster #121
(p. 381)

Predicting Blood Loss and Cell Saver Utility in Acetabular Fracture Surgery

Richard J. Jenkinson, MD*; Elliott Pally, MD; Andrew Urmson, MD; Robert Korley, MD; Hans J. Kreder, MD; David J.G. Stephen, MD;*
Sunnybrook Health Sciences Center, University of Toronto, Toronto, Ontario, Canada

Poster #122
(p. 383)

Financial Impact of Operative Pelvic and Acetabular Trauma to a Level 1 Trauma Center

Jesse T. Torbert, MD, MS; Michael Mercincavage; ***Samir Mehta, MD****;*
University of Pennsylvania, Philadelphia, Pennsylvania, USA

Poster #123
(p. 384)

Stress Radiograph to Detect the True Extent of Symphyseal Disruption in Presumed Anteroposterior Compression Type I Pelvic Injuries

Takashi Suzuki, MD[1]; Steven J. Morgan, MD[2]; Wade R. Smith, MD[3]; Philip F. Stahel, MD[2]; ***David J. Hak, MD[2]****;*
[1]Kitasato University Hospital, Sagamihara, Kanagawa, Japan;
[2]Denver Health Medical Center, Denver, Colorado, USA;
[3]Geisinger Medical Center, Danville, Pennsylvania, USA

Poster #124
(p. 385)

Trends in Survival after Complex Pelvic Trauma: Results of a Nationwide Pelvic Registry

Timothy Pohlemann, MD[1]*; Dirk Stengel, MD[2]; Florian Stuby, MD[3]; Georgios Tosounidis, MD[1]; Ulrich Stöckle, MD[4]; Hagen Schmal, MD[5]; Andreas Seekamp, MD[6]; Ulf Culemann, MD[1];*
[1]Department of Trauma, Hand and Reconstructive Surgery, Saarland University, Saarbrücken, Germany;
[2]Center for Clinical Studies, University of Greifswald, Greifswald, Germany;
[3]Department of Trauma and Orthopaedic Surgery, Berufsgenossenschaftliche Unfallklinik, Tübingen, Germany;
[4]Department of Trauma and Orthopaedic Surgery, Technical University of Munich, Munich, Germany;
[5]Department of Trauma and Orthopaedic Surgery, University of Freiburg, Freiburg, Germany;
[6]Department of Traumatology, University of Schleswig-Holstein, Kiel, Germany

See pages 75 - 103 for financial disclosure information.

Poster #125 (p. 386)

Long-Term Sexual Dysfunction following Surgically Treated Displaced Pelvic Ring Injuries

Koye Odutola, MD; Richard Baker, MD; Jeremy Loveridge, MD; Rebecca Fox; M. Kelly; Anthony J. Ward, MD; ***Tim J.S. Chesser, MD***
Pelvic and Acetabular Reconstruction Unit, Frenchay Hospital, North Bristol NHS Trust, Bristol, United Kingdom

Poster #126 (p. 387)

The Fate of Plate Fixation of the Symphysis Pubis in Anterior Pelvic Ring Injuries

Stephen A.C. Morris, MD; Jeremy Loveridge, MD; Alex Torrie, MD; David Smart, MD; Richard Baker, MD; A. Oppy; Anthony J. Ward, MD; ***Tim J.S. Chesser, MD****;*
Pelvic and Acetabular Reconstruction Unit, Frenchay Hospital, North Bristol NHS Trust, Bristol, United Kingdom

Poster #127 (p. 388)

Anatomic Description Is More Reliable for Pelvic Fractures When Orthopaedic Surgeons in the Community Communicate with Fellowship-Trained Orthopaedic Traumatologists

Utku Kandemir, MD*; Benjamin Busfield, MD; Todd Kim, MD; Akin Cil, MD; Murat Pekmezci, MD; Tigist Belaye, BS; Amir Matityahu, MD;*
Department of Orthopaedic Surgery, University of California San Francisco, San Francisco, California, USA

Poster #128 (p. 389)

Is There a Relationship Between Pregnancy Hormones and Heterotopic Ossification Prevention?

Waleed F. Mourad, MD, MSc[1]*; Satya Packianathan, MD, PhD[1]; Walid Waked, MD[1]; Rania Shourbaji, BS[2]; Zhen Zhang, MS[1]; Majid Khan, MD[1]; Matt L. Graves, MD[1]; George Russell, MD;*
[1]University of Mississippi Medical Center, Jackson, Mississippi, USA;
[2]Jackson State University, Jackson, Mississippi, USA

Poster #129 (p. 390)

The Effect of Time on the Incidence of Heterotopic Ossification

Waleed F. Mourad, MD, MSc[1]*; Satya Packianathan, MD, PhD[1]; Walid Waked, MD[1]; Rania Shourbaji, BS[2]; Zhen Zhang, MS[1]; Majid Khan, MD[1]; Matt L. Graves, MD[1]; George Russell, MD;*
[1]University of Mississippi Medical Center, Jackson, Mississippi, USA;
[2]Jackson State University, Jackson, Mississippi, USA

Poster #130 (p. 391)

Pelvic Crescent Fracture: Radiographic Variation and its Implication in Treatment Options

Zhiqing Xing, MD*; Rick J. Gehlert, MD; Thomas A. DeCoster, MD;*
Department of Orthopaedics and Rehabilitation, University of New Mexico, Albuquerque, New Mexico, 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 413.

SCIENTIFIC POSTERS

SPINE

Poster #131 (p. 393)

Current Approach to Cervical Spine Clearance in the United States: A National Survey

__Murat Pekmezci, MD__; Thomas Philips, MD; Geoffrey Manley, MD; R. Trigg McClellan, MD;
University of California San Francisco, San Francisco General Hospital, San Francisco, California, USA

HAITI

Poster #132 (p. 394)

Pelvic Fracture Experience from the Haitian Earthquake

__Christiaan N. Mamczak, DO, LCDR, MC, USN__[1]; Lawrence B. Bone, MD[2]; Brendan M. Patterson, MD[3]; Roman Hayda, COL(Ret), MD[4];
[1]Naval Medical Center Portsmouth, Portsmouth, Virginia, USA;
[2]SUNY-Buffalo Medical Center, Buffalo, New York, USA;
[3]Metro Health Medical Center, Cleveland, Ohio, USA;
[4]Brown University, Providence, Rhode Island, USA

Poster #133 (p. 395)

Immediate Medical Response to the Haiti Earthquake: The Experience of One Team to a Humanitarian Disaster

Neil MacIntyre, MD; __Devon Jeffcoat, MD__; Dan Chan, MD; Florian Huber, MD; Dean G. Lorich, MD; David L. Helfet, MD;
Hospital for Special Surgery, New York, New York, USA

Poster #134 (p. 396)

Haitian Earthquake Relief: Orthopaedic Care Aboard the USNS *Comfort*

__Christiaan N. Mamczak, DO, LCDR, MC, USN__;
Naval Medical Center Portsmouth, Portsmouth, Virginia, USA

Poster #135 (p. 397)

•Reduction of Shortened Malreduced Subacute Femur Fractures in Post-Earthquake Haiti

__Coy Allen Wright, MD__; Mark Rahm, MD; William Hamilton, MD;
Scott and White Healthcare/Texas A&M Health Science Center, Temple, Texas, USA

Poster #136 (p. 398)

Complications Associated with Nonoperative Management of Femur Fractures and Unstable Thoracolumbar Injuries in Post-Earthquake Haiti

__Coy Allen Wright, MD__; Bryce Allen, MD; Richard Barber, MD; Christopher Chaput, MD;
Scott & White Memorial Hospital, Temple, Texas, USA

Poster #137 (p. 399)

Rapid and Sustained Medical Relief to Haiti: Establishment of a University Field Hospital

__Stephen M. Quinnan, MD__; Greg Gaski, MD; Chris Boullion, DO; Zakariah Mahmood, MD; Gregory Zych, DO; Fernando Vilella, MD; Eric Schiffman, MD; John Wang, MD;
University of Miami/Jackson Memorial Hospital, Miami, Florida, USA

See pages 75 - 103 for financial disclosure information.

Poster #138 (p. 400)

Management of Earthquake Victims: 14 Days in Haiti

Keith Antonangeli, ST[1]; Nathaly Arredondo, RN[2]; Heather Bedlion, RN[3]; Akshay Dalal, MD[1]; Grace M. Deveny, RN[1]; George S.M. Dyer, MD[3]; Mitchell B. Harris, MD[3]; Giliane Joseph, MD[4]; Denise Lauria, RN[1]; Sergeline Lucien, RN[3]; Sarah Marsh, RN[5]; Selwyn O. Rogers, Jr, MD, MPH[3]; Henry Salzarulo, MD[6]; Sachita M. Shah, MD[7]; ***Raymond M. Smith, MD[1]****; R. James Toussaint, MD[1]; Judy Wagoner, RN[8];*
[1]Massachusetts General Hospital, Boston, Massachusetts, USA;
[2]Lakeland Regional Medical Center, Lakeland, Florida;
[3]Brigham and Women's Hospital, Boston, Massachusetts, USA;
[4]Albert Einstein Hospital, Bronx, New York, USA;
[5]Partners in Health, Boston, Massachusetts, USA;
[6]Blue Ridge Surgery Center, Seneca, South Carolina, USA;
[7]Rhode Island Hospital, Providence, Rhode Island, USA;
[8]Beth Israel Deaconess Hospital, Boston, Massachusetts, USA

Poster #139 (p. 402)

The American Orthopaedic Response to the 2010 Haiti Earthquake: The First 30 Days

Thomas M. Penoyar, MD; ***Amber M. Caldwell, BA****; Ralph R. Coughlin, MD; Richard Gosselin, MD;*
Institute for Global Orthopaedics and Traumatology, San Francisco, California, USA

Poster #140 (p. 403)

Coordinated Trauma Care for the Haitian Earthquake Victims by the Georgia Orthopaedic Society

Douglas W. Lundy, MD[1]*; Steve McCollam, MD[2]; Danny Guy, MD[3]; Obinwanne Ugwonali, MD[2]; Douglas H. Murray, MD[2];*
[1]Resurgens Orthopaedics, Marietta, Georgia, USA;
[2]Peachtree Orthopaedic Clinic, Atlanta, Georgia, USA;
[3]Southern Center for Orthopedics, Lagrange, Georgia, USA

Poster #141 (p. 404)

Haiti 2010: An Orthopedic Resident's Perspective on a Successful Medical Mission

Leroy Rise, MD*; Jaymes Granata, MD;*
The Ohio State University Medical Center, Columbus, Ohio, USA

(p. 405)

BEST TRAUMA RELATED POSTER - 2010 ORS MEETING: Prognosticating Acetabular Fractures Using CT Analysis

Michael Kreder[1]; David Wright[1]; Cari M. Whyne, PhD[1,2]; Hans Kreder[2]; Alex Kiss; Omri Lubovsky, PhD[2];
[1]Orthopaedic Biomechanics Laboratory,
[2]Division of Orthopaedics,
Sunnybrook Health Science Centre, Toronto, Ontario, Canada

- 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 413.

Achor, Tim . . . . . . *(n)* . . . . . . Paper #45
Ademi, Arben . . . . . . *(n)* . . . . . . Paper #43
Aderinto, Joseph . . . . . . *(n)* . . . . . . Poster #94
Adili, Anthony . . . . . . *(n)* . . . . . . Poster #32
Agarwal, Animesh . . . . . . *(3B-Medtronic, Smith & Nephew, Synthes, Acrymed)* . . . . . . OTA Committee
Agel, Julie . . . . . . *(n)* . . . . . . Poster #39
Ahmadinia, Kasra . . . . . . *(n)* . . . . . . Paper #76
Ahn, Jaimo . . . . . . *(n)* . . . . . . Paper #45
Ain, Michael C. . . . . . . *(1-LANX; 2-Stryker; 3B,6-Stryker)* . . . . . . Paper #62
Akkarapaka, Naresh . . . . . . *(Ci-Doctors Research Group)* . . . . . . Poster #21
Alam, Sartaj . . . . . . *(n)* . . . . . . Paper #68
Alander, Dirk . . . . . . *(n)* . . . . . . Paper #83
Allen, Bryce . . . . . . *(n)* . . . . . . Poster #136
Althausen, Peter L. . . . . . . *(n)* . . . . . . OTA Committee; Paper #67; Poster #34
Amanatullah, Derek . . . . . . *(n)* . . . . . . BSFF Paper #6
Altman, Gregory T. . . . . . . *(5-Synthes)* . . . . . . Lab Faculty
Ambrose, Catherine G. . . . . . . *(5-Stryker; 6-Biomet)* . . . . . . Paper #68
Andersen, Romney C. . . . . . . *(n)* . . . . . . BSFF Faculty; Mini Symposium Moderator; Paper #72
Anderson, Brent . . . . . . *(n)* . . . . . . Poster #95
Anderson, John G. . . . . . . *(1-Innomed; 2-MMI, Stryker; 4-Pfizer; 5-Biomimetic)* . . . . . . Poster #44
Anglen, Jeffrey O. . . . . . . *(1-Biomet)* . . . . . . Mini Symposium Faculty
Antonangeli, Keith . . . . . . *(n)* . . . . . . Poster #138
Appleton, Paul T. . . . . . . *(n)* . . . . . . Posters #45, 99, 100
Archdeacon, Michael T. . . . . . . *(2-Smith & Nephew, AO North America; 2,3B,6-Stryker, 3B-CardioMEMS; 7-SLACK Incorporated)* . . . . . . Mini Symposium Faculty; Poster #54
Archer-Swygert, Kristin . . . . . . *(n)* . . . . . . Paper #65
Argintar, Evan Henry . . . . . . *(n)* . . . . . . Poster #6
Armitage, Bryan M. . . . . . . *(n)* . . . . . . Poster #104
Arredondo, Nathaly . . . . . . *(n)* . . . . . . Poster #138
Assal, Mathieu . . . . . . *(n)* . . . . . . Poster #35
Atesok, Kivanc I. . . . . . . *(n)* . . . . . . BSFF Paper #10
Axelrad, T. William . . . . . . *(n)* . . . . . . Papers #41, 49
Azer, Emil . . . . . . *(n)* . . . . . . Poster #28

Disclosure – *OTA online submission*:
A= Royalties from a company or supplier; B= Speakers bureau/paid presentations; Ci= Paid employee for a company or supplier; Cii= Paid consultant for a company or supplier; Ciii= Unpaid consultant for a company or supplier; D= Other financial or material support from a company or supplier; E= Stock or stock options in a company or supplier; F= Self/family research support from a company or supplier; G= Departmental research support from a company or supplier; H= Other financial/material support from publishers; I= Self/family research support from publishers; J= Departmental research support from publishers.

Disclosure – *Items Answered through AAOS:*
(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. For full information, refer to pages 415 - 416.

DISCLOSURE LISTING – ALPHABETICAL

Babal, Jessica C.	*(n)*	Poster #74
Baker, Charlie	*(Ci,E-Smith & Nephew)*	BSFF Paper #8
Baker, Richard	*(n)*	Posters #125, 126
Baldwin, Keith	*(n)*	Poster #72
Banerjee, Rahul	*(5-Synthes, Smith & Nephew, Medtronic, Stryker; 7-Elsevier)*	Poster #51
Baratz, Michael	*(n)*	Poster #100
Barber, Richard	*(n)*	Poster #136
Barei, David P.	*(2,3B,5-Synthes; 2,5-Zimmer)*	OTA Committee; Case Presentation Moderator; Paper #54
Barkhausen, Tanja	*(n)*	BSFF Paper #20
Baron, Andrea J.	*(n)*	Posters #90, 92
Barrette-Grishow, M. K.	*(n)*	Poster #1
Bass, Alfie	*(n)*	Paper #63
Bauer, Brent J.	*(n)*	Paper #25
Bauernschub, Alexandra	*(G-Medtronic)*	Poster #87
Beauchamp, Kathryn M.	*(n)*	Paper #85
Beaumont, Eric	*(n)*	Poster #17
Beaumont, Pierre	*(n)*	Poster #17
Beaupre, Lauren	*(n)*	Paper #44
Bechtel, Christopher	*(n)*	Posters #56, 57
Becker, Edward H.	*(n)*	Poster #55
Bedlion, Heather	*(n)*	Poster #138
Beebe, Michael J.	*(n)*	Poster #70
Beeres, Frank J.P.	*(n)*	Poster #8
Behrendt, Daniel	*(G-Ziehm Imaging, Nürnberg, Germany; Brainlab AG Feldkirchen Germany)*	Poster #117
Beimesch, Claire F.	*(G-H&H Associates, Omega, OREF)*	Poster #108
Beingessner, Daphne M.	*(B,5-Synthes)*	Poster #39
Belaye, Tigist	*(n)*	Poster #127
Belthur, Mohan V.	*(n)*	Posters #71, 88
Beltran, Michael J.	*(n)*	Poster #109
Benirschke, Stephen K.	*(3C-Synthes, Zimmer)*	Case Presentation Faculty; Poster #39
Bennet, Simon J.	*(n)*	Poster #94
Bergmann, Karl	*(n)*	Poster #76
Berry, Michael R.	*(n)*	Poster #91
Bertumen, J. B.	*(n)*	Paper #71
Bessems, Gert	*(n)*	Poster #4

Disclosure – *OTA online submission*:
A= Royalties from a company or supplier; B= Speakers bureau/paid presentations; Ci= Paid employee for a company or supplier; Cii= Paid consultant for a company or supplier; Ciii= Unpaid consultant for a company or supplier; D= Other financial or material support from a company or supplier; E= Stock or stock options in a company or supplier; F= Self/family research support from a company or supplier; G= Departmental research support from a company or supplier; H= Other financial/material support from publishers; I= Self/family research support from publishers; J= Departmental research support from publishers. For full information, refer to pages 415 - 416.

Bhandari, Mohit .... *(3B,5-Stryker, Smith & Nephew;* ....OTA Committee;
3B-Eli-Lilly, Pfizer, Amgen; .... Posters #32, 63, 69,
5-AO Foundation, OTC Foundation) 80, 110
Bledsoe, J. Gary .... *(n)*.....................................Paper #32
Blomfeldt, Richard .... *(n)*.....................................Paper #42
Boardman, Matthew .... *(n)*.................................BSFF Paper #2
Böhme, Jöerg................ *(G-Ziehm Imaging, Nürnberg, Germany;*
Brainlab AG Feldkirchen Germany) .... Poster #117
Bohay, Donald R. .... *(2,3B,4-Osteotech, Stryker;*
4-Osteotech Biomemetic; 2,3B,4,5-MMI)....... Poster #44
Bojan, Alicja .... *(n)*..................................... Poster #32
Bolognesi, Michael P.......... *(B-Zimmer; Cii-Zimmer, BioMet, Total Joint*
Orthopaedics; Ciii-Amedica; G-Zimmer, DePuy,
Wright Medical; I-Journal of Arthroplasty) ..... Poster #93
Bone, Lawrence B. .... *(n)*.................................... Poster #132
Bor, Noam .... *(n)*..................................... Poster #71
Boraiah, Sreevathsa .... *(n)*.................................Posters #50, 58
Born, Christopher T........... *3B,4-Illuminoss; 3B,5-Stryker;* .... OTA Board;
3C,4-Biointraface) .... Symposium Moderator
Borrelli, Joseph .... *(Cii,G-Wright Medical Technology)* ......OTA Committee;
.... Moderator; BSFF Moderator;
.... Case Presentation Faculty; Paper #55
Boskey, Adele L.............. *(n)* ....Paper #38
Bosse, Michael J.............. *(n)*............. BSFF Moderator; Symposium Faculty;
.... Case Presentation Faculty;
.................................Posters #68, 86, 97
Bottlang, Michael .... *(1,2-Synthes;1,2,3B-Zimmer)* .... Poster #18
Boullion, Chris .... *(n)* .... Poster #137
Bowman, Eric N. .... *(n)*..................................... Poster #73
Boyden, Eric M. .... *(n)*..................................... Poster #34
Brady, Megan .... *(n)*..................................... Poster #41
Bramer, Michelle .... *(G-H&H Associates, Omega, OREF)* .... Poster #108
Bray, Timothy J. .... *(6-Synthes, Smith & Nephew,* .... OTA President;
Renown Regional Medical Center ....OTA Committee;
Institutional Trauma .... Symposium Faculty;
Fellowship Support).............. Paper #67; Poster #34
Breitbart, Eric A. .... *(n)*.....................................Paper #35
Brennan, Kindyle .... *(n)*..................................... Poster #24
Brennan, Michael L. .... *(n)*..................................... Poster #24
Brianza, Stefano .... *(n)*..................................... Poster #25
Brink, Ole .... *(n)*..................................... Poster #32
Brink, P.R.G. .... *(n)*..................................... Poster #30

Disclosure – *Items Answered through AAOS:*
(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. For full information, refer to pages 415 - 416.

DISCLOSURE LISTING – ALPHABETICAL

Brokaw, David	*(n)*	Poster #41
Brown, Kate V.	*(n)*	BSFF Paper #13
Broyles, Justin	*(n)*	Paper #68
Bruce, Brandon T.	*(n)*	Poster #97
Brunnemer, Ulf	*(n)*	BSFF Paper #20
Buch, Barbara D.	*(n)*	BSFF Moderator; BSFF Faculty
Bucheit, James	*(n)*	Paper #32
Buckley, Jennifer M.	*(n)*	Posters #11, 114
Buckley, Richard E.	*(n)*	Mini Symposium Faculty
Bühren, Volker	*(n)*	Paper #84
Buijze, Geert A.	*(n)*	Poster #8
Burden, Robert L. Jr,	*(n)*	BSFF Paper #14
Burgers, Travis A.	*(n)*	Poster #15
Burns, Sean	*(n)*	Poster #113
Burstein, Deborah	*(n)*	BSFF Faculty
Busfield, Benjamin T.	*(n)*	Poster #127
Bushelow, Michael	*(3A-Synthes Spine)*	BSFF Faculty
Busse, Jason W.	*(5-Smith & Nephew)*	Poster #63
Butler, Alison	*(n)*	BSFF Paper #16
Butterworth, Ryan	*(n)*	Poster #85
Calbucci, Lucia	*(n)*	Poster #23
Caldwell, Amber M.	*(n)*	Poster #139
Callaci, John	*(n)*	BSFF Paper #21
Canadian Orthopaedic Trauma Society	*(n)*	Paper #48; Poster #46
Cannada, Lisa K.	*(5-Zimmer, Synthes)*	Case Presentation Moderator; Paper #32; Poster #61
Carew, John D.	*(n)*	Poster #68
Carlini, Anthony	*(n)*	Paper #72
Carnahan, Heather	*(n)*	Poster #103
Carney, Joseph	*(n)*	Poster #67
Carroll, Colin	*(n)*	Paper #40; Poster #96
Carroll, Eben A.	*(n)*	Poster #61
Carson, Jeffrey L.	*(n)*	Paper #44
Carson, William	*(n)*	BSFF Paper #4; Poster #29
Cartner, Jacob L.	*(Ci-Smith & Nephew)*	BSFF Papers #1, 5, 8, 9; Paper #33
Castellani, Christoph	*(n)*	Paper #24
Castillo, Renan C.	*(n)*	Papers #71, 75; Posters #5, 52, 83, 112
Chacko, Aron T.	*(n)*	Posters #45, 99, 100
Chan, Dan	*(n)*	Poster #133
Chan, Daniel S.	*(n)*	Lab Faculty

Disclosure – *OTA online submission*:
A= Royalties from a company or supplier; B= Speakers bureau/paid presentations; Ci= Paid employee for a company or supplier; Cii= Paid consultant for a company or supplier; Ciii= Unpaid consultant for a company or supplier; D= Other financial or material support from a company or supplier; E= Stock or stock options in a company or supplier; F= Self/family research support from a company or supplier; G= Departmental research support from a company or supplier; H= Other financial/material support from publishers; I= Self/family research support from publishers; J= Departmental research support from publishers.
For full information, refer to pages 415 - 416.

Chaput, Christopher D.	*(2-Globus Medical; 3B,5-DePuy, A Johnson & Johnson Company; 3C-Link Orthopaedics; 5-Stryker, Nuvasive, Spine Guard)*	Posters #24, 136
Cheng, Stephanie Y.	*(n)*	Paper #47
Chesser, Tim J. S.	*(Cii-Stryker)*	Posters #125, 126
Choplin, Robert H.	*(G-Wright Medical Technology)*	Paper #55
Christian, Jennifer	*(n)*	Poster #72
Christofilopoulos, Laurent-Panayiotis	*(n)*	Posters #33, 35
Chu, Constance R.	*(n)*	BSFF Faculty
Chu, T. Gabriel	*(n)*	BSFF Paper #11
Cil, Akin	*(n)*	Poster #127
Cloutier, Fredric-Charles	*(n)*	Poster #17
Cohen, Mark S.	*(3B-Mylad)*	Poster #7
Cole, Peter A.	*(3B,5-Synthes; 5-DePuy, A Johnson & Johnson Company)*	Paper #26; Poster #104
Coll, Daniel J.	*(n)*	Paper #67; Poster #34
Collinge, Cory A.	*(n)*	Poster #109; Lab Faculty
Como, John	*(n)*	Paper #64
Coniglione, Franco M.	*(n)*	Paper #77
Conway, Janet D.	*(G-Medtronic)*	Poster #87
COTS Group	*(n)*	Paper #59
Coughlin, Ralph R..	*(n)*	Poster #139
Coulibaly, Marlon O.	*(n)*	Paper #29; Posters #15, 44
Cranston, William C.	*(n)*	Poster #13
Creek, Aaron T.	*(n)*	Poster #70
Creevy, William R.	*(n)*	Papers #41, 49, 73
Crist, Brett D.	*(4-Amedica Corporation; 5-KCI, Medtronic, Novalign, Smith & Nephew, Stryker, Synthes, Wound Care Technologies)*	BSFF Paper #4; Posters #26, 29, 115
Cross, Jessica D.	*(n)*	Paper #37, Poster #77
Crous, Robert	*(n)*	Paper #34
Culemann, Ulf	*(n)*	Poster #124
Cureton, Beth Ann	*(n)*	Paper #57
Curtiss, Shane	*(n)*	BSFF Paper #6
D'Alleyrand, Jean-Claude G.	*(n)*	Paper #71
Dalal, Akshay	*(n)*	Poster #138
Dancy, Lindsay	*(n)*	Papers #71, 75
David, Bertrand	*(n)*	BSFF Paper #15
Davidovitch, Roy I.	*(n)*	Paper #28; Posters #53, 62
Day, Judd	*(3A-Exponent, Inc.; 6-Stryker; Zimmer)*	Poster #96
Day, Michael	*(n)*	Paper #33

Disclosure – *Items Answered through AAOS:*
(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. For full information, refer to pages 415 - 416.

DISCLOSURE LISTING – ALPHABETICAL

de Ridder, Victor A.	*(n)*	OTA Committee; Moderator; Paper #36; Poster #4
DeAngelis, Joseph P.	*(3B-Connective Orthopaedics)*	Paper #43
DeCoster, Thomas A.	*(n)*	Poster #130
Dehaan, Alex	*(n)*	Paper #41
Della Rocca, Gregory J.	*(5-Synthes, Smith & Nephew, Kinetic Concepts, Inc., Medtronic, Stryker)*	OTA Committee; BSFF Paper #4; Posters #26, 29, 115
DeLong, William G.	*(n)*	BSFF Faculty; Symposium Faculty
Denard, Patrick J.	*(n)*	Poster #18
Dent, Ricardo	*(Ci-Employee of Amgen Inc; E-tockholder of Amgen Inc)*	BSFF Faculty; Posters #69, 80
Desai, Sagar J.	*(D-Smith & Nephew)*	BSFF Paper #7
DeSilva, Gregory L.	*(4-Pfizer)*	Mini Symposium Moderator
DeSilva, Stephen D.	*(n)*	Mini Symposium Faculty
Deveny, Grace M.	*(n)*	Poster #138
Dietz, Adam R.	*(n)*	Paper #75
Dickson, Kyle F.	*(n)*	Lab Faculty
DiPasquale, Thomas G.	*(1,7-Biomet; 2-Smith & Nephew; 2,3C-Synthes; 3C,5-Stryker)*	Paper #81
Diwan, Amna	*(n)*	Poster #45
Dombroski, Derek	*(n)*	Paper #50
Donken, Christian	*(n)*	Poster #38
Donnelly, Eve	*(n)*	Paper #38
Doornberg, Job N.	*(n)*	Posters #3, 16
Doornink, Josef	*(n)*	Poster #18
Dougherty, Paul J.	*(n)*	OTA Committee; Poster #89
Doukas, William C.	*(n)*	Paper #72
Dreese, James C.	*(n)*	Poster #55
Duckworth, Andrew D.	*(n)*	Poster #94
Duffy, Paul.	*(n)*	Lab Faculty
Dunbar, Robert P.	*(n)*	OTA Committee
Dy, Christopher	*(n)*	BSFF Paper #3
Dyer, George S.M.	*(n)*	Poster #138
Dyke, Jonathan P.	*(n)*	Poster #36
Dziadosz, Daniel R.	*(n)*	Poster #119
Eberson, Craig	*(n)*	Poster #72
Edwards, Scott G.	*(3B-Medartis; 4,5-Mylad; 5-Synthes, Zimmer, Acumed, ITS, Stryker; 7-Elsevier)*	Lab Faculty; Posters #6, 7
Eglseder, W. Andrew	*(2,3B-Mylad Orthopedic Solutions LLC)*	Paper #25; Poster #5

Disclosure – *OTA online submission*:
A= Royalties from a company or supplier; B= Speakers bureau/paid presentations; Ci= Paid employee for a company or supplier; Cii= Paid consultant for a company or supplier; Ciii= Unpaid consultant for a company or supplier; D= Other financial or material support from a company or supplier; E= Stock or stock options in a company or supplier; F= Self/family research support from a company or supplier; G= Departmental research support from a company or supplier; H= Other financial/material support from publishers; I= Self/family research support from publishers; J= Departmental research support from publishers. For full information, refer to pages 415 - 416.

Egol, Kenneth A.	*(3C-Exactech, Inc; 4-Johnson & Johnson, Surgix Inc; 5-Biomet, Stryker, Synthes; 7-SLACK Incorporated, Wolters Kluwer Health - Lippincott Williams & Wilkins)*	OTA Committee; Moderator; Lab Faculty; Papers #28, 30; Posters #9, 10, 53, 6, 57, 62
Einhorn, Thomas A.	*(1-Osteotech; 2-Smith & Nephew; 3B-Smith & Nephew, Lilly, Anika; 4-Osteogenix, Biomineral Holdings, Healthpoint Capital, Implant Protection; 7-Journal of Bone and Joint Surgery–American, Lippincott Williams and Wilkins, Elsevier)*	BSFF Faculty BSFF Moderator;
Ekholm, Carl	*(n)*	Poster #32
Elbanna, Ashraf	*(n)*	Poster #95
Elcharaani, Bilal	*(n)*	BSFF Paper #16
Eliazar, Edmund	*(n)*	Lab Faculty
Ellis, Henry	*(n)*	Paper #60
Ellis, Thomas J.	*(1-Acute Innovations; 3B,5-Stryker)*	OTA Committee
Ely, E. Wesley	*(n)*	Paper #65
Endres, Terrence J.	*(n)*	Paper #29
Enocson, Anders	*(n)*	Paper #42
Ervin, Bain	*(n)*	Paper #34
Esterhai, John	*(n)*	Paper #50
Evans, Jason M.	*(n)*	Poster #39
Fahnhorst, Courtney B.	*(n)*	Paper #32
Fayad, Laura	*(n)*	BSFF Faculty
Fellars, Todd	*(n)*	Poster #67
Ferguson, Tania A.	*(2-DePuy, A Johnson & Johnson Co.; 5-Stryker).*	Case Presentation Faculty
Ferreira, Louis	*(n)*	BSFF Paper #7
Ficke, James R.	*(n)*	Paper #72; Poster #77; Symposium Faculty
Fitzpatrick, Daniel C.	*(1-Zimmer; 1,2,3B-Synthes CMF)*	Poster #18
Flierl, Michael A.	*(n)*	Paper #85; Poster #90
Flinterman, Hendrik Jan	*(n)*	Poster #3
FLOW Pilot Study Investigators	*(n)*	Poster #79
FOCUS Investigators	*(n)*	Paper #44
Fox, Rebecca	*(n)*	Poster #125
Franzus, Martin	*(n)*	Poster #21
French, Bruce G.	(*3B-Biomet)*	OTA Committee
Frick, Steven L.	(*5-Biomet)*	Moderator
Frink, Michael	*(n)*	BSFF Paper #20
Furbee, Christopher	*(n)*	Poster #13

Disclosure – *Items Answered through AAOS:*
(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. For full information, refer to pages 415 - 416.

DISCLOSURE LISTING – ALPHABETICAL

Gage, Mark	*(n)*	Posters #9, 10
Gandhi, Ankur	*(n)*	Paper #35
Gandhi, Rajesh R.	*(n)*	Poster #81
Ganey, Timothy	*(D-Grant from Doctors Research Group; E-Doctors Research Group)*	Poster #21
Gao, Chan	*(n)*	BSFF Paper #16
Gardner, Michael J.	*(3B-DGIMed; 3B,5-Synthes; 7-Lippincott Williams & Wilkins)*	OTA Committee; Moderator; Case Presentation Moderator; Papers #46, 54, 73; Poster #49
Garrison, Robert L..	*(n)*	Poster #85
Gaski, Greg	*(n)*	Poster #137
Gauger, Erich M.	*(n)*	Paper #26
Gebhard, Florian	*(n)*	Paper #27; Poster #25
Gebuhr, Peter	*(n)*	Poster #27
Gehlert, Rick J.	*(n)*	Poster #130
Gestring, Mark	*(n)*	Poster #78
Getz, Stanley B.	*(n)*	Poster #68
Geusens, Piet P.	*(n)*	Poster #30
Giannini, Sandro	*(n)*	Poster #23
Giannoudis, Peter V.	*(n)*	BSFF Moderator; BSFF Faculty; Mini Symposium Faculty; Poster #66
Gilbert, Shawn R.	*(n)*	BSFF Paper #11
Giles, Josh	*(n)*	BSFF Paper #7
Gitajn, Leah	*(n)*	Poster #107
Gladnick, Brian P.	*(n)*	Paper #38
Glasgow, Donald L.	*(n)*	Paper #54
Gokce, Yildirim	*(n)*	Poster #56
Gold, Stuart M.	*(2,3B-Smith & Nephew; 2,3B,5-Stryker)*	Case Presentation Moderator
Golden, Robert D.	*(G-Synthes)*	Poster #106
Goldstein, Jessica B.	*(G-Synthes, Inc; Wyeth Research; Pfizer; Kinetic Concepts, Inc.)*	BSFF Paper #11
Goldwaser, Elan	*(n)*	Paper #35
Goldwyn, Elan	*(n)*	Poster #5
Gonschorek, Oliver	*(B-Aesculap, Medtronic)*	Paper #84
Gorczyca, John T.	*(n)*	Poster #102
Gordon, Wade T..	*(n)*	Mini Symposium Faculty
Goslings, J. Carel	*(n)*	Poster #3
Gosselin, Richard A.	*(n)*	Poster #139
Goulet, James A.	*(1-Zimmer; 2-AO; 5-Stryker)*	OTA Committee; Moderator

Disclosure – *OTA online submission*:
A= Royalties from a company or supplier; B= Speakers bureau/paid presentations; Ci= Paid employee for a company or supplier; Cii= Paid consultant for a company or supplier; Ciii= Unpaid consultant for a company or supplier; D= Other financial or material support from a company or supplier; E= Stock or stock options in a company or supplier; F= Self/family research support from a company or supplier; G= Departmental research support from a company or supplier; H= Other financial/material support from publishers; I= Self/family research support from publishers; J= Departmental research support from publishers. For full information, refer to pages 415 - 416.

Granata, Jaymes	*(n)*	Poster #141
Graves, Matt L.	*(2,3B,5-Synthes; 5-Stryker)*	OTA Committee; Paper #82; Posters #128, 129; Case Presentation Faculty
Greisberg, Justin K.	*(7-Saunders/Mosby-Elsevier)*	Case Presentation Moderator
Griffith, Cullen K.	*(n)*	BSFF Paper #19
Grimshaw, Charles S.	*(n)*	Paper #78
Grogan, Brian F.	*(n)*	Poster #13
Gross, Jonathan M.	*(n)*	Poster #102
Gruen, Gary S.	*(n)*	Poster #28
Guda, Teja	*(n)*	BSFF Paper #13
Guelcher, Scott	*(n)*	BSFF Paper #13
Gugala, Zbigniew	*(n)*	Poster #113
Guillamondegui, Oscar D.	*(n)*	Paper #65
Guitton, Thierry G.	*(n)*	Posters #2, 3, 98
Gupta, Rishi R.	*(n)*	Posters #52, 112
Gurkan, Erkula	*(n)*	Paper #62
Guy, Daniel K.	*(3A,4-Wright Medical Technology, Inc.)*	Poster #140
Guy, Pierre	*(3B,5-Stryker; 5-Synthes, DePuy, A Johnson & Johnson Company).*	OTA Committee; Moderator; Mini Symposium Moderator; Paper #47
Guyatt, Gordon H.	*(n).*	Poster #63
Haglund, Emily	*(Ci-Wright Medical Technology)*	Paper #55
Haidukewych, George J.	*(1-DePuy, A Johnson & Johnson Company; 4-Surmodics, Orthopediatrics)*	Case Presentation Faculty
Hak, David J.	*(2,3B-Medtronic; 4-Emerge; 5-Synthes, Stryker)*	Posters #43, 123
Hall, Jeremy A.	*(5-AMGEN, Physicians Services Incorp.; 6-Smith & Nephew, Stryker, Zimmer)*	Mini Symposium Faculty; Case Presentation Faculty
Halvorson, Jason J.	*(n)*	Poster #61
Hamadouche, Moussa	*(3B-Osteotech)*	BSFF Paper #15
Hamilton, William P.	*(n)*	Poster #135
Han, Hyun Kyu	*(n)*	Poster #11
Han, Kaiwei	*(n)*	Poster #60
Hansen, Philipp	*(n)*	Paper #27
Hansen, Sigvard T. Jr.	*(unknown)*	Lecturer
Hanson, Tim	*(n)*	Poster #8
Hardcastle, John	*(n)*	Posters #107, 111
Harris, Mitchell B.	*(n)*	OTA Committee; Poster #138

Disclosure – *Items Answered through AAOS:*
(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. For full information, refer to pages 415 - 416.

DISCLOSURE LISTING – ALPHABETICAL

Hartsell, Zane . . . . *(Ci,E-Smith & Nephew)*. . . . . BSFF Papers #1, 5
Hartsock, Langdon A. . . . . *(5-Synthes)*. . . . . Poster #61
Harvey, Edward J. . . . . *(3C-MedTexel; 5-Synthes)* . . . . .OTA Committee;
. . . . .BSFF Moderator;
. . . . Case Presentation Faculty;
. . . . .BSFF Paper #16
Harwood, Paul . . . . *(n)*. . . . . Poster #66
Hauck, Stefan . . . . *(B-Aesculap, Medtronic)* .Paper #84
Hawks, Michael A. . . . . *(G-Synthes)* . . . . Poster #106
Hawsawi, Abullah A. . . . . *(n)*. . . . . .Paper #59
Hayda, Roman A.. . . . . *(2-AONA; 3C-BioIntraface)* . . . . Poster #132
Hebert-Davies, Jonah . . . . *(n)*. . . . . Poster #17
Hedbeck, Carl Johan . . . . *(n)*. . . . . .Paper #42
Heels-Ansdell, Diane . . . . *(n)*. . . . . Poster #63
Helfet, David L. . . . . *(3C-Synthes, OHK Medical Devices,* . . . . Paper #45;
FxDevices) . . . . .Posters #36, 50, 58, 103, 133
Heller, Yonah . . . . *(n)*. . . . . Poster #56
Henderson, Janet E. . . . . *(n)*. . . . . .BSFF Paper #16
Hentel, Keith . . . . *(n)*. . . . . Poster #50
Herscovici, Dolfi, Jr.. . . . . *(n)*. . . . . .Case Presentation Faculty
Herzenberg, John E.. . . . . *(4-Voyant)* . . . .Case Presentation Faculty; Posters #71, 88
Higgins, Thomas F. . . . . *(2-AONA, Smith & Nephew)* . . . . .OTA Committee;
.. . . .Case Presentation Faculty
Hildebrand, Frank . . . . *(n)*. . . . . .BSFF Paper #20
Hildebrand, Kevin . . . . *(n)*. . . . . .Paper #44
Hileman, B. . . . . *(n)*. . . . . Poster #1
Himes, Ryan . . . . *(n)*. . . . . .BSFF Paper #21
Hinojosa, Lauren N.. . . . . *(n)*. . . . . Poster #51
Ho, Christine A. . . . . *(n)* . . . . .Paper #60
Hoard, Daniel . . . . *(n)*. . . . . Poster #95
Hoffmann, Martin . . . . *(n)*. . . . . .Paper #73
Holck, Kim . . . . *(n)* . . . . Poster #27
Hoolachan, Jordan . . . . *(n)*. . . . . Poster #5
Hoque, Martha . . . . *(n)*. . . . . Poster #23
Hsieh, Adam H. . . . . *(D,G-Synthes)* . . . . .Posters #20, 106
Hsu, Joseph R. . . . . *(5-The Geneva Foundation)*. . . . . .Mini Symposium Faculty;
. . . . .Paper #70; Posters #13, 75, 77
Hu, Calvin T.. . . . . *(n)*. . . . . .BSFF Paper #18
Hu, Xiaopeng . . . . *(n)*. . . . . Poster #105
Hu, Yue Yung . . . . *(n)*. . . . . Poster #100
Hubbard, David F. . . . . *(2,5-Synthes)* . . . . Poster #108
Huber, Florian . . . . *(2-Synthes)*. . . . . Poster #133

Disclosure – *OTA online submission*:
A= Royalties from a company or supplier; B= Speakers bureau/paid presentations; Ci= Paid employee for a company or supplier; Cii= Paid consultant for a company or supplier; Ciii= Unpaid consultant for a company or supplier; D= Other financial or material support from a company or supplier; E= Stock or stock options in a company or supplier; F= Self/family research support from a company or supplier; G= Departmental research support from a company or supplier; H= Other financial/material support from publishers; I= Self/family research support from publishers; J= Departmental research support from publishers. For full information, refer to pages 415 - 416.

Hui, Emily	*(n)*	Posters #52, 112
Humphrey, Catherine A.	*(3B-Synthes)*	BSFF Paper #18; Poster #102
Huntjens, Kirsten M.B.	*(n)*	Poster #30
Hurwitz, Shepard R.	*(7-Saunders/Mosby-Elsevier)*	OTA Committee; Moderator
Hussain, Nasir	*(n)*	Poster #32
Hyatt, Eddie L.	*(n)*	BSFF Paper #11
Immerman, Igor	*(n)*	Poster #56
Iobst, Christopher	*(n)*	Poster #71
Ipaktchi, Kyros	*(n)*	Paper #31
Jackson, James C.	*(n)*	Paper #65
Jacobsen, Steffen	*(n)*	Poster #27
Jeffcoat, Devon	*(n)*	Poster #133
Jenkinson, Richard J.	*(n)*	Mini Symposium Faculty; Poster #121
Jeray, Kyle J.	*(2-AONA; 3B,5-Zimmer; 5-Synthes)*	OTA Committee; Lab Faculty
Jiang, Xie-yuan	*(n)*	Poster #47
Jimenez, Carlos	*(n)*	Poster #113
Jindal, Gaurav	*(n)*	Posters #71, 88
Joensson, Anders	*(Ci-Employee of Stryker Osteosynthesis)*	Poster #32
Johnson, Aaron J.	*(n)*	Paper #75
Johnson, James	*(n)*	BSFF Paper #7
Johnson, Jeffrey E.	*(1,3B,4-OrthoHelix Surgical Designs, Inc.; 4,5-Midwest Stone Institute, Inc)*	Poster #49
Johnson, Wesley O.	*(n)*	Poster #8
Jones, Alan L.	*(n)*	OTA Board; OTA Committee
Jones, Bob	*(Ci,E-Smith & Nephew)*	BSFF Paper #5
Jones, Clifford B.	*(2-AONA)*	Moderator; Lab Faculty; Case Presentation Faculty; Paper #29, 73; Posters #15, 44, 120
Jordan, Charles J.	*(n)*	Poster #62
Joseph, Giliane	*(n)*	Poster #138
Josten, Christoph	*(G-(n)Ziehm Imaging, Nürnberg, Germany; Brainlab AG Feldkirchen Germany)*	Poster #117
Kaijzel, Erik	*(n)*	Poster #16
Kandemir, Utku	*(F-Synthes, Biomet, Stryker)*	Poster #127; Lab Faculty
Kane, Patrick	*(n)*	Paper #69
Kassubek, Jan	*(n)*	Paper #27
Katarincic, Julia	*(n)*	Poster #72
Kaufman, Adam M.	*(n)*	Poster #93
Kazemi, Namdar	*(n)*	Poster #54

Disclosure – *Items Answered through AAOS:*
(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. For full information, refer to pages 415 - 416.

DISCLOSURE LISTING – ALPHABETICAL

Keating, John F.	*(n)*	Poster #94
Keeling, John J	*(n)*	Paper #72
Kellam, James F.	*(n)*	Poster #86
Keller, Julie M.	*(n)*	Poster #31
Kelly, Derek M.	*(n)*	Poster #70
Kelly, Michael	*(n)*	Poster #125
Kerver, Bert	*(n)*	Poster #4
Ketz, John	*(n)*	Paper #51
Khan, Majid A.	*(n)*	Paper #82; Posters #128, 129
Khan, Safdar N.	*(n)*	BSFF Paper #6
Khazzam, Michael	*(n)*	BSFF Paper #4; Poster #115
Khoury, Amal	*(n)*	BSFF Paper #23; Poster #53
Kilic, Ayhan	*(n)*	Paper #31
Kim, Hyunchul	*(D,G-Synthes)*	Posters #20, 106
Kim, Todd	*(n)*	Poster #127
Kindya, Michael	*(n)*	Poster #65
Kinney, R. C.	*(n)*	Poster #37
Kinzl, Lothar	*(n)*	Paper #27
Kiss, Alex	*(n)*	ORS Best Trauma Related Poster
Klatt, Joshua W. B.	*(n)*	Paper #61
Klein, Guy	*(n)*	Poster #74
Klein, Sandra E.	*(n)*	Poster #49
Kleinrensink, Gert J.	*(n)*	Poster #4
Kloen, Peter	*(n)*	Posters #3, 16
Knight, Justin R.	*(n)*	Poster #51
Knops, Simon P.	*(n)*	Poster #118
Koestler, Martin	*(Ci-BrainLAB AG, Feldkirchen, Germany)*	Poster #117
Kolb, Eric	*(Ci,E-Doctors Research Group)*	Poster #21
Konda, Sanjit R.	*(n)*	Poster #62
Kops, Nicole	*(n)*	Paper #36
Korley, Robert	*(n)*	Poster #121
Kottmeier, Stephen A.	*(n)*	OTA Committee
Koval, Kenneth J.	*(1,2,3B,5-Biomet; 2,3B,5-Stryker; 2-Sanofi-Aventis; 7-Wolters Kluwer Health - Lippincott Williams & Wilkins)*	OTA Committee
Krasheninnikoff, Michael	*(n)*	Poster #27
Kreder, Hans J.	*(n)*	Mini Symposium Faculty; Posters #103, 121; ORS Best Trauma Related Poster
Kreder, Michael	*(n)*	ORS Best Trauma Related Poster
Kregor, Philip J.	*(n)*	BSFF Faculty
Krettek, Christian	*(n)*	BSFF Paper #20

Disclosure – *OTA online submission*:
A= Royalties from a company or supplier; B= Speakers bureau/paid presentations; Ci= Paid employee for a company or supplier; Cii= Paid consultant for a company or supplier; Ciii= Unpaid consultant for a company or supplier; D= Other financial or material support from a company or supplier; E= Stock or stock options in a company or supplier; F= Self/family research support from a company or supplier; G= Departmental research support from a company or supplier; H= Other financial/material support from publishers; I= Self/family research support from publishers; J= Departmental research support from publishers.
For full information, refer to pages 415 - 416.

Krieg, James C. . . . . *(1-SAM Medical Synthes CMF; 3B-Synthes)*. . . . . Case Presentation Faculty
Krumrey, Jacqueline J. . . . . *(n)*. . . . . Faculty
Kulkarni, Abhaya V. . . . . *(n)*. . . . . Poster #63
Kulp, Brenda . . . . *(n)*. . . . . Poster #61
Kumar, Gunasekaran . . . . *(n)*. . . . . .Paper #63
Kuramoto, Lisa . . . . *(n)*. . . . . .Paper #47
Kurtz, Steven . . . . *(n)*. . . . . Paper #40; Poster #96
Kwon, John Y. . . . . *(n)*. . . . . Poster #45
Kyle, Richard F.. . . . . *(1,2,3B-Zimmer)* . . . . Lab Moderator
Lädermann, Alexandre . . . . *(n)*. . . . . Poster #33
Langford, Joshua . . . . *(n)*. . . . . Lab Faculty
Lansdowne, Jennifer . . . . *(n)*. . . . . BSFF Faculty
Lane, Joseph M. . . . . *(2,3B-Eli Lilly, 2-Norvartis, Sanofi-Aventis, Weber Chilcott; 3B-Amgen Co, Biomimetic, Zimmer, DFine, Inc, Graftys SA, Kuros Biosurgery AG, Zelos Therapeutics, Inc.)* . . . . Papers #38, 45
Lapalme, Suleiman . . . . *(n)*. . . . . Poster #11
Lapidus, Gunilla . . . . *(n)*. . . . . .Paper #42
Latta, Loren L. . . . . *(5-Aesculap/B.Braun, Alphatec Spine, Biomet, DePuy, A Johnson & Johnson Company, DJ Orthopaedics, EBI, Hand Innovations, Johnson & Johnson, Lippincott, National Institutes of Health (NIAMS & NICHD), OREF, SBI, Small Bone Innovations, Smith & Nephew, Stryker, Synthes, Zimmer; 7-Springer, Saunders/Mosby-Elsevier)*. . . . . BSFF Faculty; BSFF Moderator; BSFF Paper #3
Lattanza, Lisa L. . . . . *(n)*. . . . . Poster #11
Lau, Edmund . . . . *(n)*. . . . . Paper #40; Poster #96
Lauing, Kristen . . . . *(n)*. . . . . .BSFF Paper #21
Lauria, Denise . . . . *(n)*. . . . . Poster #138
Law, Janessa . . . . *(n)* . . . . .Paper #58
Lawendy, Abdel . . . . *(n)*. . . . . Poster #42
Lawrence, J. Todd . . . . *(n)*. . . . . .Paper #50
Le, Theodore T. . . . . *(n)*. . . . . Poster #54
LeBrun, Christopher T. . . . . *(n)*. . . . . Poster #5
LeClere, Lance E. . . . . *(n)*. . . . . Poster #48
Lee, Gene . . . . *(n)*. . . . . Poster #54
Lee, Mark A. . . . . *(2,3B,5-Synthes, Zimmer; 3B- Biomet; 5-Smith & Nephew; 6-Synthes Fellowship Support)*. . . . . .Paper #39
Lee, Steve K. . . . . *(3C,5-Arthrex, Inc; 3C-Synthes;5-Stryker, Mitek)* Paper #30

Disclosure – *Items Answered through AAOS:*
(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. For full information, refer to pages 415 - 416.

DISCLOSURE LISTING – ALPHABETICAL

Leet, Arabella I. . . . . *(n)*. . . . . Paper #62
Lefaivre, Kelly A. . . . . *(5-Stryker, Synthes, Zimmer)* Mini Symposium Faculty; . . . . Paper #47
Leighton, Ross K. . . . . *(1-Zimmer; 2-Biometric, Stryker; 2,5-DePuy, A Johnson & Johnson Company, Synthes; 2,3B,5,6-Smith & Nephew; 2,3B,6-Etex)* . . . . Paper #59
Lekic, Nikola . . . . *(n)*. . . . . Paper #30
Leu, Dirk . . . . *(n)*. . . . . Paper #62
Levy, Adrian R. . . . . *(n)*. . . . . Paper #47
Lewis, Courtland G.. . . . . *(n)*. . . . . Papers #43, 44
Lhowe, David . . . . *(G-Synthes)* . . . . Paper #79
Li, Ailian . . . . *(n)*. . . . . BSFF Paper #16
Li, Bing . . . . *(n)*. . . . . BSFF Paper #13
Li, Peng . . . . *(n)*. . . . . Poster #105
Li, Ru . . . . *(G-Stryker, Synthes)* . . . . BSFF Papers #10, 12
Liang, He . . . . *(n)*. . . . . Poster #84
Liebergall, Meir . . . . *(n)*. . . . . BSFF Paper #23; Poster #53
Lin, Jian . . . . *(n)*. . . . . Poster #105
Lin, Sheldon S. . . . . *(2-Smith & Nephew. Tornier; 3B,5-Biomimetic; 5-EBI)* . . . . Paper #35
Lindsell, Christopher J. . . . . *(n)*. . . . . Poster #73
Lindsey, Ronald W. . . . . *(n)*. . . . . Poster #113
Lindtner, Richard A. . . . . *(n)*. . . . . Paper #24
Liporace, Frank A. . . . . *(2,3B-DePuy, A Johnson & Johnson Company, Osteotech; 2,3B,5-Synthes, Smith & Nephew; 3C-AO)* Lab Faculty . . . . Case Presentation Faculty
Liston, Michael . . . . *(n)*. . . . . Poster #95
Loeffler, Bryan J. . . . . *(n)*. . . . . Poster #86
Lopez, Donna M. . . . . *(n)*. . . . . Poster #13
Lorich, Dean G.. . . . . *(n)*. . . . . Papers #38, 45; Posters #36, 50, 58, 133
Loveridge, Jeremy . . . . *(n)*. . . . . Posters #125, 126
Lowe, Jason . . . . *(Ciii-Synthes; D-AONA Resident Grant, Synthes Grant; J-University of Missouri Department of Orthopaedics Research Fund)* . . . . Poster #29
Löwik, Clemens W.G.M. . . . . . *(n)*. . . . . Poster #16
Lu, Chuanyong . . . . *(n)*. . . . . BSFF Paper #17
Lübbeke, Anne . . . . *(n)*. . . . . Poster #35
Lubovsky, Omri . . . . *(n)*. . . . . ORS Best Trauma Related Poster
Lucien, Sergeline . . . . *(n)*. . . . . Poster #138
Lundy, Douglas W. . . . . *(2-AO; 3C-Synthes; 4-Livengood Engineering)* Poster #140
Lybrand, Kyle . . . . *(n)*. . . . . Poster #102
Lysén, Charlotte . . . . *(n)* . . . . Poster #27

Disclosure – *OTA online submission*:
A= Royalties from a company or supplier; B= Speakers bureau/paid presentations; Ci= Paid employee for a company or supplier; Cii= Paid consultant for a company or supplier; Ciii= Unpaid consultant for a company or supplier; D= Other financial or material support from a company or supplier; E= Stock or stock options in a company or supplier; F= Self/family research support from a company or supplier; G= Departmental research support from a company or supplier; H= Other financial/material support from publishers; I= Self/family research support from publishers; J= Departmental research support from publishers. For full information, refer to pages 415 - 416.

Maccagnan, Elena	*(n)*	Poster #23
MacIntyre, Neil	*(n)*	Poster #133
MacKenzie, Ellen J.	*(n)*	Case Presentation Faculty; Paper #72; Poster #83
Madey, Steven M.	*(1,3C-Zimmer, Synthes)*	Poster #18
Magaziner, Jay	*(n)*	Paper #44
Mahmood, Zakariah	*(n)*	Poster #137
Makowski, Anna-Lena	*(n)*	BSFF Paper #3
Malik, Ali	*(n)*	BSFF Paper #3
Malkani, Arthur L.	*(1,3B,5-Stryker; 5-Synthes)*	Paper #40; Poster #96
Mallee, Wouter H.	*(n)*	Poster #8
Mamczak, Christiaan N.	*(n)*	Case Presentation Faculty; Posters #132, 134
Mandel, Scott J.	*(n)*	Poster #63
Manley, Geoffrey	*(n)*	Poster #131
Manson, Theodore T.	*(G-Synthes, Stryker, Smith & Nephew)*	Paper #71; Poster #5
Marburger, Robert	*(n)*	Paper #69
Marcucio, Ralph	*(n)*	BSFF Paper #17
Marker, David R.	*(n)*	Poster #19
Marmor, Meir T.	*(n)*	Posters #11, 22, 114
Marsh, Martin	*(n)*	Poster #66
Marsh, Sarah	*(n)*	Poster #138
Martin, Elizabeth	*(n)*	Poster #78
Martineau, Paul A.	*(2-Arthrex; 3C-Wyeth; 5,6-Smith & Nephew, Synthes).*	BSFF Faculty
Marcucio, Ralph	*(n)*	Paper #17
Masini, Brendan D.	*(n)*	Posters #12, 75, 77
Maslow, Andrea	*(n)*	Poster #97
Mason, James	*(Ci-OrthoX, LLC)*	Poster #15
Mather, Richard C.	*(n)*	Poster #93
Matityahu, Amir M.	*(n)*	Posters #11, 22, 114, 127
Matuszewski, Paul	*(n)*	Papers #45, 50
Mayich, Joshua	*(n)*	Poster #42
Mazurek, Michael T.	*(n)*	Posters #48, 67
McAndrew, Mark P.	*(n)*	Symposium Faculty
McAuley, William	*(n)*	Paper #44
McClellan, R. Trigg	*(n)*	Posters #22, 131
McCollam, Steven M.	*(n)*	Poster #140
McCormick, Jeremy J.	*(2-Smith & Nephew; 6-Midwest Stone Institute, Wright Medical Technology, Inc.)*	Poster #49
McCormick, William	*(n)*	Poster #42
McDonald, Erik	*(n)*	Poster #114
McFarland, Lynne V.	*(n)*	Poster #89

Disclosure – *Items Answered through AAOS:*
(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. For full information, refer to pages 415 - 416.

DISCLOSURE LISTING – ALPHABETICAL

McKee, Michael D.	*(1-Stryker; 2,3B-Synthes; 2,3B,5-Zimmer; 5-Wright Medical Technology, Inc.; 7-Wolters Kluwer Health – Lippincott Williams & Wilkins)*	BSFF Faculty; Lab Moderator; Lab Faculty; Case Presentation Moderator
McKinley, Todd O.	*(n)*	OTA Committee; BSFF Moderator; Symposium Faculty
McQueen, Margaret M.	*(5-Acumed, LLC)*	Moderator
Meade, Sharonda	*(n)*	Paper #35
Mears, Simon C.	*(4-Father has stock in Mako)*	Case Presentation Faculty
Medically Unexplained Syndromes Study Group	*(n)*	Poster #63
Mehlman, Charles T.	*(3C-Stryker; 8-Spine, Springer, Wolters Kluwer Health - Lippincott Williams & Wilkins)*	Posters #73, 74
Mehr, David C.	*(n)*	Poster #26
Mehta, Samir	*(2-Zimmer; 2-AO North America); 2,3B,5 Smith & Nephew; 5-Amgen Co, Medtronic; 7-Wolters Kluwer Health - Lippincott Williams & Wilkins)*	Paper #50; Poster #122; Case Presentation Faculty
Mehta, Siddhant	*(n)*	Paper #35
Mello, Michael J.	*(n)*	Poster #72
Mercer, Jeff.	*(n)*	Paper #58
Mercincavage, Michael	*(n)*	Poster #122
Meskey, Thomas	*(n)*	Poster #111
Messina, Adam	*(Ci,E-Smith & Nephew).*	BSFF Paper #8
METALS Study Group	*(n)*	Paper #72
Micera, Giovanni	*(n)*	Poster #23
Miclau, Theodore	*(3B-Amgen Co; 4-Johnson & Johnson, Merck, Pfizer; 5-Stryker, Synthes, Zimmer)*	OTA Committee; BSFF Moderator; Moderator; Case Presentation Moderator; BSFF Paper #17
Mignemi, Nicholas	*(n)*	BSFF Paper #22
Mileski, William	*(n)*	Poster #113
Miller, Anna N.	*(n)*	Poster #36
Miller, John R.	*(n)*	Paper #80
Miller, Micah	*(G-Synthes)*	Paper #79
Milne, Edward L.	*(6-Alphatec Spine, Embrace Medical, FxDevices LLC)*	BSFF Paper #3
Mir, Hassan R.	*(n)*	Poster #119
Moed, Berton R.	*(1-DePuy, A Johnson & Johnson Company); 7-Clinical Orthopaedics & Related Research)*	Papers #78, 80
Mohnani, Dena	*(n)*	BSFF Paper #3

Disclosure – *OTA online submission*:
A= Royalties from a company or supplier; B= Speakers bureau/paid presentations; Ci= Paid employee for a company or supplier; Cii= Paid consultant for a company or supplier; Ciii= Unpaid consultant for a company or supplier; D= Other financial or material support from a company or supplier; E= Stock or stock options in a company or supplier; F= Self/family research support from a company or supplier; G= Departmental research support from a company or supplier; H= Other financial/material support from publishers; I= Self/family research support from publishers; J= Departmental research support from publishers.
For full information, refer to pages 415 - 416.

Mommsen, Philipp .... *(n)*.................................BSFF Paper #20
Montero, Nicole .... *(n)*.................................... Poster #57
Moor, Timothy A. .... *(n)*......................................Paper #66
Moore, Ernest E. .... *(n)*......................................Paper #85
Moore, Thomas .... *(n)*.................................... Poster #21
Morandi, Massimo Max ...... *(n)*.................................... Lab Faculty
Morgan, Steven J............. *(n)*..........................Posters #43, 90, 92, 123
Morgan, Thomas .... *(n)*.................................... Poster #78
Moroni, Antonio .... *(n)*.................................... Poster #23
Morris, Elizabeth M. .... *(n)*................................Posters #50, 58
Morris, Stephen A.C. .... *(n)*.................................... Poster #126
Morrison, T. .... *(n)*.................................... Poster #37
Mosheiff, Rami .... *(n)*...................... BSFF Paper #23; Poster #53
Mourad, Waleed F. .... *(n)*......................Paper #82; Posters #128, 129
Moylan, Kyle C. .... *(n)*.................................... Poster #26
Mullis, Brian H. .... *(5-Amgen Co, Wyeth, Synthes)*.......... OTA Committee
Murphy, Josh .... *(n)*.................................... Poster #21
Murray, Clinton K. .... *(n)*.................................... Poster #13
Murray, Douglas H. .... *(3C-Exactech, Inc; unpaid member of the development team)*..................... Poster #140
Murtha, Yvonne M. .... *(n)*................BSFF Paper #4; Posters #26, 29, 115
Mütze, Maria................ *(G-Ziehm Imaging, Nürnberg, Germany; Brainlab AG Feldkirchen Germany)* .... Poster #117
Myrtil, Valentin .... *(n)*.................................BSFF Paper #15
Nahm, Nickolas J. .... *(n)*.......................... Paper #64; Poster #101
Nascone, Jason W. .... *3B (Synthes)*................Paper #75; Posters #5, 106
Nash, Clyde L. .... *(n)*......................................Paper #76
Nauth, Aaron .... *(n)*..................................BSFF Faculty; ....BSFF Papers #10, 12
Nayak, Geetanjali .... *(n)*.................................BSFF Paper #16
Neviaser, Andrew S. .... *(n)* ....Paper #45
Newell, Mary Zadnik .... *(n)*...................Paper #25; Posters #52, 83, 112
Newman, Justin .... *(n)*.................................... Poster #92
Nich, Christophe .... *(n)*.................................BSFF Paper #15
Nickisch, Florian .... *(2,3B-Smith & Nephew)* .... Poster #51
Norris, Brent L............... *(5-Synthes, AO North America)*.............. Poster #85
Northam, Casey L. .... *(G-Zimmer, Biomet, Smith & Nephew; J-Arthroscopy)*........................... Poster #19
Nousiainen, Markku T. .... *(n)*............. Mini Symposium Faculty; Poster #103
Nowotarski, Peter .... *(n)*......................................Paper #34
Nydick, Jason .... *(n)*.................................BSFF Paper #2
Nyman, Jeffry .... *(n)* ....BSFF Paper #22

Disclosure – *Items Answered through AAOS:*
(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. For full information, refer to pages 415 - 416.

O'Keefe, Regis J.	*(n)*	BSFF Paper #18
O'Mara, Timothy J.	*(G-Synthes, Smith & Nephew)*	Paper #67; Poster #34
O'Neill, Kevin	*(n)*	BSFF Paper #22
O'Toole, Robert V.	*(3B,5-Synthes; 5-Stryker, OREF)*	Mini Symposium Faculty; Lab Faculty; BSFF Paper #19; Papers #25, 71, 75; Posters #5, 20, 31, 52, 106, 107, 111, 112
Obremskey, William T.	*(3B-Medtronic)*	OTA Committee; Moderator; Mini Symposium Faculty; BSFF Paper #22; Paper #65; Poster #61
Odland, Rick	*(Ci,F- Twin Star Inc.)*	Poster #59
Odutola, Koye	*(n)*	Poster #125
Offley, Sarah C.	*(n)*	BSFF Paper #18
Oglesby, Alan	*(Ci-Employee of Amgen Inc; E-Stockholder of Amgen Inc)*	Poster #69
Ojeda, Christopher	*(n)*	Paper #35
Oliphant, Bryant W.	*(G-Synthes)*	Poster #106
Olson, Cody	*(n)*	Poster #119
Olson, Steven A.	*(6-Synthes)*	OTA Committee; BSFF Moderator; BSFF Faculty; Posters #61, 93
Olszewski, Dana	*(n)*	Paper #73
Omoto, Daniel	*(n)*	Poster #103
Ong, Crispin	*(n)*	Paper #28
Ong, Kevin	*(n)*	Paper #40; Poster #96
Oppy, Andrew	*(n)*	Poster #126
Orlando, Lori	*(n)*	Poster #93
Orsini, Riccardo	*(n)*	Poster #23
Ortega, Gilbert R.	*(Cii-Smith & Nephew; Stryker)*	Poster #76; Lab Faculty
Osborn, Patrick M.	*(n)*	Poster #68
Osgood, Gregory M.	*(3B,5-Synthes; Stryker; 5-Smith & Nephew)*	Papers #62, 75
Ostrum, Robert F.	*(G-AONA/Synthes)*	Symposium Faculty; Case Presentation Moderator; BSFF Paper #2; Paper #69
Otto, Antoni	*(n)*	Paper #63
Oudina, Karim	*(n)*	BSFF Paper #15
Ouellette, Elizabeth A.	*(n)*	BSFF Paper #3
Owen, Sean	*(n)*	Papers #32, 83
Owens, Brett D.	*(n)*	Poster #75
Ozer, Kagan	*(n)*	Paper #31
Packianathan, Satya	*(n)*	Paper #82; Posters #128, 129
Paglia, David	*(n)*	Paper #35
Paksima, Nader	*(2,3B,5-Stryker; 4-SBI)*	Paper #30

Disclosure – *OTA online submission*:
A= Royalties from a company or supplier; B= Speakers bureau/paid presentations; Ci= Paid employee for a company or supplier; Cii= Paid consultant for a company or supplier; Ciii= Unpaid consultant for a company or supplier; D= Other financial or material support from a company or supplier; E= Stock or stock options in a company or supplier; F= Self/family research support from a company or supplier; G= Departmental research support from a company or supplier; H= Other financial/material support from publishers; I= Self/family research support from publishers; J= Departmental research support from publishers. For full information, refer to pages 415 - 416.

Paley, Dror	*(1-Smith & Nephew; 7-Springer)*	Poster #88
Pally, Elliott	*(n)*	Poster #121
Palm, Henrik	*(n)*	Poster #27
Panagis, James S.	*(n)*	BSFF Faculty
Pant, Bhaskar.	*(n)*	Lab Faculty
Pape, Hans-Christoph	*(n)*	OTA Committee; BSFF Faculty; Poster #28
Papp, Steven R.	*(5-KCI, Synthes)*	Case Presentation Faculty
Park, Min Jung	*(n)*	Poster #72
Parker, Robert J.	*(n)*	Posters #50, 58
Parmer, Nathan M.	*(n)*	Poster #83
Paryavi, Ebrahim	*(n)*	Poster #112
Patka, Peter	*(n)*	Poster #118
Patterson, Brendan M.	*(n)*	OTA Board; Symposium Faculty; Paper #57; Posters #101, 132
Paul, Omesh	*(n)*	Paper #45; Posters #50, 58
Peacher, Gabrielle	*(n)*	Poster #90
Pekmezci, Murat	*(n)*	Posters #127, 131
Pellegrini, Vincent D. Jr	*(1-DePuy, A Johnson & Johnson Company; 3B-Covidien Ortho McNeil pharmaceuticals; 7-Journal of Bone and Joint Surgery-American)*	BSFF Paper #19
Penoyar, Thomas M.	*(n)*	Poster #139
Pensy, Raymond A.	*(n)*	Poster #5
Perdue, Paul	*(n)*	Poster #107
Perrien, Daniel	*(n)*	BSFF Paper #13
Persohn, Scott A.	*(G-Wright Medical Technology)*	Paper #55
Peter, Robin	*(n)*	Poster #33
Petite, Herve	*(n)*	BSFF Paper #15
Petrisor, Brad A.	*(2-Smith & Nephew; 2,3B,6-Stryker; 6-Synthes)*	Case Presentation Faculty; Posters #79, 80
Pfeiffer, Ferris	*(n)*	BSFF Paper #4; Poster #29
Phieffer, Laura S.	*(n)*	Faculty; Lab Faculty
Philips, Thomas	*(n)*	Poster #131
Podeszwa, David A.	*(n)*	Paper #60
Pohlemann, Timothy	*(n)*	Poster #124
Pollak, Andrew N.	*(1,3B-Extraortho; 2-KCI; 2,3B,5-Smith & Nephew; 5-Stryker; 7-AAOS Orange Book Series)*	OTA Board; OTA Committee; Case Presentation Moderator; Symposium Faculty; Papers #25, 75; Poster #83
Ponton, Ryan P.	*(n)*	Poster #48
Ponzer, Sari	*(n)*	Paper #42
Potter, Benjamin Kyle	*(n)*	Mini Symposium Faculty

Disclosure – *Items Answered through AAOS:*
(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. For full information, refer to pages 415 - 416.

Potter, Hollis G. . . . . *(3B-Biomimetic, Stryker, Histogenics Corporation, Synthes, Kensey Nash Corporation; 5-General Electric Healthcare)*. . . . . BSFF Faculty
Potters Jan-Willem . . . . *(n)*. . . . . Poster #4
PRAISE Investigators . . . . *(n)*. . . . . Poster #110
Prasarn, Mark L.. . . . . *(n)* . . . . Paper #45; Posters #36, 78
Preiss, Richard A. . . . . *(n)*. . . . . Paper #59
Principe, Michael J. . . . . *(n)*. . . . . Poster #119
Probe, Robert A.. . . . . *(B-Speaker AO North America/ BOD Orthopedic Trauma Society; Ciii-Stryker)* . . . . OTA Board; OTA Committee; Symposium Faculty; Case Presentation Faculty; Poster #14
Qadir, Rabah . . . . *(n)*. . . . . Paper #53
Qiu, Xing . . . . *(n)*. . . . . Poster #102
Que, Ivo . . . . *(n)*. . . . . Poster #16
Quinnan, Stephen M.. . . . . *(n)* . . . . Poster #137
Rahm, Mark D.. . . . . *(3B,5-K2M; 3C-Spinesmith; 4-Johnson & Johnson; 5-DePuy, A Johnson & Johnson Company)* . . . . Poster #135
Ramappa, Arun J. . . . . *(n)*. . . . . Poster #99
Ramirez, Miguel A. . . . . *(n)*. . . . . Poster #99
Rathbone, Christopher R. . . . . . *(n)*. . . . . Paper #37
Rebolledo, Brian J. . . . . *(n)*. . . . . Paper #38
Rechtine, Mark. . . . . *(n)*. . . . . Poster #78
Reddix, Robert N. Jr, ... *(2-Integra Life Sciences; 2,3B-Smith & Nephew; 2,5-Orthofix, Inc.)* . . . . Poster #81
REGAIN Investigators. . . . . *(n)*. . . . . Poster #32
Reiber, Gayle . . . . *(n)*. . . . . Poster #89
Reilly, Mark C. . . . . *(2-Synthes, Smith & Nephew)* Case Presentation Faculty; Mini Symposium Faculty
Reinert, Charles M. . . . . *(n)*. . . . . Case Presentation Faculty
Reisman, William M. . . . . *(n)*. . . . . Poster #68
Rhemrev, Steven J. . . . . *(n)*. . . . . Poster #8
Ricci, William M. . . . . *(1,2,3B,3C,5-Smith & Nephew; Wright Medical Technology, Inc.; 5-Synthes, AONA; 7-Wolters Kluwer Health-Lippincott Williams & Wilkins)* . . . . OTA Board; OTA Committee; Moderator; Case Presentation Faculty; BSFF Papers #1, 5, 8, 9; Papers #33, 46, 54, 73; Poster #49
Riccio, Anthony I.. . . . . *(2-Synthes)*. . . . . Posters #48, 67
Richards, Justin E. . . . . *(n)*. . . . . Paper #65

Disclosure – *OTA online submission*:
A= Royalties from a company or supplier; B= Speakers bureau/paid presentations; Ci= Paid employee for a company or supplier; Cii= Paid consultant for a company or supplier; Ciii= Unpaid consultant for a company or supplier; D= Other financial or material support from a company or supplier; E= Stock or stock options in a company or supplier; F= Self/family research support from a company or supplier; G= Departmental research support from a company or supplier; H= Other financial/material support from publishers; I= Self/family research support from publishers; J= Departmental research support from publishers.
For full information, refer to pages 415 - 416.

Richards, R. Geoff	*(5-The AO Research Institute Davos is part of the AO Foundation, which is partly funded by non-directed and unrestricted royalties from licenses granted to Synthes Inc. The AO Research Institute Davos and its employees is/are not compensated and there are no other institutional subsidy, corporate affiliations, or funding sources supporting our work unless clearly documented and disclosed; 6-As Director of The AO Research Institute Davos we have more than 80 projects running at one time. One project PEEKSURF (not related to my talks at the OTA in 2010) is partly funded (including material) by Invibio Inc. which produces nearlY all raw material of PEEK and supplies all Trauma companies.)*	BSFF Moderator; BSFF Faculty
Richardson, Lars C.	*(n)*	Poster #99
Ring, David C.	*(1-Wright Medical Technology, Inc.; 2,3B-Acumed, LLC; 3B-Wright Medical Technology, Inc.; 4-Illuminos, Mimedex; 3B,5-Biomet; 5-Stryker)*	Lab Moderator; Lab Faculty; Posters #2, 3, 8, 98
Ringler, James R.	*(n)*	Paper #29; Poster #44
Rise, Leroy	*(n)*	Poster #141
Roberts, Craig S.	*(5-Synthes; 7-Skeletal Trauma royalties)*	Mini Symposium Moderator; Paper #40; Poster #96
Robicheaux, Grant W.	*(n)*	Paper #58
Röderer, Götz	*(B-Instructional Lecturer for Zimmer)*	Paper #27; Poster #25
Rodriguez, Edward K.	*(3B-Xtra-ortho; 4-MXO Orthopedics; 5-Synthes)*	Posters #45, 99, 100
Rogers, Selwyn O. Jr,	*(n)*	Poster #138
Ross, Erin E.	*(n)*	Poster #90
Rouleau, Dominique	*(n)*	Poster #17
Roussos, Constantinos	*(n)*	Poster #33
Russell, George V..	*(2-AONA - Honorarium for two courses per year); 4-Zimmer, Stock Options, < 5%); 5-Synthes, Research Support, Salary support for research, Zimmer, Stock Options, < 5%; 5-Synthes, Research Support, Salary support for research manager)*	OTA Committee; Paper #82; Posters #128, 129
Russell, Thomas A. (Toney)	*(1,2,3B,4-Smith & Nephew; 3C,4-Etex; 4-Stryker, Pfizer, Medtronic; 7-Wolters Kluwer Health - Lippincott Williams & Wilkins)*	BSFF Faculty; Lab Moderator; BSFF Paper #8
Ruth, John T.	*(2-DePuy, A Johnson & Johnson Company)*	OTA Committee

Disclosure – *Items Answered through AAOS:*
(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. For full information, refer to pages 415 - 416.

DISCLOSURE LISTING – ALPHABETICAL

Ryan, Scott P.	*(n)*	OTA Committee
Rybak, Leon	*(n)*	Posters #9, 10
Sagi, H. Claude	*(2,3B,5-Stryker; Synthes; Smith & Nephew)*	Papers #77, 81; Poster #119; Lab Faculty
Saldua, Nelson S.	*(n)*	Poster #48
Salzarulo, Henry	*(n)*	Poster #138
Sanders, David W.	*(3B,5-Smith & Nephew Richards Canada; 5-Synthes Canada).*	Case Presentation Faculty; BSFF Paper #7; Papers #44, 48, 52, 56; Poster #42, 46, 63
Sanders, Roy W.	*(1-CONMED Linvatec, DePuy, A Johnson & Johnson Company, Stryker; 1,2,3B,5-Smith & Nephew; 2-Medtronic; 5-Health and Human Services, National Institutes of Health (NIAMS & NICHD), Medtronic; 7-Journal of Orthopaedic Trauma)*	Moderator; Lab Moderator; Papers #51, 53
Sands, Steven S.	*(n)*	Poster #28
Sargent, M. Catherine	*(n)*	Paper #62
Sauro, Gina	*(n)*	Poster #58
Sawyer, Jeffrey R.	*(n)*	Poster #70
Schaden, Wolfgang	*(n)*	Paper #36
Scharfstein, Daniel O.	*(n)*	Poster #112
Schemitsch, Emil H.	*(1,3B-Stryker; 3B-Amgen Co, Pfizer, Synthes, Baxter; 3B,5-Smith & Nephew; 6-Canadian Institutes of Health, Research (CIHR), Brainlab, OMEGA; 7-Saunders/Mosby-Elsevier)*	OTA Committee; BSFF Moderator; Mini Symposium Moderator; Mini Symposium Faculty; Case Presentation Faculty; BSFF Papers #10, 12; Posters #32, 63, 110
Scherl, Susan A.	*(7-Up-To-Date, Wolters Kluwer Health – Lippincott Williams & Wilkins)*	OTA Committee
Schiffman, Eric	*(n)*	Poster #137
Schipper, Inger B.	*(n)*	Poster #118
Schiuma, Damiano	*(n)*	Poster #25
Schmal, Hagen	*(n)*	Poster #124
Schmidt, Andrew H.	*(1-Smith & Nephew; 2-Synthes; 3B-Medtronic, DGIMed Orthopedics, AGA; 3B,4,5-Twin Star Medical; 4-Anthem Orthopedics; 7-Thieme, Inc.).*	OTA Committee; Mini Symposium Moderator; Poster #59
Schoenecker, Jonathan	*(n)*	BSFF Paper #22
Schreck, Michael	*(n)*	Poster #78
Schultz, Robert S.	*(n)*	Lab Faculty

Disclosure – *OTA online submission*:
A= Royalties from a company or supplier; B= Speakers bureau/paid presentations; Ci= Paid employee for a company or supplier; Cii= Paid consultant for a company or supplier; Ciii= Unpaid consultant for a company or supplier; D= Other financial or material support from a company or supplier; E= Stock or stock options in a company or supplier; F= Self/family research support from a company or supplier; G= Departmental research support from a company or supplier; H= Other financial/material support from publishers; I= Self/family research support from publishers; J= Departmental research support from publishers. For full information, refer to pages 415 - 416.

Schwieger, Karsten	*(n)*	Poster #25
Sciadini, Marcus F.	*(2,3B,4-Stryker;*	Case Presentation Faculty;
	2-Smith & Nephew)	Paper #75; Posters #5, 31
Scola, Alexander	*(n)*	Poster #25
Sears, Benjamin W.	*(n)*	BSFF Paper #21
Seekamp, Andreas	*(n)*	Poster #124
Sees, Julieanne P.	*(n)*	Paper #69
Seligson, David	*(3B-Stryker)*	Paper #40; Poster #96
Sembler Soles, Gillian L.	*(n)*	Poster #120
Sems, S. Andrew	*(3B-DePuy)*	Lab Faculty
Sen, Milan K.	*(n)*	Paper #68; Lab Faculty
Serna, Fernando H.	*(n)*	Poster #102
Sethi, Anil	*(n)*	Poster #95
Seuntjens, Jan	*(n)*	BSFF Paper #16
Seyler, Thorsten M.	*(3C-Heraeus Medical)*	Poster #19
Shah, Sachita M.	*(n)*	Poster #138
Shah, Swap	*(n)*	Lab Faculty
Shi, Nianwen	*(Ci-Employee of Thomson Reuters; Cii-Thomson Reuters provides consulting service for major pharmaceutical and biotech companies; D-Study funded by Amgen, Inc.)*	Poster #69
Shin, Sangmin Ryan	*(n)*	Paper #74
Shirtliff, Mark E.	*(2,3B-Stryker)*	Mini Symposium Faculty
Shourbaji, Rania	*(n)*	Paper #82; Posters #128, 129
Siebler, Justin	*(n)*	Paper #81
Sietsema, Debra L.	*(B-Eli Lilly, Inc.)*	Papers #29, 73; Posters #15, 44, 120
Simon, Anne-Marie	*(n)*	Paper #35
Simon, Barton	*(n)*	Poster #66
Sims, Stephen H.	*(n)*	Mini Symposium Faculty; Poster #86
Sinapi, Fabrizio	*(n)*	Poster #23
Sinclair, Elizabeth	*(n)*	Poster #83
Sing, Ron	*(n)*	Poster #97
Singer, Syndie B.	*(n)*	BSFF Paper #23
Siska, Peter A.	*(n)*	Poster #28
Sirkin, Michael S.	*(1,2,3B-Biomet;*	Lab Faculty
	7-Saunders/Mosby-Elsevier)	OTA Committee
Skeletal Trauma Research Consortium (STReC)	*(n)*	Poster #13
Slobogean, Gerard P.	*(n)*	Poster #46
Smart, David	*(n)*	Poster #126
Smith, Douglas G.	*(n)*	Poster #89
Smith, John T.	*(n)*	Paper #61

Disclosure – *Items Answered through AAOS:*
(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. For full information, refer to pages 415 - 416.

DISCLOSURE LISTING – ALPHABETICAL

Smith, R. Malcolm . . . . *(G-Synthes)* . . . . Case Presentation Faculty;
. . . . Lab Faculty; Paper #79; Poster #98
Smith, Raymond M. . . . . *(n)*. . . . . Poster #138
Smith, Thomas L. . . . . *(5-Zimmer, Wright Medical Technology, Inc., Medtronic, KCI, DePuy, A Johnson & Johnson Company)*. . . . . Poster #19
Smith, Wade R. . . . . *(5-Synthes)* . . . . Symposium Faculty;
. . . . Case Presentation Faculty;
. . . . .Posters #90, 123
Smucker, Ben . . . . *(n)*. . . . . .Paper #76
Sobolev, Boris . . . . *(n)*. . . . . .Paper #47
Soileau, Ramona . . . . *(Ci-Smith & Nephew)* . . . . .BSFF Paper #9
Song, Xue . . . . *(Ci-Employee of Thomson Reuters; Cii-Thomson Reuters provides consulting service for major pharmaceutical and biotech companies; D-Study funded by Amgen, Inc.)* . . . . Poster #69
Souder, Christopher D. . . . . *(n)*. . . . . Poster #24
Souder, Nicholas . . . . *(n)*. . . . . Poster #14
Southeastern Fracture Consortium . . . . *(n)*. . . . . Poster #61
Spanjersberg, W. Richard . . . . . *(n)*. . . . . Poster #118
Specht, Stacy C. . . . . *(5-OHK Medical Devices, Orthofix, Inc.)* . . . .Posters #87, 88
Sperfeld, Anne-Dorte . . . . *(n)*. . . . . .Paper #27
Spiegel, David A. . . . . *(n)*. . . . . Poster #72
Sponseller, Paul D. . . . . *(1-Globus Medical; 1,2,3B, 5-DePuy, A Johnson & Johnson Company; 7-Oakstone Medical)* . . . . .Paper #62
Sprague, Sheila . . . . *(n)*. . . . . .Posters #32, 80
SPRINT Investigators . . . . *(n)*. . . . . .Paper #56; Posters #63, 64
Staeheli, John W.. . . . . *(n)*. . . . . Lab Faculty
Stafford, Paul R. . . . . *(5-AO / Synthes)* . . . . Poster #85
Stahel, Philip F. . . . . *(2-Synthes, Stryker, NovoNordisk)* . . . . Paper #85;
. . . . .Posters #90, 123
Stahl, Daniel . . . . *(n)*. . . . . Poster #14
Stall, Alec C. . . . . *(n)*. . . . . .Posters #52, 112
Stanford, Jason H. . . . . *(n)*. . . . . .Paper #77
Stannard, James P. . . . . *(2,3B-KCI, Medtronic Sofamor Danek; 7-Theime)* . . . . OTA Board;
. . . . OTA Committee; Poster #115
Steen, Brandon . . . . *(n)*. . . . . Poster #65
Steinke, Hanno . . . . *(n)*. . . . . Poster #117
Stengel, Dirk . . . . *(n)*. . . . . Poster #124

Disclosure – *OTA online submission*:
A= Royalties from a company or supplier; B= Speakers bureau/paid presentations; Ci= Paid employee for a company or supplier; Cii= Paid consultant for a company or supplier; Ciii= Unpaid consultant for a company or supplier; D= Other financial or material support from a company or supplier; E= Stock or stock options in a company or supplier; F= Self/family research support from a company or supplier; G= Departmental research support from a company or supplier; H= Other financial/material support from publishers; I= Self/family research support from publishers; J= Departmental research support from publishers. For full information, refer to pages 415 - 416.

Stephen, David J.G. . . . . *(n)*. . . OTA Board; Mini Symposium Faculty; Poster #121
Stern, Richard . . . . *(Cii-Stryker)*. . . . . .Posters #33, 35
Stewart, Rena L. . . . . *(G-Synthes, Inc; Wyeth Research; Pfizer; Kinetic Concepts, Incorporated)*. . . . . BSFF Paper #11; Poster #40
Steyn, Chris . . . . *(n)*. . . . . .Paper #52
Stinner, Daniel J. . . . . *(5-Smith & Nephew, EZ Care)* . . . . . Paper #70; Poster #12
Stöckle, Ulrich . . . . *(n)*. . . . . Poster #124
Stotts, Alan K. . . . . *(n)*. . . . . .Paper #61
Stover, Michael D. . . . . *(5-Synthes)*. . . . . .BSFF Paper #21
Strauss, Joseph E. . . . . *(G-Synthes)* . . . . Poster #106
Strebe, Sara . . . . *(n)*. . . . . Poster #20
Streubel, Philipp N. . . . . *(n)*. .Papers #46, 54, 73; Poster #49
Stuby, Florian . . . . *(n)*. . . . . Poster #124
Stucken, Charlton . . . . *(n)*. . . . . .Paper #73
Stutz, Christopher . . . . *(n)* . . . . .BSFF Paper #22
Sugi, Michelle . . . . *(n)*. . . . . .Paper #28
Super, Dennis M. . . . . *(n)*. . . . . .Paper #66
Suzuki, Takashi. . . . . *(n)* . . . . Poster #123
Swiontkowski, Marc F. . . . . . . *(3B-Baxter Healthcare, Eli Lilly, Wyeth; 7-Saunders/Mosby-Elsevier, Wolters Kluwer Health - Lippincott Williams & Wilkins)* . . . .Posters #63, 64
Takemoto, Richelle . . . . *(n)*. . . . . .Posters #9, 10
Tamai, Junichi . . . . *(n)*. . . . . Poster #73
Tami, Andrea . . . . *(n)*. . . . . Poster #25
Tannous, Oliver O. . . . . *(n)*. . . . . .BSFF Paper #19
Tarkin, Ivan S. . . . . *(n)*. . . . . Poster #28
Teague, David C. . . . . *(n)*. . . . . OTA Committee
Tejwani, Nirmal C. . . . . *(1-Biomet;2,3B-Zimmer; Stryker)* . . . . Poster #57
Templeman, David C. . . . . *(1-Zimmer; 2,3B-Stryker)* . . . OTA Board; OTA Committee; . . . . Case Presentation Faculty; . . . . Lab Faculty
Terrin, Michael L. . . . . *(n)*. . . . . .Paper #44
Tharakan, Binu . . . . *(n)*. . . . . Poster #14
Theeuwes, Hilco P. . . . . *(n)*. . . . . Poster #4
Thompson, Norfleet . . . . *(n)*. . . . . Poster #70
Tidermark, Jan . . . . *(n)*. . . . . .Paper #42
Tieszer, Christina A. . . . . *(n)*. . . . . Paper #48; Poster #42
Tis, John E. . . . . *(n)*. . . . . .Paper #62
Toker, Serdar . . . . *(n)*. . . . . Poster #43
Tonne, Brian M. . . . . *(n)*. . . . . Poster #116
Torbert, Jesse T. . . . . *(n)*. . . . . Poster #122

Disclosure – *Items Answered through AAOS:*
(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. For full information, refer to pages 415 - 416.

DISCLOSURE LISTING – ALPHABETICAL

Tornetta, Paul . . . . *(1,3B-Smith & Nephew); 7-Wolters Kluwer Health - Lippincott Williams & Wilkins)* . . . . OTA Committee; Symposium Faculty; Case Presentation Moderator; Case Presentation Faculty; Lab Faculty; Mini Symposium Faculty; BSFF Papers #1, 8, 9; Papers #41, 49, 53, 73, 74; Posters #63, 65, 120

Törnkvist, Hans . . . . *(n)* . . . . Paper #42

Torrie, Alex . . . . *(n)* . . . . Poster #126

Tosounidis, Georgios . . . . *(n)* . . . . Poster #124

Toussaint, R. James . . . . *(n)* . . . . Poster #138

Trask, Kelly . . . . *(n)* . . . . Paper #59

Tschegg, Stefanie . . . . *(n)* . . . . Paper #24

Ugwonali, Obinwanne F.C.. . . . *(n)* . . . . Poster #140

Unger, Daniel V. . . . . *(n)* . . . . Symposium Faculty

Unnanuntana, Aasis. . . . . *(n)* . . . . Paper #38

Unno-Veith, Florence . . . . *(n)* . . . . Poster #33

Urmson, Andrew . . . . *(n)* . . . . Poster #121

Vaidya, Rahul . . . . *(n)* . . . . Poster #95

Vallier, Heather A. . . . . *(5-Synthes Institutional support)* . . Symposium Moderator; Papers #57, 64, 66, 76; Poster #101

van Bezooijen, Rutger . . . . *(n)* . . . . Poster #16

van den Bergh, Joop . . . . *(n)* . . . . Poster #30

van der Jagt, Olav P. . . . . *(n)* . . . . Paper #36

van Dijk, C. Niek . . . . *(n)* . . . . Poster #8

van Geel, Tineke . . . . *(n)* . . . . Poster #30

van Helden, S.H. . . . . *(n)* . . . . Poster #30

van Laarhoven, Kees . . . . *(n)* . . . . Poster #38

van Lieshout, Esther M.M. . . . . *(n)* . . . . Poster #118

Van Osten, G. Karl III . . . . *(n)* . . . . Paper #39

Varecka, Thomas F. . . . . *(n)* . . . . Posters #6, 7, 82; Lab Faculty

Verhaar, Jan . . . . *(n)* . . . . Paper #36

Verhofstad, Michael . . . . *(n)* . . . . Poster #38

Verma, Ravi . . . . *(n)* . . . . Paper #35

Vilella, Fernando . . . . *(n)* . . . . Poster #137

Virkus, Walter W. . . . . *(2,3B-Smith & Nephew; 2,3B,4-Stryker; 3A-Norvartis; 4-Johnson & Johnson)* . . . . . OTA Committee

Volgas, David A. . . . . *(G-Synthes, Inc.; Wyeth Research; Kinetic Concepts, Inc.; Pfizer)* . . . . Poster #40

Volkmer, Dustin . . . . *(n)* . . . . BSFF Paper #21

Disclosure – *OTA online submission*:
A= Royalties from a company or supplier; B= Speakers bureau/paid presentations; Ci= Paid employee for a company or supplier; Cii= Paid consultant for a company or supplier; Ciii= Unpaid consultant for a company or supplier; D= Other financial or material support from a company or supplier; E= Stock or stock options in a company or supplier; F= Self/family research support from a company or supplier; G= Departmental research support from a company or supplier; H= Other financial/material support from publishers; I= Self/family research support from publishers; J= Departmental research support from publishers.
For full information, refer to pages 415 - 416.

Voor, Michael J.	*(D-Vivorte, LLC; G-Kentucky Science and Technology Corporation)*	BSFF Paper #14
Vrahas, Mark S.	*(4-Pioneer Medical; 5-Synthes, Zimmer, DePuy, A Johnson & Johnson Company)*	Paper #79; Poster #98
Waarsing, J. H.	*(n)*	Paper #36
Wagenheim, Gavin	*(n)*	Paper #68
Wagoner, Judy	*(n)*	Poster #138
Wai, Eugene	*(n)*	Poster #63
Waked, Walid	*(n)*	Paper #82; Posters #128, 129
Walker, Peter S.	*(1-Stryker; 1,3B,5-Zimmer; 3B,3C,5-Mako)*	Poster #56
Walsh, Michael	*(n)*	Paper #30; Poster #57
Walter, Stephen D.	*(n)*	Poster #63
Wang, Huifen	*(n)*	BSFF Paper #16
Wang, John	*(n)*	Poster #137
Wang, Man-yi	*(n)*	Posters #47, 84
Wang, Qiugen	*(n)*	Poster #105
Wang, Xiaodong	*(n)*	BSFF Paper #17
Ward, Anthony J.	*(n)*	Posters #125, 126
Ward, Russell	*(n)*	Poster #14
Wardak, Ishmayal	*(n)*	Lab Faculty
Warner, William C.	*(3C-Medtronic Sofamor Danek; 7-Saunders/Mosby-Elsevier)*	Poster #70
Wasserman, Scott M.	*(Ci-Employee of Amgen Inc; E-Stockholder of Amgen Inc)*	Poster #80
Waterman, Scott M.	*(n)*	Poster #12
Watson, J. Tracy	*(1-DePuy, A Johnson & Johnson Company, Smith & Nephew; 3B-Digimed)*	OTA Board; BSFF Faculty; Case Presentation Faculty; Lab Faculty; Papers #32, 55; Poster #91
Watson, Jeffrey D.	*(n)*	Poster #55
Weaver, Michael J.	*(G-Synthes)*	Paper #79
Webb, Lawrence X.	*(2-Musculoskeletal Transplant Foundation; 3B-Zimmer; 6-Synthes, Smith & Nephew, Stryker, Kinetic Concepts, Inc.)*	Posters #19, 61
Weber, Timothy G.	*(G-Wright Medical Technology)*	Paper #55
Wegener, Stephen T.	*(n)*	Poster #83
Weil, Yoram A.	*(n)*	BSFF Paper #23; Posters #53, 103
Weinans, Harrie	*(n)*	Paper #36
Weinberg, Annelie-Martina	*(F-Synthes)*	Paper #24
Weiß, Thomas	*(n)*	Paper #84
Weiss-Laxer, Nomi	*(n)*	Poster #72

Disclosure – *Items Answered through AAOS:*
(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. For full information, refer to pages 415 - 416.

DISCLOSURE LISTING – ALPHABETICAL

Wenke, Joseph C. . . . . *(6-Smith & Nephew)* . . . . .BSFF Faculty;
. . . . .Papers #37, 70; Posters #12, 75, 77
Wenke, Josh C. . . . . *(n)*. . . . . .BSFF Paper #13
Westesson, Per-Lennart . . . . . . *(n)*. . . . . Poster #78
White, Rena . . . . *(Ci-Wright Medical Technology)* . . . . .Paper #55
Whitlock, Patrick W. . . . . *(G-Zimmer, Biomet, Smith & Nephew;*
J-Arthroscopy) . . . . Poster #19
Whitman, Timothy . . . . *(n)*. . . . . Mini Symposium Faculty
Whitten, Andy . . . . *(Ci,E-Smith & Nephew)*. . . . . .Paper #33
Whyne, Cari M. . . . . *(3B-Relievant; 5-Baylis Medical)*. . . . . BSFF Paper #10;
. . . . .ORS Best Trauma Related Poster
Wiesner, Lindsay . . . . *(n)*. . . . . Poster #82
Wiggers, Jimme K. . . . . *(n)*. . . . . Poster #98
Wijdicks, Coen A. . . . . *(n)*. . . . . Poster #104
Wilber, John H. . . . . *(n)*. . . . . OTA Committee; Papers #64, 66; Poster #116
Willems, P. . . . . *(n)*. . . . . Poster #30
Williams, Allison E. . . . . *(n)*. . . . . Poster #90
Williams, Bart . . . . *(n)*. . . . . Poster #15
Williams, Johnathan . . . . *(n)*. . . . . Poster #24
Willis, Matthew . . . . *(n)*. . . . . .Paper #34
Wilson, Philip L. . . . . *(n)*. . . . . .Paper #60
Winkens, B. . . . . *(n)*. . . . . Poster #30
Wolinsky, Philip R. . . . . *(n)*. . . . . .BSFF Paper #6
Wong, Ambrose Hok-Ming. . . . *(n)*. . . . . Papers #46, 54
Wright, Coy Allen . . . . *(n)*. . . . . .Posters #135, 136
Wright, David . . . . *(n)*. . . . . BSFF Paper #10;
. . . . .ORS Best Trauma Related Poster
Wright, John . . . . *(n)*. . . . . Poster #78
Wyatt, Marilynn . . . . *(n)*. . . . . Poster #67
Wyrick, John D. . . . . *(n)*. . . . . Poster #54
Xing, Zhiqing . . . . *(n)*. . . . . BSFF Paper #17; Poster #130
Yach, Jeff. *(n)*. . . . . Lab Faculty
Yantis, Matthew G. . . . . *(n)*. . . . . Poster #70
Yi, Chengla . . . . *(n)*. . . . . Poster #92
Yoder, Eric M. . . . . *(n)*. . . . . .BSFF Paper #14
Yong, Sherri . . . . *(n)*. . . . . .BSFF Paper #21
Yu, Baoqing . . . . *(n)*. . . . . Poster #60
Yurgin, Nicole . . . . *(Ci-Employee of Amgen Inc;*
E-Stockholder of Amgen Inc) . . . . .Posters #69, 80
Zamorano, David P. . . . . *(2-AO North America;* . . . . Lab Faculty
3B,5-Smith & Nephew; 2,5-Synthes) . . . . .Paper #58
Zeckey, Christian . . . . *(n)*. . . . . .BSFF Paper #20

Disclosure – *OTA online submission*:
A= Royalties from a company or supplier; B= Speakers bureau/paid presentations; Ci= Paid employee for a company or supplier; Cii= Paid consultant for a company or supplier; Ciii= Unpaid consultant for a company or supplier; D= Other financial or material support from a company or supplier; E= Stock or stock options in a company or supplier; F= Self/family research support from a company or supplier; G= Departmental research support from a company or supplier; H= Other financial/material support from publishers; I= Self/family research support from publishers; J= Departmental research support from publishers. For full information, refer to pages 415 - 416.

Zehnder, Scott W.	*(n)*	Poster #91
Zhang, Bo-song	*(n)*	Poster #84
Zhang, Guo-zhu	*(n)*	Poster #47
Zhang, Qiulin	*(n)*	Poster #105
Zhang, Zhen	*(n)*	Paper #82; Posters #128, 129
Zheng, Yanming	*(Ci,E-Smith & Nephew)*	BSFF Paper #9
Zingg, Patrick	*(n)*	Poster #103
Zingman, Allissa	*(n)*	Paper #30
Ziran, Bruce H.	*(n)*	Mini Symposium Faculty; Posters #1, 37
Zirkle, Lewis G.	*(3C-SIGN)*	Lab Moderator
Zlowodzki, Michael P.	*(n)*	Poster #104
Zuckerman, Joseph D.	*(1-Exactech, Inc; 7-SLACK Incorporated, Wolters Kluwer Health - Lippincott Williams & Wilkins)*	Paper #28
Zura, Robert D.	*(Cii-Smith & Nephew; G-Synthes, Smith & Nephew)*	OTA Committee; Poster #93
Zych, Gregory	*(n)*	Poster #137

Disclosure – *Items Answered through AAOS:*
(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. For full information, refer to pages 415 - 416.

BSFF SYMPOSIUM I:
Biomechanics: Choosing the Right Model

Moderators: *Steven A. Olson, MD*
Loren L. Latta, MD, PhD

Introduction
Steven A. Olson, MD

Choosing the Right Specimen
Steven A. Olson, MD

Plate Fixation – A Clinician's Perspective
Philip J. Kregor, MD

Plate Fixation – An Engineer's Perspective
Michael Bushelow, MS

IM Nail Fixation – A Clinician's Perspective
Thomas (Toney) A. Russell, MD

IM Nail Fixation – An Engineer's Perspective
Loren L. Latta, MD, PhD

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 413.

Can We Trust Ex Vivo Mechanical Testing of Fresh Frozen Cadaveric Specimens? The Effect of Post-Freezing Delays

Paul Tornetta, III, MD[1]; ***Jacob L. Cartner, PhD***[2]; *Zane Hartsell, PhD*[2];
William M. Ricci, MD[2];
[1]*Boston University Medical Center, Boston, Massachusetts, USA;*
[2]*Smith and Nephew, Inc, Memphis, Tennessee, USA*

Background: Because embalming has been demonstrated to decrease the mechanical integrity of bone, most investigators favor fresh-frozen specimens for biomechanical evaluation. However, little is known about how the integrity of fresh-frozen specimens may change during biomechanical testing or may be affected by standard practices in testing.

Purpose: The purpose of this study was to evaluate how the time after removal from a freezer may affect the mechanical properties of fresh-frozen diaphyseal bone.

Methods: Matched pairs of nonosteoporotic fresh-frozen human cadaveric femora were thawed prior to instrumentation with bicortical screws. Matched femora were randomized to either control or delayed use. Each specimen received standard diaphyseal bicortical screws (n ≥7 in each group). At specified time points, screws were axially pulled out following the guidelines of ASTM F543-07. Test groups were stored in air (21 ± 0.5ºC) for 16, 50, or 90 hours. In the control group, screws were pulled out at 16 hours, which corresponds to the minimum elapsed time for specimen thawing, instrumentation, potting, and biomechanical test initiation. This represents the baseline mechanical properties of the fresh-frozen bone at the inception of any biomechanical test. The 90-hour group corresponds to the time needed to cycle a construct 300,000 times at a physiological test frequency of 1 Hz. This is roughly 2 to 4 months of in vivo loading. A midpoint of 50 hours was also tested, representing approximately 180,000 cycles.

Results: Failure for all specimens occurred due to bone failure at the screw to bone interface. There was a decrease in screw pull-out strength as drying time increased. The 50-hour test group showed a 9% decrease in screw pull-out strength as compared to the 16-hour control group ($P = 0.65$). However, the 90-hour test group showed a 30% decrease in screw pull-out strength as compared to the 16-hour control group ($P = 0.03$).

Conclusion: This study indicates that when utilizing fresh-frozen cadaveric bone in biomechanical tests to simulate the orthopaedic clinical setting, specimen exposure time should be considered. The timing of testing should be kept constant between specimens to allow for a proper comparison. Furthermore, for fresh-frozen cadavers, the physical properties of bone may be detrimentally affected in biomechanical testing that exceeds the 50-hour time point after removal from the freezer.

See pages 75 - 103 for financial disclosure information.

A Biomechanical Comparison of Standard Screw and Hybrid Fixation of Unstable Humeral Shaft Fractures

***Robert F. Ostrum, MD*[1]**; *Jason Nydick, DO*[2]; *Matthew Boardman, DO*[2];
[1]*Cooper University Hospital, Camden, New Jersey, USA;*
[2]*Philadelphia College of Osteopathic Medicine, Philadelphia, Pennsylvania, USA*

Purpose: The goal of this study was to perform a biomechanical comparison between 3.5-mm and 4.5-mm plating of an unstable humeral shaft fracture model. The null hypothesis was that hybrid (both locked and unlocked) screw configurations and standard screw fixation constructs would perform similarly with both a 3.5-mm plate and a 4.5-mm plate in terms of stiffness.

Methods: 30 synthetic Sawbones humeri were divided into 6 groups of 5 specimens each. A middiaphyseal osteotomy was made and a 1-cm defect was created. Six different plating constructs were tested: (1) standard screw fixation, 3.5-m dynamic compression plate (DCP) (3.5 standard screw [SS]); (2) hybrid screw fixation, 3.5 DCP (3.5 hybrid screw [HS]); (3) standard screw fixation, 4.5 narrow DCP (4.5 NSS); (4) hybrid screw fixation, 4.5 narrow DCP (4.5 NHS); (5) standard screw fixation, 4.5 broad DCP (4.5 BSS); and (6) hybrid screw fixation, 4.5 broad DCP (4.5 BHS). Seven-hole locking plates with 6 screws were used. Three nonlocking bicortical screws were placed proximal and distal to the osteotomy gap in the standard screw fixation group. For hybrid fixation, one bicortical nonlocking screw was used on each side of the osteotomy and 2 locking screws were then inserted on either side to simulate the clinical construct of fixation. The humeri were potted and tested in torsion to 1000 cycles. Testing was done on an MTS machine with an axial load of 0 N, torque = ±10 Nm, R = –1, rate = 0.3 Hz with stiffness measured at 1, 10, and 1000 cycles. For those constructs that failed prior to the 1000-cycle mark, the total number of cycles prior to failure was recorded. Data analysis was performed using an independent *t* test with Bonferroni correction and a Kruskall-Wallis test.

Results: For the 3.5-mm standard screw fixation group (3.5 SS), only 1 of 5 implants completed the 1000 cycles of testing, while the 3.5-mm hybrid group (3.5 HS) had 3 of 5 constructs complete 1000 cycles. In the 4.5 NSS and the 4.5 BSS groups, 4 of 5 made it to 1000 cycles and in the 4.5 NHS and 4.5 BHS groups, all 5 implants in both groups made it to completion of 1000 cycles. At 1000 cycles, there were significant differences in stiffness when comparing the 4.5 BHS and the 4.5 BSS to the 3.5 HS, 4.5 NSS, and the 4.5 NHS (P = 0.001). The 3.5 SS did not make it to 1000 cycles and was too weak to be compared. At 1000 cycles, the 4.5-mm plate constructs were stiffer than the 3.5-mm constructs (P = 0.022) and there were no differences when comparing the standard screw to the hybrid construct for each type of plate (P = 0.607). There were no statistical differences between the 3.5 HS and the 4.5 NSS and 4.5 NHS (P = 0.136).

Conclusions: Traditionally, plating humeral shaft fractures has been achieved using 4.5-mm plates. While several studies have compared fixation methods of humeral shaft fractures, clinical studies have shown no difference in union rates between 3.5-mm and 4.5-mm plates. Our study showed that the 4.5-mm broad constructs were significantly stiffer than

- 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 413.

all other constructs with the hybrid (BHS) being the stiffest, but not statistically significantly stiffer at 1000 cycles than the 4.5 BSS. The 4.5-mm constructs were stiffer than their 3.5-mm counterparts. For each type of plate used, there were no differences when comparing the hybrid fixation to the standard screw fixation. These results in simulated good quality bone do show an advantage to using the 4.5-mm broad plates but no real advantage to the use of hybrid screw over standard screw fixation in an unstable fracture model.

See pages 75 - 103 for financial disclosure information.

Biomechanics of Distal Radioulnar Repair: Ligament Reconstruction versus Capsulorraphy

Christopher Dy, MD[1]; Elizabeth Anne Ouellette, MD[2]; Anna-Lena Makowski[2]; Dena Mohnani[3]; Ali Malik [4]; Edward L. Milne, BS[5]; ***Loren L. Latta, MD, PhD[4,5]****;*
[1]Hospital for Special Surgery, New York, New York, USA;
[2]Miami International Hand Surgery Service, North Miami Beach, Florida, USA;
[3]University of Florida, School of Medicine, Gainesville, Florida, USA;
[4]University of Miami, Department of Orthopaedics, Miami Beach, Florida, USA;
[5]Max Biedermann Institute for Biomechanics, Miami Beach, Florida, USA

Purpose: Injuries to the distal radioulnar joint often require reconstruction. The initial clinical results provided by Adams and Berger are promising, but the biomechanics and long-term clinical follow-up are not reported. The purpose of this study is to compare the stability of the DRUJ after Adams ligament reconstruction and Herbert sling after the creation of a simulated tear in the triangular fibrocartilage complex (TFCC).

Methods: Six matched pairs of cadaveric upper extremity specimens were fixed to an MTS machine with the elbows in 90° flexion and forearm in pronation and the wrist in neutral. The MTS cycled the distal ulnas in a dorsal-volar direction while holding the radius to isolate the ulnoradial stability, and next holding the pisiform to isolate the ulnocarpal stability. Load was applied in displacement control to the extent that a recognizable neutral zone (NZ, as described by Panjabi) was displayed for each test and condition. The NZ was derived from the load-displacement curve as the displacement between the tension and compression portions of the curve. The length of the NZ is inversely related to stiffness of the joint and directly related to the laxity of the joint. Thus, NZ analysis was used as a measure of laxity prior to the TFCC's contribution to ulnocarpal and radioulnar stability. Following the completion of nondestructive testing, a standardized 2- to 3-mm lesion of the ulnar-sided peripheral TFCC was created, to emulate the injury pattern similar to that for which a ligament reconstruction is indicated, and the tests were repeated. One specimen in each pair was assigned for repair with the Herbert sling and the other specimen in the pair assigned for repair with anatomic ligament reconstruction. The tests were repeated and statistical comparisons made by *t* test with Bonferroni correction for multiple comparisons.

Results: Radioulnar and ulnocarpal laxity increased following the creation of the TFCC tear, and decreased following either type of surgical repair. Both the mean radioulnar NZ and the mean ulnocarpal NZ increased 30% after the creation of the TFCC tear when compared to its initial state and decreased 8% after either surgical repair when compared to its torn state. The mean radioulnar NZ was increased 20% and the mean ulnocarpal NZ length increased 26.7% after either surgical repair when compared to the intact pre-experimental state. Movement of the pisiform relative to the triquetrum increased 10% after the TFCC tear, then decreased 67% following surgical repair using either technique. The Adams ligament reconstruction provided a better restoration of radioulnar stability than the Herbert sling, but this difference was not statistically significant ($P = 0.06$). However, there was a significant difference in ulnocarpal stability between the two repair techniques ($P = 0.038$),

• 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 413.

with the ulnocarpal joints in the Adams specimens significantly more lax than the Herbert specimens.

Conclusions: The findings of the current study suggest that radioulnar and ulnocarpal stability of the distal radioulnar joint can be achieved using the Herbert sling, a relatively simple and less time-consuming procedure, with biomechanical results equivalent to those following a more invasive and complex surgical reconstructive procedure.

Acknowledgments: The authors would like to gratefully acknowledge Eli Herndon and Veronica Diaz for their assistance and Smith & Nephew Endoscopy for lending arthroscopic equipment for use in this project. Support was provided by the Max Biedermann Institute and the Jackson Health System Foundation.

See pages 75 - 103 for financial disclosure information.

Δ Biomechanical Evaluation of Transsacral, Transalar, and Iliosacral Screw Fixation for Comminuted Transforaminal Sacral Fractures

Brett D. Crist, MD; *Ferris Pfeiffer, PhD; Michael Khazzam, MD; Yvonne M. Murtha, MD; Gregory J. Della Rocca, MD, PhD, FACS; William Carson, PhD;*
University of Missouri, Columbia, Missouri, USA

Purpose: This study was undertaken to evaluate the biomechanical stability of transsacral and transalar screw fixation versus standard iliosacral screw constructs for stabilization of comminuted transforaminal (Denis zone II) sacral fractures, which have been associated with a higher risk of clinical failure. Transalar and transsacral screws have been proposed to decrease risk of construct failure. We hypothesize that the bone-screw interface resistance to bending moments and the associated boney parameters are the primary factors influencing the stability of screw-based pelvic fixation.

Methods: Synthetic pelves were used to eliminate cadaveric variability. A comminuted transforaminal sacral and rami fracture was modeled by creating a 0.5-cm gap. Each pelvis was stabilized by either (1) two iliosacral screws in S1, (2) one transsacral screw in S1 and one iliosacral screw in S1, (3) one transalar screw in S1 and one iliosacral screw in S1, or by the addition of an anterior inferior iliac pelvic external fixator to create groups 4 through 6. 18 instrumented pelvic models (n = 3 per group) were tested with the right ilium fixed to simulate a physiologic single-leg stance. Torque and axial load were applied to the center of the S1 superior endplate with no other external constraints on its 3-dimensional motion. Five cycles of ±10-Nm torque was initially applied then sequentially increased by ±5 Nm until material yield (as detected by an offset of 5° at zero torque at end of a cycle). Five cycles of axial load from 15 to 50-N compression was next applied, then sequentially max compression was increased 50 N until material yield (as detected by an offset of 2 mm when a cycle returned to 15 N). This was followed by axial loading to catastrophic failure. Three-dimensional relative motion across the sacral and rami fractures and of screws relative to bone was measured with an optical tracking system. Construct torsional and axial stiffness were determined during the fifth cycle of loading. Student *t* (2-tail, unequal variance) was used to determine significance, $P < 0.05$.

Results: Torsional failure of groups 1 through 3 initiated as bone crushing of the iliac cortices at the screw head-shank interfaces, and screw heads alternating (one pull-through, the other push-out) of the ilium with torque reversal, resulting in increased transverse plane rotation of the sacrum relative to the ipsilateral ilium, and opening/closing of the rami fracture. Addition of the external pelvic fixator reduced the transverse plane rotation as evidenced by the statistically significant reduction in rami fracture open-closing range of motion. Axial load failure of groups 1 through 3 continued as additional bone crushing at the screw head-shank interfaces, which resulted in increased flexion rotation of the sacrum relative to the ipsilateral ilium about a medial-lateral axis in the vicinity of the screw heads. Catastrophic failure occurred as fracture of the ipsilateral ilium, typically initiating through a screw site. Relative motion between sacrum and the screws was small, inferring that screw/sacral bone interface remained intact. Differences in stiffness were not statistically significant.

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 413.

Conclusion: Construct failure appeared similar to clinical cases, inferring realistic in vivo simulation. Our results indicate that failure of screw alone–based constructs are due to localized bone failure and screw pull-through push-out at the screw head-shank/ipsilateral ilium junction and not in the sacrum, and is less likely to occur at the same level of loading with rami fixation. As a result, patients with comminuted transforaminal sacral fractures with ipsilateral rami fractures would appear to benefit from posterior and anterior pelvic ring fixation.

See pages 75 - 103 for financial disclosure information.

Quantifying the Load Sharing Capabilities of Distal Femur Plating through Strain Analyses in Healthy and Osteoporotic Bone in Different Fracture Types

Jacob L. Cartner, PhD; Zane Hartsell, BS; ***Bob Jones, III, BS****; William M. Ricci, MD;*
Smith & Nephew, Memphis, Tennessee, USA

Purpose: Intramedullary nails are typically described as load-sharing devices and plate-screw constructs as load-bearing. However, depending on the specific construct, fracture pattern, and bone quality, locked plate-screw constructs must also share and then transfer load during the successful fracture healing process. This load transfer remains poorly characterized. The purpose of this study was to evaluate the strain distribution along the length of distal femur plates for different bone qualities (osteoporotic or not), fracture patterns (simple or complex), and screw type (locked or nonlocked). We hypothesized that each of these parameters affect the ability of plate-screw constructs to share load with the affected bone.

Methods: An 8-hole stainless steel distal femur plate (Peri-Loc, Smith & Nephew) was instrumented with 8 vertically oriented strain gauges at increasing distances from the fracture. Eight groups of five specimens included either a simulated healthy or osteoporotic bone surrogate, each with either a simple oblique fracture without a fracture gap (OTA 33A1) or a complex fracture with a 2-cm gap (OTA 33A3), and each with either locked or nonlocked proximal fixation (4.5-mm bicortical screws). Distal fixation was with 5.7-mm locked screws in all specimens. Strain data were collected during quasistatic loading. Loading was repeated five times per construct per group.

Results: *Location of Plate Strain.* In all instances, plate strain was greatest near the fracture with both fracture types having similar qualitative trends. *Effect of Fracture Pattern.* A3 fractures resulted in greater plate strain in all cases ($P < 0.05$). *Effect of Bone Quality and Screw Type.* In nonosteoporotic A3 fractures, nonlocked constructs had greater plate strain than locked constructs ($P < 0.05$). In contrast, locked constructs had greater plate strain than nonlocked constructs in the osteoporotic A3 specimens ($P = 0.001$).

Conclusion: Our results show that regardless of bone quality, fracture pattern, or screw type, strain in plate-screw distal femur fixation constructs is concentrated near the fracture region. Additionally, more complex fractures (OTA 33A3 compared to 33A1 in this case) result in higher strain in the plate, indicating a lack of load-sharing by the bone. Both bone quality and screw type affected plate strain: in healthy bone, nonlocked constructs resulted in higher plate strain, whereas in poor bone, higher plate strains were observed in locked constructs. Thus, bone quality and screw type must be considered in instances when working-length constraints create high localized plate strain.

- 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 413.

Does Screw Orientation Influence Construct Stiffness in Vertical Shear Fractures of the Medial Malleolus?

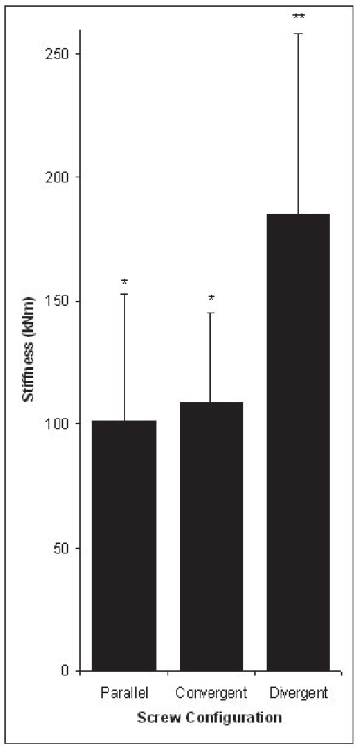
Safdar N. Khan, MD; ***Derek Amanatullah, MD****; Shane Curtiss, AS; Philip R. Wolinsky, MD; University of California at Davis Medical Center, Sacramento, California, USA*

Purpose: This study was designed to mechanically evaluate the effectiveness of three different screw orientation patterns for the treatment of vertical shear fractures of the medial malleolus. The hypothesis was that a divergent, nonparallel screw orientation would be stiffer than the traditional parallel two-screw orientation for this fracture pattern.

Methods: To ensure uniform testing materials, 30 polyurethane distal tibial models of uniform size and composition were used to test three different screw orientation techniques to stabilize vertical fractures of the medial malleolus. Identical vertical osteotomies were created and the models were randomly assigned to one of three fixation methods: group 1, two 40-mm length, 4.0-diameter screws placed parallel to each other and the joint line; group 2, two 40-mm length, 4.0-diameter screws placed 30° divergent to each other; and group 3, two 40-mm length, 4.0-diameter screws placed 15° convergent to each other. Ten specimens from each group were tested under axial loading conditions loaded at 1 mm/s until 2 mm of displacement occurred.

Results: All results were normalized by evaluating the elasticity of the intact model under loading conditions. The average stiffness of medial malleolus fixation utilizing either a parallel or convergent screw configuration was 109 ± 37 kNm and 102 ± 51 kNm, respectively. There was no statistically significant difference ($P = 0.76$) in the stiffness of these two screw configurations in our model system. However, the average stiffness of a divergent screw configuration was 185 ± 73 kNm. The divergent screw pattern was statistically significantly stiffer ($P = 0.02$) than both parallel and convergent screw fixation in our model system.

Conclusion: Use of a divergent screw pattern results in a stiffer construct for stabilizing vertical shear fractures of the medial malleolus compared to other screw patterns. Further studies comparing the two-screw, divergent model versus an antiglide plate configuration need to be performed to assess the best fixation strategy for these challenging fractures.



See pages 75 - 103 for financial disclosure information.

The Mechanical Effect of Targeted Blocking Screws in Distal Femur Fractures

Sagar J. Desai, MD; *David W. Sanders, MD; Louis Ferreira, MD; Josh Giles, BESc; James Johnson, PhD;*
University of Western Ontario, London, Ontario, Canada

Purpose: Blocking screws placed adjacent to intramedullary nails supplement fixation in long-bone fractures with a short proximal or distal segment. Placement of blocking screws using fluoroscopy results in variability in screw placement. The mechanical significance of this variability of screw placement is unknown. Recently, a targeted blocking screw device was developed, enabling accurate placement of blocking screws adjacent to the nail. The purpose of this study was to evaluate the mechanical effects of targeted (TBS) and nontargeted blocking screws (NBS) in distal femur fractures stabilized with and without standard locking screws. We hypothesized that TBS constructs would provide more stability than NBS constructs.

Methods: 16 Sawbone femurs were used to create a distal femoral fracture model (OTA 32-C3.2[3]). Specimens were osteotomized 8 cm proximal to the knee joint and a 2-cm gap was created. Reamed intramedullary nails (diameter, 11.5 mm; length, 40 cm) were used for stabilization, including 1 proximal locking screw (LS) and varying the distal screw configuration for study purposes. TBS were inserted using a commercially available targeting device. NBS were inserted 1 screw diameter medial or lateral to the targeted position. Four study groups were created: group 1 consisted of TBS and 2 distal LS; group 2 had TBS and 1 LS; group 3 had NBS and 2 LS; and group 4 consisted of NBS and 1 LS. Specimens were subjected to a cyclic compression protocol along the mechanical axis of the femur using an Instron servohydraulic mechanical testing device. Applied load varied from 100 to 700 N in 100-N incremental staircase loading protocol with 10 cycles at 0.5 Hz. Stiffness was determined from the slope of the load-displacement curve generated by the testing device. Fracture gap motion was measured with electronic calipers.

Results: Constructs with TBS were stiffer than those with NBS at all load levels, and 10% stiffer overall. Differences were statistically significant at moderate load levels (group 1 vs 3: 400 N and 500 N, $P < 0.05$; group 2 vs 3: 400 N, 500 N, and 600 N, $P < 0.05$). Fracture gap data revealed a difference in sagittal motion at the fracture site ($P < 0.05$). Anteriorly, the mean displacement was 1.43 mm and 3.53 mm in group 1 versus 4, respectively ($P < 0.05$). The mean displacement in groups 3 versus 4 was 1.66 and 3.53, respectively ($P < 0.05$).

Conclusion: Targeted constructs were stiffer at all load levels compared to NBS constructs. Furthermore, a difference in sagittal stability was found between groups with 1 and 2 locking screws, independent of the position of blocking screws. The use of TBS and multiple distal LS provided the greatest stability in this study of distal femoral 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 413.

•Does Insertion Torque Affect the Mechanics of Locking Hole Inserts and Fatigue Performance of Bridge Plate Constructs?

Jacob L. Cartner, PhD[1]; Adam Messina, BS[1]; Charlie Baker[1]; Thomas (Toney) A. Russell, MD[2]; ***Paul Tornetta III, MD[3]****; William M. Ricci, MD[1];*
[1]Smith & Nephew, Memphis, Tennessee, USA;
[2]Regional Medical Center, Memphis, Tennessee, USA;
[3]Boston University Medical School, Boston, Massachusetts, USA

Purpose: Empty holes over the zone of comminution in plate-screw constructs is recommended to create relative stability and encourage secondary bone healing via callus formation, the goal of bridging. However, stress is localized to that region of the plate. Empty holes represent a weak link in the construct, and with delayed healing can lead to permanent deformity or plate failure. It has been shown that placing locking screw heads (shaft of standard screw cut off) into open holes improves fatigue properties, but these fillers are prone to loosening. The purpose of this investigation was twofold: first, to evaluate fatigue performance of locking plates instrumented with new locking hole inserts (LHIs), and to determine if increased insertion torque improves performance.

Methods: New LHIs were designed specifically to reduce the likelihood of loosening. Their engagement with plate screw-hole threads results in an increased coefficient of friction over normal screw heads, while still allowing for ease of removal. Both 3.5-mm and 4.5-mm 8-hole locking plates (Peri-Loc, Smith & Nephew) were fatigued to failure (defined as implant fracture) using four-point bend per ASTM standards. For each size, plates instrumented with six LHIs were compared to plates with all holes open. Four LHIs were located within the loading span and two were outside the loading span. The 3.5-mm LHIs were inserted to either 1.70 N-m or to 3.96 N-m. The 4.5-mm LHIs were inserted to 3.96 N-m only. Upon failure, the amount of LHI loosening was evaluated by measuring removal torque.

Results: *Failure Mode.* Every plate fractured through one or more of the locking screw holes located within the loading span. *Effect of Fillers and Insertion Torque.* At the 1.70-N-m insertion torque, 3.5-mm plates with LHIs survived an average 114,300 cycles, which was 52% more cycles ($P = 0.01$) than plates without LHIs (average 75,487 cycles). Increasing insertion torque to 3.96 N-m led to a further increase in 3.5-mm plate fatigue life ($P = 0.02$) to an average 155,177 cycles. This represented a 106% increase compared to plates without LHIs ($P < 0.05$). The 4.5-mm plates with LHIs survived 48% more cycles (average 74,369 cycles) than plates without LHIs (average 50,214 cycles) ($P = 0.001$). *Loosening of Inserts.* At the 1.70-N-m insertion torque, all 3.5-mm LHIs inside the loading span had nearly completely loosened (removal torque <0.2 N-m) upon failure. Increasing insertion torque to 3.96 N-m reduced loosening as 3.5-mm LHIs retained on average 63% of their insertion torque despite a higher cycle count at plate failure. The 4.5-mm LHIs retained on average 64% of their insertion torque at failure.

Conclusion: Locking hole inserts placed into empty holes of bridge plating constructs improves plate fatigue performance. Increasing insertion torque of LHIs further improves plate fatigue survival and lessens the likelihood of loosening during cyclic loading.

See pages 75 - 103 for financial disclosure information.

Biomechanical Investigation of Plate Working Length on Fatigue Characteristics of Locking Plate Constructs in Cadaveric Distal Metaphyseal Femoral Fracture Models

William M. Ricci, MD[1]*; Paul Tornetta, III, MD*[2]*; Yanming Zheng, PhD*[1]*;*
Ramona Soileau[1]*; Jacob L. Cartner, PhD*[1]*;*
[1]*Smith and Nephew, Inc., Memphis, Tennessee, USA;*
[2]*Boston University Medical School, Boston, Massachusetts, USA*

Purpose: The working length of plate-screw constructs is known to modulate construct stiffness. The purpose of this study was to evaluate how changes in working length of locked plate constructs affects fatigue properties using a cyclical physiologically relevant loading condition in a human cadaveric distal metaphyseal femoral fracture model, and to determine if the fatigue performance and construct stiffness are dependent on bone quality (osteoporotic or nonosteoporotic). An evaluation of the locations of the screws that loosened most during loading is also included.

Methods: Matched pairs of fresh-frozen nonosteoporotic (n = 7) and osteoporotic (n = 7) human cadaveric femora had a trapezoidal distal metaphyseal defect spanning 3 holes laterally and 1 cm in length medially created, and then either 1 or 5 screw holes were left unfilled (ie, "short" or "long" working lengths [WL]) after instrumentation with a distal femur locking plate system. Proximal fixation was with 4.5-mm bicortical locking screws and distal fixation with 5.7-mm cannulated locking screws. A physiological combined loading configuration per ISO 7206-4 (2002[E]) was applied with failure defined as fracture gap closure or a loss of maintenance in load. Construct stiffness was evaluated initially and after each subsequent 12,500-cycle interval. After fatigue failure, screw removal torque was measured.

Results: *Failure Modes–Nonosteoporotic*. The modes of failure for short WL constructs were most commonly plate fracture (6 of 7), whereas the modes of failure for long WL constructs were mixed (4 plate failures, 3 screw failures), indicating stress concentration was less focused on the plate in the long WL constructs. The short WL failed at a significantly higher number of cycles (103,734) compared to the long WL constructs (86,090) ($P = 0.047$). When considering only constructs with plate failure, the WL did not influence fatigue life (short = 103,000 cycles vs long = 86,000 cycles; $P = 0.49$). *Failure Modes–Osteoporotic.* Failure modes were more varied in the osteoporotic specimens, with more failures related to the bone-screw-plate interface (n =5 for short WL, n = 6 for long WL) and fewer related to plate fatigue (n = 2 for short WL, n = 1 for long WL). Short and long WL constructs had similar fatigue life (79,500 vs 65,300 cycles; $P = 0.25$) *Stiffness–Nonosteoporotic.* Again, the short WL was stiffer initially (1115 lbf/in vs 638 lbf/in; $P = 0.002$) and at 62,500 cycles (957lbf/in vs 584 lbf/in; $P = 0.006$). The loss of stiffness was significantly more over the testing for the short WL as compared with the long WL ($P = 0.026$). *Stiffness–Osteoporotic.* Short WL constructs had greater stiffness than long WL constructs in osteoporotic bone at test initiation (867 lbf/in vs 617 lbf/in; $P < 0.0001$), which diminished to 545 lbf/in versus 271 lbf/in for the surviving specimens at 62,500 cycles ($P = 0.06$). However, the trendlines did not differ ($P = 0.66$), indicating that the loss of stiffness was at a similar rate. *Screw Loosening.* Using removal torque as a measure, the screws nearest to the gap loosened the most in all specimens.

• 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 413.

Conclusion: In nonosteoporotic bones, short and long WL constructs tend to fail by plate fracture. The long WL constructs had plate failure at fewer cycle counts than short WL constructs in nonosteoporotic but not osteoporotic bone. For the osteoporotic bones, the modes of failure for both short and long WL constructs were more diverse than those for the nonosteoporotic bones, indicating sensitivity to other construct parameters such as bone quality, screw purchase, etc. As expected, the stiffness of the short WL constructs was significantly higher than the long WL at all time points. While the slope of stiffness over time did not differ in the osteoporotic specimens, it did in the nonosteoporotic specimens, with the long WL maintaining stiffness over time. This study characterizes the failure modes and stiffness for long versus short WL constructs. It should be noted that all of these constructs were locked at all fixation points, so extrapolation of these data to unlocked or hybrid constructs may not be appropriate.

See pages 75 - 103 for financial disclosure information.

BSFF SYMPOSIUM II:
Bone Defect Repair

Moderators: *Emil H. Schemitsch, MD*
Thomas A. Einhorn, MD

Selecting the Right Autograft
Aaron Nauth, MD

Induced Membranes (Masquelet Technique): What Is the Evidence?
Hans-Christoph Pape, MD

Subchondral Defects: What Is the Best Bone Void Filler?
William G. DeLong, Jr., MD

The Use of Osteobiologics in Bone Defects
J. Tracy Watson, MD

Large Diaphyseal Defects: What Is the Best Treatment?
Michael D. McKee, MD

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 413.

Δ Endothelial Progenitor Cells for Healing of Segmental Bone Defects

Ru Li, PhD[1]; Kivanc Atesok, MD[1]; Aaron Nauth, MD[1]; ***Erion Qamirani, MD[1]****;*
David Wright, BS[2]; Cari M. Whyne, PhD[2]; Emil H. Schemitsch, MD[1]
[1]St Michael's Hospital, University of Toronto, Toronto, Ontario, Canada;
[2]University of Toronto, Toronto, Ontario, Canada

Purpose: Severe fractures damage blood vessels and disrupt circulation at the fracture site, resulting in an increased risk of poor fracture healing. Endothelial progenitor cells (EPCs) are bone-marrow–derived cells with the ability to differentiate into endothelial cells and contribute to neovascularization and re-endothelialization after tissue injury and ischemia. We have previously reported that EPC therapy resulted in improved radiographic healing and histological blood vessel formation in a rat fracture model. The purpose of this study was to further quantify the effects of EPC therapy with micro CT and biomechanical analyses.

Methods: 5-mm segmental defects were created and stabilized in the femora of 14 Fischer 344 rats. The treatment group (n = 7) received 1×10^6 EPCs within gel foam locally at the area of the bone defect, and control animals (n = 7) received only saline–gel foam with no cells. The formation and healing of bone after 10 weeks were asessed by radiographic, micro CT, and biomechanical analyses.

Results: Radiographically, all the animals in EPC-treated group healed with bridging callus formation, whereas control group animals demonstrated radiographic nonunion. Micro CT assessment demonstrated significantly improved parameters of bone volume (35.34 to 20.68 mm^3, $P < 0.001$), bone volume density (0.24% to 0.13%, $P = 0.001$), connectivity density (25.13% to 6.15%, $P = 0.030$), trabecular number (1.14/mm to 0.51/mm, $P < 0.001$), trabecular thickness (0.21 to 0.26 mm, $P = 0.011$), trabecular spacing (0.71 to 1.88 mm, $P = 0.002$), bone surface area (335.85 to 159.43 mm, $P < 0.001$), and bone surface to bone volume ratio (9.43/mm to 7.82/mm, $P = 0.013$) in the defect site for the EPC group versus the control group, respectively. Biomechanical testing showed that the EPC treatment group had a significantly higher torsional strength compared with the control group (EPC = 164.6 ± 27.9 Nmm, control = 29.5 ± 3.8 Nmm; $P < 0.001$). Similarly, the EPC-treated fractures demonstrated significantly higher torsional stiffness versus controls (EPC = 30.3 ± 5.0 Nmm/deg, control = 0.9 ± 0.1 Nmm/deg; $P < 0.001$). When biomechanically compared to contralateral intact limbs, the EPC-treated limbs had similar torsional stiffness ($P = 0.996$), but significantly lower torsional strength ($P < 0.001$) and smaller angle of twist ($P = 0.002$).

Conclusion: These results suggest that local EPC therapy significantly enhances fracture healing in an animal model. The biomechanical results show that control animals develop a mechanically unstable nonunion. In contrast, EPC therapy results in fracture healing that restores the biomechanical properties of the fractured bone closer to that of intact bone.

Δ OTA Grant
See pages 75 - 103 for financial disclosure information.

Increasing Vascularity to Improve Healing of a Segmental Defect of the Rat Femur

Rena L. Stewart, MD[1]; *Jessica B. Goldstein, RN*[1]; *Eddie L. Hyatt, BS*[1];
T. Gabriel Chu, PhD[2]; *Shawn R. Gilbert, MD*[1];
[1]*University of Alabama at Birmingham, Birmingham, Alabama, USA;*
[2]*Indiana University, Indianapolis, Indiana, USA*

Purpose: This study was undertaken to investigate whether a proangiogenic drug can increase vascularity in a rat segmental femoral defect model, and whether increased bone healing would follow. The drug tested, desferrioxamine (DFO), has been shown to increase bone vascularity and healing in fractures and distraction osteogenesis (by activating the hypoxia inducible factor pathway, a master regulator of response to low oxygen and nutrient availability).

Methods: A 5-mm diaphyseal femoral defect was created in 49 rats using a saw. A load-bearing, biodegradable scaffold of polypropylene fumarate (PPF) was fixed in the defect with an intramedullary Kirschner wire. The rats were then assigned to one of four treatment groups: (1) normal saline control, (2) DFO alone, (3) DFO plus 5 μg bone morphogenetic protein (BMP), and (4) BMP 10 μg (positive control). Each treatment was applied in solution to dicalcium phosphate portals engineered in the scaffold. Serial radiographs were taken at 3, 6, and 12 weeks postoperatively. Vascularity was assessed by micro CT angiography following MICROFIL perfusion at 6 weeks. Bone healing on radiographs at 12 weeks was scored by two blinded examiners as no callus (0), some callus (1), or bridging callus (2).

Results: Vascularity in the DFO-treated animals, as represented by vessel number/mm^3 in micro CT angiography, was increased compared to saline control ($P = 0.005$). Vessel number was also increased in the DFO/BMP group compared to control, with a strong trend toward statistical significance ($P = 0.08$). 100% of radiographs in the BMP and DFO/BMP groups were scored as "complete bridging callus," compared to 15% for saline and 29% for DFO. Final results from micro CT and biomechanical testing at 12 weeks to further assess final bone healing are pending.

Conclusion: The proangiogenic drug DFO increases vascularity during the healing of segmental bone defects in the rat model. To our knowledge, this is the first investigation to merge the approaches of a bioengineered scaffold with a proangiogenic drug to promote bone healing. This novel approach offers the possibility of speeding/improving bone healing using an inexpensive, readily available, US Food and Drug Administration (FDA)-approved drug in the highly challenging clinical setting of bone defects. Alternately, the combination of the proangiogenic strategy with the BMP may permit use of lower doses of BMP. This highly clinically relevant concept merits further study.

• 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 413.

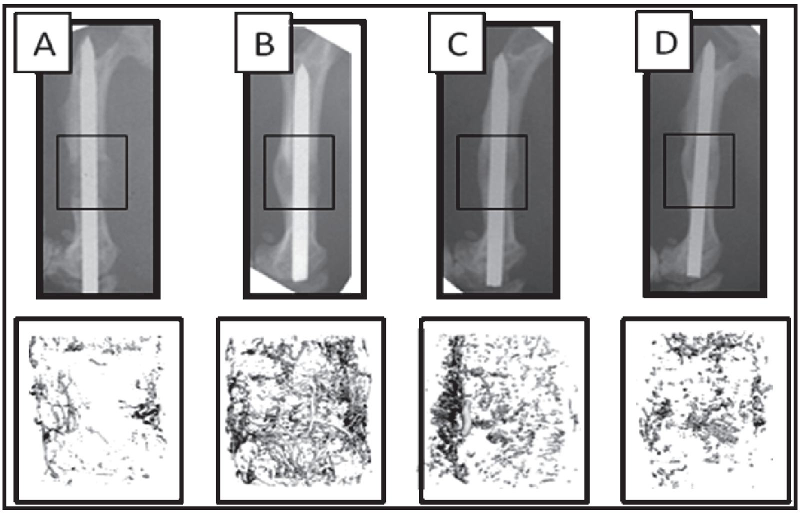


Fig. 1 Radiographs and micro CT images. Rat femur segmental defects were stabilized with biodegradable scaffolds and intramedullary Kirschner wire. They were then treated with (A) saline (control), (B) DFO, (C) DFO/BMP, or (D) BMP. **Top row:** Representative radiographs after 12 weeks healing are shown. The boxed region indicates the defect and also indicates the area that was examined for micro CT angiography. **Bottom row:** Micro CT angiograms of the defects at 6 weeks in the same groups.

See pages 75 - 103 for financial disclosure information.

Δ Endothelial Progenitor Cells for Healing and Angiogenesis in a Segmental Bone Defect Model: A Comparison with Mesenchymal Stem Cells

Aaron Nauth, MD*; Ru Li, MD; Emil H. Schemitsch, MD;*
St. Michael's Hospital, Toronto, Ontario, Canada

Purpose: Fracture healing requires a coordinated coupling between osteogenesis and angiogenesis. The purpose of this study was to compare the effects of two types of stem/progenitor cells on the healing of critical-sized bone defects in a rat model. Endothelial progenitor cells (EPCs), a novel cell type with previously demonstrated effects on angiogenesis in animal models of vascular disease, were compared to both a control group of no cell therapy, and a treatment group of mesenchymal stem cells (MSCs). The hypothesis was that EPCs would demonstrate both superior bone healing and angiogenesis, when compared to the control group and MSC group.

Methods: EPCs and MSCs were isolated from the bone marrow of syngeneic rats by differential culture and grown ex vivo for 10 days. Subsequently the cells were harvested, seeded on a gel-foam scaffold, and implanted into a 5-mm segmental defect in a rat femur that had been stabilized with a plate and screws. Bone healing was assessed radiographically and by micro CT. Angiogenesis was assessed by histology and physiologically, using laser Doppler to assess blood flow in the bone and soft tissues.

Results: The EPC group demonstrated radiographic evidence of healing of the bone defect as early as 2 weeks, and all specimens were radiographically healed at 6 weeks. Both the control group and the MSC group showed no radiographic evidence of healing at 10 weeks (Fig. 1). Micro CT comparison of the EPC group versus the control group showed significantly greater bone volume and density at the defect site ($P<0.001$). More blood vessel formation was observed in the EPC group versus the control group on histology at 2 weeks. Laser Doppler assessment showed significantly more soft tissue and bone blood flow at 2 and 3 weeks in the EPC group versus the control group ($P = 0.021$).

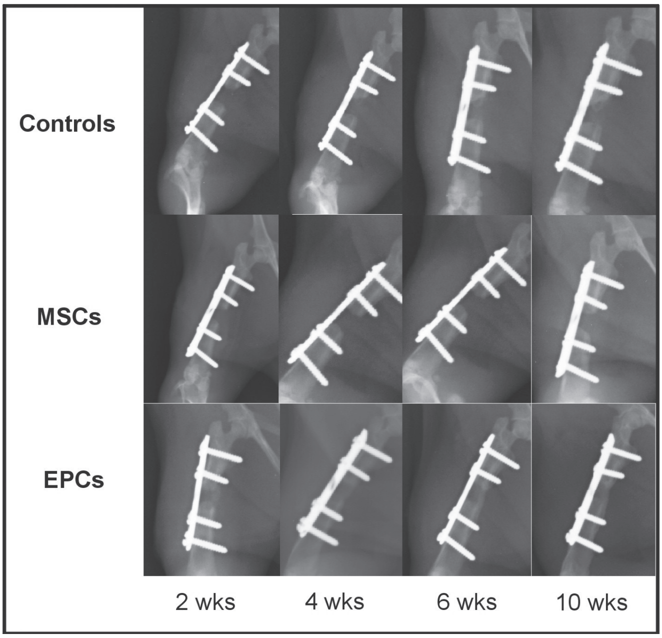


Fig. 1 Radiographs comparing progressive healing of a bone defect in a rat femur between control defects, MSC-treated defects, and EPC-treated defects.

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 413.

Conclusions: EPCs are effective as cell-based therapy for healing critical-sized bone defects in a rat model. EPCs are superior to MSCs in this model. EPCs demonstrate superior angiogenesis over controls in a rat model of fracture healing. These results strongly suggest that EPCs are effective for therapeutic angiogenesis and osteogenesis in fracture healing.

See pages 75 - 103 for financial disclosure information.

Decreasing Complications in Open Fractures with a Novel Bone Graft
Kate V. Brown, MD[1]*; Bing Li, PhD*[2]*; Teja Guda, PhD*[1]*; Daniel Perrien, PhD*[2]*;*
Scott Guelcher, PhD[2]*; Josh C. Wenke, PhD*[1]*;*
[1]*United States Army Institute of Surgical Research, San Antonio, Texas, USA;*
[2]*Vanderbilt University Medical Center, Nashville, Tennessee, USA*

Introduction: Complications such as nonunion are frequent in open fractures. Polyurethane (PUR) scaffolds have been developed with tunable delivery characteristics for both growth factors and antibiotics and may reduce complications. The aim of this study is to compare the two different bone morphogenetic protein (BMP) release rates from PUR scaffolds to the current standard of clinical care to promote bone growth in a stringent model.

Methods: The release kinetics of rhBMP-2 from the collagen implants and the PUR scaffolds were investigated in vitro using replicate samples in a release medium. The ability of implants to regenerate bone was investigated in vivo in a rat femoral critical-sized defect model. There were 5 groups (n = 10) at 4 and 8 weeks: the control group was rhBMP-2 on a collagen sponge (the current standard of clinical care); the experimental groups were PUR slow release (SR) blank scaffolds, PUR fast release (FR) blank scaffolds, PUR SR + rhBMP-2 scaffolds, and PUR FR + rhBMP-2. The PUR scaffolds were synthesized by reactive liquid molding. FR scaffolds were prepared by incorporating rhBMP-2 as a dry powder, and SR materials were prepared by first microencapsulating rhBMP-2 in 1.3-μm microspheres prior to incorporation in the foam. 2 μg of rhBMP-2 was used per implant. The amount of bone regenerated was assessed using micro CT and the underlying processes were delineated by histology. Statistical significance was assessed with one-way analysis of variance ($P < 0.05$).

Results: In vitro, the release kinetics demonstrated 92% of BMP had been delivered from the collagen sponge by day 1 and 100% by day 2. In contrast, the PUR FR + BMP scaffolds showed a release of 36% of rhBMP-2 on day 1, followed by a sustained period of release until day 21 (71% cumulative release). Encapsulation of the rhBMP-2 in the PUR SR scaffolds reduced the initial release to 3%; the cumulative release at day 21 was 22%. In vivo, average bone volume in the PUR FR + BMP and collagen + BMP was 42 mm^3 and 30 mm^3, respectively. Bone volume in these two groups was significantly greater than the other experimental groups ($P < 0.001$). Average total bone formation in the blank scaffolds and the PUR SR + BMP at both 4 and 8 weeks was 10 mm^3 with no significant differences between the groups. There were no significant differences in total bone volume for any group from the 4- to 8-week time point. Histology demonstrated a highly organized pattern of bone formation and vasculogenesis within the scaffold pores in the PUR FR + BMP group. This was not seen in the other groups.

Discussion: The PUR (FR) scaffolds with BMP had the two desired effects of regenerating more bone and stimulating a greater vascular response than the current standard of care. This bioabsorbable and osteoconductive scaffold therefore shows potential for use clinically to promote healing in severe open fractures. Furthermore, the effect on vasculogenesis, along with its ability to release effective antibiotic levels for over 8 weeks, will help to reduce the risk of infection in these devastating 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 413.

Xenograft Bone Inclusion Improves Incorporation of Hydroxyapatite Cement into Cancellous Defects

Michael J. Voor, PhD; *Eric M. Yoder, BS; Robert L. Burden, Jr., MEng;*
University of Louisville, Orthopaedic Bioengineering Laboratory, Louisville, Kentucky, USA

Purpose: Hydroxyapatite cement (HAC) is biocompatible and osteoconductive, but its slow resorption limits new bone formation. The addition of pores or biological materials helps resorption, but typically compromises short-term strength. The purpose of this investigation was to determine the effects of adding partially decalcified xenograft bone on cement resorption, new bone formation, and strength over 10 weeks in an established critical-defect animal model. The hypothesis was that adding processed xenograft bone particles would increase the incorporation of the HAC and formation of new bone within the HAC without decreasing its strength.

Methods: Eight 6-month-old female New Zealand White rabbits were used. Drill-hole defects (8.0-mm long, 5.0-mm diameter) were prepared and filled with either HAC alone or HAC mixed with processed xenograft bone particles from young pigs (XBC) at a volumetric ratio of approximately 25%. The particles were elongated "needles" of cortical bone approximately 5 mm long and 1 mm in diameter that were extensively washed, demineralized in dilute HCl, and rewashed. Micro CT scanning, decalcified and undecalcified histology, and mechanical indentation testing of the healing defects were performed after 10 weeks (n = 8). New bone and inflammatory/immune response were graded on a 0 to 3 scale and calcein labeling was quantified as % area new bone. Statistical analyses were by Student *t* tests.

Results: XBC showed significantly more new bone formation than HAC throughout the defect ($P < 0.05$) (Fig. 1). XBC, however, showed significantly more inflammatory/immune response than HAC ($P < 0.05$). The three-dimensional micro CT reconstructions showed that the HAC was basically inert, while the XBC takes on an appearance suggestive of more extensive incorporation. The indentation strength of HAC was significantly stronger than XBC only after 10 weeks ($P < 0.05$). Both were stronger than normal cancellous bone at all times.

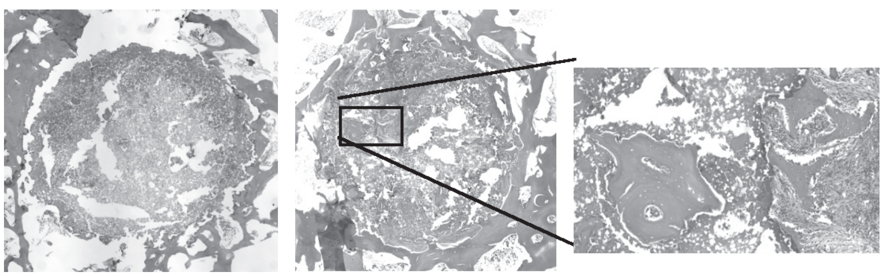


Fig. 1 After 10 weeks, there was no new bone formation within the HAC-filled defect (far left), while the XBC-filled defect had several regions of extensive cellular activity with new bone formation.

See pages 75 - 103 for financial disclosure information.

Conclusions: Adding xenograft to HAC creates a bioactive composite that is more rapidly incorporated, resorbed, and replaced by new bone. The presence of xenograft particles creates a vigorous inflammatory response, but there may be some benefit to the resorption rate of the HAC component of the XBC due to the infiltration of cells. This volumetric inclusion of rapidly resorbed bone graft does not compromise the initial indentation strength of the filled defect relative to normal cancellous bone. Future research should focus on the longer term incorporation and remodeling of XBC to determine if complete resorption of the HAC is facilitated.

- 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 413.

Evaluation of Histological and Mechanical Properties of Plexur M. Bone/Polymer Biocomposite in a Rabbit Defect Model

Christophe Nich, MD[1]; Bertrand David, PhD[2]; Karim Oudina, BS[1]; Valentin Myrtil, BS[1]; Herve Petite, PhD[1]; ***Moussa Hamadouche, MD[3]****;*
[1]Orthopaedic Research Laboratory, Paris, France;
[2]Ecole Central, Paris, France;
[3]Department of Orthopaedics, Hopital Cochin, Paris, France

Purpose: The aim of this study was to evaluate the histological and mechanical properties over time of a remodelable bone-graft substitute in a rabbit defect model.

Methods: Plexur M (Osteotech) is a biocomposite of bioresorbable polymer and mineralized allograft bone fibers. When heated, the material becomes shapeable, allowing the graft to conform to standard or irregular defects. Plexur M was implanted during its moldable phase in 6-mm long × 4.5-mm outside diameter defects performed in both medial condyles of adult male New Zealand White rabbits. In some specimens, after hardening, a hole was predrilled and a 2.5-mm outside diameter × 5-mm long cancellous screw was placed in the material. The animals were sacrificed immediately after implantation, at 8, 16, and 24 weeks. The distal femurs were harvested en bloc. Specimens dedicated to mechanical testing were stored at –20°C. Implants were removed using a 6-mm trephine and tested in compression using an MTS machine to calculate the Young modulus. Specimens dedicated to histology were embedded in polymethylmethacrylate (PMMA) for non-decalcified histology. Cross-sections were prepared to 120-μm thickness. Tissues were analyzed using light optical microscopy. Custom software, used in conjunction with an image analyzer, allowed for histomorphometric measurement of bone tissue in the defect and also in direct contact with the screw. Untreated medial condyles were used as controls. Statistical analysis was performed using nonparametric tests.

Results: The biocomposite graft progressively remodeled into newly formed bone from the periphery towards the center of the defect. Histomorphometric analysis revealed that bone fraction increased from 27.7% (representing the composite) immediately after implantation to 36.7% at 8 weeks and 74.5% at 16 weeks. This increase was significant ($P < 0.001$). The control untreated condyles averaged 35% bone tissue. In the composite groups, bone tissue in direct contact with the screw increased from 2.8% immediately after implantation to 17.7%, 41.6%, and 61.8% at 8, 16, and 24 weeks, respectively ($P = 0.007$). The mean Young modulus of untreated medial condyles was 310 MPa. Immediately after implantation, the modulus was 384.5 MPa, and then 250 MPa at 8 weeks, 666 MPa at 16 weeks, and 644 MPa at 24 weeks.

Conclusion: Plexur M bone graft, implanted in a rabbit femoral defect, showed remodeling activity by 8 weeks. The amount of bone tissue was comparable to untreated medial condyles by 8 weeks. Moreover, the mechanical properties of the composite exceeded the untreated condyle properties immediately after implantation and again after new bone formation by 16 weeks. Clinical applications of this composite can be expected in load-bearing situations.

See pages 75 - 103 for financial disclosure information.

BSFF SYMPOSIUM III:
Choosing a Pre-Clinical Model in Orthopaedic Trauma

Moderators: *Edward J. Harvey, MD*
R. Geoff Richards, PhD

Osteoporotic Fractures
Peter V. Giannoudis, MD

Bone Defects
Jennifer Lansdowne, AVCS

Articular Injury
Paul A. Martineau, MD

Osteomyelitis
R. Geoff Richards, PhD

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 413.

Mesenchymal Stem Cell Transplantation to Promote Fixation of Orthopaedic Hardware

(FDA=Non-U.S. research conducted within guidelines of my country)

Chan Gao, MD[1,2]; *Ailian Li, BMed*[1]; *Huifen Wang, BMed*[1]; *Alison Butler, BSc*[1,3]; *Geetanjali Nayak, MSc*[2]; *Bilal Elcharaani, BSc*[2]; *Jan Seuntjens, PhD*[4]; *Edward J. Harvey, MD, MSc*[1,5]; *Janet E. Henderson, PhD*[1,2,5];
[1]*JTN Wong Laboratories for Bone Engineering, Research Institute, McGill University Health Centre, Montreal, Quebec, Canada;*
[2]*Department of Medicine, McGill University, Montreal, Quebec, Canada;*
[3]*Department of Microbiology and Immunology, University of British Columbia, Vancouver, British Columbia, Canada;*
[4]*Department of Oncology, McGill University, Montreal, Quebec, Canada;*
[5]*Department of Surgery, McGill University, Montreal, Quebec, Canada*

Background: 50% of women and 18% of men greater than 50 years of age will sustain an osteoporotic fracture during their lifetime. Internal fixation of these fractures can have a high failure rate, ranging from 10% to 25%. Enhancing bone formation and osseous integration of orthopaedic hardware is therefore a priority when treating elderly patients with impaired bone regenerative capacity. Mice with mutations in genes that impact bone development and regeneration are useful models to study bone regeneration and implant integration in the context of poor bone regenerative capacity. The fibroblast growth factor receptor (FGFR3)-deficient ($FGFR3^{-/-}$) mouse represents such an animal.

Hypothesis: Transplantation of mesenchymal stem cells (MSCs) from normal ($FGFR3^{+/+}$) donor mice into osteopenic ($FGFR3^{-/-}$) recipient mice could enhance intrafemoral implant fixation.

Methods: Smooth nylon rods measuring 0.4 mm × 10 mm were evenly coated with a 150-nm layer of titanium by physical vapor deposition at the McGill Institute for Advanced Materials. The hind limbs of 5-month-old osteopenic $FGFR3^{-/-}$ recipient mice were irradiated with 13.5 Gy to ablate endogenous MSCs. Two days later, 10^5 MSCs from age-matched $FGFR3^{+/+}$ donor mice were injected via the pyriformis fossa into one femoral canal, while the contralateral femur received carrier alone, before inserting the titanium-coated implants. The mice were euthanized after 6 weeks and the femurs harvested for micro CT imaging on a Skyscan 1172 equipped with a 10-megapixel camera and 3-dimensional reconstruction capabilities at a detection limit of 0.7 µm isotropic detail. After scanning, the femora were processed for embedding in polymethylmethacrylate (PMMA) at low temperature, to preserve enzyme activity, and sectioned at 5 µm for histochemical and immunochemical staining.

Results: All mice returned to normal activity levels within 24 hours after surgery and had an uneventful postoperative course. A peri-implant cylinder measuring 0.6 mm × 2 mm around the titanium-coated implant in the proximal metaphysis was identified as the region of interest for micro CT analyses of newly formed bone. A significant increase in bone formation was seen in the femur that received the MSC transplant compared with the femur that received carrier alone. The newly formed bone had increased trabecular connectivity and superior structural properties compared with the native bone seen in $FGFR3^{-/-}$ mice.

See pages 75 - 103 for financial disclosure information.

Histological analyses confirmed the increase in bone formation, with a concomitant reduction in fibrous tissue formation.

Conclusion: The results suggest MSC transplantation represents a potential adjunct therapy to improve the fixation and osseointegration of orthopaedic hardware in patients with poor-quality bone.

Acknowledgment: This work was supported in part by peer-reviewed support from the Canadian Institutes of Health Research (CIHR) (J.H., E.J.H.) and the Fonds de la Recherche en Santé du Québec (J.H.). Chan Gao is supported by studentships from CIHR-MENTOR, Federation of Dentists of Quebec, and the Research Institute, McGill University Health Centre.

- 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 413.

Mechanical Stability Affects Angiogenesis during Fracture Healing

Chuanyong Lu, MD; *Xiaodong Wang, PhD; Zhiqing Xing, MD; Ralph Marcucio, PhD; Theodore Miclau, III, MD;*
University of California at San Francisco, Department of Orthopaedic Surgery, San Francisco, California, USA

Purpose: Mechanical stimuli regulate fracture healing. Stabilized fractures heal through direct bone formation and nonstabilized fractures form cartilage first, which then gets replaced by bone. We hypothesized that mechanical instability may impair vascular repair and cause tissue hypoxia, leading to the formation of cartilaginous tissues. As a first step, here we examined the effects of mechanical stability on tissue vascularization during early fracture healing in a murine fracture model.

Methods: Male 129J/B6 mice (3-month-old) were used in this study. A closed fracture was created in the middiaphysis of right tibia. Fractures were either left completely unstabilized or rigidly stabilized with an external fixator. For histological analysis, fractures were collected at 3 and 10 days after injury (n = 3 per group) and tissues were fixed in 4% paraformaldehyde (PFA), decalcified, and embedded in OCT. Sagittal sections (10 μm) were prepared and 2 to 3 middle sections from each sample were subjected to safranin O / fast green staining to visualize cartilage or PECAM (platelet endothelial cell adhesion molecule) immunohistochemistry to visualize blood vessels. To analyzed the effect of mechanical stability on tissue vascularization, a second group of animals with nonstabilized fractures, stabilized fractures, or unfractured legs (n = 4-5) were sacrificed at 3 days after injury. Fracture tissues were collected, fixed in 4% PFA overnight, decalcified in 19% EDTA (ethylenediaminetetraacetic acid), and embedded in OCT. Vertical uniform random sections (10 μm) were prepared through the whole block. For each sample, 5 to 10 slides were selected using systematic random sampling for PECAM immunohistochemistry to visualize blood vessels. The reference volume of the tissue analyzed for each sample was estimated using Cavalieri's principle. The length density (the length of blood vessels per unit volume of the reference space) and surface density (the area of the outer surface of blood vessels per unit volume of the reference space) of blood vessels within the fracture limbs were estimated using stereology. To analyze the effect of mechanical stability on vascular endothelial growth factor (VEGF) expression and tissue metabolism, animals with nonstabilized fractures, stabilized fractures, or unfractured legs (n = 5) were sacrificed at 3 days after injury. VEGF levels in tissue lysates of fracture callus were determined using a VEGF enzyme-linked immunosorbent assay (ELISA) kit. Lactate levels were determined using an YSI 1500 lactate analyzer. VEGF and lactate levels were normalized by tissue weight.

Results: *Histology.* At 10 days after fracture, nonstabilized fractures exhibited large calluses and abundant cartilage. In contrast, stabilized fractures had smaller calluses and minimal cartilage. *Quantification of tissue vascularization.* Nonstabilized fractures have significantly higher length density, surface density, total length, and surface area of blood vessels compared to stabilized fractures. *VEGF and Lactate Levels.* Mechanical stability did not significantly affect tissue VEGF and lactate levels at either 3 or 10 days after injury.

See pages 75 - 103 for financial disclosure information.

Conclusions: Contrary to our hypothesis, our results demonstrate that mechanical instability is associated with increased vascularity in conjunction with cartilage formation. The increased vascularity may be associated with the larger callus in nonstable fractures and may be a necessary prerequisite for replacement of cartilage by bone at later stages of repair.

Acknowledgement: This work is supported by OTA (a research grant to C.L.), National Institutes of Health (R01 grant to T.M), and Zimmer Inc.

- 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 413.

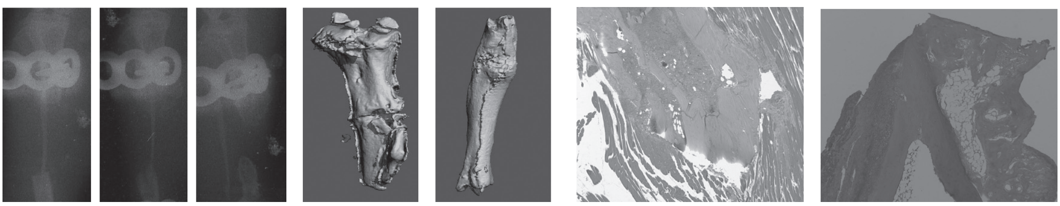
Murine Model of Oligotrophic Tibial Nonunion

Calvin T. Hu, MD; *Sarah C. Offley, MD; Catherine A. Humphrey, MD; Regis J. O'Keefe, MD;*
Department of Orthopaedics, University of Rochester School of Medicine,
Rochester, New York, USA

Purpose: Nonunion is a problematic clinical entity and little is known about its underlying molecular events. This study aimed to use modified distraction osteogenesis techniques to develop a reproducible mouse fracture nonunion model with an oligotrophic phenotype.

Methods: Twenty-six 10- to 14-week-old C57BL/6 male mice underwent a midshaft tibial osteotomy with a 2-mm bone resection; the fibulae were sharply transected at the same level. An external fixator device was applied to the tibia with cerclage wires. A total of 2 mm of distraction was applied over 3 days, resulting in an average distraction gap of 4 mm. Plain radiographs of the fractures were taken immediately postoperatively, weekly for the first 4 weeks, and every 2 weeks until sacrifice at 7 (9), 10 (13), or 12 (4) weeks. After sacrifice, all samples were fixed in 10% neutral buffered formalin, scanned with micro CT, decalcified in formic acid, and finally prepared in paraffin and stained with Alcian blue/Mayer's hematoxylin.

Results: In the distraction groups, 5 animals were prematurely euthanized due to wound complications stemming from loss of distal fixation. Of the remaining 21, 2 healed, resulting in an 81% nonunion rate. Moreover, these nonunions radiographically resembled clinical nonunions with tapered, cone-like fracture ends, and histologically demonstrated evidence of attempted healing, as seen with cartilage capping. Additionally, the plain radiographic appearance of those nonunions sacrificed at 10 and 12 weeks did not change over the final 4 to 6 weeks.



Left to right: Plain radiographs at 1, 6, and 10 weeks postoperatively; micro CT proximal and distal fracture sites; and proximal and distal fracture sites stained with Alcian blue/Mayer's hematoxylin, 5× magnification.

Conclusion: The use of 2-mm tibial resection osteotomy with 2-mm distraction provides a predictable model for fracture nonunion in mice. Moreover, the oligotrophic phenotype closely resembles the clinical correlate. Given the unchanged radiographic appearance over time, 6 weeks is an acceptable time point for evaluating nonunion. This model offers a promising means for characterization of the molecular events that occur during the development of fracture nonunion and evaluate noninvasive methods for nonunion rescue.

See pages 75 - 103 for financial disclosure information.

Δ Heterotopic Ossification following Extremity Blast Amputation: An Animal Model in the Sprague-Dawley Rat

***Oliver O. Tannous, MD*[1]**; *Cullen K. Griffith, MD*[1]; *Robert V. O'Toole, MD*[2];
Vincent D. Pellegrini, Jr., MD[1];
[1]*University of Maryland School of Medicine, Baltimore, Maryland, USA;*
[2]*University of Maryland School of Medicine, R Adams Cowley Shock Trauma Center, Baltimore, Maryland, USA*

Purpose: The investigators created a survival animal model for heterotopic ossification (HO) in the residual limb of the rat following extremity blast amputation. The hypothesis was that the rat exposed to the extremity blast amputation would develop HO in the residual limb.

Methods: 12 Sprague-Dawley rats were exposed to a controlled, isolated high-energy blast; 7 rats were designated as hindlimb amputees, and 5 rats as forelimb amputees. The blast set-up consists of a protective platform with a hole in its center, placed above a water-filled tank. The anesthetized rat is strapped onto the platform with the designated extremity exposed above the opening. A calculated charge of pentaerythritol tetranitrate (PETN) is buried in the water, beneath the center of the platform; detonation causes a column of water to rise through the hole with sufficient energy to create an amputation of the exposed extremity. Immediately following the injury, the rat is transported to a sterile field for wound management and surgical closure. Radiographs of the amputated limbs are obtained every 2 weeks following the injury.

Results: Overall, 9 of 12 animals survived the procedure; 5 of 5 forelimb and 4 of 7 hindlimb amputees survived with no complications. Of the 3 that died, 1 died of hemorrhagic shock secondary to an aggressive level of amputation. One died of anesthetic complications, and one died of non–blast-related septic shock. The presence of HO was determined radiographically by 3 independent observers. Heterotopic bone was classified as either periosteal growth (type A) or noncontiguous growth (type B). One forelimb amputee exhibited types A and B HO. All 4 surviving hindlimb amputees exhibited type A growth, and 3 of 4 additionally exhibited noncontiguous islands of heterotopic bone (type B) within the zone of injured muscle in the stump.

Conclusions: We have developed a reproducible model for heterotopic bone formation in the residual limbs of blast-amputated rats without addition of exogenous osteogenic stimulus. Preliminary data suggest that hindlimb blast amputation has a greater preponderance to form HO, which is also observed in humans. Future studies will use this animal model to investigate the effects of the blast medium and concurrent traumatic brain injury, as well as surgical technique on the formation of HO.

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 413.

Androstendiol Exerts Protective Effects in a Murine Two-Hit Model
(FDA=Non-U.S. research conducted within guidelines of my country)
Christian Zeckey, MD; *Philipp Mommsen, MD; Michael Frink, MD; Ulf Brunnemer, MD; Christian Krettek, MD; Tanja Barkhausen, MD; Frank Hildebrand, MD;*
Trauma Department, Hannover Medical School, Hannover, Germany

Purpose: Sepsis and subsequent multiorgan dysfunction remain the leading causes for mortality in trauma patients. The overwhelming posttraumatic immune response and the associated release of inflammatory mediators are known to play an important role in the pathogenesis of posttraumatic multiple organ dysfunction syndrome and sepsis. A gender dimorphism in the host response after trauma and sepsis could be revealed. Sex steroids have been shown to beneficially modulate the posttraumatic immune response. The precursor androstenediol resulted in a reduction of posttraumatic mortality in different experimental trauma models. However, the exact mechanism by which androstenediol exerts its beneficial effects remains unknown. We therefore investigated whether the application of androstenediol has an effect on plasma chemokine levels in a two-hit mouse-model (trauma-hemorrhage [T-H]/CLP [cecal ligation and puncture]).

Methods: T-H was induced by orbital puncture in C57BL/6 mice. One hour after induction of T-H, the animals were resuscitated with 4 times the shed blood volume of Ringers solution. Sepsis was induced 48 hours later by CLP. Four hours after CLP, the animals were exsanguinated by cardiac puncture. From day 1 to day 3, androstenediol (1mg/kg body weight) was applied daily (n = 10), whereas the control group was treated with vehicle only (n = 10). Animals of the sham group were treated with vehicle or androstenediol over a period of 3 days without further interventions (n = 10). Measurement of plasma monocyte chemotactic protein (MCP)-1, MCP-3, and macrophage inflammatory protein (MIP)-1 beta was performed by fluorescence-activated cell sorting (FACS) analysis. Additionally, a mortality analysis over a 7-day observation period was performed.

Results: T-H and CLP induction resulted in a significant increase of MCP-1, MCP-3, and MIP-1 beta plasma levels. Application of androstenediol led to significantly lower MCP-1, MCP-3, and MIP-1 beta levels compared with vehicle-treated animals after T-H/CLP ($P < 0.05$). No significant differences were found for mortality comparing both groups.

Conclusion: Androstenediol can considerably modulate the immune reaction induced after T-H and a septic insult by reducing the systemic levels of chemokines, which are known to direct immune cells into the tissue and thereby possibly lead to organ damage. Consequently, androstenediol could represent a potential therapeutic agent. However, mortality rates were not improved by androstenediol.

See pages 75 - 103 for financial disclosure information.

Effects of Binge Alcohol Consumption and Anti-Oxidant Therapy on Healing of Femur Fractures in a Rat Model

Dustin Volkmer, MD*; Benjamin Sears, MD; Ryan Himes, BS; Kristen Lauing, BS; Michael Stover, MD; Sherri Yong, MD; John Callaci, PhD;*
Loyola University Medical Center, Maywood, Illinois, USA

Purpose: The aim of this study was to determine whether binge alcohol consumption prior to orthopaedic trauma affects the rate and ultimate strength of bone healing in a rat model of femur fracture. In addition, we examined the effect of N-acetylcysteine on the rate and quality of fracture healing following traumatic femur fracture with prior alcohol exposure.

Methods: 144 Sprague-Dawley rats were administered either intraperitoneal saline or alcohol injections simulating a binge pattern for 3 days per week for a total of 2 weeks. These animals then underwent unilateral femoral intramedullary pinning and closed femoral shaft fracture using a blunt guillotine model. Animals in the antioxidant treatment group were administered N-acetylcysteine by intraperitoneal injection daily for 2 or 2 weeks. Animals were euthanized at specific time points following surgery and femurs were collected for biomechanical and histologic analysis.

Results: Binge alcohol administration was associated with significant decreases in biomechanical strength at 1- and 2-week time points ($P < 0.05$), with a trend toward decreased strength at 4- and 6-week time points as well. Animals in the alcohol-treated group had considerably less cartilage component within the fracture callus and healed primarily by intramembranous ossification. Administration of N-acetylcysteine in alcohol-treated animals improved biomechanical strength to levels comparable to the control animals and was also associated with increased endochondral ossification.

Conclusions: Binge alcohol consumption inhibited the strength of healing of femur fractures and altered the composition of the fracture callus in a rat model. Antioxidant therapy following alcohol consumption improved the strength and composition of the fracture healing to a level comparable to rats not exposed to alcohol.

- 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 413.

BSFF SYMPOSIUM IV:
Advances in Imaging: Articular Cartilage

Moderators: *Joseph Borrelli, Jr., MD*
Todd O. McKinley, MD

Can Non-Destructive MRI Provide a Measurement of Cartilage Function? The Role of Delayed Gadolinium-Enhanced MRI of Cartilage (dGEMRIC)
Deborah Burstein, PhD

T2 and Ultra-Short T2 Weighted Imaging: Research and Clinical Applications
Constance R. Chu, MD

Imaging of the Acutely Injured Joint: What Do the Findings Mean?
Hollis G. Potter, MD

Limiting Metallic Implant Artifacts
Laura Fayad, MD

Discussion

NOTES

See pages 75 - 103 for financial disclosure information.

Quantitative Micro-CT Compared to Biomechanics in a Mouse Fracture Model

Kevin R. O'Neill, MD*; Christopher Stutz, MD; Nicholas A. Mignemi, BS;*
Jeffry S. Nyman, PhD; Jonathan Schoenecker, MD; William T. Obremskey, MD;
Vanderbilt University Medical Center, Nashville, Tennessee, USA

Purpose: Advances in molecular biology have opened a new era in the study of fracture healing. The mouse is a preferred animal model because of the available phenotypes, ability to create targeted gene mutations, and availability of gene-mapping techniques. Mechanical testing has been the gold standard for investigating structure-function properties of bone. However, testing fracture calluses in mice is tedious and prone to errors. The assessment of mechanical properties through an alternate nondestructive means would be advantageous. The hypothesis is that micro CT (μCT) imaging is more sensitive than mechanical testing in the mouse fracture model.

Methods: With IACUC (Institutional Animal Care and Use Committee) approval, unilateral transverse midshaft femur fractures were created in 177 mice after intramedullary fixation. Mice were sacrificed every week between 2 and 12 weeks. Fractured and contralateral femurs were harvested, and axial μCT images were obtained. Torsional rigidity and ultimate strength were calculated from torque versus angular displacement curves obtained by torsion testing. Bone volume fraction (BV/TV), bone mineral density (BMD), and polar moment of inertia (pMOI) were determined from μCT images. The healing time was estimated by when the parameters were statistically equal to values from the contralateral side. The coefficient of variance in biomechanics and μCT parameters were compared.

Results: The μCT parameters trended towards normal values, whereas no such trend was appreciated in biomechanics measurements (Fig. 1). From nonfractured specimens, the coefficient of variance was 0.19 and 0.21 for torsional rigidity and ultimate strength, compared with 0.08, 0.03, and 0.16 for BV/TV, BMD, and pMOI respectively. The healing time estimated from the pMOI was 9 weeks. BMD values remained statistically different throughout the 12 weeks of evaluation. The biomechanics measurements were not statistically different at most time points.

Conclusions: The μCT parameters were more sensitive than biomechanics measurements in detecting differences between healing fractures and intact mouse femurs. High numbers of animals are required to achieve significance in biomechanics due to high variability, whereas μCT imaging allows the longitudinal study of fewer animals. Therefore, μCT imaging provides a powerful and efficient tool for evaluating new therapeutic agents in fracture healing, providing the basis for future human clinical studies.

- 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 413.

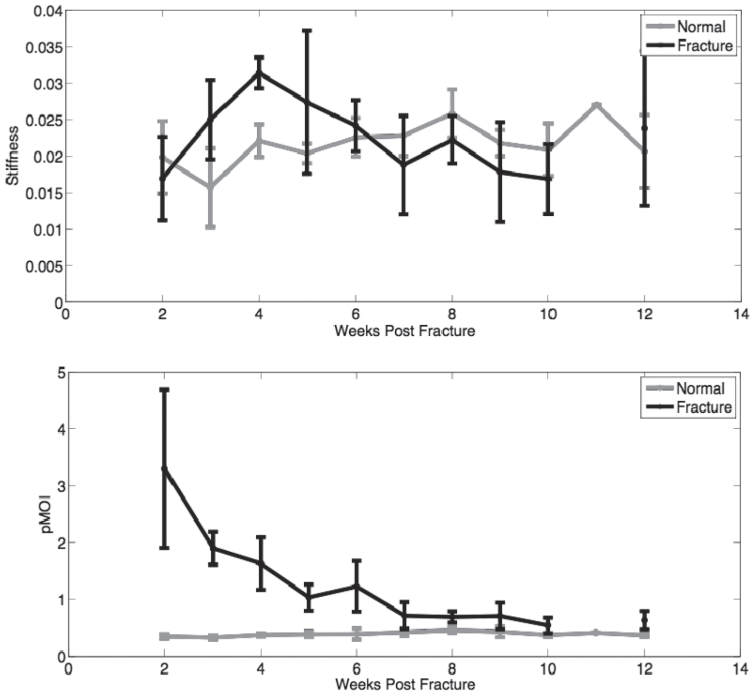


Fig. 1 Timeline of torsional stiffness (*top*) and average polar moment of inertia (pMOI, *bottom*) for normal and healing femurs. Bars show standard deviations of each time point.

See pages 75 - 103 for financial disclosure information.

Use of Two 3-Dimensional Fluoroscopic Systems for the Assessment of Articular Reduction: A Cadaveric Study

(FDA=Non-U.S. research conducted within guidelines of my country)

Yoram A. Weil, MD[1]; *Meir Liebergall, MD*[1]; *Rami Mosheiff, MD*[1];
Syndie Singer, MD[2]; *Amal Khoury, MD*[1];
[1]*Hadassah Hebrew University Medical Center, Jerusalem, Israel;*
[2]*University of Toronto, Toronto, Ontario, Canada*

Background: The most commonly used imaging device for assessment of fracture reduction remains the 2-dimensional fluoroscope. However, some significant joint malreductions can be overlooked with conventional fluoroscopy. Recently, newer devices enabled the surgeon to obtain spatial (3-dimensional [3D]) information invaluable for the assessment of articular reduction and hardware placement, with a recently developed fluoroscopic device (C-InSight) enabling 3D intraoperative imaging using a conventional C-arm fluoroscope coupled with computer software, thus enhancing availability and potentially reducing costs.

Purpose: Our objective was to assess the accuracy of two 3D fluoroscopes in measuring articular reduction in a simulated cadaveric tibial plateau fracture model.

Methods: Six cadaveric knee specimens were osteotomized at the lateral tibial plateau and fixed with a maximal articular step-off of 0 mm (specimens 1 and 2), 1 mm (specimen 3), 2.5 mm (specimen 4), 5 mm (specimen 5) and 7.5 mm (specimen 6). Each specimen was scanned with two different 3D fluoroscopes (ISO-C3D and C-InSight). Ten scans were performed on each modality for each specimen, alternating specimen and fluoroscope orientation on each scan (overall 120 scans). Images were reformatted and interpreted for articular displacements at four locations at the plateau level and were compared to high-resolution CT scans of the same specimens by an independent observer, using a Digital Imaging and Communications in Medicine (DICOM)-compatible software. Four different locations along the tibial plateau as well as their average were assessed for malreduction among each scan on the coronal reformatted images.

Results: For the nondisplaced fractures (first two specimens), no displacement (average <0.1 mm) was observed in both modalities. Average scanning time for the ISO-C3D was 2 minutes, while the C-Insight took 20 seconds. The measurements of articular step-off in each malreduced specimen were similar in 15 out of 20 sets of 10 measurements between the ISO-C3D and C-InSight. Significant differences in measurements between the 2 modalities were found between 2 of 4r measurement sets in specimen 4 and 3 of 5 measurement sets of specimen 5, with the rest of the measurements being similar (15 of 20 sets), However, the differences in these measurements did not exceed 2 mm. The high-resolution CT scan was found to be accurate within less than 0.5-mm error in 3 of 4 displaced fracture specimens. A significantly larger number of measurement sets was similar between the ISO-C3D and CT (11 of 20) than these of the C-InSight (5 of 20) and CT. However, most of these differences were within the 1- to 2-mm range, with only 2 sets (in specimen 5) of measurements exceeding this number.

• 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 413.

Conclusions: Intraoperative 3D fluoroscopes can detect clinically significant intra-articular step-off with an acceptable measurement error as compared to the specimens and a high-resolution CT.

Clinical Relevance: 3D fluoroscopy may improve fracture reduction quality and outcome in complex intra-articular fractures, while newer devices may enable it with the use of a conventional C-arm, potentially reducing costs and radiation.

See pages 75 - 103 for financial disclosure information.

Comparative Biomechanical and MicroCT Analysis of Osseointegration: Biodegradable Magnesium Alloy versus Titanium Control

(FDA=Non-U.S. research conducted within guidelines of my country)

***Richard A. Lindtner, MD*[1,2]**; *Christoph Castellani, MD*[2]; *Elmar Tschegg, PhD*[3]; *Annelie-Martina Weinberg, MD*[2];
[1]*Department of Trauma Surgery and Sports Medicine, Innsbruck Medical University, Innsbruck, Austria;*
[2]*Department of Pediatric Surgery, Medical University of Graz, Graz, Austria;*
[3]*Institute of Solid State Physics, Vienna University of Technology, Vienna, Austria*

Purpose: Previous research on feasibility of biodegradable magnesium alloys for bone implant application mainly focused on biocompatibility and corrosion resistance disregarding the mechanical properties of the bone-implant interface. This comparative study therefore evaluates bone-implant interface strength and osseointegration of a new biodegradable magnesium alloy implant and a titanium control in a rat transcortical model. The study hypothesis was that the investigated magnesium alloy exhibits properties at least equal to those of the titanium control.

Methods: 72 male Sprague-Dawley rats were randomly assigned to 6 experimental groups and implanted with either a novel biodegradable magnesium alloy rod (1.6 mm in diameter and 7 mm in length; chemical composition: Mg-Y-Nd-HRE) or a commercial titanium alloy control (Ti6Al7Nb) for 4, 12 and 24 weeks, respectively. Each rat received one rod randomly implanted either into the left or into the right femoral bone. After sacrifice, harvested femurs were subjected to microfocus computed tomography to quantify peri-implant bone formation. Biomechanical push-out testing was used to determine three well established biomechanical parameters (maximum push-out force, ultimate shear strength and energy absorption to failure) indicating bone-implant interface strength. Additionally, mechanically tested samples were examined by means of scanning electron microscopy and blood samples obtained at sacrifice were analysed to detect potential systemic inflammatory reactions in consequence of pin implantation.

Results: Push-out testing revealed highly significantly greater maximum push-out force, ultimate shear strength and energy absorption to failure in the investigated magnesium alloy implant than in the titanium control after each implantation period ($P \leq 0.004$ for all comparisons). Microfocus computed tomography showed significantly higher bone-implant contact and trabecular bone volume per tissue volume in magnesium alloy implants as well. Moreover, in vivo degradation of the magnesium-based alloy did neither induce any systemic inflammatory reactions nor affect cellular blood composition.

Conclusion: These results suggest that the investigated magnesium alloy achieves an enhanced bone response as well as greater interfacial strength even than a commercial titanium control. Thus, it seems to be a promising candidate for future bone implant application especially in pediatric trauma 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 413.

BSFF SYMPOSIUM V:
Funding Orthopaedic Trauma Research

Moderators: *Theodore Miclau, III, MD*
Michael J. Bosse, MD

Update from the National Institute of Arthritis and Musculoskeletal and Skin Diseases/National Institutes of Health
James S. Panagis, MD, MPH

Opportunities through the Department of Defense: Basic Research
Joseph C. Wenke, PhD

Opportunities through the Department of Defense: Clinical Research
James R. Ficke, COL, MD

Other Funding Opportunities: Getting Started
Theodore Miclau, III, MD

Discussion

NOTES

See pages 75 - 103 for financial disclosure information.

BSFF SYMPOSIUM VI:
Bring Products to Market

Moderators: *Emil H. Schemitsch, MD*
Barbara D. Buch, MD

Re-thinking the 510K Mechanism for Devices: What Does the Future Hold?
Barbara D. Buch, MD

Getting Fracture Healing Biologics Approved: What Are the New Standards for Industry?
Ricardo Dent, MD

Surgeon-Industry Collaborations in Implant Design: Are the Roadblocks Worth the Hassle?
Thomas (Toney) A. Russell, MD

Designing the Right Fracture Healing: If We Only Knew?
Thomas A. Einhorn, MD

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 413.

See pages 75 - 103 for financial disclosure information.

Orthopaedic Trauma Association

26th Annual Meeting

October 13 - 16, 2010

Annual Meeting Begins

Baltimore Convention Center
Baltimore, Maryland

Timothy J. Bray, MD, President
William M. Ricci, MD, Program Chair
James A. Goulet MD, Program Co-Chair

Andrew N. Pollak, MD, Local Host

Bone *and* Joint DECADE 2002 - USA - 2011

See pages 75 - 103 for financial disclosure information.

SYMPOSIUM I: CONTROVERSIES IN EVERYDAY ORTHOPAEDIC CARE

Moderator: *Paul Tornetta, III, MD*

Faculty: *Michael D. McKee, MD*
Robert F. Ostrum, MD
Robert A. Probe, MD

1:20 pm **Distal Radius Fractures: Cast, Ex Fix or Plate?**
Michael D. McKee, MD

1:35 pm **Intertrochanteric Hip Fractures: Nail or Plate?**
Robert A. Probe, MD

1:50 pm **Discussion/Questions**
Faculty

2:00 pm **Proximal Tibia Fractures: Nail or Plate?**
Robert F. Ostrum, MD

2:15 pm **Syndesmotic Fixation: When and How?**
Paul Tornetta, III, MD

2:30 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 413.

What Is the Outcome of a Protocol of Non-Operative Treatment of All Displaced Scapula Fractures?

Brent J. Bauer, MD*; Robert V. O'Toole, MD; Andrew N. Pollak, MD;*
Mary Zadnik Newell, OT; W. Andrew Eglseder, MD;
R Adams Cowley Shock Trauma, Department of Orthopaedics,
University of Maryland Medical School, Baltimore, Maryland, USA

Purpose: Controversy exists regarding the best treatment as authors have argued that a subset of displaced scapula fractures have poor outcomes when treated nonoperatively. At our institution, all extra-articular closed scapula fractures are treated nonoperatively. Our goal was to determine the validated patient outcomes of this protocol.

Methods: To ensure that our results were not influenced by other upper extremity injuries, we identified 421 patients with isolated scapula fractures without other injury to either upper extremity. Using published operative criteria for scapula body fractures, we evaluated 329 CT scans of surviving patients to find a subgroup of 42 patients with unilateral scapular body fractures displaced ≥1 cm from 2002 to 2007. 32 patients died and 60 patients were excluded secondary to penetrating trauma. 14 were alive for follow-up and willing to participate. The average age was 44 years (±15.8) with 86% males at an average follow-up of 50 months (range, 18-77). Outcomes included the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire, changes in occupation, and patient-perceived limitations as a result of shoulder injury.

Results: The average DASH score was 3.6 (range, 0-13.3), which is clinically indistinguishable from a normal shoulder. 36% scored a 0 out of a possible 100 points, indicating no evidence of ongoing upper extremity disability. 21% of patients did not know which shoulder was injured and one of those patients was confident he had never actually sustained a scapular injury despite conclusive evidence in the medical record to the contrary. None of the 14 patients reported any perceived functional limitation as a result of his or her shoulder injury.

Conclusion: In long-term follow-up, we were unable to identify any poor outcomes after nonoperative treatment of 14 consecutive displaced scapular body fractures. The DASH scores were very low, no patient changed occupation as a result of his or her shoulder injury, and no patient had any perceived limitation secondary to his or her shoulder injury. These findings suggest that nonoperative treatment of displaced scapular body fractures leads to excellent long-term results and that displacement alone should not be an indication for operative intervention. In the absence of evidence refuting these conclusions, operative treatment of displaced scapular body fractures should not be employed and a prospective randomized comparison of operative versus nonoperative treatment does not seem justifiable or otherwise warranted.

See pages 75 - 103 for financial disclosure information.

Surgical and Functional Outcomes after Operative Management of Extra-Articular Glenoid Neck and Scapula Body Fractures

Erich M. Gauger, MD*; Peter A. Cole, MD;*
Division of Orthopaedic Trauma, Department of Orthopaedic Surgery,
University of Minnesota, Regions Hospital, St. Paul, Minnesota, USA

Purpose: Scapula fractures are relatively rare and typically result from high-energy trauma. Some case series have suggested that a certain subset of patients benefit from open reduction and internal fixation. However, there have been no large, prospective case series critically examining the functional results with motion and strength analysis after operative management. The purpose of this study is to assess the surgical and functional results after treatment of extra-articular scapula body/neck fractures.

Methods: 72 patients (58 males and 14 females) with extra-articular fractures of the scapula were treated surgically between July 2002 and June 2009. Fractures were classified as scapula body (14-A3) or extra-articular glenoid neck (14-C1) according to the revised OTA classification. Indications for operative treatment included >20 mm medialization of the glenohumeral joint, >45° of angular deformity in the semicoronal plane, angulation >30° and medialization >15 mm, double disruptions of the superior shoulder suspensory complex displaced >10 mm, glenopolar angle <22°, and open fractures. Disabilitities of the Arm, Shoulder and Hand (DASH) and Short Form 36 (SF-36) functional outcome scores, range of motion, strength, endurance, and return to work/activities were obtained on 60 patients (83%). This group forms the study cohort for follow-up.

Results: At a mean follow-up of 25 months (range, 5.5-69.5 months), all patients demonstrated clinical and radiographic union of their fracture. There were 62 body fractures (14-A3) with 39 of 62 (63%) comminuted and 10 neck fractures (14-C1) with 9 of 10 (90%) comminuted. 25 patients (35%) had 2 or more operative indications. 28 patients (39%) had a double or triple disruption of the superior shoulder suspensory complex. Mean preoperative medialization, glenopolar angle, and angulation were 21.1 mm (range, 0-43 mm), 29.2° (range, 15°-42°), and 17.4° (range, 0°-43°), respectively. The mean DASH score at follow-up was 13.7 (range, 0-58; normative mean = 10.1). For all parameters, the mean SF-36 scores of the study patients were comparable to those of the normal population. Range of motion in degrees for the operated (O) and uninjured (U) shoulder were forward flexion: O = 153, U = 158; abduction: O = 103, U = 105; and external rotation with the arm at the side and elbow flexed to 90°: O = 65, U = 69. Strength measured with a dynamometer in pounds of force for the operated (O) and uninjured (U) shoulder were external rotation: O = 18, U = 22; forward flexion: O = 19, U = 23; and abduction: O = 14, U = 16. 49 of 60 patients returned to their preinjury work and activities. Nine patients were unable to return to work/activities due to reasons unrelated to their scapula fracture (ie, brachial plexus injury, spinal cord injury). Complications included three patients with shoulder stiffness requiring manipulation under anesthesia postoperatively, exchange of intra-articular screws in two patients immediately postoperative, removal of clavicle hardware in two patients and scapula hardware in one patient, and repeat open reduction and internal fixation of a clavicle nonunion.

Conclusion: Our data suggest surgery for extra-articular fractures of the scapula is associated with good functional results and a low 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 413.

Electrophysiological Assessment after Minimally Invasive Fracture Treatment of the Proximal Humerus Using a Minimal Anterolateral Acromial Approach

***Götz Röderer, MD*[1]**; *Philipp Hansen*[2]; *Anne-Dorte Sperfeld, MD*[2];
Lothar Kinzl; *Florian Gebhard, MD*[1]; *Jan Kassubek, MD*[2];
[1]*University of Ulm, Orthopaedic Trauma, Ulm, Germany;*
[2]*University of Ulm, Neurology, Ulm, Germany*

Purpose: Minimally invasive fracture treatment of the proximal humerus can be performed using a minimal anterolateral acromial approach with the aim of soft-tissue protection. The anatomical relationship to the axillary nerve is close and there is risk of nerve lesion. In many cases it is difficult to clinically diagnose an axillary nerve lesion at the level of the minimal anterolateral acromial approach. The aim of this study was to investigate whether electromyography (EMG) shows signs of deltoid muscle impairment as a result of an axillary nerve lesion after performing a minimal anterolateral acromial approach, and to what possible extent it goes along with functional impairment.

Methods: 23 patients (14 men, 9 women; average age, 58 years) who sustained a fracture of the proximal humerus that was treated with minimally invasive locked plating using the minimal anterolateral acromial approach were included. Ten postoperative follow-up investigations were performed at 6 weeks, 6 months, and 12 months, respectively. As a control group, 10 patients (7 women, 3 men; average age, 67 years) with proximal humerus fractures that were treated nonoperatively were investigated once 6 weeks after the initial trauma. EMG changes indicating lesion of the axillary nerve were distinguished in "acute," "chronic," and "combined," and semiquantified in "slight," "medium," and "severe." Functional outcome was assessed using the Constant score.

Results: In summary, there were 3 (10%) cases with signs of acute neurogenic impairment of the anterior part of the deltoid muscle (2 slight and 1 medium), 15 (50%) chronic (10 slight and 5 medium), and 6 (20%) combined (3 slight, 1 medium, and 2 severe). There were more cases with signs of neurogenic impairment (acute and chronic) at initial/early follow-up (6 weeks, n = 8; 6 months, n = 9) compared to 12 months postoperatively (n = 7). The EMG findings were in 2 cases (7%) after 6 weeks in accordance with an incomplete lesion of the axillary nerve with different functional outcome (Constant 73 vs 24.5 points) and in 1 case after 6 months with complete lesion of the axillary nerve (Constant 49 points). The overall rate of axillary nerve lesion according to EMG in our study was 10%. One case of incomplete lesion (Constant 73 points) showed good regression during follow-up (slight neurogenic impairment after 6 months, Constant 83 points). The average Constant score in patients without any signs of neurogenic impairment in EMG was 74 points, compared to 51 points (acute neurogenic impairment), 69 points (chronic), and 68 points (combined).

Conclusion: There are EMG signs of neurogenic impairment of the deltoid muscle after minimal anterolateral acromial approach in almost all patients. However, even in patients treated nonoperatively, there are such findings in 10%. The functional outcome (Constant score) is worse in patients with neurogenic impairment than without. The severity of impairment together with the functional outcome can improve during the postoperative course even in case of axillary nerve lesion in the EMG. In those cases, no lesion of the axillary nerve in its structure seems to be present.

See pages 75 - 103 for financial disclosure information.

Fracture-Site Augmentation with Calcium Phosphate Cement Prevents Screw Penetration following Open Reduction and Internal Fixation (ORIF) of Proximal Humerus Fractures

Kenneth A. Egol, MD; ***Michelle Sugi, BS****; Crispin Ong, MD;*
Roy I. Davidovitch, MD; Joseph D. Zuckerman, MD;
NYU Hospital for Joint Diseases, New York, New York, USA

Purpose: The purpose of this study was to evaluate screw settlement, intra-articular penetration, and complications following locked plating of proximal humerus fractures when augmented with a calcium phosphate bone substitute compared to cancellous chips or no augment.

Methods: Between February 2003 and June 2009, 88 patients underwent surgical repair of a displaced proximal humerus fracture. All fractures were operated through a deltopectoral incision and repaired with a locked plate and heavy, nonabsorbable braided sutures. Fracture voids following reduction were treated with 3 different strategies in a nonrandomized manner: no graft, cancellous allograft chips, or calcium phosphate cement. Radiographs were obtained immediately postoperatively and at various time points of healing. Radiographs were examined for "fracture settling" and screw penetration. A Student *t* test was used to compare change in fracture position during healing between groups.

Results: Patients had minimum 3-, 6-, and 12-month follow-up with radiographs. 32 fractures were augmented with cancellous chips, 20 with calcium phosphate cement, and 32 were repaired with no augment. Radiographically, 98% of factures were healed at latest follow-up. There was more radiographic settling when no augmentation was used; however, the difference was not significant. There were 11 cases of postoperative joint penetration. Of the 11 patients with joint penetration, 7 were treated with locked plates and screws alone, 3 with cancellous chips, and 1 with calcium phosphate cement. Findings of joint penetration were significant among patients treated with plate and screws alone versus augmented with calcium phosphate ($P = 0.05$), as well as for those augmented with cancellous chips versus calcium phosphate ($P = 0.04$).

Conclusion: We found augmentation with calcium phosphate bone cement significantly decreased the incidence of intra-articular screw penetration following treatment of proximal humerus fractures with locked plates. Based upon these findings, we recommend its use in this clinical application.

• 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 413.

Results of 70 Consecutive Ulnar Nightstick Fractures

Marlon O. Coulibaly, MD[1]; ***Clifford B. Jones, MD***[2]; *Debra L. Sietsema, PhD*[2];
James R. Ringler, MD[2]; *Terrence J. Endres, MD*[2];
[1]*Grand Rapids Medical Education and Research Center, Grand Rapids, Michigan, USA;*
[2]*Orthopaedic Associates of Michigan. Michigan State University, Grand Rapids, Michigan, USA*

Purpose: Adult isolated ulnar shaft fractures (IUSF) are uncommon and treatment remains controversial. The purpose of this study was to compare results of operative (RIF) and nonoperative (NOT) treatment in patients with IUSF.

Methods: A retrospective case-control analysis was undertaken on patients diagnosed with IUSF between 2002 and 2008 at a Level 1 teaching trauma center. Clinical outcomes consisted of complications and functional ability.

Results: 70 patients had a mean age of 44.6 years (range, 18-86) and body mass index (BMI) of 27.9 (range, 17-47). Mechanism of injury included high-energy injuries (60 [85.7%]), low-energy falls (8 [11.4%]), and sports (2 [2.9%]). AO/OTA fracture classification was 48 (68.6%) type A1, 20 (28.6%) B2, and 2 (2.9%) C1. Treatment consisted of 33 (47.1%) NOT and 37 (52.9%) RIF. NOT and RIF showed comparable healing time, but RIF required a shorter immobilization period ($t = 4.557$, $P = 0.001$). At final follow-up, level of activity (LOA) was 61 without restrictions, 6 with restrictions, and 3 did not return to work. Function determined by range of motion was 55 (78.6%) full, 10 slightly limited, 2 severely limited, and 3 missing data, and was similar between treatment groups ($P > 0.05$). 14 nonunions (NU) and 17 malunions (NU) occurred. NOT was associated with NU ($\chi^2 = 0.001$) and MU ($\chi^2 < 0.001$), respectively. Fracture angulation ≥8° was related to the inability to return to previous LOA ($\rho = 0.406$, $P = 0.001$). Secondary displacement >2 mm was related to MU ($\rho = 0.488$, p < 0.001) and weakly to an inferior functional result ($\rho = 0.353$, $P = 0.003$). NU was weakly related to an inferior functional result ($\rho = 0.313$, $P = 0.010$). Treatment did not associate with increasing severity of fracture pattern ($P > 0.05$). Injury severity did not relate to clinical or functional outcome ($P > 0.05$).

Conclusions: Despite improved understanding of functional anatomy and techniques, IUSF treatment remains challenging in the adult population. Fracture pattern and injury severity did not predict healing and outcome. However, nonoperative treatment of displaced fractures were at high risk for complications and fracture characteristics determined patient outcome.

See pages 75 - 103 for financial disclosure information.

Hand Stiffness following Distal Radius Fractures: Who Gets It and Is It a Functional Problem?

Steve K. Lee, MD[1]; Nader Paksima, DO[1]; Nikola Lekic, BA[2]; Allissa Zingman, BA[3]; Michael Walsh, PhD[4]; ***Kenneth A. Egol, MD[1]****;*
[1]*NYU Hospital for Joint Diseases, New York, New York, USA;*
[2]*Georgetown University, Washington, District of Columbia, USA;*
[3]*University of Maryland, College Park, Maryland, USA;*
[4]*SUNY Downstate, Brooklyn, New York, USA*

Purpose: The purpose of this study was to identify predictors for hand stiffness following distal radius fractures and to identify the association between hand stiffness and pain, functional outcomes, and work status.

Methods: 352 patients with distal radius fractures were followed prospectively. Baseline demographics were obtained at presentation. Outcome parameters obtained at regular intervals included wrist and hand range of motion, radiographs, visual analog pain scales, and Disability of the Arm, Shoulder and Hand (DASH) questionnaires. Stiffness was defined as tip-to-palm distance greater than 1 cm for all fingers based on the distribution of data. Data was analyzed using the Student *t* test and Fisher exact tests to evaluate for predictors of stiffness and to compare the effects of stiffness on outcomes.

Results: Predictors for hand stiffness included advanced age ($P = 0.009$) and higher osteoarthritis grade ($P < 0.001$) but not OTA fracture classification type, articular step-off, ulnar variance, gender, or educational level. Patients with hand stiffness had worse functional outcomes. Stiff patients were significantly less likely to have returned to full-duty work at 3-month ($P < 0.001$), 6-month ($P = .007$), and 12-month ($P = 0.047$) intervals. Grip strength was weaker for stiff patients at 3 ($P < 0.001$), 6 ($P < 0.001$), and 12 months ($P = 0.035$) postoperatively. There was no significant difference between pain level or overall DASH score of stiff versys non-stiff patients; however, stiff patients scored significantly lower on hand dexterity–based DASH questions, such as ability to cut food, at 3 ($P < 0.001$) and 6 ($P = 0.015$) months postoperatively.

Conclusion: Advanced patient age and preexisting osteoarthrosis were positive predictors for postoperative hand stiffness. Fracture type did not influence the development of hand stiffness. Hand stiffness had a significant effect on recovery and return to work and on grip strength.

- 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 413.

Corrective Osteotomy for Malunited Fractures of the Distal Radius: Do We Need to Use Bone Graft?

Kagan Ozer, MD; *Ayhan Kilic, MD; Kyros Ipaktchi, MD;*
University of Colorado, Denver Health Medical Center,
Department of Orthopaedics, Denver, Colorado, USA

Purpose: Malunited fractures of the distal radius are traditionally treated with osteotomy, plating, and bone grafting. The use of bone graft gives additional structural stability and promotes bone healing. Most previous studies on the use of bone grafts at the fracture site were published in an era when volar locking plates were not available. Volar locking plates provide excellent stability and support at the fracture site so that the use of bone graft for the purpose of adding to the structural stability may not be necessary. In this study, we tested the hypothesis that there is no need to use bone graft provided that the contact on the volar cortex is maintained following opening-wedge corrective osteotomy of the distal radius with volar locked plating.

Methods: Two groups of age-matched patients were identified, with dorsally angled malunited extra-articular fractures of the distal radius, who underwent opening-wedge corrective osteotomy with volar locked plating. In group 1 (n = 14), patients refused to receive any form of synthetic graft, allograft, or autograft. In group 2 (n = 14), patients agreed to have allograft (demineralized bone matrix chips) at the osteotomy site. No patients had a body mass index (BMI) above 35 and none of the patients had diabetes.

Table 1: Radiographic Findings

	Age	AP Inclination, deg (Range)		Dorsal Tilt, deg (Range)		Radial Height, mm (Range)		Time to Union, wk
		Preop	Postop	Preop	Postop	Preop	Postop	
Group 1	34	5 (–5 to 5)	12 (8-16)	–18 (–45 to –15)	8 (0-15)	–3 (–4 to 0)	0.5 (–1 to 3)	11
Group 2	37	3 (–7 to 8)	14 (9-20)	–20 (–35 to –15)	7 (0-15)	–2 (–3 to 0)	0.9 (–1 to 3)	7

Table 2: Range of Motion

	Wrist Flex/Ext, deg (Range)		Wrist Radial/Ulnar Deviation, deg (Range)		Pronation/Supination, deg (Range)		DASH Score	
	Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop
Group 1	42 (20-110)	110 (100-175)	8 (7-12)	15 (12-20)	85 (60-100)	140 (100-170)	35	12
Group 2	55 (25-130)	115 (105-180)	10 (6-14)	18 (11-25)	79 (65-103)	145 (95-175)	42	14

See pages 75 - 103 for financial disclosure information.

Results: All patients in both groups had a complete radiographic union at the end of 6 months without hardware failure. Patients in group 1 (without bone graft) had a longer time to union (11 weeks) compared to group 2 (7 weeks) ($P < 0.05$). Return to work, maintenance of correction at the final follow-up, and Disabilities of the Arm, Shoulder and Hand (DASH) scores showed no statistical difference. One patient had an extensor pollicis longus rupture in group 2 and was treated with a tendon transfer.

Conclusion: In a small cohort of nondiabetic patients with BMIs less than 35, it is possible to achieve complete union following opening-wedge osteotomy of the distal radius without the application of the bone graft, provided that a contact is maintained on the volar aspect of the radius with a locked volar plate. The use of allograft bone chips therefore is not needed. This reduces the overall of the cost of the surgery, eradicates the disease transmission risk associated with the use of bone allograft chips, and finally eliminates the donor-site morbidity seen after autogenous bone grafting.

- 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 413.

Immediate Weight Bearing after Fixation of Humeral Shaft Fractures with Small-Fragment Hybrid Plating: A Clinical and Biomechanical Study

***Lisa K. Cannada, MD*[1]**; *J. Tracy Watson, MD*[1]; *Courtney B. Farnhorst, BA*[2];
Sean Owen, MD[1]; *James Bucheit, MS*[2]; *J. Gary Bledsoe, PhD*[2];
[1]*St. Louis University Hospital, St. Louis, Missouri, USA;*
[2]*St. Louis University Medical School, St. Louis, Missouri, USA*

Purpose: For polytrauma patients with humeral shaft fractures, weight bearing on the upper extremity is advantageous to assist with mobilization and rehabilitation. Previous studies evaluated weight bearing after humerus fixation with nonlocking large-fragment and small-fragment locking plates. We sought to correlate a biomechanical study with a clinical series of humeral shaft fractures in multiple trauma patients. All patients were treated with small-fragment low-contact dynamic compression combination plates (LCP) in hybrid mode. Immediate weight bearing on the involved extremity was allowed.

Methods: Mechanical testing was performed on 16 fourth-generation humeral Sawbones. Initial axial and torsional stiffness was determined for each specimen. A 3.5-mm locking compression plate or a 4.5-mm nonlocking compression plate was applied on each specimen. Each sample then had a 5-mm segment removed. Specimens were then cyclically loaded to –333 N and 1.0 N-m for 90,000 cycles to simulate 90 days of crutch usage. Samples then underwent load to failure. Failure was defined as bone fracture, screw cutout, gap closure, or axial rotation >13°. Statistical analysis was performed using analysis of variance ($P < 0.05$.) We retrospectively reviewed all patients with lower extremity, pelvic, and/or acetabular trauma with an associated humeral shaft fracture treated with a 3.5-mm small-fragment LCP plate configured in hybrid mode. To be included in the study group, the patients were required to have initiated immediate weight bearing on the extremity. Clinical and radiographic follow-up was completed.

Results: The 3.5-mm plate specimens had average axial stiffness of 980.56 ± 143.10 N with an initial unplated average axial stiffness of 1938.51 ± 386.79 N. The 4.5-mm plated specimens had an average axial stiffness of 1220.37 ± 276.02 N with an initial unplated average stiffness of 1829.90 ± 628.97 N. Torsional stiffness for the 3.5-mm and 4.5-mm constructs was 1.53 ± 0.19 N-m and 2.04 ± 0.40 N-m, respectively. Failure loads for 3.5-mm plates averaged 1870 N and 4.5-mm plates averaged 2366 N. The 3.5-mm plated bones failed due to incidental torsion during axial loading, whereas 4.5-mm constructs all failed as a result of gap closure. Clinical evaluation revealed 13 patients with an average age of 36 years (range, 15-65). There were 5 OTA 12-A, 5 12-B, and 3 12-C fracture types. All fractures were treated with at least an 8-hole 3.5-mm plate. There was 1 nonunion requiring revision at 6 months that healed. There were no failures of fixation.

Conclusion: Successful fracture fixation requires matching the correct plate to fit the bone. Humeral fixation has classically required a 4.5-mm broad LCP. Biomechanical comparison by analysis of variance reveals a significant difference between the average axial stiffness and torsional stiffness of 4.5-mm compression plates versus 3.5-mm locking compression plates. These results followed expectations due to differences in plate dimensions. However, 3.5-mm plates provided 92% of the axial stiffness and 75% of the torsional stiffness of 4.5-

See pages 75 - 103 for financial disclosure information.

mm plates. Failure loads and mode of failure were significantly different between plates. No construct failed by bone fracture or screw cutout, and cyclic loading was not a contributing factor. Our model includes a significant fracture gap, which required the plate to carry the entire load, and is the worst-case scenario for constructs in a clinical setting. While the plates performed differently, both appear to support loads that are anticipated in the clinical setting. This was confirmed, as no hardware failures occurred in our patients stabilized with 3.5-mm hybrid plating techniques who were allowed immediate weight bearing. This study supports the use of small-fragment plates for humeral shaft fractures if anatomically appropriate. Immediate loading can be initiated without fear of construct 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 413.

Biomechanical Test Load Discrepancies in the Medical Literature

***Jacob L. Cartner, PhD*[1]**; *Andy Whitten*[1]; *Michael Day, BS*[2]; *William M. Ricci, MD*[1];
[1]*Smith & Nephew, Memphis, Tennessee, USA;*
[2]*University of Tennessee, Knoxville, Tennessee, USA*

Purpose: There exist no standard loading scenarios for biomechanical studies of fracture fixation. The purpose of this investigation was to analyze the loading scenarios utilized in published reports of biomechanical fracture fixation studies. The hypothesis was that loading scenarios used in biomechanical testing are inconsistent and poorly documented.

Methods: The English-language medical literature was searched for references to lower extremity biomechanical testing related to fracture fixation that utilized "body weight" (keyword) as an orthopaedic loading scenario. Included articles were categorized based upon weight-bearing (WB) protocol, implant type, and anatomic region. These results were compared to reported body weights published by the US Department of Health and Human Services Centers for Disease Control and Prevention (CDC) and National Center for Health Statistics.

Results: 5289 publications were identified as potentially applicable. Of these, 56 articles (1%) met all inclusion conditions and were included in analyses. The majority of articles (78%) attempted to mimic full WB. Others utilized half body weight (9%), partial WB (9%), crutch-assisted WB (3%), and toe-touch–only SB (1%). A range of 31 to 980 N was chosen as a biomechanical test load, depending upon desired percentage WB. Of all studies mimicking full body weight, a mean load of 722 N was reported, but the range spanned between 562 and 932 N. Fixation with nails (46%) and plates (42%) were evenly cited, whereas there were few external fixation (12%) tests. The body weight values cited indicated no statistical difference based on implant ($P = 0.24$-0.77, depending on type). Pelvic studies utilized the lowest body weight justifications (668 ± 45 N), whereas proximal femur studies implemented the highest body weight loads (739 ± 93 N). The CDC reports a mean body weight for US females across all ethnicities as 74 kg (727 N) and reports a mean body weight for US males across all ethnicities as 86 kg (847 N), for an averaged total across both groups of 80 kg (787 N). When compared to the report from the CDC, the studies underestimated mean body weight).

Conclusions: Consistent loading parameters among biomechanical tests are not well documented. Biomechanical testing results should support clinical experience, and in this study we observed a discrepancy between biomechanical test parameters, which may ultimately influence our standard of care. A loading scheme of 722 to 787 N may be most appropriate for full body weight based on the literature search and reported CDC findings.

See pages 75 - 103 for financial disclosure information.

A Comparison between the Use of Unicortical versus Bicortical Medial Malleolar Fixation with Lag Screws

Robert O. Crous, MD; *Matthew P. Willis, MD; Timothy B. Ervin, BS; Peter J. Nowotarski, MD;*
University of Tennessee, College of Medicine Chattanooga,
Dept. of Orthopaedic Surgery, Chattanooga, Tennessee, USA

Purpose: This study is a biomechanical assessment to test the hypothesis that a bicortical fixation would be stiffer and stronger than unicortical cancellous insertion. If this was indeed so, then bicortical fixation would be the preferred method for medial malleolar fixation, but especially so for fixation where the bone quality was poor.

Methods: 40 synthetic tibias with osteoporotic bone density were used for testing. A jig was constructed to create a reproducible oblique shear fracture of the medial malleolus (OTA type 44-A2.1). The bones were then divided into 2 groups of 20 and were fixated with 1 of 2 techniques. Group 1 was stabilized with two 3.5-mm fully threaded cortical screws and a bicortical lag screw technique was used. Group 2 was stabilized with two 4.0-mm partially threaded cancellous screws and a unicortical lag screw technique was used. Each group was split into two sets: in one set, force was applied in offset axial loading, and in the other, it was applied in offset transverse loading. Force was applied at a rate of 10 N per second and the construct was loaded to 800 N, 2 mm of displacement, or until catastrophic failure. The two groups were compared using Welch's *t* test with 95% confidence intervals.

Results: Our results show statistically significant increases in construct stiffness for bicortical versus unicortical fixation in offset axial loading (685.56 N/mm vs 359.70 N/mm; $P = 0.018$) and max load to failure (770.14 N vs 539.62 N; $P = 0.0126$). The results also show statistically significant increases in construct stiffness for bicortical versus unicortical fixation in offset transverse loading (186.56 N/mm vs 102.75 N/mm; $P < 0.0001$) and max load to failure (370.49 N vs 184.26 N; $P = 0.002$).

Conclusion: On the basis of the positive results of this study, we recommend the use of bimalleolar fully threaded 3.5-mm screws inserted in a lagged manner. The bimalleolar purchase, as well as the increased thread engagement length, gives excellent and firm fixation in almost all cases. This is especially important in fractures with questionable bone quality, ie, osteoporotic fractures in the elderly and comminuted fractures in the young. In these cases, micromovement and the subsequent formation of fibrous rather than bony ingrowth are likely to be significantly decreased by the use of bicortical rather than the traditional unicortical screws, thus increasing the likelihood of a positive 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 413.

The Effect of Pulsed Electromagnetic Field (PEMF) upon Diabetic Fracture Healing

Elan Goldwaser, BS; Ravi Verma, MD; David Paglia, PhD; ***Eric A. Breitbart, MD****;*
Sharonda Meade, PhD; Siddhant Mehta, MD; Christopher Ojeda, BS; Anne Marie Simon, PhD;
Ankur Gandhi, PhD; Sheldon S. Lin, MD;
UMDNJ: New Jersey Medical School, Newark, New Jersey, USA

Purpose: Diabetes mellitus (DM) has been associated with impaired fracture healing including cellular proliferation resulting in inferior mechanical properties. Pulsed electromagnetic fields (PEMF) have been used in the clinical setting to enhance fracture healing since the 1970s. Therefore, this purpose of this study was to evaluate the role of PEMF in DM fracture healing

Methods: *Animals.* BB Wistar nondiabetic (non-DM) and diabetic (DM) animals were used for this study. *Surgical Procedure.* A 4-mm incision was made over the patella and a 1.1-mm 40-gauge Kirschner wire was inserted into the femur. After an intramedullary fixation, a closed, middiaphyseal transverse fracture was created with a three-point bending machine, which was confirmed by radiography and the appropriate treatment applied. One day following surgery, animals were placed for up to 8 hours a day in cages and PEMF treatment applied. *Experimental Animal Groups.* The animal groups consisted of a non-DM group without PEMF, an insulin-treated, poorly controlled diabetic animals group without PEMF, and the last group consisted of insulin-treated, poorly controlled diabetic animals with PEMF. Local levels of growth factors were measured on day 7 and determined using ELISA (enzyme-linked immunosorbent assay) specific for rat platelet-derived growth factor (PDGF)-AB, transforming growth factor (TGF)-β1, insulin growth factor (IGF)-1, and vascular endothelial growth factor (VEGF). At 6 weeks, animals were sacrificed for mechanical testing. Early histomorphometry and cell proliferation analysis using BrDU staining were performed at 4 and 7 days postfracture.

Results: *Cellular Proliferation Analysis.* A significant increase in BrDU-positive cells were seen in the DM group with PEMF treatment compared with the DM control group at both 4 and 7 days ($P < 0.001$). *Early Histomorphometry.* A significant increase in cartilage production was observed in DM animals with PEMF treatment at 4 days compared to DM controls ($P < 0.001$). *Mechanical Testing.* At week 6 postfracture, a significant increase in torque to failure ($P < 0.001$) was seen compared to the DM control group. A significant difference in stiffness ($P = 0.006$) and % average stiffness ($P = 0.03$) existed between DM, PEMF-treated animals compared to DM controls. *Growth Factor Levels in Callus Area.* At day 7 postfracture, diabetic rats that had received PEMF treatment showed significant increases in PDGF-AB ($P = .006$), IGF-1 ($P = .002$), and VEGF ($P < .001$) levels in the fracture callus when compared to diabetic rats that had not received any PEMF treatment. There was a significant decrease in TGF-β1 ($P < .001$) levels in DM animals receiving PEMF treatment when compared to DM controls

Conclusion: DM rats treated with PEMF had significantly increased PDGF, IGF-1, and VEGF levels in the fracture callus as well as significantly improved mechanical and early histological parameters. This study justifies a role for PEMF in the treatment of diabetic fractures.

See pages 75 - 103 for financial disclosure information.

•Unfocused Extracorporeal Shock Waves Induce Anabolic Responses in Osteoporotic Bone

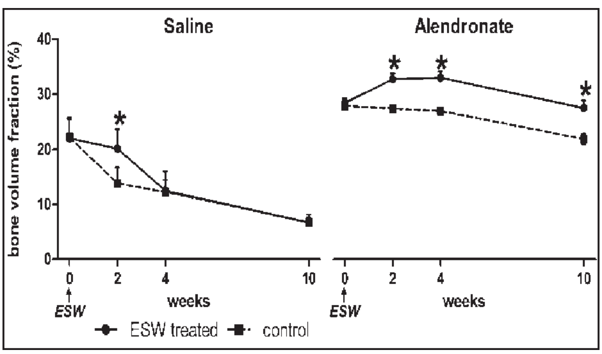
***Olav P. van der Jagt, MD*[1]**; *J.H. Waarsing, PhD[1]; Nicole Kops, BS[1]; Wolfgang Schaden, MD[2]; Victor A. De Ridder, MD[3]; Jan Verhaar, MD[1]; Harrie Weinans, PhD[1];*
[1]Erasmus MC, Rotterdam, The Netherlands;
[2]Traumacenter Meidling, Vienna, Austria;
[3]Sint Franciscus Hospital, Rotterdam, The Netherlands

Purpose: Current therapy for osteoporosis aims to reduce further bone loss using bisphosphonates. It was previously shown that nonosteoporotic rats treated with extracorporeal shock waves (ESW) had higher cortical and cancellous bone volumes and improved mechanical properties. In the current study, we examined the effects of unfocused ESW in osteoporotic rats. To explore the clinical value of ESW for patients who do or do not receive antiresorptives, rats were treated with or without a bisphosphonate.

Methods: Female Wistar rats received an ovariectomy. Two weeks after ovariectomy, one group received saline (n = 9) and another group received alendronate (n = 9). At 0 weeks, 1000 ESW were applied to one hind leg; the other was not treated and served as control. At 0, 2, 4, and 10 weeks after ESW, in vivo micro CT scans were made. Cancellous and cortical bone changes were analyzed. Furthermore, mechanical testing and histological analysis were performed. Paired *t* tests were used for statistical analyses.

Results: In saline-treated rats, ESW resulted in higher cancellous bone volume in cancellous bone at 2 weeks ($P = 0.003$), but not at 4 and 10 weeks (Fig. 1). ESW resulted in higher cortical volume at 2, 4, and 10 weeks with 3.2%, 5.5%, and 5.5%, respectively, more than the untreated control side (Fig. 2). In rats receiving alendronate, ESW resulted in higher cancellous bone volume at 2, 4, and 10 weeks ($p = 0.002$, $p = 0.001$, and $p = 0.001$, respectively) (Fig. 1). ESW resulted in higher cortical volume at 2, 4, and 10 weeks with 7%, 10.5%, and 12%, respectively, more than the untreated control side (Fig. 2). In both groups, ESW-treated legs showed significant higher maximal force at failure. Large areas of direct bone formation were observed at the cortex and around de novo bone niches in the marrow of ESW-treated legs. Intramedullary soft-tissue damage, but no periosteal or bone micro damage, was observed.

Fig. 1 Cancellous bone volume.



• 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 413.

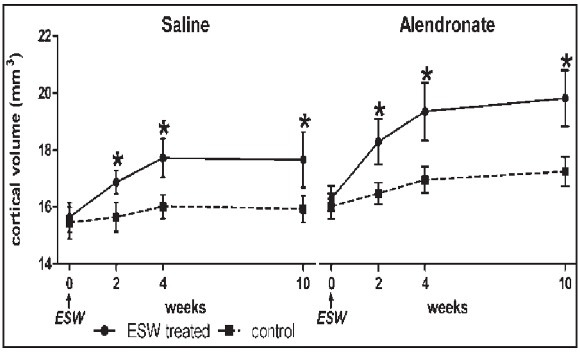


Fig. 2 Cortical bone volume

Conclusions: Unfocused ESW drastically increase cancellous and cortical bone volume and improve biomechanical properties. When shock-wave treatment is combined with an antiresorptive treatment, these beneficial effects are enhanced and retained. This study shows promising results for the use of ESW in the treatment of osteoporosis, but more research is needed to further investigate the biological responses and the safety for human therapy.

See pages 75 - 103 for financial disclosure information.

Comparison of Osteogenic Potential of Different Bone Morphogenetic Proteins

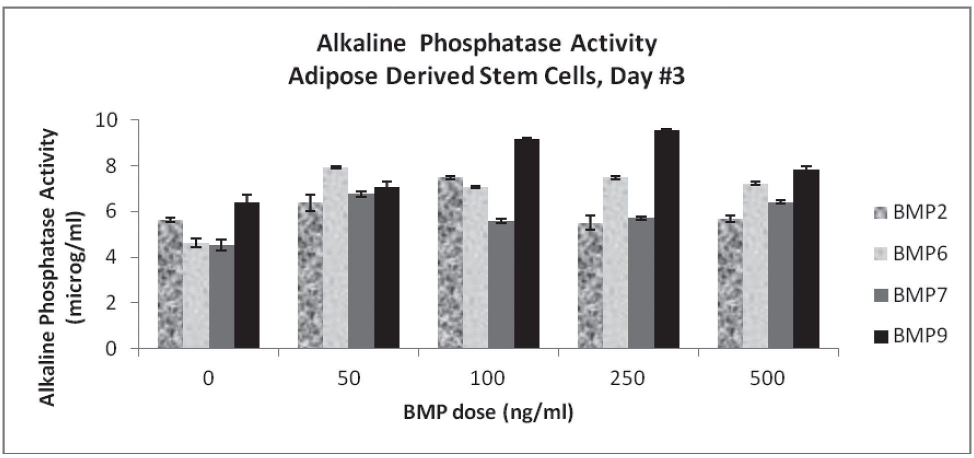
***Jessica D. Cross, MD*[1,2]**; *Christopher R. Rathbone, PhD*[2]; *Joseph C. Wenke, PhD*[2];
[1]*United State Army Institute of Surgical Research and Brooke Army Medical Center, San Antonio, Texas, USA;*
[2]*United States Army Institute of Surgical Research, Fort Sam Houston, Texas, USA*

Purpose: This investigation was conducted to compare the osteogenic potential of the bone morphogenetic proteins (BMPs) 2, 4, 5, 6, 7, and 9 in multiple cell types.

Methods: C3H10T1/2, C_2C_{12}, human bone marrow–derived stem cells, and human adipose–derived stem cells were seeded on 24-well plates. BMP-2, 4, 5, 6, 7, and 9 were added at 10, 50, 100, 250, and 500 ng/mL for 3 days. Cell lysates were obtained at 3 and 7 days after BMP treatment for the determination of alkaline phosphatase activity.

Results: In both immortalized cell lines, the C3H10T1/2 cells and C_2C_{12} cells, BMP-9 resulted in statistically significant higher alkaline phosphatase levels at day 3 compared to the other BMPs ($P < 0.05$). In the bone marrow–derived cells, alkaline phosphatase activity was modest; however, BMP-9 at all doses greater than 50 ng/mL tended to result in higher activity. In the adipose-derived stem cells, alkaline phosphate activity was quite robust, and the BMP-9–treated cells demonstrated the highest activity compared to the other BMPs ($P < 0.001$) at all doses greater than 100 ng/mL by day 3. At day 7, both BMP-9 and BMP-6 demonstrated the highest alkaline phosphatase activities compared to the other BMPs at all doses greater than 10 ng/mL ($P < 0.001$) with little difference between them. Activity due to BMP-2 and BMP-7 treatment was similar. BMPs 4 and 5 consistently resulted in the lowest alkaline phosphatase activity (data not shown in graph).

Conclusions: BMP-9 may possess greater osteogenic potential than the currently US Food and Drug Administration (FDA)-approved BMPs. In general, it stimulated the largest increase in alkaline phosphatase activity, and did so at lower doses. BMP-6 also resulted in high alkaline phosphate activity in some cell lines. Between the two commercially available BMPs, BMP-2 and -7, there was no difference in resultant alkaline phosphatase 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 413.

Altered Bone Quality in Bisphosphonate-Related Femoral Fractures of Postmenopausal Women

Brian J. Rebolledo, BA[1]; *Eve Donnelly, PhD*[2]; *Dean G. Lorich, MD*[2]; *Brian P. Gladnick, BA*[1]; *Aasis Unnanuntana, MD*[2]; *Adele L. Boskey, PhD*[2]; *Joseph M. Lane, MD*[2];
[1]*Weill Cornell Medical College, New York, New York, USA;*
[2]*Hospital for Special Surgery, New York, New York, USA*

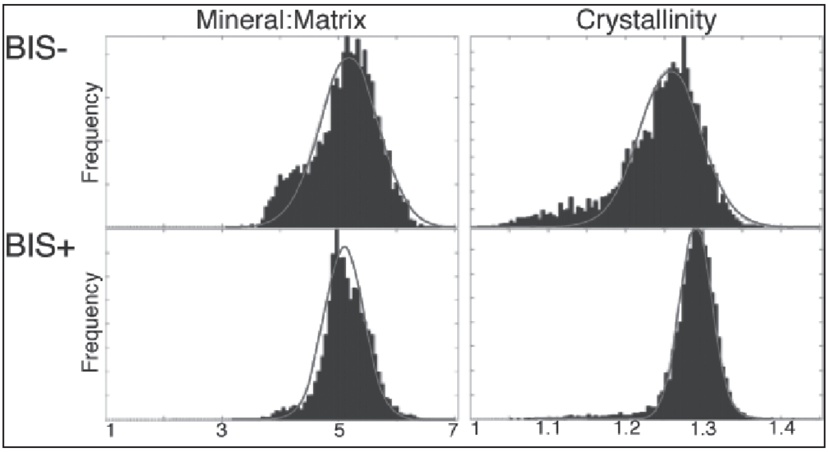
Purpose: Bisphosphonates have proven to be useful in the prevention of bone loss in osteoporotic patients, yet less is known about the effects on bone quality. Recent reports have proposed that long-term bisphosphonate treatment (BIS+) could adversely affect bone quality by resulting in accumulation of microdamage and leading to low-energy "atypical" transverse fractures of the femoral diaphysis. In this study, we compared the microarchitectural and compositional parameters of bone quality in femoral fracture patients on BIS+ versus bisphosphonates-naive (BIS–) patients.

Methods: 21 postmenopausal women with proximal femoral fractures requiring internal fixation and trochanteric femoral nail (TFN) had corticocancellous bone biopsies obtained from the lateral proximal femur, distal to the greater trochanter. In the BIS+ group, there were 12 patients (age 81 ± 12 years) with average treatment duration of 8.5 ± 5 years. There were 9 patients (age 86 ± 6 years) in the BIS– group. Specimens were first analyzed by micro CT to measure bone volume fraction, trabecular (Tb) number, Tb thickness, Tb separation, and Tb connectivity. Histomorphometry was used to measure the ratio of unmineralized to mineralized bone surface of cortical and Tb bone. Specimens were then analyzed with Fourier transform infrared imaging (FTIRI) to assess properties of cortical and Tb bone with the following parameters: mineral:matrix ratio, carbonate:phosphate ratio, collagen cross-linking maturity, and mineral crystallinity. Each distribution was measured by mean values and full width at half maximum (FWHM) of the Gaussian curve fit to the distribution. Groups were compared with the Student *t* test, with $P < 0.05$ being significant.

Results: Cortical tissue mineral properties indicated a narrower distribution in the BIS+ group compared to the BIS– group (mineral:matrix ratio: –23%, $P = 0.03$; mineral crystallinity: –36%, $P = 0.02$) (Fig. 1). While the widths of distribution values were different between groups, the mean cortical and trabecular values of all FTIRI parameters were similar. Micro CT and histomorphometry analysis showed no difference between groups. There was no difference in demographic data between groups.

Conclusion: In this study, BIS+ in femoral fracture patients was associated with a narrower distribution in compositional parameters of cortical tissue. The primary abnormality was a narrower pattern of aged bone matrix. Older unremodeled collagen can undergo glycation and result in reduced toughness. Narrow tissue distributions of bone have been reported previously in nonfractured osteoporotic patients on BIS+ for up to 3 years, and may be associated with a loss of mechanical integrity. This may also contribute to difficulties in preparing the femoral shaft for TFN and cause delay in the healing process. Using FTIRI, these preliminary results suggest narrower tissue properties detected in patients on long-term BIS+ could lead to adverse effects on bone quality and increase the risk of fracture.

See pages 75 - 103 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 413.

CASE PRESENTATIONS

Proximal Humerus Fractures *(#F-1)*
Moderator: *Michael J. Gardner, MD*
Faculty: *Clifford B. Jones, MD* and *Samir Mehta, MD*

Nonunions and Malunions *(#F-2)*
Moderator: *Stuart M. Gold, MD*
Faculty: *Mark C. Reilly, MD; William M. Ricci, MD* and *J. Tracy Watson, MD*

The Not-So-Straightforward Ankle Fracture *(# F-3)*
Moderator: *Justin K. Greisberg, MD*
Faculty: *Stephen K. Benirschke, MD; Kenneth A. Egol, MD* and *David W. Sanders, MD*

Nailing Difficult Femur and Tibia Fractures *(# F-4)*
Moderator: *Robert F. Ostrum, MD*
Faculty: *Dolfi Herscovici, Jr., DO; Wade R. Smith, MD* and *Paul Tornetta, III, MD*

Fractures About the Knee *(# F-5)*
Moderator: *David P. Barei, MD*
Faculty: *Matt L. Graves, MD* and *Thomas F. Higgins, MD*

See pages 75 - 103 for financial disclosure information.

SYMPOSIUM II:
DISASTER PREPAREDNESS: WHAT WE LEARNED FROM HAITI

Moderator: *Christopher T. Born, MD*

Faculty: *Andrew N. Pollak, MD*
Mark P. McAndrew, MD
William G. DeLong, Jr., MD
Michael J. Bosse, MD
Capt. Daniel V. Unger, MD

Introduction / Goals and Objectives
Christopher T. Born, MD
(Co-Chair, AAOS/OTA Haiti Relief: Disaster Preparedness Project Team)

8:00 am **Personal Safety and Medical Ethics in the Disaster Response Setting**
Andrew N. Pollak, MD

8:15 am **Orthopaedic Care in the Austere, Mass Casualty Medical Environment**
Mark P. McAndrew, MD

8:30 am **Humanitarian Response: Future Directions for the Academy & the OTA**
William G. DeLong, Jr., MD
(Co-Chair, AAOS/OTA Haiti Relief: Disaster Preparedness Project Team)

8:40 am **Question/Answer Session**

8:50 am **Civilian/Military Collaboration: Expanded Disaster Surge Capacity**
Michael J. Bosse, MD

9:05 am **OTA Surgeons on the Comfort: What Worked and What Did Not**
Capt. Daniel V. Unger, MD (Orthopaedic Specialty Advisor to the US Navy, Chief of Orthopaedic Surgery on the Comfort for the Haiti deployment)

9:20 am **Question/Answer Session**

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 413.

Radiographic Evaluation of Intertrochanteric Hip Fractures Treated With or Without Distal Interlocking in a Cephalomedullary Construct

***George Karl Van Osten, III, MD*[1]**; *Mark A. Lee, MD*[2];
[1]*North Mississippi Medical Center, Tupelo, Mississippi, USA*
[2]*University of California, Davis, Sacramento, California, USA*

Purpose: This study was designed to identify any difference with regard to classically accepted radiographic parameters for construct failure between intertrochanteric (IT) fractures treated with or without distal interlocking in a long cephalomedullary (CM) component. The hypothesis was that fractures treated without distal interlocking would show radiographic evidence of proximal cutout and construct failure.

Methods: This study is an IRB-approved, single institution, retrospective radiographic review. 150 total patients with IT hip fractures (OTA 31A) treated with a CM construct were identified in a previously compiled institutional database. Inclusion criteria were OTA 31 A1, A2, A3 fracture; treatment with long CM construct ± distal interlocking bolt; adequate radiographic documentation; and absence of ipsilateral injury. 104 total cases were selected as meeting these criteria, with 57 distally unlocked and 47 distally locked. Fractures were further subclassified as stable or unstable by the principal investigator using the OTA classification scheme and original injury radiographs. Three separate categories were analyzed: overall (N = 104), locked (N = 47) versus nonlocked (N = 57); stable (N = 28), locked (N = 12) versus nonlocked (N = 16); and unstable (N = 76), locked (N = 35) versus nonlocked (N = 41). All radiographic measurements were made by the principal investigator using a digital radiography system, and a conversion factor based upon known implant diameter was used for neutralization of magnification error. Measured radiographic parameters for implant failure were calculated based on an AP hip or pelvis view and included: (1) lag screw to femoral head medial distance (Δm), (2) lag screw to femoral head vertical distance (Δh), and (3) construct neck-shaft angle (Δa). Mean differences (Δm, Δh, Δa) from immediate postoperative radiograph to final follow-up radiograph between locked and unlocked CM constructs were calculated for each group (overall, stable, unstable). Statistical analysis was performed using a Student *t* test technique for identification of significance.

Results: In the overall group (N = 104), locked (N = 47) exhibited Δm 0.231, Δh 0.493, and Δa 3.32; unlocked (N = 57) had Δm 0.386, Δh 0.296, and Δa 1.97. In the stable group (N = 28), locked (N = 12) had Δm –0.452 (increased mean distance), Δh 0.450, and Δa 2.25; unlocked (N = 16) exhibited Δm 0.458, Δh 0.631, and Δa 0.31. In the unstable group (N = 76), locked (N = 35) showed Δm 0.467, Δh 0.508, and Δa 3.69; unlocked (N = 41) data were Δm 0.358, Δh 0.166, and Δa 2.61. The stable group showed a mathematically significant difference ($P = 0.0286$) with regard to medial distance, yet this represents a trend counterintuitive to predicted failure mechanisms. There was no other significant difference calculated.

Conclusion: There is no evidence of an increased incidence of failure, with regard to classically designed radiographic parameters, between IT fractures treated with or without distal interlocking in a long CM construct.

See pages 75 - 103 for financial disclosure information.

Risk of Complications following Treatment of Intertrochanteric Hip Fractures with Intramedullary Nails and Plate Fixation inthe Medicare Population

Arthur L. Malkani, MD[1]; Colin Carroll[1]; ***Craig S. Roberts, MD, MBA[1]****; David Seligson, MD[1]; Edmund Lau, PhD[2]; Steven Kurtz, PhD[2]; Kevin Ong, PhD[2];*
[1]University of Louisville, Louisville, Kentucky, USA;
[2]Exponent Inc, Philadelphia, Pennsylvania, USA

Purpose: This study was designed to: (1) evaluate the temporal trends in treatment patterns for intertrochanteric hip fractures using intramedullary (IM) nails and plate fixation; (2) compare postoperative complication and mortality risk following IM nail and plate fixation; and (3) evaluate the risk factors for complications and mortality.

Methods: Intertrochanteric hip fracture patients were identified from the 5% nationwide sample of the Medicare claims data (1998-2007), using ICD-9-CM codes 820.2 and 820.3. Patients who underwent IM nail or plate fixation were identified using CPT codes 27245 and 27244, respectively. The cumulative incidence of deep venous thrombosis (DVT), infection, mechanical complications, neurologic complications, pulmonary embolism, and cardiac complications were computed for up to 90 days postsurgery, while mortality, malunion/nonunion, conversion to hip replacement, and reoperation with a subsequent internal fixation were evaluated for up to 1 year postsurgery. Multivariate Cox regression (adjusted) was used to evaluate the risk factors for complications, which included age, gender, race, comorbidity (Charlson index), year of procedure, socioeconomic status, site of service (inpatient, outpatient), and type of procedure.

Results: 9,157 IM nail and 27,687 plate fixation procedures were identified. The proportion of intertrochanteric hip fractures treated with IM nailing increased from 3.3% to 63.1% between 1998 and 2007, compared with plate fixation. Based on 1998-2007 data, IM nail patients had a higher adjusted risk of pulmonary embolism at 90 days (+39%; $P = 0.003$) and mortality at 1 year (+9%; $P < 0.001$), compared with plate fixation patients. However, IM nail patients had a lower adjusted risk of conversion to hip replacement at 1 year (–22%; $P = .054$), which was also observed (–36%; $P = 0.037$) for the subgroup analysis (2006-2007 data). No other significant differences were found for the overall and subgroup analyses. Of the selected complications, DVT and death were the most frequently reported 90-day and 1-year complications (4% for DVT and 25% mortality in 2006-2007), respectively.

Conclusion: The changing treatment patterns for intertrochanteric hip fracture in the Medicare population from 1998-2007 agree with previous findings among younger orthopaedic surgeons. Our data suggest that there is limited improvement in outcomes, as measured by selected complications at 90 days and 1 year, for IM nail fixation compared with plate fixation. The IM group had a lower incidence of failure leading to total hip arthroplasty compared with the plate fixation 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 413.

The Orthopaedic Traumatologist and the Peritrochanteric Hip Fracture: Does Experience Matter?

*Paul Tornetta, III, MD; **T. William Axelrad, MD**; Alex Dehaan, MD; William R. Creevy, MD; Boston University Medical Center, Boston, Massachusetts, USA*

Background: The choice of implant for peritrochanteric fractures is controversial. Evidence supports the use of an intramedullary (IM) device for unstable fractures (with comminution, subtrochanteric extension, or loss of lateral support) as more shortening has been noted with sliding hip screw devices in unstable fractures.

Purpose: The purpose of this study was to review our protocol of sliding hip screws for stable and IM devices for unstable peritrochanteric fractures to evaluate the correctness of the decisions made based on complication rates and on shortening (collapse) of the fractures.

Methods: Over a 5-year period, two orthopaedic traumatologists followed a protocol for peritrochanteric fractures utilizing a standard sliding hip screw (dynamic hip screw [DHS]) for all fractures that were felt to be stable and a cephallomedullary nail for unstable fractures. This was based on medial or subtrochanteric extension and the status of the lateral wall. Injury radiographs were reviewed independently by a blinded observer to classify each fracture pattern as stable or unstable based on the Evans classification. The tip apex distance, femoral neck-shaft angle, and shortening were evaluated in addition to any screw cut-out, screw loosening, nonunion, or loss of reduction. Operative data, transfusion requirements, and 30-day mortality were documented.

Results: 121 patients were treated over the 5-year period (62 male and 59 female; average age, 64 years). Of these, 62 were classified as stable and 59 unstable. 28 patients were operated on in the first 24 hours, 81 between 1 and 4 days, and 12 after 5 days, based on medical optimization. After a careful reclassification, stable fractures were treated with a DHS in 59 and an IM nail in 3 cases, whereas unstable fractures were treated with an IM nail in 55 and a plate in 4 cases. The average operating time was 86 ± 42 minutes for the DHS and 115 ± 30 minutes for IM devices. Blood transfusions occurred in 42% of the DHS group and 39% of the IM nail group. The tip apex distance was >25 for 2 of 61 plates (3.3%) and 6 of 60 (10%) of the IM nails. The average tip apex distance was 16 mm for the DHS and 22 for the IM nail group. Two partial cut-outs occurred, both in the DHS group, with 15- and 19-mm tip apex distances. At union, shortening was 5.9 ± 5 mm for the DHS group and 5.3 ± 5 mm for the IM nail group. The neck-shaft angle averaged 135° in the DHS group and 126° in the IM nail group, with neither group showing any loss of this relationship over time. There were 3 (2.5%) deaths within 30 days of surgery.

Discussion: This study validates a protocol utilizing sliding hip screws for stable and IM nails for unstable peritrochanteric fractures. We found that sliding hip screws resulted in less operative time and less occurrences of >25 mm tip apex distance, but no difference in blood requirements. Despite 10% of the IM nails having a tip apex angle of >25mm, there were no cases of cut-out, indicating that this measure may not be as important for IM nails. Overall shortening averaged <6 mm in both groups, validating the preoperative assessment of fracture stability. More anatomic restoration of the neck-shaft angle was accomplished

See pages 75 - 103 for financial disclosure information.

with plates, but these were also more stable fractures. The minimal shortening and restoration of the neck-shaft angle support the use of sliding hip screws in stable fractures. 30-day mortality was low (2.5%), possibly owing to attempts to fully optimize patients prior to intervention.

Conclusion: A protocol utilizing sliding hip screws for stable and IM nails for unstable peritrochanteric hip fractures based on the judgment of experienced surgeons is reasonable and can save costs compared to using IM nails for all cases ($104,898 in this series).

- 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 413.

Bipolar Hemiarthroplasty Compared with Total Hip Arthroplasty in Patients with Displaced Femoral Neck Fractures: A Four-Year Follow-Up of a Randomized Controlled Trial

(FDA=Non-U.S. research conducted within guidelines of my country)

Carl Johan Hedbeck, MD[1]; *Anders Enocson, MD, PhD[1]; Gunilla Lapidus, MD[2];*
Richard Blomfeldt, MD, PhD[1]; Hans Törnkvist, MD, PhD[1];
Sari Ponzer, PhD[1]; Jan Tidermark, MD, PhD[1];
[1]Karolinska Institutet, Dept. of Clinical Science and Education, Sodersjukhuset, Stockholm, Sweden;
[2]Unilabs St. Goran Radiology, Capio St. Goran Hospital, Stockholm, Sweden

Purpose: The primary aim of the study was to determine whether the superior hip function for total hip arthroplasty (THA) as compared to bipolar hemiarthroplasty (HA) after 1 year (Blomfeldt et al, *J Bone Joint Surg Br.* 2007;89:160-165) persisted during the 4-year follow-up. The secondary aim was to analyze the degree of acetabular erosion in the HA group during the same period of time.

Methods: 120 patients (101 females [84%]; mean age, 81 years) with an acute displaced femoral neck fracture were randomized to a bipolar HA or a THA. The inclusion criteria were age 70 to 90 years, absence of severe cognitive dysfunction, independent living status, and independent walking capability. Hip complications, hip function according to the Harris hip score (HHS) and health-related quality of life (HRQoL) according to the EQ-5D were assessed. Acetabular erosion was graded (0-3) according to Baker et al (*J Bone Joint Surg Am.* 2006;88:2583-2589).

Results: There were no significant differences in hip complications and reoperations between the groups and there were no dislocations. In the HA group, a total of 5 patients presented with acetabular erosion, all grade 1, but not affecting hip function. The difference in hip function (HHS) in favor of the THA group previously reported at 1 year persisted and seemed to increase with time—score 87 versus 78 at 24 months ($P < 0.001$) and 89 versus 75 at 48 months ($P < 0.001$). The HRQoL (EQ-5D index score) was assessed better in the THA group at each follow-up, but the difference was statistically significant only at 48 months ($P < 0.039$).

Conclusion: The results confirm the better outcome for hip function and quality of life after THA compared to HA in elderly, lucid patients with a displaced fracture of the femoral neck. The results imply that THA should be the preferred treatment method for the active, relatively healthy patient with long life expectancy. However, the low rate of acetabular erosion after 4 years and the relatively good hip function after a modern bipolar HA imply that a bipolar HA may suffice as treatment for the oldest patients with lower functional demands.

See pages 75 - 103 for financial disclosure information.

Functional Status, Morbidity and Mortality in Cemented versus Press-Fit Hemiarthroplasty for Displaced Femoral Neck Fractures: A Prospective Randomized Trial

Joseph P. DeAngelis, MD[1]; *Arben Ademi, BA*[2]; *Courtland G. Lewis, MD*[2];
[1]*Beth Israel Deaconess Medical Center/Harvard Medical School - Orthopaedics, Boston, Massachusetts, USA;*
[2]*Hartford Hospital, University of Connecticut, Hartford, Connecticut, USA*

Purpose: This study was conducted to compare prospectively the morbidity, mortality, and functional outcome associated with cemented and press-fit hemiarthroplasty for displaced femoral neck fractures.

Hypothesis: The use of press-fit hemiarthroplasty in the treatment of displaced subcapital fractures of the femoral neck would be associated with a decreased risk of adverse perioperative outcomes, and that the functional results of cemented and press-fit hemiarthroplasty would be equivalent at 1 year.

Methods: In a prospective, randomized trial, patients 55 years of age and older with a nonpathologic, displaced femoral neck fracture were randomly assigned to treatment with a cemented (66 patients) or a press-fit (64 patients) femoral implant and a unipolar head.

Results: No statistically significant differences were present in the groups' preoperative or intraoperative characteristics, including American Society of Anesthesiologists (ASA) grade, operative time, anesthesia time, use of perioperative beta blockers, estimated blood loss, or the rate of intraoperative fracture. Postoperatively, no difference was found in hemoglobin level, transfusion rate, discharge disposition, or acute complication rate. At 30-day, 60-day, and 1-year follow-up, no clinically or statistically significant differences were found in mortality, disposition, need for assistance with ambulation, Older Americans Resources & Services (OARS) Activities of Daily Living subscales, or the energy/fatigue (EF) scale.

Conclusions: In the treatment of nonpathologic, displaced femoral neck fractures, the use of press-fit and cemented femoral components is associated with similar mortality, morbidity, and functional outcome at 1 year. Practitioners may inform their clinical decisions using these equally good results.

- 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 413.

Functional and Cardiac Outcomes Comparing Symptomatic versus 10 g/dL Transfusion Threshold: A Randomized Trial in over 2000 Patients with Hip Fracture

***David W. Sanders, MD*[1]**; *Jeffrey L. Carson, MD*[2]; *Michael L. Terrin, MD*[3]; *Jay L. Magaziner, MD*[3]; *Courtland G. Lewis, MD*[1]; *Lauren Beaupre, MD*[4]; *William McAuley, MD*[5]; *Kevin Hildebrand, MD*[6]; *FOCUS Investigators*
[1]*University of Western Ontario, London, Ontario, Canada;*
[2]*UMDNJ: New Jersey Medical School, Newark, New Jersey, USA;*
[3]*University of Maryland, College Park, Maryland, USA;*
[4]*University of Alberta, Edmonton, Alberta, Canada;*
[5]*Columbia University, Columbia, New York, USA;*
[6]*University of Calgary, Calgary, Alberta, Canada*

Purpose: Postoperative anemia is common after hip fracture. The threshold at which transfusion is beneficial is controversial. The Transfusion Trigger Trial for Functional Outcomes in Cardiovascular Patients Undergoing Surgical Hip Fracture Repair (FOCUS) is a randomized controlled trial designed to determine whether higher blood transfusion thresholds improve functional recovery and reduce mortality and morbidity after hip fracture repair.

Methods: 2,016 patients 50 years of age or older who underwent surgery for hip fracture, had a history of or risk factors for cardiovascular disease, and had postoperative anemia (hemoglobin [Hgb] <10 g/dL) were randomized from 47 North American centers. Patients were randomly allocated to a transfusion threshold of 10 g/dL, or to receive transfusion when anemia symptoms occurred. Transfusion in the restrictive group was permitted but not required if Hgb level was <8 g/dL. Inhospital mortality, cardiac events, and complications (pneumonia, infection, heart failure, stroke, deep venous thrombosis/pulmonary embolism), and length of stay were compared between the groups. Functional outcome, defined as the ability to walk across a room without human assistance, was compared at 30 and 60 days.

Results: 2,016 patients were enrolled from 47 North American medical centers. The mean age of the study subjects was 81.6 ± 8.9 years, and 75.7 % were female. Fracture types included femoral neck fractures (841), intertrochanteric fractures (973), and subtrochanteric fractures (196); 6 fractures were not classified. Surgical treatment included arthroplasty (728 patients), extramedullary fixation (708 patients), and intramedullary fixation (424 patients). 141 patients had combined treatment strategies and 15 patients did not have the surgical procedure identified. The 1,007 patients in the liberal group were transfused a total of 1,866 units of blood for an average Hgb of 9.2 g/dL, while the 1009 patients in the restrictive group received a total of 652 units for an average Hgb of 7.9 g/dL. Inhospital outcomes including mortality, cardiac events, infection, and length of stay did not differ between the groups. The rates of death or inability to walk without human assistance at 60 days were similar between the two arms ($P = 0.80$). In the liberal (10 g/dL) group, 34.9% were dead or unable to walk without human assistance and for the symptomatic group 34.3%. The 30- and 60-day mortality rates were similar between the two arms of the trial.

See pages 75 - 103 for financial disclosure information.

Conclusions: A restrictive transfusion threshold had no adverse effects on functional outcome, cardiac events, or mortality in this high-risk group of elderly patients. Patients in the symptomatic arm of the trial received much less blood transfusion (65% fewer units) than the 10 g/dL group; 58.5% of patients in the symptomatic arm did not receive any blood transfusion. Widespread implementation of the symptomatic approach to transfusion in comparable patients would greatly reduce blood demands with no discernible effect on mortality or function.

- 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 413.

Operative Outcomes and Treatment Difficulties for Fractures of the Proximal Femur Associated with Bisphosphonate Therapy

Jaimo Ahn, MD[1]; *Omesh Paul, MD*[2]; *Paul Matuszewski, MD*[1]; *Mark L. Prasarn, MD*[3]; *Andrew S. Neviaser, MD*[2]; *Timothy S. Achor, MD*[4]; *David L. Helfet, MD*[2]; *Joseph M. Lane, MD*[2]; *Dean G. Lorich, MD*[2];
[1]*University of Pennsylvania, Philadelphia, Pennsylvania, USA;*
[2]*Hospital for Special Surgery, New York, New York, USA;*
[3]*University of Rochester, Rochester, Minnesota, USA;*
[4]*University of Texas, Houston, Houston, Texas, USA*

Purpose: Fractures of the proximal femur associated with bisphosphonate therapy are being increasingly recognized as a clinical entity but lack adequate clinical characterization. Our goal was to describe the operative treatment and outcomes including some of the challenges associated with these difficult fractures.

Methods: A retrospective operative database review identified 43 patients with bisphosphonate-associated fractures of the femur between 2002 and 2008. Data were extracted from a final bisphosphonate cohort (BC) of 25 patients and was compared to a similar control cohort (CC) of 20 patients regarding preoperative, intraoperative, and postoperative variables of interest.

Results: The average age of the BC was 71 years (SD = 11) and average follow-up was 83 weeks. Fractures were typically subtrochanteric to middle-third femur (mean of 6 cm subtrochanteric). The average duration of bisphosphonate therapy was 7.6 years. 64% of patients regained preoperative ambulatory status; 18% reported returning to previous living environments. When compared to the CC, the BC had a significantly higher overall complication rate ($P < 0.0001$)—most notably intraoperative fractures and postoperative plate failures. Furthermore, healing time was delayed compared to controls (26 weeks vs 19 weeks; $P = 0.01$).

Conclusion: Our data begin to illustrate the difficulties in treatment of these injuries. Intramedullary nailing, which is otherwise standard treatment, was not routine due to a high risk of iatrogenic fractures and plate constructs were prone to failure. Despite the low rate of other risk factors and the ample use of biologic adjuvants, patients have lengthy healing times and a difficult return to preinjury living environments. These fractures require vigilance and appropriately aggressive care from providers and careful further study.

See pages 75 - 103 for financial disclosure information.

Mortality after Distal Femur Fractures in Elderly Patients

Philipp N. Streubel, MD; *William M. Ricci, MD; Ambrose Wong, BS; Michael J. Gardner, MD; Washington University School of Medicine, St. Louis, Missouri, USA*

Purpose: Although hip fractures in the elderly are associated with high 1-year mortality rates, it is not clear whether patients with other lower extremity fractures are exposed to a similar mortality risk. The purpose of this study was to compare survivorship of elderly patients with distal femur fractures to a matched hip fracture control group. The null hypothesis was that similar mortality rates would be found. Additionally, we aimed at identifying predictors for mortality after distal femur fractures.

Methods: 92 consecutive patients with low-energy supracondylar femur fractures admitted between 1999 and 2009 were included (mean age 77.9, years; 78% females; average follow-up 2.8 years; mean Charlson Comorbidity Index [CCI], 1.8). Patient, fracture, and treatment characteristics were extracted from operative records, charts, and radiographs. Data on mortality were obtained from the Social Security Death Index. A 1:1 age, gender, comorbidity, and follow-up–matched hip fracture control group (n = 92) was evaluated.

Results: *Distal Femur Versus Hip Fracture Survival.* Overall mortality rates for distal femur and hip fracture patients were each 38% (P = 1.00). Equality was confirmed with log-rank test (P = 0.83, power=0.80). One-year mortality was 25% after distal femur fracture and 21% after hip fracture (P = 0.55). *Distal Femur Fracture Survival.* Age-adjusted CCI and the presence of a previous total knee arthroplasty led to shorter survival (hazard ratio [HR] = 3.21, P = 0.005 and HR = 1.32, P = 0.004 respectively). Congestive heart failure (HR = 4.52, P < 0.001), dementia (HR = 4.52, P = 0.002), moderate to severe renal disease (HR = 4.67, P =0.001), and history of a malignant tumor (HR = 2.9, P = 0.02) lead to significantly shorter survival times. The effect of gender, smoking habit, body mass index, fracture classification, and delay to surgery on survival was not significant.

Conclusions: Mortality after fractures of the distal femur in the geriatric population is high and similar to the mortality seen after hip fractures. Periprosthetic fractures and those occurring in patients with dementia, heart failure, advanced renal disease, and metastasis lead to a significant reduction in survival. Age-adjusted CCI may serve as a useful tool to predict survival after 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 413.

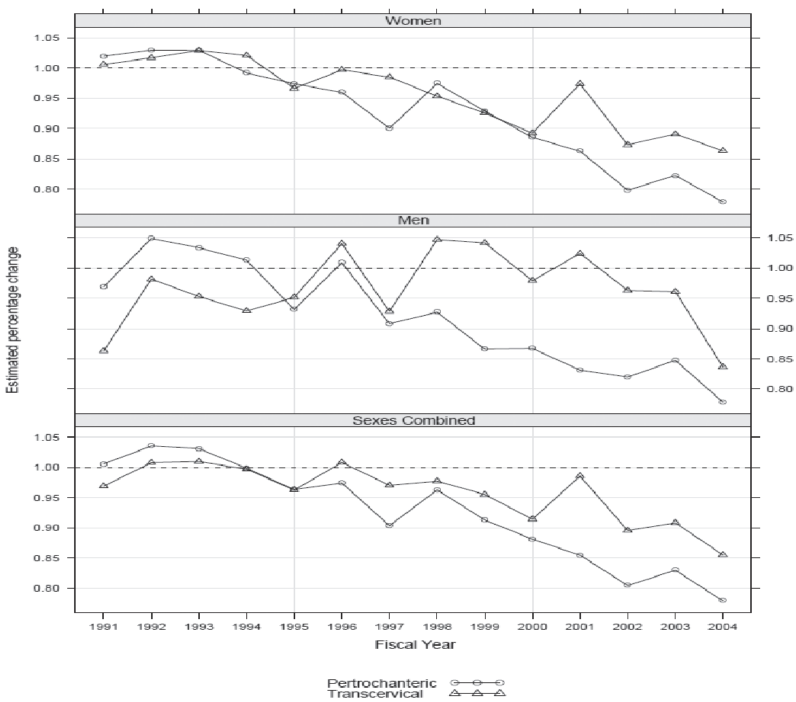
Changes in Hip Fracture Rates in British Columbia Canada, 1990-2004

Kelly A. Lefaivre, MD*; Adrian R. Levy, PhD; Boris Sobolev, PhD; Stephanie Y. Cheng, BS; Lisa Kuramoto; Pierre Guy, MD;*
University of British Columbia, Department of Orthopaedic Surgery
Vancouver, British Columbia, Canada

Purpose: Our objective was to determine whether there have been changes in the age, sex, and subtype-specific hip fracture rates in the Canadian province of British Columbia (BC) between 1990 and 2004.

Methods: Records of all persons aged 60 years and older hospitalized with hip fractures in BC between 1985 and 2004 were obtained from the Canadian Institute for Health Information Discharge Abstract Database. Only the first hip fractures were recorded, and records were excluded based on causes other than trauma (eg, metastatic disease). Age- and sex-specific rates were calculated using population denominators from Statistics Canada and direct standardization was used. Age-standardized rates allowed for comparison across years with adjustment for age distribution.

Results: There were 41,990 records of first hip fracture included, and 73% among women. Trends in age-specific rates by fracture type were similar to previous reports. Between 1990 and 2004, there has been an age-adjusted 18% decrease in hip fracture rates in women, and 19% decrease in hip fracture rates in men. The decrease was statistically more significant in femoral neck fractures in women, but not in men.



See pages 75 - 103 for financial disclosure information.

Conclusions: The decrease in age-adjusted hip fracture rates in BC between 1990 and 2004 is consistent with the fact that public health measures to decrease hip fractures are having some success.

- 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 413.

Operative versus Nonoperative Treatment of Unstable Lateral Malleolar Fractures: A Randomized, Multicenter Trial

David W. Sanders, MD*; Christina A. Tieszer; Canadian Orthopedic Trauma Society; University of Western Ontario, London, Ontario, Canada*

Purpose: The preferred treatment for undisplaced but unstable lateral malleolar fractures is controversial. The purpose of this study was to compare functional outcomes following surgical and nonsurgical treatment of undisplaced, potentially unstable, isolated fibula fractures in an adult population. Secondary objectives were to compare the radiographic outcomes and complications between the two groups.

Methods: This registered clinical trial enrolled 81 patients, 18 to 65 years of age, at 6 sites. Institutional Review Board approval was obtained. Prior to randomization, all patients had injury films with no evidence of talar shift, followed by an external rotation stress radiograph demonstrating an increase in the medial clear space to 5 mm or greater. 41 patients were randomized to operative repair, which included open reduction and internal fixation of the fibula. Forty patients were treated nonoperatively, including use of a short-leg cast or brace and protected weight bearing for a minimum of 6 weeks. Clinical and radiographic review was performed at 6, 12, 24, and 52 weeks. Clinical outcomes included the Olerud and Molander ankle score and Short Form-36 (SF-36). Radiographic outcomes included measurement of union and displacement at each visit. Statistical analysis included analysis of variance of means and standard deviations at each time interval, as well as analysis of the slope of the recovery curve with multiple logistical regression analyses.

Results: The mean (± SD) SF-36 physical component summary score for all patients was 45 ± 19 at 6 weeks, 63 ± 19 at 3 months, 76 ± 19 at 6 months, and 79 ± 19 at 1 year. The overall Olerud-Molander score improved from 37 ± 20 at 6 weeks to 84 ± 22 at 1 year. There were no differences in functional outcome scores or pace of recovery between the operative and nonoperative groups at any time interval. Radiographs demonstrated 8 patients with a medial clear space ≥5 mm in the nonoperative group. One patient in the operative group had an increase in tibiofibular clear space. Complications in the nonoperative group included 8 patients with delayed union or nonunion. In the operative group, 5 patients had a surgical-site infection, of which 4 were superficial. Five patients required hardware removal.

Conclusions: Functional outcome following unstable, undisplaced fractures of the lateral malleolus demonstrated ongoing recovery 12 months following injury. Patients managed operatively had equivalent functional outcomes compared to nonoperative treatment; however, the risk of displacement and problems with union was substantially lower in patients managed with surgery.

See pages 75 - 103 for financial disclosure information.

Treatment of the Stress-Positive Ligamentous SE4 Ankle Fracture: Incidence of Syndesmotic Injury and Clinical Decision Making

*Paul Tornetta, III, MD; **T. William Axelrad, MD**; William R. Creevy, MD;*
Boston University Medical Center, Boston, Massachusetts, USA

Background: It has been demonstrated that only one-third of patients with an isolated supination–external rotation (SE)-pattern fibula fracture who present with an aligned mortise have instability on stress examination. Those with no instability are treated without surgery without the risk of displacement. The treatment for the stress-positive (stress+) fracture is more controversial. Additionally, while the incidence of syndesmotic instability in subluxated ligamentous SE4 ankle fractures is reported between 19% and 40%, there is no information regarding the incidence of syndesmotic instability in patients with stress+ SE-type fibula fractures.

Purpose: The purpose of this study is to report on a large series of stress+ isolated SE-type fibula fractures, as regards the ability to gain anatomic union, and to report the rate of syndesmotic instability in the operative cases.

Methods: Over a 9-year period, we treated 99 patients (age 19-76 years; average, 43) with stress+ isolated SE-type fibula fractures to union. All presented with an aligned mortise and were found to have widening of the medial clear space (MCS) with talar subluxation on external rotation stress radiographs with the ankle in neutral position. All radiographs were rereviewed and the MCS measured on the presentation, stress, and final united radiographs. The decision for surgical or nonsurgical management was made by the patient and surgeon after a discussion of the risks and benefits of both. The presumed ability to hold the reduction in a cast was part of the discussion in all cases. Syndesmotic instability for the operative cases was defined as medial widening and talar subluxation on an abduction external rotation stress radiograph after fibular fixation. Syndesmotic fixation was performed for any elicited subluxation.

Results: Of the 99 cases, 43 were definitively treated in a cast (6 weeks non–weight bearing, then weight bearing as tolerated in brace and weaned) and 56 were treated operatively. 24 (43%) of the operative cases demonstrated intraoperative syndesmotic instability. The presentation MCS measurements were not different for patients treated with a cast, open reduction and internal fixation (ORIF) fibula only, or ORIF fibula and syndesmosis; however the stress radiograph MCS was statistically different for all groups ($P < 0.001$) (Table). The casted group had minimal displacement on stress radiograph whereas the operative group had more, with those demonstrating intraoperative syndesmotic instability being greater than those without. No patient healed with any subluxation.

	Presentation MCS (mm)	Stress MCS (mm)	United MCS (mm)
Casted (43)	2.51 ± .3	5.01 ± .6	2.55 ± .4
ORIF, syndesmosis stable (32)	2.66 ± .4	6.09 ± .9	2.41 ± .3
ORIF, syndesmosis unstable (24)	280 ± .4	7.51 ± 2	2.50 ± .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 413.

Discussion: Patients with stress+ SE-pattern lateral malleolar fractures are clearly a spectrum of injury. The treatment of these injuries is controversial and outcome has been correlated with initial MCS widening. In this series, clinical judgment resulted in those patients with minimal displacement on the initial stress radiograph being treated successfully nonoperatively and those with greater stress MCS having surgery. Within the surgical group, the incidence of syndesmotic injury is the same as prior reports of ligamentous equivalent SE4 fibular fractures (43%). All patients healed with a well-aligned mortise.

Conclusions: Stress+ SE-pattern fibular fractures with minimal MCS widening on stress radiographs may be treated in a cast to union without displacement. Those with greater displacements (wider MCS) on stress radiographs have an incidence of syndesmotic injury that is the same as patients who presented with subluxation of their ankle and should be sought out.

See pages 75 - 103 for financial disclosure information.

Prospective Intraoperative Syndesmotic Evaluation during Treatment of Ankle Fractures: Stress External Rotation versus Lateral Fibular Stress

Derek G. Dombroski, MD; *Paul E. Matuszewski, MD; J. Todd Lawrence, MD; John Esterhai, MD; Samir Mehta, MD;*
University of Pennsylvania, Department of Orthopaedic Surgery, Philadelphia, Pennsylvania, USA

Purpose: The syndesmosis of the distal tibia-fibula joint is important for stability in the weight-bearing function of the ankle mortise. Disruption of the syndesmosis influences treatment plans in ankle fractures and therefore diagnosis of this injury is important. Accurate diagnosis of a syndesmotic injury often requires intraoperative evaluation with stress imaging. Stressing the ankle can be achieved by one of two methods—stress external rotation and lateral fibular stress. We hypothesized that the method of stress external rotation more accurately reproduces the mechanism of injury and therefore this diagnostic method more likely detects injury to the syndesmosis.

Methods: A prospective evaluation using stress external rotation and lateral fibular stress was performed on 20 ankle fractures with syndesmotic injury at a single institution. These results were compared against unstressed images with normalized measurements of the tibia-fibula clear space, tibia-fibula overlap, and medial clear space.

Results: After normalization of the fluoroscopic measurements, there was no difference in detecting changes in tibia-fibula clear space or tibia-fibula overlap. However, there was a significant difference in detecting medial clear-space widening with stress external rotation. Compared to lateral fibular stress, stress external rotation demonstrated a 35% increase ($P < 0.05$) in medial clear-space widening. This difference correlates to between 1 and 2 mm difference of additional widening with stress external rotation.

Conclusion: While widening of the medial clear space does not directly indicate injury to the syndesmosis, this change is indicative of mortise instability, which impacts patient outcomes. The difference in widening with stress external rotation was significantly greater than lateral fibular stress and appreciable on standard fluoroscopic views. Stress external rotation radiographs are a more reliable indicator of mortise instability than traditional lateral fibular stress.

- 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 413.

Staged Posterior Tibial Plating for the Treatment of OTA 43C2 & 43C3 Tibial Pilon Fractures

John Ketz, MD; *Roy Sanders, MD;*
Florida Orthopaedic Institute, Tampa, Florida, USA

Purpose: Obtaining an accurate reduction of the posterior malleolar fragment in high-energy pilon fractures can be difficult through standard anterior or medial incisions, resulting in a less than optimal articular reduction. The purpose of this study was to report on our results using a direct approach with posterior malleolar plating in combination with staged anterior fixation in high-energy pilon fractures.

Methods: From January 1, 2005 to December 31, 2008, 19 OTA 43C pilon fractures (16 C3 and 3 C2) with a separate, displaced, posterior malleolar fragment were treated by us. Five were open fractures, while 14 fractures had an associated fibula fracture. Nine patients were treated with posterior plating of the tibia (PP) through a posterolateral approach followed by a staged direct anterior approach. Ten patients with similar fracture patterns were treated using standard anterior or anteromedial incisions (AP) with indirect reduction of the posterior fragment. Quality of reduction was assessed using postoperative plain radiographs and CT. Serial radiographs were taken during the postoperative course to assess the progression of healing and the development of joint arthrosis. Clinical follow-up included physical examination, and evaluation of the ankle using the American Orthopaedic Foot & Ankle Society ankle and hindfoot score (AHS) and Maryland Foot Score (MFS), as well as noting all complications.

Results: All 19 patients were available for follow-up at an average of 20 months (range, 14-37 months). There were no differences in injury pattern or time to surgery between groups. Of the 10 patients who were in the AP group, 6 (60%) had at least 2 mm of joint incongruity at the posterior articular fracture edge compared with no patients in the PP group, as measured on postoperative CT scans. At latest follow-up, 5 patients (50%) in the AP group had radiographic evidence of joint-space narrowing compared to 1 (11%) in the PP group. Ankle range of motion for the AP group was 35.8° versus 34.2° for the PP group (not significant). There were 2 delayed wound-healing complications in each group with 1 deep infection in the PP group. Two patients in the AP group required arthrodesis procedures due to post-traumatic arthrosis compared to none in the PP group. No significant difference was seen in postoperative complications across both groups. The average MFS and AHS for the PP group were 86.8 and 84.8 compared to 67.5 and 76.5 for the AP group.

Conclusion: The addition of a posterior lateral approach offers direct visualization for reduction of the posterior distal fragment of the tibial pilon. Although the joint surface itself cannot be visualized, this reduction allows the anterior components to be secured to a stable posterior fragment at a later date. This technique improved our ability to subsequently obtain an anatomic articular reduction based on CT scans and preservation of the tibiotalar joint space at a minimum 1-year follow-up. Furthermore, it correlated with an improvement in clinical outcomes with increases in MFS and AHS for the PP group. Although promising, continued follow-up will be needed to determine the long-term outcome using this technique for treating tibial pilon fractures.

See pages 75 - 103 for financial disclosure information.

Intraoperative Stress Examination of the Lateral Midfoot for Lisfranc Injuries
(FDA=Non-U.S. research conducted within guidelines of my country)
Chris Steyn, MBChB, CCFP; *David W. Sanders, MD, MSc, FRCSC;*
University of Western Ontario, London, Ontario, Canada

Purpose: Operative treatment of Lisfranc joint injuries typically includes reduction and stabilization of the medial and middle columns of the midfoot. Mobility of the lateral column is preserved where possible, such that indications for lateral column stabilization rely upon the surgeon's assessment of instability. In this case series, the indication for lateral column stabilization was defined by the results of an intraoperative stress test. The purpose of this study was to determine whether an intraoperative fluoroscopic stress test of the lateral column was sufficient to determine the need for internal fixation of the lateral column in Lisfranc joint injuries.

Methods: 35 adult patients with Lisfranc injuries operated in our center by a single surgeon from 2005 to 2009 were reviewed. All patients had unstable midfoot fracture dislocations, treated by reduction and internal fixation including an intraoperative stress examination to determine the need for lateral column fixation. Patients were contacted for clinical and radiographic review at a mean of 31 months after injury. Functional outcome was assessed using general and joint-specific outcome tools (American Orthopaedic Foot & Ankle Society [AOFAS] midfoot score, Short Form-36, and Lower Extremity Measure [LEM]). Radiographic review included analysis of joint displacement and arthritic changes in preoperative, postoperative, and most recent radiographs.

Results: Preoperative imaging demonstrated displacement of the lateral column in 25 of 36 patients. Of those 25, 19 had a stable anatomic reduction of the lateral column following medial and middle column fixation based upon an intraoperative stress examination of the lateral column. Only 6 patients with persistent instability on intraoperative stress examination were treated with lateral column stabilization. Reduction of the lateral column was maintained at final follow-up in 100% of 24 patients (1 patient in this group had later complications requiring amputation). Lateral midfoot pain was present in 5 patients requiring lateral fixation, compared to 1 patient who did not require lateral fixation. AOFAS midfoot scores (mean) were 80.12 in patients with no evidence of lateral column instability, 78.82 in patients with preoperative displacement but a negative stress examination, and 77.39 in patients requiring lateral fixation ($P > 0.05$). Posttraumatic arthrosis was present in the lateral column in 4 of the 19 patients.

Conclusion: The decision to stabilize the lateral column during surgery on Lisfranc injuries was aided by an intraoperative fluoroscopic stress examination. Based upon the stress examination, 19 of 24 patients who had a displaced lateral column at the time of presentation avoided lateral fixation. None of these 19 patients treated without lateral fixation lost reduction in the follow-up period. A fluoroscopic intraoperative stress test safely reduced the need for lateral column fixation in displaced Lisfranc joint 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 413.

Summed Scores for Hindfoot and Ankle Trauma:
What Do They Really Tell Us and How Many Do We Need?

Paul Tornetta, III, MD[1]; *Rabah Qadir, MD[1]; Roy Sanders, MD[2];*
[1]Boston University Medical Center, Boston, Massachusetts, USA;
[2]Tampa General Hospital, Tampa, Florida, USA

Background: Recent emphasis on evidence-based medicine has resulted in more "patient-based" summed scores being used to report functional outcomes without reporting of the component scores. Issues of floor and ceiling effects are widely appreciated, but little is known about the effect of each of the component scores on the overall summed score in hindfoot and ankle injury.

Purpose: The purpose of this study was to determine which subscores contributed to the overall variation in summed scores, paying particular attention to pain, and to evaluate the correlation of multiple scoring systems (Short Form 36 physical component score [SF-36 PCS], American Orthopaedic Foot & Ankle Society [AOFAS], and Maryland) for calcaneus fractures, pilon fractures, and ankle fusions. Additionally, the correlation of range of motion with summed outcomes was examined.

Materials: 46 pilon fractures, 44 calcaneus fractures, and 54 ankle fusions were evaluated at greater than 2 years after injury with the SF-36, AOFAS, and Maryland scoring systems. Correlations were made between the summed scores using a Pearson correlation matrix, and the percentage of the overall variation of the summed score that is accounted for by the answer to the pain question within each score was determined. For the SF-36, this is the bodily pain subscale, and for the AOFAS and Maryland it is a single question about pain. The correlation of ankle and subtalar motion for pilon and calcaneus fractures and subtalar motion for ankle fusions with the summed scores was determined and added to a regression analysis if significant.

Results: For all subsets of patients, there was a strong statistical correlation between the SF-36 PCS, AOFAS, and Maryland scores ($P < 0.001$). The strongest correlation was between the AOFAS and the Maryland scores: calcaneus ($r = 0.9565$, $P < 0.0001$), pilon ($r = 0.9463$, $P < 0.0001$), and ankle fusion ($r = 0.9436$, $P < 0.0001$). The MCS (mental component score of the SF-36) also correlated with the other scores for the pilon and ankle fusion groups ($P < 0.04$), but not for the calcaneus group ($r = 0.26$). Ankle motion correlated with outcomes for the pilon fractures but not the calcaneus fractures. Subtalar motion correlated with outcomes for ankle fusions and pilon fractures, but not for calcaneal fractures. The overall summed scores were markedly affected by the pain score for all of the outcome scores examined. The individual subscale of pain accounted for as much as 86% of the overall variation. Even the SF-36 MCS was affected, with 18% to 36% of the overall variation being accounted for by pain (see table). Adding range of motion to the regression model did not account for more of the variation in outcome scores than did pain alone.

See pages 75 - 103 for financial disclosure information.

Table: Percentage of Overall Variation Accounted for by Pain Alone

Injury	AOFAS	Maryland	SF-36 PCS	SF-36 MCS
Calcaneus fractures	86%	86%	52%	18%
Pilon fractures	83%	85%	49%	25%
Ankle fusion	83%	80%	76%	36%

Discussion: Summed scores in evaluating outcomes for complex hindfoot and ankle injury and reconstruction show a high degree of correlation, particularly the AOFAS and Maryland scores. For all scores, pain is the dominant factor in the total variation of the scores. It represents more than 80% of the overall variation in the AOFAS and Maryland scores. Even the MCS is affected by the bodily pain subscale to a large degree.

Conclusions: Summed scores for complex hindfoot and ankle injury and reconstruction may not be needed in comparing outcomes as pain is the single dominant factor. We strongly recommend that when summed scores are used, that the individual components are reported so that surgeons may interpret the raw data. Future instruments may not need to be as burdensome as the current set of disease-specific measures as pain is the overriding constituent of the summed scores.

- 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 413.

SKILLS LABS

IM Nailing of Proximal Tibia Fractures with Semi-Extended Nailing Technique *(#F-6)*
Moderator: *Thomas (Toney) A. Russell, MD*
Faculty: *Massimo Max Morandi, MD; Gilbert R. Ortega, MD, MPH; H. Claude Sagi, MD; Paul Tornetta, III, MD; J. Tracy Watson, MD* and *David P. Zamorano, MD*

ORIF Distal Humerus Fractures *(#F-7)*
Moderator: *Michael D. McKee, MD*
Faculty: *Paul Duffy, MD; Kyle J. Jeray, MD; Utku Kandemir, MD* and *David C. Ring, MD*

ORIF Calcaneus *(#F-8)*
Moderator: *Roy Sanders, MD*
Faculty: *Daniel S. Chan, MD; Joshua Langford, MD; Frank A. Liporace, MD; Michael S. Sirkin, MD* and *Jeff Yach, MD*

NOTES

See pages 75 - 103 for financial disclosure information.

MINI SYMPOSIA

Management of Blast Injuries for Civilian Surgeons *(#F-9)*
Moderator: *LTC Romney C. Andersen, MD*
Faculty: *MAJ Wade T. Gordon, MD; MAJ Joseph R. Hsu, MD; MAJ B. Kyle Potter, MD* and *CDR Timothy Whitman, MD*

Bone Graft Options *(#F-10)*
Moderator: *Craig S. Roberts, MD, MBA*
Faculty: *William G. DeLong, Jr., MD; Peter V. Giannoudis, MD; Roman Hayda, COL(Ret), MD* and *Michael J. Voor, PhD*

Periprosthetic Fractures: Current Concepts *(#F-11)*
Moderator: *Emil H. Schemitsch, MD*
Faculty: *Jeremy A. Hall, MD; Richard J. Jenkinson, MD; Hans J. Kreder, MD; Markku Nousiainen, MD* and *David J. Stephen, 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 413.

PRESIDENT'S MESSAGE

Timothy J. Bray, MD

"The Community Orthopaedic Traumatologist"

NOTES

See pages 75 - 103 for financial disclosure information.

Sagittal Plane Deformity in Bicondylar Tibial Plateau Fractures

***Philipp N. Streubel, MD*[1]**; *Donald Glasgow, MD*[2]; *Ambrose Wong, BS*[1]; *David P. Barei, MD*[2]; *William M. Ricci, MD*[1]; *Michael J. Gardner, MD*[1];
[1]*Washington University School of Medicine, St. Louis, Missouri, USA;*
[2]*Harborview Medical Center, Seattle, Washington, USA*

Purpose: The goal of surgical treatment of bicondylar tibial plateau fractures is anatomical reduction and stable articular and metaphyseal fixation. Sagittal plane deformity of large plateau fragments can be difficult to visualize on lateral fluoroscopic imaging, and may be not be readily apparent on sagittal CT reconstructions if not actively sought. Alterations in the tibial slope, particularly between the tibial plateaus, can lead to contact force aberrations and may affect functional outcome. The hypothesis of this study was that sagittal plane deformity in a large series of bicondylar tibial plateau fractures is highly prevalent and of variable magnitude.

Methods: 195 patients with acute bicondylar tibial plateau fractures (OTA 41C) were identified from prospective databases from two Level 1 trauma centers during a 30-month period. Patients without adequate CT scans, and those with coronal plane fractures or plateau comminution were excluded, leaving 74 patients available for study. 47 (64%) were male, and the average age was 49 years (range, 16-82). Sagittal inclination of the main fragment of both the medial and lateral plateau was measured in relation to the longitudinal tibial axis on CT reconstruction images. Student t tests and χ^2 tests were used for statistical comparisons. Interobserver and intraobserver reliability were determined by repeat measures by two independent reviewers.

Results: For the lateral tibial plateau, average sagittal plane angulation was 9.8° apex anterior (range, 37° apex anterior to 17° apex posterior; SD, 9.8°). In the medial plateau, average angulation was 4.1° apex anterior (range, 31° apex anterior to 16° apex posterior; SD, 9.1°). For each patient, the difference in sagittal plane alignment between the medial and lateral plateaus was 9.0° (range, 0°-31°; SD, 7.1°), which was statistically significant ($P < 0.001$). 42 lateral plateaus were angulated more than 5° from the "normal" anatomic slope (defined as 5° of posterior tibial slope). Of these, 76% were angulated in the apex anterior direction (ie, increased posterior slope). 43 (58%) of the medial plateaus were angulated greater than 5° from normal, of which only 47% were apex anterior ($P = 0.019$ compared to lateral plateaus). Intraobserver correlation was high for both observers for the medial ($r = 0.99$ and $r = 0.92$, $P < 0.01$) and lateral plateaus ($r = 0.90$ and $r = 0.95$, $P < 0.01$). Similarly, correlation between observers was high for both medial and lateral measurements ($r = 0.96$ and $r = 0.92$, respectively; $P < 0.01$).

Conclusions: Substantial sagittal plane deformity exists in a majority of bicondylar tibial plateau fractures. The lateral plateau has a higher propensity for sagittal angulation, and tends to be in the apex anterior direction (increased posterior slope). Accurate restoration of anatomic alignment requires identification of this deformity and appropriate specific reduction maneuvers.

• 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 413.

A Prospective Functional Analysis of Proximal Tibia Fractures Using a Calcium Sulfate/Calcium Phosphate Composite Graft with an Early Weight Bearing Protocol

J. Tracy Watson, MD[1]; *Joseph Borrelli, Jr., MD*[2]; *Timothy G. Weber, MD*[3]; *Robert H. Choplin, MD, FACR*[4]; *Scott A. Persohn, RT*[4]; *Rena White, BS*[5]; *Emily M. Haglund, MD*[5];
[1]*St. Louis University, St. Louis, Missouri, USA;*
[2]*University of Texas Southwestern, Dallas, Texas, USA;*
[3]*OrthoIndy, Indianapolis, Indiana, USA;*
[4]*Indiana University, Indianapolis, Indiana, USA;*
[5]*Wright Medical Technology, Arlington, Tennessee, USA*

Purpose: Bone grafting of subchondral voids during open reduction and internal fixation (ORIF) of tibial plateau fractures is commonly performed and recently a $CaSO_4$-$CaPO_4$ graft was shown to resist postoperative articular displacement. The most appropriate time to initiate weight bearing as tolerated (WBAT) and the actual time of full weight bearing (FWB) remains largely unstudied. This study was designed to determine whether a $CaSO_4$-$CaPO_4$ composite graft facilitates earlier weight bearing while maintaining postoperative reduction for patients with lateral tibial plateau fractures.

Methods: 49 patients with unilateral tibial plateau fractures (OTA 41A-B) were enrolled in a prospective multicenter single cohort study. The treatment protocol included ORIF and defect augmentation with a $CaSO_4$-$CaPO_4$ graft. The first 35 patients enrolled (group I) were instructed to initiate WBAT at 12 weeks. The next consecutive 14 patients (group II) were instructed to start WBAT at 6 weeks. Four patients had complications (infection, polytrauma, significant subchondral defect, and prior tibial injury) that did not allow the WBAT order and were excluded from group II based on attending physician recommendation. Actual weight-bearing status and Knee Society scores were collected.

Results: Group I (n = 35) had no patients FWB at 6 weeks, 32.3% of patients FWB at 12 weeks, and 90.0% of patients FWB at 24 weeks. Group II (n = 10) had 20% of patients FWB at 6 weeks and 100% of patients FWB at 12 weeks. When comparing the FWB status at the 12-week interval, group II patients achieved FWB status significantly earlier than group I patients ($P < 0.001$). CT evaluation demonstrated initial reduction was maintained within 2.1 mm on average for all patients. The average Knee Society score improved from 77.0 to 79.9 for group I and 76.6 to 83.7 for group II at 12 weeks ($P = .9722$) and 24 weeks ($P = .5101$), respectively.

Conclusion: The larger percentage of patients that were able to weight-bear at 12 weeks in group II suggests that some patients may benefit from an earlier WBAT order. Earlier weight bearing is a treatment option, although the potential benefits and risks of earlier weight bearing should be considered on a per-patient basis.

See pages 75 - 103 for financial disclosure information.

The Critical-Sized Defect in the Tibia: Is It Critical? Results from the SPRINT Trial
(FDA=Non-U.S. research conducted within guidelines of my country)

David W. Sanders, MD[1]*, on behalf of the SPRINT (Study to Prospectively Evaluate Reamed Intramedullary Nails in Tibial Fractures) Investigators;*
[1]Department of Surgery, Division of Orthopaedic Surgery, University of Western Ontario, London, Ontario, Canada

Purpose: A critical-sized defect in a long bone is defined as one that requires surgical intervention to heal. For the tibia, there is no clear definition of "critical size". In the SPRINT trial, a critical-sized defect of the tibial diaphysis was defined as a fracture gap at least 1 cm in length and involving over 50% of the cortical diameter, based on published reports of failed exchange nailing and a consensus process. The purpose of this study is to determine if this definition of a "critical-sized defect" was accurate, to discern which other factors may predict reoperation in patients with the critical defect, and to compare the patient-based outcomes of these patients to patients without a critical defect.

Methods: Of the over 1200 patients with diaphyseal tibia fractures enrolled in the SPRINT trial, 37 patients had a "critical-sized defect". By definition, secondary procedures to gain union were allowed in these patients, but not required. To determine if these defects are in fact critical, we evaluated these patients for planned and unplanned secondary interventions to gain union. Additionally, we evaluated which other factors predicted the need for reoperation. Finally, the 37 patients with a critical defect were compared to the larger cohort of patients without a defect with respect to demographics, mechanism of injury, fracture characteristics, and patient-based outcome.

Results: Of the 37 patients with a large fracture gap, 7 patients had a secondary procedure planned at the time of the initial surgery. Of the remaining 30 patients in whom the attending physician adopted a "watch and wait" strategy, 16 patients (53%) required secondary intervention(s) to gain union and 14 patients (47%) did not. Additional surgery to gain union was required less commonly in patients treated with a reamed nail ($P = 0.04$) and in female patients ($P = 0.04$). Smoking and AO/OTA 42-C-type fractures were more common in the patients who required a reoperation, but this was not statistically significant. As compared with the rest of the SPRINT cohort, patients with a critical-sized defect were more likely to have a high-energy mechanism of injury ($P = 0.001$), AO-OTA fracture type 42-B or C ($P < 0.001$), and location involving the middle third of the tibia ($P = 0.02$). Of note, the mean (SD) of the 12-month Short Form–36 Health Survey Questionnaire Physical Component Score in patients with a critical-sized defect was 38.2 (10.5), poorer than 43.3 (10.7) in the overall cohort ($P = 0.02$; difference = 5.2; 95% confidence interval, 0.8-9.6).

Conclusion: Tibial diaphyseal defects of ≥1 cm and >50% cortical circumference healed without additional surgery in 47% of cases. This definition of a critical-sized defect is not "critical." However, as compared with the overall cohort of tibial fractures, patients with these bone defects had a higher rate of reoperation and worse patient-based outcomes. Further investigation is required to determine which factors predict union in this challenging fracture to avoid unnecessary secondary 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 413.

Factors Influencing Functional Outcomes after Distal Tibia Shaft Fractures

Heather A. Vallier, MD*; Beth Ann Cureton, BS; Brendan M. Patterson, MD;*
MetroHealth Medical Center, Cleveland, Ohio, USA

Purpose: Surgical treatment of displaced distal tibia fractures yields reliable results with either plate or nail fixation. Comparative research in our hospital has shown more malalignment and nonunions with nails. In other studies, knee pain has been associated with tibial nailing. However, plates have been associated with infections and soft-tissue irritation in some reports. We hypothesized that tibial nails would be associated with more knee pain, and that plates would be associated with pain from hardware prominence, each of which would adversely affect functional outcome scores.

Methods: 104 patients with extra-articular distal tibia shaft fractures (OTA 42) were randomized to treatment with a reamed intramedullary nail (n = 56) or standard large-fragment medial plate (n = 48). Mean age was 38 years (range, 18-95) and mean injury severity score (ISS) was 14.3 (range, 9-50). Work ability was evaluated after a minimum of 12 months. Knee pain, Foot Function Index (FFI) and Musculoskeletal Function Assessment (MFA) questionnaires were completed.

Results: After mean follow-up of 22 months, 86 patients were evaluated (45 nails, 41 plates). Mean MFA was 27.1 and mean total FFI was 0.26, which are substantially worse than an uninjured reference population ($P < 0.0001$). The two treatment groups were evenly matched with respect to age, gender, ISS, fracture pattern, and presence of open fracture and other injuries, and equal numbers had undergone elective removal of prominent hardware. 61 of 64 patients (95%) who were employed at the time of their injury had returned to work, although 31% of these had modified their work duties because of injury. Three patients were unable to find work. None reported unemployment secondary to their tibial fracture. 40% of all patients described some persistent ankle pain and 31% had knee pain after nailing, versus 32% and 22%, respectively, after plating. Both knee and ankle pain were present in 27% of patients with nails and 15% with plates ($P = 0.08$). Patients with angular malunion ≥5° were more likely to report knee or ankle pain (36% versus 20%, $P < 0.05$). Excepting one patient with knee pain when kneeling, none reported modifying activity specifically because of persistent knee or ankle pain, although knee pain and ankle pain were present more often in unemployed people ($P = 0.03$). Patients who were unemployed had requested hardware removal more frequently (24% vs 9.2%), and continued to report pain after hardware removal. While FFI and MFA scores were not related to plate or nail fixation, open fracture, fracture pattern, multiple injuries, ISS, or age, both MFA and FFI scores were worse when knee pain or ankle pain was present (all $P < 0.004$) and in patients who remained unemployed ($P = 0.0001$). Only 4 patients had work-related injuries; all of them had returned to employment, but had worse FFI scores ($P = 0.01$).

Conclusion: Mean MFA and FFI scores suggest substantial residual dysfunction after distal tibia fractures when compared with an uninjured population. Mild ankle or knee pain was reported frequently after plate or nail fixation, but was not limiting to activity in most patients. Angular malunion was associated with both knee and ankle pain, and there was a trend toward more patients with knee and ankle pain after tibial nailing. This

See pages 75 - 103 for financial disclosure information.

is consistent with a larger number of patients with primary angular malalignment after nails versus plates. No patients reported unemployment because of their tibia fracture, but those who were unemployed described knee and ankle pain more frequently and had the worst functional outcome scores.

- 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 413.

Semi-Extended Nailing: Is the Patellofemoral Joint Safe?

David P. Zamorano, MD; *Grant W. Robicheaux, MD; Janessa Law, BS; Jeff Mercer, MD;*
University of California Irvine Medical Center, Orange, California, USA

Background: Intramedullary (IM) nailing of proximal-third tibial shaft fractures is fraught with difficulty and associated with an increase risk of malunion. To help reduce the chances of poor implant placement, the surgical technique of placing the IM nail with knee in a semi-extended position relaxes the extensor mechanism and may help to prevent an apex-anterior deformity. This technique, however, requires intra-articular passage of instruments and implants that may cause damage to the patellofemoral joint.

Hypothesis: IM nailing of tibial shaft fractures with the knee in the semi-extended position can be performed without causing iatrogenic damage to the articular surfaces of the patella or intercondylar groove of the femur.

Methods: From March 2008 to June 2009, 17 patients with 18 tibial shaft fractures at a single institution amenable to IM nailing were included. All of the fractures were stabilized using a semi-extended IM nailing technique. Knee arthroscopy was performed before and after instrumentation through a suprapatellar incision using the same quadriceps-splitting approach used for IM nail insertion. Inspection of the femoral intercondylar groove and the patellar facets were performed and noted for any gross damage.

Results: 14 of the 18 knees (78%) did not demonstrate any iatrogenic articular surface damage; 4 of the 18 knees (22%) had articular cartilage damage seen in the postnailing arthroscopy that was not visualized prior to instrumentation and nailing. The 4 knees with postnailing articular damage occurred early in the study and were due to errors in technique. The articular damage was consistently located in the intercondylar notch.

Conclusions: IM nailing of tibial fractures in the semi-extended position can be done with minimal risk of iatrogenic damage to the articular surfaces of the patella and intercondylar notch of the femur. Proper technique is imperative to minimize damage to the patellofemoral joint while nailing through a semi-extended technique.

See pages 75 - 103 for financial disclosure information.

A Multicenter Prospective Randomized Trial Comparing the Less Invasive Stabilization System (LISS) and Mini-Invasive Dynamic Condylar System (DCS)
(FDA=Non-U.S. research conducted within guidelines of my country)

***Abdullah A. Hawsawi, MD*[1]**; *Ross K. Leighton, MD*[1]; *Richard A. Preiss, MD*[1]; *COTS Group*[2]; *Kelly Trask, PhD, RC*[1];
[1]*Queen Elizabeth II & Health Science Center, Dalhousie University, Halifax, Nova Scotia, Canada;*
[2]*Multiple Canadian Orthopaedic Trauma Society Centers in Canada: Toronto and London, Ontario; Calgary, Alberta; Vancouver, British Columbia*

Background: Surgical fixation of distal femoral fractures has been associated with nonunion and varus collapse. The soft-tissue stripping associated with this fracture and the surgical approach have been factors associated with delayed union and infection. The limited soft-tissue exposure has been lauded as a solution to this fracture. However, it has occurred with new fixation as well. This study is an attempt to look at the fixation. Does the LISS system improve the results of this difficult fracture? Is there truly a difference in the outcome of this fracture utilizing the locked plate system or is the perceived difference due to the surgical mini-invasive approach.

Methods: 140 patients were screened and only 60 were randomized and treated in 8 academic centers over 5 years. All C3 fractures were excluded as they were felt not to be treatable by the DCS device. 40 females and 27 males were included in the study at the beginning and randomized appropriately. Thirteen patients were excluded later during the evaluation, as they were C3 fractures. They were followed with intent to treat, and all but one went on to union.

Results: 53 patients were randomized: 28 had the LISS implant, and 25 had the DCS utilized. There were three nonunions in the LISS group plus two early cases requiring further surgery to correct an early malreduction on day 2 to 5 postsurgery. Furthermore, one patient developed a knee arthrofibrosis that required arthroscopic joint release with subsequent implant failure. That necessitated a reoperation. This translated into a reoperation rate of 21% in the LISS group compared to 4% in the DCS.

Conclusion: This prospective multicenter trial showed a significant difference when comparing the LISS to the DCS system in a minimally invasive approach of distal femur 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 413.

A Comparison of Locked versus Non-Locked Enders Rods for Length-Unstable Pediatric Femoral Shaft Fractures

Henry B. Ellis, MD[1]; Christine A. Ho, MD[2]; ***David A. Podeszwa, MD[2]****; Philip L. Wilson, MD[2];*
[1]University of Texas Southwestern, Dallas, Texas, USA;
[2]Texas Scottish Rite Hospital, Dallas, Texas, USA

Purpose: Stainless steel flexible Enders rods have been used for intramedullary fixation of pediatric femur fractures with good success. However, despite intraoperative anatomic alignment, length-unstable femur fractures can present postoperatively with fracture shortening or malrotation. The purpose of this study was to review all length-unstable pediatric femoral shaft fractures in which Enders rods were used and compare those that were locked to those that were not locked. Our hypothesis was that locked Enders rods would maintain length, alignment, and rotation of length-unstable pediatric femoral shaft fractures.

Methods: We conducted a retrospective clinical and radiographic review of all patients at a single institution undergoing flexible intramedullary rodding for a length-unstable femoral shaft fracture from 2001 to 2008. A length-unstable fracture was defined as either a comminuted or a spiral fracture longer than twice the diameter of the femoral shaft. 107 length-unstable femoral shaft fractures fixed with Enders rods were identified, of which 37 cases (35%) had both Enders rods locked through the eyelet in the distal femur with a 2.7-mm fully threaded, cortical screw. Patient demographics, clinical course, complications, fracture characteristics, and radiographic outcome were compared for the locked and non-locked groups.

Results: There were no statistically significant differences between the groups for demographic data, operative variables, fracture pattern, fracture location, time to union, femoral alignment, or major complications. Shortening of the femur, defined as the change in distance of the distal end of the rod from its intraoperative position to that measured at 6 weeks postoperatively, was significantly greater for the nonlocked cases. The medial and lateral locked Enders rods moved 1.3 and 1.9 mm, respectively, and the unlocked Enders each moved 12.1 mm ($P < 0.05$). There was no clinical or radiographic evidence of screw breakage, pull-out, loosening, or plowing in the metaphysis. At final follow-up, there were significantly more ($P < 0.05$) clinical complaints in the nonlocked group, including complaints of limp, gross malrotation, clinical shortening, and palpable painful rods.

Conclusions: Locking Enders rods for length-unstable pediatric fractures is an excellent option to prevent shortening and possibly malrotation of these inherently unstable fractures. In this study, locking the Enders rods resulted in no additional complications, added surgical time, or increased blood loss.

See pages 75 - 103 for financial disclosure information.

Isolated Pediatric Tibial Shaft Fractures Do Not Need to be Treated in Above-Knee Cast

Joshua W.B. Klatt, MD; *Alan K. Stotts, MD; John T. Smith, MD*
University of Utah, Primary Children's Medical Center, Salt Lake City, Utah, USA

Purpose: The gold standard for conservative management of closed tibial shaft fractures in children, whether isolated or with associated fibula fracture, historically has been an above-knee cast (AKC), transitioned to a below-knee cast (BKC) after 2 to 4 weeks. The purpose of this study was to evaluate the effectiveness of using an immediate BKC for pediatric tibia fractures without fibula fracture by reviewing a large cohort of patients treated in this manner.

Methods: A retrospective analysis was performed reviewing all the isolated tibia fractures treated at a Level 1 pediatric trauma center over a 4-year period (2003-2006). The medical records and radiographs of 332 children were reviewed. Those patients treated only with a BKC were compared to a cohort of those treated initially with an AKC, examining differences in rates of malunion and complications. Choice of treatment was at surgeon discretion.

Results: Of the 332 children with isolated tibial shaft fracture, 47 were initially treated elsewhere. Seven fractures were treated operatively, and nine had either inadequate follow-up or were treated definitively in splints or fracture boots, leaving 269 patients for final review. 225 were treated in a BKC and 44 were treated in an AKC. Age ranged from 6 months to 15 years, with a mean of 5.1 years. There were 186 boys and 83 girls. 132 patients had left tibia fractures, 136 had right tibia fractures, and 1 patient had bilateral fractures. Two patients had compartment syndrome treated with fasciotomy, subsequently treated in BKCs. One BKC patient had a partial-thickness skin ulcer, with none in the AKC group. All fractures healed. There was one refracture in the AKC group (2%) and three refractures in the BKC group (1.3%). Refractures occurred at a mean of 7 weeks (range, 6-8 weeks) after cast removal. In the AKC group, the average presenting angulation was 2.0° (range, 0°-8°) in the coronal plane and 0.8° (range, 0°-12°) in the sagittal plane. Final angulation was 2.1° coronal (range, 0°-10°) and 2.5° sagittal (range, 0°-9°). In the BKC group, the average presenting angulation was 0.9° (range, 0°-9°) in the coronal plane and 1.8° (range, 0°-7°) in the sagittal plane. Final angulation was 3.4° coronal (range, 0°-10°) and 1.1° sagittal (range, 0°-12°).

There were 2 BKC patients (0.9%) and 1 AKC patient (2.3%) with postcast coronal angulation ≥10°. There were 7 patients (3.1%) in the BKC group and 6 (13.6%) in the AKC with postcast sagittal angulation ≥5°.

Conclusion: In this retrospective cohort study, below-knee casting for isolated pediatric tibial shaft fractures without fibula fracture appears to be equally effective to above-knee casting. There was no significant increase in the risk of malunion or refracture with this form of treatment. This study supports that below-knee casting for isolated tibial shaft fractures is a safe and effective alternative to above-knee casting in children.

- 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 413.

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*

Background: 1.5-leg spica casting is the treatment of choice at many centers for the treatment of diaphyseal femur fractures in children 2 to 6 years of age. We hypothesize that these patients can be effectively treated with 1-leg spica casting and that such treatment will result in easier care and better patient function during treatment.

Methods: In a prospective randomized controlled study of 52 patients between 2 and 6 years of age with diaphyseal femur fractures, patients were randomly assigned to either immediate 1- or 1.5-leg spica casting groups after consent was obtained. Radiographs were serially evaluated for maintenance of reduction with respect to length, varus/valgus angulation, and procurvatum/recurvatum angulation. After casts were removed, the Activity Scale for Kids (Performance Version) questionnaire and a custom written survey were given to the parents evaluating ease of care and function of children during treatment.

Results: All children healed in satisfactory alignment. Children treated with 1-leg spica casts were more likely to fit into car seats ($P < 0.05$) and fit more comfortably into chairs($P < 0.05$). Caretakers of patients treated with 1-leg casts took less time off of work ($P < 0.05$). There was also a trend toward more walking ($P = 0.076$) in the 1-leg group. There were no major complications in either group.

Conclusion/Discussion: Treatment of pediatric femur fractures with 1-leg spica casts is effective and safe and results in more facile care and better function of children with femur fractures during treatment.

See pages 75 - 103 for financial disclosure information.

Delay in Surgery for Displaced Supracondylar Humeral Fracture: Does It Matter?
(FDA=Non-U.S. research conducted within guidelines of my country)
Gunasekaran Kumar, FRCS; *Antoni Otto, MBBS; Alfie Bass, FRCS;*
Royal Liverpool Children's Hospital, Alder Hey Children's NHS Foundation Trust, Liverpool, United Kingdom

Background/Purpose: The purpose of this study was to assess association between time from injury to surgery and any perioperative complications. With literature supporting both operating on these fractures as early as possible and also delaying surgery until the next day, we reviewed our cohort of patients to ascertain whether there was a need for early surgery. There is also evidence for significant increase in complications in surgeries performed late in the night.

Methods: Between April 2005 and Sept 2008, 81 consecutive uncomplicated extension-type supracondylar elbow fractures requiring surgery were identified. Case notes and Meditech data were reviewed. Data collected included time of injury, time of surgery, senior surgeon present at surgery, open or closed reduction of fracture, perioperative complications including infections, reoperation rate, residual stiffness, and neurovascular injuries. Odds ratio was calculated for open reduction based on a cut-off of 24 hours since injury.

Results: Of the 81 fractures, 69 had surgery <24 hours and 12 had surgery >24 hours. All had either closed or open reduction and crossed Kirschner-wire fixation. 15 fractures required open reduction, 10 <24 hours and 5 >24 hours. There was no difference with respect to the grade of surgeon present. All patients were followed for at least 12 weeks. Two with closed reduction required surgery for redisplacement (initial surgery at 5 hours and 19 hours). One had refracture at 2 months after surgery following a significant fall. Odds ratio of open reduction of fracture if surgery was delayed beyond 24 hours was 4.2; 95% confidence interval, 1.2 to 16. There were 4 cases of superficial pin-site infection treated with oral antibiotics without sequelae. None of the patients required further surgery for stiffness of elbow.

Discussion: Displaced supracondylar fractures in children are a relatively common injury. Our institute is a tertiary pediatric referral center with a limited number of dedicated trauma lists. Hence, these injuries often are operated in the emergency theater in the middle of the night. Our data show that delaying surgery beyond 24 hours after injury increased the risk of open reduction of the fracture fourfold. However, there was no increased incidence of infection or any other complications. Limitations of our study include retrospective study, and the small number of open reductions. We did not assess the surgical time, number of attempts at closed reduction, or length of hospital stay. In spite of these limitations, there is a good basis for leaving uncomplicated supracondylar elbow fractures in children overnight provided surgery is performed within 24 hours of 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 413.

CASE PRESENTATIONS

Pelvis and Acetabulum *(#S-1)*
Moderator: *Paul Tornetta, III, MD*
Faculty: *Tania A. Ferguson, MD; Charles M. Reinert, MD; Wade R. Smith, MD* and *David C. Templeman, MD*

The Difficult Proximal Femur Fracture *(#S-2)*
Moderator: *Lisa K. Cannada, MD*
Faculty: *George J. Haidukewych, MD; Frank A. Liporace, MD* and *Simon C. Mears, MD, PhD*

Cases from the Haiti Disaster *(#S-3)*
Moderator: *Andrew N. Pollak, MD*
Faculty: *Michael J. Bosse, MD; John E. Herzenberg, MD; James C. Krieg, MD; LCDR Christiaan N. Mamczak, DO; Marcus F. Sciadini, MD* and *R. Malcolm Smith, MD*

Elbow Trauma *(#S-4)*
Moderator: *Michael D. McKee, MD*
Faculty: *Jeremy A. Hall, FRCSC; Steven R. Papp, MD; Brad A. Petrisor, MD* and *Emil H. Schemitsch, MD*

Grantsmanship 101: Writing an Effective Proposal *(#S-5)*
Moderator: *Theodore Miclau, III, MD*
Faculty: *Joseph Borrelli, Jr., MD; Edward J. Harvey, MD* and *Ellen J. MacKenzie, PhD*

See pages 75 - 103 for financial disclosure information.

SYMPOSIUM III: ORTHOPAEDIC TRAUMA CALL: OPPORTUNITY OR OBLIGATION?

Moderator: *Heather A. Vallier, MD*

Faculty: *Timothy J. Bray, MD*
Timothy G. Weber, MD
Brendan M. Patterson, MD
Wade R. Smith, MD

8:00 am **Introduction: The Call Crisis, Does It Exist?**
Heather A. Vallier, MD

8:10 am **Challenges and Realities of Call**
Timothy G. Weber, MD

8:20 am **Finances of a Trauma Center**
Timothy J. Bray, MD

8:35 am **Acute Care Surgery: Is There a Market?**
Wade R. Smith, MD

8:45 am **Development of Regionalized Trauma Systems**
Brendan M. Patterson, MD

9:00 am **Question/Answer Session**

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 413.

Δ Early Appropriate Care: Definitive Stabilization of Femoral Fractures within 24 Hours of Injury Is Safe in Most Multiply-Injured Patients

Nickolas J. Nahm, BS*; John J. Como, MD; John H. Wilber, MD; Heather A. Vallier, MD;*
MetroHealth Medical Center, Cleveland, Ohio, USA

Purpose: Type and timing of treatment of femur fractures is controversial. While safe and effective in many reports, early definitive stabilization may be associated with complications, particularly in patients with chest and head injuries. Damage control orthopaedics was proposed as an alternative in unstable patients. This study examines the effects of timing of definitive fixation and investigates risk factors for complications.

Methods: 750 skeletally mature patients underwent stabilization of femur fractures. Their mean age was 35.8 years and mean injury severity score (ISS) 23.7. 492 patients had ISS ≥18. Early stabilization (n = 656) was defined as definitive treatment of the femur fracture within 24 hours of injury.

Results: Early definitive stabilization in multiply injured patients was associated with fewer complications than delayed stabilization (18.9% vs 42.9%, $P < 0.037$) after adjusting for patient age and ISS. Early treatment was also associated with shorter hospital stay, ICU stay, and ventilator days ($P < 0.001$). Severe abdominal injury (abbreviated injury scale [AIS] ≥3) was associated with more complications than severe head (Glasgow coma scale ≤8) and chest (AIS≥3) injuries (44.2%, 40.9%, and 34.4%, respectively) and was an independent risk factor for complications ($P < 0.0001$). Chest injury was an independent risk factor for pulmonary complications ($P < 0.001$), but surgical delay in chest-injured patients was also associated with pulmonary complications ($P = 0.04$). More sepsis was noted with severe head injury (22.7% vs 4.5%, $P = 0.037$) or severe chest injury (10.2% vs 2.5%, $P = 0.044$) when treated on a delayed basis. Patients transferred from other hospitals were more likely to be treated on a delayed basis (48.9% vs 37.5%, $P = 0.04$) despite similar injury severity.

Conclusions: Early definitive stabilization is associated with acceptably low rates of complications and is safe in most multiply injured patients, including some with severe abdominal, chest, or head injuries. More complications and longer hospital stay were noted with delayed fixation after adjusting for age and ISS. Chest injury was associated with pulmonary complications; however, the presence of severe abdominal injury was the greatest risk factor for complications, warranting further investigation. Expediting access to definitive care may reduce complications and expenses.

Δ OTA Grant
See pages 75 - 103 for financial disclosure information.

The Effect of Intramedullary Nailing on Cognitive Impairment following Multiple Trauma without Intracranial Hemorrhage

Justin E. Richards, MD; *Oscar D. Guillamondegui, MD; E. Wesley Ely, MD; James C. Jackson, PsyD; Kristin Archer-Swygert, PhD; William T. Obremskey, MD, MPH; Vanderbilt University Medical Center, Nashville, Tennessee, USA*

Purpose: The primary purpose of this study is to evaluate the prevalence of cognitive deficit at 12 months postinjury in a cohort of patients who sustained multiple trauma without intracranial hemorrhage (ICH) and had fractures treated with intramedullary nailing (IMN). A secondary purpose is to determine whether IMN is a predictor of cognitive deficit at 12 months from initial injury. We hypothesize that long-term cognitive deficits are more likely in patients treated with IMN.

Methods: 173 patients with multiple trauma (injury severity score [ISS] >15) who presented to a Level 1 trauma center from July 2006 to July 2007 were enrolled in this study. Of these patients, 108 were evaluated 12 months after hospital discharge with a comprehensive battery of neuropsychological tests. Cognitive impairment was defined as having 2 neuropsychological test scores 1.5 standard deviations (SD) below the mean or 1 neuropsychological test score 2 SD below the mean. Medical records for each patient evaluated at 1 year were reviewed, demographic data were noted, and ISS was obtained. Operative data was recorded with respect to operative intervention and stratified by treatment with IMN or without IMN. Timing of fracture fixation (<24 hours or >24 hours), initial 24-hour blood requirements, and presence of intraoperative hypoxia (SpO_2 <90%) or hypotension (systolic blood pressure <90 mm Hg) were documented.

Results: 59 patients (55%) demonstrated cognitive impairment at 12-month follow-up, with 3 (5.5%) of these patients having pre-existing impairment. There were 18 patients (OTA classification 32 and 42) who underwent IMN. 14 patients (78%) with IMN had cognitive deficit at follow-up. A significant difference in cognitive impairment was identified among patients treated with a reamed intramedullary device and those who were not treated with IMN (78% vs 50%, $P = 0.03$). A multiple variable logistic regression analysis found that IMN (odds ratio [OR], 3.0; $P = 0.08$) and having less than a high school education had a moderate effect on cognitive impairment (OR, 3.4; $P = 0.07$) after adjusting for ISS, ventilator days, and open fracture. Interaction between IMN and timing of fixation with regard to outcome was not found to be statistically significant ($P = 0.08$)

Conclusions: Fracture fixation with a reamed intramedullary nail is moderately associated with cognitive impairment in this cohort of multiple trauma patients without ICH at 1 year postinjury. The potential clinical neurocognitive consequences of intramedullary reaming cannot be ignored. To date, there are little data evaluating long-bone fracture fixation with IMN and the association with long-term cognitive impairment. Rare events of cerebral fat embolism have been reported but the etiology and risk factors are unknown.

- 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 413.

Δ Do Patients with Multiple System Injury Benefit from Early Fixation of Unstable Axial Fractures? The Effects of Timing of Surgery on Initial Hospital Course

Heather A. Vallier, MD*; Dennis M. Super, MD, MPH;*
Timothy A. Moor, MD; John H. Wilber, MD;
MetroHealth Medical Center, Cleveland, Ohio, USA

Purpose: Unstable fractures of the pelvis, acetabulum, femur, and thoracolumbar spine require bed rest and recumbency until they are stabilized. While fixation will promote mobilization, the timing of that fixation is influenced not only by the availability of surgeon specialists, but also by associated injuries to other systems, which add to the total hemorrhage and the risk of systemic inflammation and immune dysfunction. Damage control orthopaedics using external fixation as a temporizing measure has been advocated to reduce complications; however, many of these fractures are not amenable to external fixation. Our general practice has been early definitive management of major axial skeletal injury in a team-based fashion. We hypothesized that early definitive management of unstable fractures of the pelvis, acetabulum, femur, and spine would reduce complications and shorten length of stay.

Methods: Over an 8-year period, 1,005 skeletally mature patients with multiple system trauma were treated surgically for unstable fractures of the pelvis (n = 259), acetabulum (n = 266), proximal or diaphyseal femur (n = 569), and/or thoracolumbar spine (n = 98) at a Level 1 trauma center. Associated injuries of the chest (n = 447), abdomen (n = 328), and head (n = 489) were present. Timing of definitive surgical treatment for these fractures was within 24 hours in 572 patients and after 24 hours of injury in 433 patients. Hospital records and radiographs were reviewed. Early complications including wound infections, sepsis, pneumonia, deep venous thrombosis (DVT), pulmonary embolism (PE), acute respiratory distress syndrome (ARDS), organ failure, and death were identified.

Results: The mean injury severity score (ISS) was 29.1 ± 9.3 for patients treated within 24 hours of injury, versus 32.5 ± 11.3 when after 24 hours ($P = 0.001$), and the mean age was 36.2 years for early versus 40.1 years for delayed ($P < 0.001$). However, the mean initial pH and base excess were 7.32 ± 0.09 versus 7.34 ± 0.12 ($P = 0.004$) and –5.5 ± 4.3 versus –4.4 ± 5.6 ($P = 0.005$), respectively, for early versus delayed patients, indicating a greater level of initial acidosis in the early group. Both the days in ICU and the overall length of stay were lower in the early group (5.1 ± 8.8 vs 8.4 ± 11.1 ICU days; 10.5 ± 9.8 vs 14.3 ± 11.4 total days; $P < 0.001$). These differences remained significant after adjusting for ISS and age. In addition, the early group had lower rates of overall complications (24.0% vs 35.8%), ARDS (1.7% vs 5.3%), pneumonia (8.6% vs 15.2%), and sepsis (1.7% vs 5.3%), with $P = 0.040$, $P = 0.048$, $P = 0.070$, and $P = 0.054$, respectively, after adjusting for ISS, severity of chest injury, and age. Rates of DVT, PE, wound infection, other organ failure, and death were not significantly different between the two groups.

Conclusion: 1,005 patients with multiple system injury and 1,192 unstable fractures of the pelvis, acetabulum, femur, and thoracolumbar spine were reviewed. Patients who had definitive management of all of these fractures within 24 hours of injury had shorter ICU and hospital stays and lower overall rates of complications and ARDS, compared with those treated later, even when adjusted for age and associated injury types and severity. While

Δ OTA Grant
See pages 75 - 103 for financial disclosure information.

fracture fixation serves a role in reducing ongoing bleeding and in promoting mobility from bed, surgical timing must be determined with consideration of the overall physiological status of the patient and the complexity of the surgery needed. Parameters should be established within which it is safe and efficacious to proceed with fixation. These data will serve as a baseline for comparison for prospective evaluation of such parameters in the future.

- 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 413.

Surgical Stabilization of Flail Chest with Locked Plate Fixation

***Peter L. Althausen, MD*[1]**; *Daniel Coll, PAC*[2]; *Timothy O'Mara, MD*[1]; *Timothy J. Bray, MD*[1];
[1]*Reno Orthopaedic Clinic, Reno, Nevada, USA;*
[2]*Renown Regional Medical Center, Reno, Nevada, USA*

Purpose: Flail chest occurs in about 10% of patients with chest trauma, carrying an associated mortality rate of 10% to 15%. The standard of care has become selected ventilatory support and tracheostomy when indicated. This treatment algorithm has been complicated by multiple cases of prolonged ventilatory support, pneumonia, empyema, respiratory insufficiency, and chronic pain. Long-term disability has been reported in over one-third of these patients. Over the last few years, surgical stabilization has become increasingly popular but there are few reports of locked plate fixation. The primary objective of this study is to compare the results of surgical stabilization with locked plating to nonoperative care of flail chest injuries.

Methods: From January 2005 to January 2010, 21 patients with flail chest were treated with locked plate fixation. Flail chest was defined as fractures of 4 or more ribs fractured at more than 2 sites. Data with regard to age, sex, mechanism, injury severity score (ISS), number of rib fractures, and severity of lung contusion was collected. These patients were compared to an age, mechanism, and ISS-matched cohort of nonoperatively managed patients at our institution. ICU data were collected on length of stay (LOS), time on ventilator, complications, epidural, anesthesia, and antibiotic requirements. Operative data such as time to operating room, operative time, estimated blood loss (EBL), operative cost, and complications was collected. Total hospital LOS, need for reintubation, and home oxygen requirements were recorded. Patients were contacted to assess pain scores and return to full employment. Clinic charts were reviewed to identify any complications of care such as posttraumtic pneumonia, wound infection, plate failure, and nonunion. Cost data with regard to ICU LOS, hospital LOS, operative costs (rib fixation, tracheostomy, chest tube placement, bronchoscopy), pain medicine requirement (epidural, patient-controlled analgesia, narcotics), and antibiotic use were analyzed.

Results: Average follow-up of operatively managed patients was 26 months. No case of hardware failure, hardware prominence, wound infection, or nonunion was reported. Operatively treated patients had shorter ICU stays (2.1 vs 7.3 days), shorter hospital LOS (5.2 vs 13 days), fewer tracheostomies(0 vs 5), decreased home oxygen requirements(30% vs 100%), 70% less narcotic use, and less need for reintubation (0 vs 4). Overall cost of operative patients was significantly less than nonoperatively managed patients.

Conclusions: This study demonstrates the potential benefits of surgical stabilization of flail chest with locked plate fixation. When compared to case-matched controls, operatively managed patients demonstrated improved clinical outcomes and decreased hospital costs. Locked plate fixation is safe as no complications associated with hardware failure, plate prominence, wound infection, or nonunion were noted.

See pages 75 - 103 for financial disclosure information.

A High Ratio of Fresh Frozen Plasma to Packed Red Blood Cells Significantly Decreases Mortality in Femur Fracture Patients Requiring Massive Transfusion

Justin Michael Broyles, BS; *Gavin Wagenheim, BBA; Sartaj Alam, MS;*
Catherine Ambrose, PhD; Milan Sen, MD;
The University of Texas Health Science Center at Houston, Houston, Texas, USA

Purpose: This study was designed to evaluate new treatment modalities in the management of the severely injured polytrauma patient. Specifically, we evaluated the outcomes of two populations of femur fracture patients requiring massive transfusions: a population who received packed red blood cells (PRBC) only, and a population who received a 1:1 ratio of fresh-frozen plasma (FFP) to PRBC. The hypothesis was that a 1:1 FFP:PRBC ratio will improve survival in this selected patient population.

Methods: Excluding patients under the age of 18 years, 1594 consecutive blunt trauma patients were admitted to our trauma center and diagnosed with one or more femur fractures during a 100-month period from September 1, 1999 to December 31, 2007. This large cohort of orthopaedic fractures was retrospectively examined for patients who only received massive transfusions, and only 161 of these patients met the criteria to be included in our study. We defined a massive transfusion as 10 or more units of PRBC within a 24-hour period. The 1:1 FFP:PRBC massive transfusion protocol was implemented July 1, 2005. Retrospectively, these patients were divided into two cohorts: group I consisted of 101 patients who presented to the emergency department between September 1, 1999 and June 30, 2005, and group II consisted of 61 patients who presented to the emergency department between July 1, 2005 and December 31, 2007. Group I received only PRBC initially and coagulation parameters were later corrected with FFP, but never in an initial 1:1 FFP:PRBC ratio. Group II received 1:1 FFP:PRBC transfusions from the start of transfusion.

Results: Patients in group I did not differ significantly with regards to age, sex, race, surgical treatment modality, or injury severity score (ISS) when compared to group II. In group I, 41.5% of patients died despite treatment. Of the patients in group II, only 22.9% died. This difference was significant ($P < 0.01$).

Conclusion: The implementation of a 1:1 FFP:PRBC product ratio in patients with fractures of the femur requiring massive transfusion significantly decreases mortality when compared to lower FFP:PRBC product ratios.

• 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 413.

Is Septicemia a Contraindication to Internal Fixation in the Multiply Traumatized Patient?

Robert F. Ostrum, MD[1]; *Julieanne P. Sees, DO*[2]; *Patrick Kane, MD*[3]; *Robert Marburger, RN*[1];
[1]*Cooper University Hospital, Camden, New Jersey, USA;*
[2]*UMNDJ- School of Osteopathic Medicine, Newark, New Jersey, USA;*
[3]*Brown University Medical School, Providence, Rhode Island, USA*

Purpose: This study investigates the incidence of infection and complications associated with internal fixation in multiply injured patients with a prolonged stay in the trauma ICU (TICU).

Methods: A retrospective review of data collected prospectively from our trauma database from January 2004 to June/2009 was performed to identify injured patients with a prolonged TICU stay and a closed fracture requiring internal fixation. Inclusion criteria were patients with an injury severity score (ISS)>4, a combined stay of longer than 5 days in the TICU or trauma step-down unit, temperature spikes of >100°F, and hardware placed for internal fixation of a fracture. Our population sustained a total of 92 fractures that subsequently underwent surgical fixation. Exclusion criteria included patients with an open fracture or fractures that did not require fixation. Identification of deep infection requiring surgical intervention, nonunion, or wound complications was examined. A comparison of the group with positive blood cultures (PBC) to the group with negative blood cultures (NBC) was performed using an independent *t* test. An analysis of the deep infections in the PBC versus NBC groups was done using a χ^2 test. Statistical significance was set at <0.05.

Results: 54 patients met our inclusion criteria, with 28 patients in the PBC group and 26 patients in the NBC group. There was no difference in the ISS between these two groups ($P = 0.27$). There was a difference in the length of stay in critical care as the NBC group averaged 17.2 days (SD, 8.3), whereas the PBC patients averaged 29.4 (SD, 17.4) ($P = 0.002$). There were no differences noted in the rate of deep infection after open reduction and internal fixation as there were 5 deep infections in the PBC group (17.9%) versus 3 infections in the NBC group (7.7%) ($P = 0.565$). In 2 of the 5 deep infections in the PBC group, the blood culture and wound culture organism did not match. The remaining 3 deep infections in the PBC group, blood and wound culture organisms were the same; however, the operative fixation preceded septicemia by 2, 5, and 22 days, respectively. There was no correlation between length of stay in critical care or ISS with deep infection in the PBC group, as 2 patients had an ISS of 4. In the 2 deep infections in the NBC group, 1 patient with an ISS of 22 had a femoral external fixator and fasciotomies performed on presentation. This patient subsequently became infected. One acetabulum fracture had an infected hematoma.

Conclusions: There are currently no guidelines for a safe interval for surgical implantation of orthopaedic hardware in the septic patient. Our results demonstrate that there is not a higher rate of deep infection in patients with hardware and PBC, and that often the infective organism from the orthopaedic surgery does not appear to correlate with the organism of the blood culture. We found that a longer length of stay in the TICU did correlate with a higher incidence of PBC. Three patients had positive blood cultures after their orthopaedic intervention, which demonstrates the systemic complications associated with these critically

See pages 75 - 103 for financial disclosure information.

ill patients. The ISS was a poor predictor of deep infection as many patients with minimal injuries developed respiratory complications leading to a prolonged TICU stay and PBC. Overall, these patients may be under greater stress, negative nitrogen balance, and poor nutrition, making them more susceptible to nosocomial infection. It appears safe to operate on multiply injured patients with PBC when the “window of opportunity” and clinical parameters are optimal. This, however, may not prevent subsequent postoperative sepsis and deep wound infection.

- 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 413.

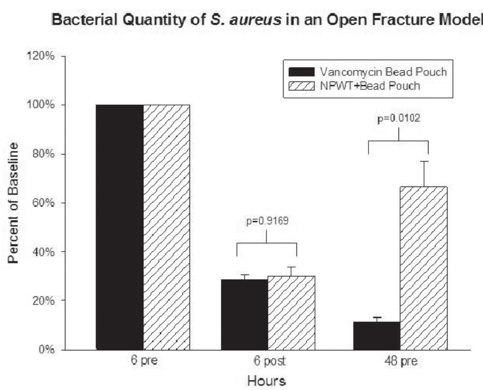
•Negative Pressure Wound Therapy (NPWT) Reduces Effectiveness of Antibiotic Beads

CPT Daniel J. Stinner, MD; *MAJ(P) Joseph R. Hsu, MD; Joseph C. Wenke, MD;*
United States Army Institute of Surgical Research, Fort Sam Houston, Texas, USA

Purpose: Negative pressure wound therapy (NPWT) is commonly used as an effective wound management technique. Compared to wet to dry dressings, it has been shown to have a favorable effect on minimizing bacteria in wounds contaminated with *Pseudomonas aeruginosa*, but not with *Staphylococcus aureus*. Adjunctive treatments, to include the addition of local antibiotics, offer an attractive alternative to NPWT alone, but there is concern that the antibiotics will be removed from the wound milieu. This study evaluates the ability of antibiotic-impregnated polymethylmethacrylate (PMMA) beads used in conjunction with NPWT to minimize infection in contaminated wounds compared to the standard antibiotic bead pouch.

Methods: A complex musculoskeletal wound was created on the hindlimb of 20 goats and contaminated with *S. aureus* (lux) bacteria. The bacteria are genetically engineered to emit photons, allowing for quantification with a photon-counting camera system. The wounds were débrided and irrigated 6 hours after inoculation. Goats were assigned to two different treatment groups: a control group using an antibiotic bead pouch and an experimental group using NPWT in conjunction with antibiotic beads. The wounds were evaluated 48 hours after contamination and the bacteria within the wounds were quantified. NPWT effluent levels of antibiotic were measured at 6, 12, 24, 36, and 42 hours after treatment was initiated.

Results: The bacterial load was significantly minimized in wounds treated with the antibiotic bead pouch when compared to treatment with NPWT and antibiotic beads ($P < 0.05$). High levels of antibiotic were consistently recovered from NPWT effluent samples at all time points (51 ± 3 μg/mL).



Conclusion: As suspected, antibiotic was found in the NPWT effluent in wounds treated with NPWT and antibiotic beads, which decreased its effectiveness when compared to the antibiotic bead pouch. When comparing previous data using an identical musculoskeletal wound model, NPWT with antibiotic beads remains more effective than NPWT alone. Thus, consideration must be given to the indications and desired outcomes of the different treatment options. If infection control is the surgeon's primary concern, the antibiotic bead pouch is most effective. If both infection control and wound management are priorities, the addition of antibiotic beads to NPWT does appear beneficial when compared to previous studies using NPWT alone.

See pages 75 - 103 for financial disclosure information.

Is Time to Flap Coverage an Independent Predictor of Flap Complication

Jean-Claude G. D'Alleyrand, MD[1]; *Lindsay Dancy, BS*[1]; *Renan Castillo, PhD*[2]; *J.B. Bertumen, BS*[1]; *Theodore T. Manson, MD*[1]; *Robert V. O'Toole, MD*[1]; *Tom Meskey, BS*[2];
[1]*R Adams Cowley Shock Trauma, Dept of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA;*
[2]*Center for Injury Research and Policy, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA*

Purpose: Many studies have reported increased complications and infections associated with delay in flap coverage of open tibia fractures. Only one previous study has attempted to control for risk factors for complication and this study found no influence of timing of flap coverage on outcome. Our hypothesis is that timing of flap coverage of open tibia fractures requiring flap coverage is not predictive of complication after controlling for previously described risk factors for complication.

Methods: A retrospective review of all acute fractures of the tibia requiring flap coverage at a single Level 1 trauma center yielded 74 patients from 2004 to 2009. Patients were excluded if they required a flap later for wound breakdown or infection. Most patients had tibial shaft fractures (n = 45), but 17 of the patients had plateau, and 12 had pilon fractures. Electronic records were reviewed as were data in the prospective trauma database. All fractures were classified using the AO system by a trauma fellowship–trained orthopaedic surgeon. Our primary outcome was flap complication, which we defined as infection or other flap failure requiring surgical treatment. Analysis was performed using logistic regression adjusting for either multiple confounders (including factors such as age, injury severity, fracture classification, and initial treatment characteristics) or for a single summary score due to sample size limitations. Results were substantially similar with both approaches.

Results: Even after controlling for fracture severity and other parameters thought to increase risk for complication, time to flap coverage was a significant predictor of complication. The odds of complication increased 14% for every day of delay (95% confidence interval [C.I]: 1.5%, 28.5%; $P = 0.028$). Including only the patients with infection increased the magnitude of the effect (17.1% increased odds for every day delay, $P = 0.023$). A breakpoint for increased infection appeared to exist around 7 days from injury: a second logistic regression model that separated the first 7 days to surgery from subsequent days found no increased risk for days 1 to 7 ($P = 0.95$). However, the odds of complication increased by 18% for each day beyond day 7 (95% CI: 1.3%, 37.2%; $P = 0.033$).

Conclusions: One explanation for the observation that infection rates increase with delay in flap coverage of open tibia fractures is that worse injuries and sicker patients undergo flap coverage later. In contrast to previous studies in the literature, we attempted to control for risk factors for complication and still observed a significant increase in infection despite controlling for injury severity.

• 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 413.

The Military Extremity Trauma Amputation/Limb Salvage (METALS) Study: Comparing Outcomes for Amputation versus Limb Salvage following Major Lower Extremity Trauma

*Ellen J. MacKenzie, PhD[1]; **William C. Doukas COL(Ret.), MD[2]**;*
Romney C. Andersen, LTC, MD[3]; James R. Ficke, COL, MD[4]; Roman Hayda, COL(Ret), MD[5];
John J. Keeling, CDR, MD[3]; Anthony Carlini[6];
[1]Center for Injury Research & Policy, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA;
[2]UHC Orthopaedics, Clarksburg, West Virginia, USA;
[3]Walter Reed National Military Medical Center, Washington, District of Columbia, USA;
[4]San Antonio Military Medical Center, San Antonio, Texas, USA;
[5]Brown University Medical School, Providence, Rhode Island, USA;
[6]Johns Hopkins University, Baltimore, Maryland, USA

Purpose: This study was undertaken to examine functional outcomes and disability following severe lower extremity trauma sustained as a result of high-energy blast and ordnance-related mechanisms. We hypothesized that outcomes would be similar among those undergoing amputation or limb salvage.

Methods: This is a retrospective cohort study of 298 United States service members who sustained a major lower limb injury while serving in Afghanistan or Iraq. Major limb trauma was defined as having a traumatic amputation or one or more of the following: revascularization, bone graft or bone transport, local or free flap coverage, complete deficit of a major nerve, or complete compartment injury / compartment syndrome. Excluded from this analysis were persons with a major upper limb amputation. Participants were interviewed by telephone (mean 38 months) and medical records abstracted. The Short Musculoskeletal Functional Assessment (SMFA) was used to measure overall function. Additional batteries were used to assess depressive symptoms (Center for Epidemiological Studies Depression Scale [CES-D]), posttraumatic stress (Military PTSD Checklist [PCL]), and chronic pain (the Chronic Pain Grade Scale). Differences in outcomes were compared using regression analysis adjusting for age, time to interview, military rank, presence of a major upper limb injury, social support, and combat experiences.

Results: Participants report high levels of disability. 40% have depressive symptoms (CES-D ≥16); 20% screen positive for posttraumatic stress (PCL ≥50). One-fifth report pain that interferes with daily activity and 35% were not working, on active duty, or going to school. Mean SMFA scores are shown below for 5 principal groups defined by unilateral versus bilateral injuries and whether the injury resulted in amputation (AMP) or limb salvage (SAL). After adjusting for covariates, patients with at least 1 major AMP had better scores on all domains of the SMFA ($P < .001$) compared to those without an AMP. There were no significant differences by AMP status in percent with depressive symptoms, posttraumatic stress disorder (PTSD), or pain interference.

See pages 75 - 103 for financial disclosure information.

	Unilateral Injuries		Bilateral Injuries		
Mean SMFA score	AMP (n = 104)	SAL (n = 116)	2 AMPs (n = 35)	2 SALs (n = 16)	AMP/SAL (n = 27)
Total	21.8	29.8	23.6	30.6	25.3
Mobility	27.6	37.4	31.7	41.5	31.6
Hand/arm	1.5	7.8	3.3	9.0	4.9
Activities	20.7	28.1	24.6	28.1	30.2
Emotional	39.0	47.6	34.8	45.1	33.5

Conclusion: Major lower limb trauma sustained in the military results in significant long-term disability. As a group, those undergoing amputation appear to have better functional outcomes than those definitively treated with limb salvage. Further study is needed to determine if differences are related to rehabilitation protocols, ancillary services, or other external factors.

Disclaimer: The views expressed in this presentation are those of the authors and do not reflect the official policy of the Department of the Army, Navy, Department of Defense, or US Government.

- 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 413.

The Fate of Patients with a 'Surprise' Positive Culture after Nonunion Surgery

*Paul Tornetta, III, MD[1]; Dana Olszewski, MD[1]; Clifford B. Jones, MD[2]; Martin Hoffmann, MD[2]; Debra L. Sietsema, PhD[2]; **Charlton Stucken, MD[1]**; William R. Creevy, MD[1]; William M. Ricci, MD[3]; Michael J. Gardner, MD[3]; Phillipp N. Streubel, MD[3];*
[1]Boston University Medical Center, Boston, Massachusetts, USA;
[2]Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA;
[3]Washington University Medical Center, St. Louis, Missouri, USA

Introduction: Patients who had prior surgery and undergo surgery for a nonunion typically have cultures sent at the time of definitive treatment. A positive culture result that comes back after the procedure is done may represent indolent infection and presents a challenge in treatment. The purpose of this study is to review a series of patients who had a "surprise" positive culture result from definitive surgery for nonunion with regard to postoperative treatment and ultimate result.

Materials: All patients treated for nonunion at 3 Level 1 trauma centers who were considered at risk for indolent infection and had cultures taken at the time of definitive nonunion surgery were evaluated. The course of the patients with a "surprise" positive culture result was documented, including the use of antibiotics, surgery performed, and the outcome regarding infection and union.

Results: Of 666 consecutive nonunions, 456 (68%) had cultures sent at the time of definitive surgical management. This was for a history of prior surgery or open fracture. 94 (21%) had a "surprise" positive culture. The definitive procedures were intramedullary nail (45), open reduction and internal fixation (42), external fixation (1), and bone graft alone (6). 45 (52%) of the patients who had internal stabilization also had local augmentation with graft and/or bone morphogenetic protein. The bacteria isolated from the cultures were: coagulase-negative staphylococcus (45), *Staphylococcus aureus* (unspecified) (3), *S. epidermidis* (1), enterococcus (2), pseudomonas (8), bacillus (4), peptostreptococcus (3), methicillin-resistant *S. aureus* (MRSA) (12), methicillin-sensitive *S. aureus* (MSSA) (7), Propionobacter (6), strep viridans (2), beta hemolytic streptococcus (1), *Serratia marcescens* (1), *Clostridium tertium* (2), Aspergillus (1), and *Escherichia coli* (1). Seven of the patients had multiple organisms. Infectious disease consultants were involved in all cases. Eight cultures were considered probable contaminants and no additional antibiotics were given. The other 86 patients were treated with 6 to 8 weeks of culture specific antibiotics (77) or with a slightly shorter duration (9). Of the 8 patients with presumed contaminants, 5 have healed and 3 have a persistent nonunion, of which 2 are infected and 1 was amputated. Of the 86 treated with antibiotics, 79 (92%) healed, 5 (6%) developed a recurrent nonunion, and 2 (2%) became grossly infected. Ultimately, 12 (15%) of the 79 who healed had their hardware removed after union. 94% of patients who had augmentation healed as compared with 93% of those not grafted. 2% of those grafted and 2% without grafting developed an infection.

Discussion: The treatment of nonunions is challenging, and in patients with a history of prior surgery or open fracture, we found that 21% had positive intraoperative cultures from the definitive surgery. All but those felt to be contaminants were treated with antibiotics, leading to a postreconstruction infection rate of 2.2%, all with the same organisms cultured

See pages 75 - 103 for financial disclosure information.

at the definitive procedure. Infection was not more common after grafting than if fixation was performed without grafting (such as exchange nailing). The use of culture-specific antibiotics seems justified based on the overall low rate of infection in this complex patient population. This is further supported by 2 of 8 (25%) of those treated as contaminants resulting in infection. Patients may be counseled that a positive culture after nonunion surgery is largely a treatable problem, but that hardware removal may be recommended (15% in this series).

• 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 413.

Does Long Term Donor Site Morbidity after Anterior Iliac Crest Bone Graft Harvesting Exist?

Sangmin Ryan Shin, MD; *Paul Tornetta, III, MD;*
Boston University Medical Center, Boston, Massachusetts, USA

Background/Purpose: High rates of donor-site morbidity after harvest of posterior iliac crest bone grafts have been reported in patients undergoing spine procedures. The purpose of this study is to evaluate long-term donor-site morbidity associated with anterior iliac crest bone graft harvesting via the inner table for orthopaedic trauma reconstructions.

Methods: The medical records of 46 consecutive patients who had undergone iliac crest bone graft with anterior harvesting technique by a single orthopaedic traumatologist over a 7-year period were reviewed. All grafts were taken by removing the inner table of the ilium from 2 cm posterior to the anterior superior iliac spine for a 6- to 8-cm distance after releasing the abdominal musculature, allowing harvesting of cancellous bone and corticocancellous strips. The average bone obtained was 40 cc. The abductor insertion was left intact and the external contour of the ilium remained unaffected. Patients' demographic characteristics, preoperative diagnoses, procedures, and postoperative wound complications were recorded. Questionnaires (adapted from a published questionnaire) pertaining to duration and severity of pain assessed with a visual analog scale (VAS), functional limitations, scar numbness, thigh numbness (in lateral femoral cutaneous nerve distribution), scar tenderness, cosmetic satisfaction, and whether the patient would consent to a future iliac crest bone graft procedure if needed were used to evaluate the long-term morbidity of the bone graft harvest.

Results: 30 patients (20 men and 10 women; average age, 46 years [range, 29-65 years]) were evaluated at mean follow-up of 7 years after index anterior iliac bone graft harvesting for nonunion (24) or fusion for posttraumatic arthrosis (6). There were no postoperative wound complications. Four (13%) of the 30 patients reported pain lasting more than 2 weeks after the harvest (2 weeks, 3 weeks, 2 months, and 6 months). Their average VAS was 7.5 (range, 6-8) during that time. However, no patient had any pain at final follow-up (VAS = 0 for all patients). Three of the four patients who had pain for more than 2 weeks after graft harvest expressed that they would not elect to have another bone graft and would seek alternative graft sources. All other patients would consent to another bone graft if recommended. Three patients (10%) reported some scar numbness; however, none complained of thigh numbness (lateral femoral cutaneous nerve). 28 patients (93.3%) were satisfied with the cosmetic result. Finally, no patient had any limitations in activity related to the harvest site.

Conclusions: Anterior inner table iliac graft harvesting resulted in minimal morbidity and no pain or functional limitations at an average of 7 years after the index procedure. Four of 30 patients (13%) had pain that lasted more than 2 weeks and three of these four patients would be resistant to another bone graft due only to the postoperative pain. This technique has lower long-term consequences than prior reports of posterior graft sites.

See pages 75 - 103 for financial disclosure information.

CT Scans Have a High Rate of Missed Femoral Neck Fractures

***Robert V. O'Toole, MD*[1]**; *Lindsay Dancy, BS*[1]; *Adam R. Dietz, MD*[1];
Aaron J. Johnson, MD, MS[1]; *Andrew N. Pollak, MD*[1]; *Gregory M. Osgood, MD*[1];
Jason W. Nascone, MD[1]; *Marcus F. Sciadini, MD*[1]; *Renan C. Castillo, PhD*[2];
[1]*R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland Medical School, Baltimore, Maryland, USA;*
[2]*Center for Injury Research and Policy, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA*

Purpose: Femoral neck fractures occurring with ipsilateral femoral shaft fractures have been associated with high rates of missed diagnosis. Based on the results of our previously presented pilot study on displaced femoral neck fractures, our hypothesis was that axial CT would be superior to plain radiographs at detecting both displaced and nondisplaced femoral neck fractures.

Methods: Image sets, including axial CT, AP pelvis, and AP femur radiographs, were created for 28 patients with ipsilateral femoral neck and shaft fractures, and 60 patients with isolated femoral shaft fractures. Images were deidentified, randomized, and viewed on computer workstations by 5 trauma fellowship–trained orthopaedic surgeons who were blinded to treatment or diagnosis. Interobserver agreement, sensitivity, specificity, post-test positive probability, and post-test negative probability were all calculated, adjusting for the incidence of ipsilateral neck and shaft fractures in clinical practice (9%). To further validate our findings, we performed a retrospective review of all patients with ipsilateral femoral shaft and neck fractures between 2003 and 2008, when our center used a protocol of routine CT scan for all patients with femoral shaft fractures

Results: Interobserver reliability indicated "substantial agreement" (kappa >0.66) for all imaging modalities. Sensitivity was generally poor (AP femur film, 0.51; AP pelvis, 0.56; CT, 0.64), and specificity was better (AP femur film, 0.95; AP pelvis, 0.96; CT, 0.96) for all imaging modalities. Positive probability was low (AP femur, 0.48; AP pelvis, 0.58; CT, 0.52) but the negative predictive ability was high (AP femur, 0.95; AP pelvis, 0.96; CT, 0.96). For a subset of 10 neck fractures that were not discovered clinically until intraoperative imaging, only 1 CT scan was read as positive by the 5 attending physicians (1 of 50 true positives for this subset of the study). This result mirrored our clinical experience where 25% (15 of 59) of femoral neck fractures were missed preoperatively, despite routine use of CT scans.

Conclusions: Clinicians should be aware that in both our blinded study evaluation and in our clinical experience, a normal CT scan does not guarantee the absence of femoral neck fracture. These data contradict our pilot study that focused only on displaced femoral neck fractures and demonstrated better performance of the imaging studies. In clinical practice, both plain films and CT scans have a rate of missed femoral neck fractures on the order of >25%, emphasizing the importance of intraoperative and postoperative imaging in detecting minimally displaced femoral neck fractures in association with femoral shaft 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 413.

Radiation Exposure Has Increased in Trauma Patients over Time

Kasra Ahmadinia, MD; *Ben Smucker, MD; Clyde L. Nash, MD; Heather A. Vallier, MD;*
MetroHealth Medical Center, Cleveland, Ohio, USA

Purpose: Diagnostic imaging is a burgeoning industry. One of the settings in which CT scans are utilized the most often is acute trauma. Emergent CT scans of the head, spine, chest, abdomen, and pelvis have become imaging modalities of choice in trauma centers around the country. The purpose of this study was to evaluate the trend of radiation exposure in acute trauma patients in a busy Level 1 trauma center and determine if there were associations with injury severity and acute survival of the patient. Our hypothesis was that the number of radiological tests, amount of radiation within 24 hours of injury, and cost would increase over time without change in patient acuity or outcome.

Methods: 100 consecutive trauma patients at an urban Level 1 trauma center were retrospectively reviewed each year for the years 2002, 2005, and 2008. Trauma patients are categorized based on severity of initial injury as category 1 or category 2 (less injury). The total number of CT scans and total dosage of radiation (mSV) were determined. Total charges were also calculated based on the 2008 technical and professional charges for each diagnostic study. Injury types and injury severity scores (ISS) were characterized for each patient and controlled for during our analysis. Mortality rate was calculated for each year for the entire trauma population.

Results: Mean ISS scores for category 1 patients in 2002, 2005, and 2008 were 15, 13.2, and 16.7, respectively ($P = 0.43$). Mean ISS scores for category 2 patients in 2002, 2005, and 2008 were 9.4, 9.4, and 8.6, respectively ($P = 0.60$). The mean number of CT scans for category 1 patients in 2002, 2005, and 2008 was 1.5, 3.5, and 4.2, respectively ($P = 0.01$). This trend was similar in category 2 patients: 2.0, 3.8, 4.6, respectively ($P < 0.01$). This contributed to increased total radiation exposure to category 1 and category 2 patients over 2002, 2005, and 2008: 12.4 mSV, 28.0 mSV, 28.5 mSV ($P = 0.02$); and 17.8 mSV, 26.3 mSV, 33.6 mSV ($P < 0.001$), respectively. The charges (based on 2008 charges) for diagnostic imaging per patient also increased for category 1 and category 2 patients over 2002, 2005, and 2008: $2933, $5442, $5608; and $4104, $5912, $6750, respectively (all $P < 0.01$). Over the course of a year for 4800 trauma patients treated at our hospital, this is expected to accrue additional charges of $12.8 million. Mortality of all trauma patients during 2002, 2005, and 2008 was 4.0%, 3.0%, and 4.0%, respectively.

Conclusion: The number of CT scans in our trauma patients has more than doubled over 6 years, generating more radiation exposure and charges per patient. While scans are intended to diagnose and characterize known or occult injuries, the mortality rate in our study was similar between the three study periods despite more CT scans and no change in injury severity. Given that previous studies have demonstrated that increased radiation is a risk factor for developing cancer, the clinician is responsible for balancing the risks of missing an acute injury versus potentially contributing to a long-term one. Furthermore, judicious utilization of advanced imaging technologies may help to contain costs without compromising the level of care.

See pages 75 - 103 for financial disclosure information.

SKILLS LABS

ORIF Distal Radius *(#S-6)*
Moderator: *David C. Ring, MD*
Faculty: *Cory A. Collinge, MD; Scott G. Edwards, MD; Kenneth A. Egol, MD; Michael D. McKee, MD; Milan K. Sen, MD* and *R. Malcolm Smith, MD*

IM Nailing Trochanteric Fractures *(#S-7)*
Moderator: *Richard F. Kyle, MD*
Faculty: *Clifford B. Jones, MD; Laura S. Phieffer, MD; S. Andrew Sems, MD;* and *Thomas F. Varecka, MD*

SIGN Nailing *(#S-8)*
Moderator: *Lewis G. Zirkle, Jr., MD*
Faculty: *Kyle F. Dickson, MD; Edmund Eliazar, MD; Robert V. O'Toole, MD; Bhaskar Pant, MD; Robert S. Schultz, MD; Swap Shah, MD; John W. Staeheli, MD; David C. Templeman, MD* and *Ishmayal Wardak, 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 413.

MINI SYMPOSIA

2 Minutes/ 2 Slides: Technical Tips and Tricks (Rapid Fire Cases) *(#S-9)*
Moderator: *Pierre Guy, MD*
Faculty: *Richard E. Buckley, MD; Kelly A. Lefaivre, MD; Mark C. Reilly, MD; Emil H. Schemitsch, MD; Stephen H. Sims, MD* and *Paul Tornetta, III, MD*

Infection Following Internal Fixation – What's New? *(#S-10)*
Moderator: *Andrew H. Schmidt, MD*
Faculty: *Jeffrey O. Anglen, MD, William T. Obremskey, MD; Robert V. O'Toole, MD* and *Mark E. Shirtliff, PhD*

Soft Tissue Coverage for the Non-Microsurgeon *(#S-11)*
Moderator: *Gregory L. DeSilva, MD*
Faculty: *Michael T. Archdeacon, MD* and *Stephen D. DeSilva, MD*

NOTES

See pages 75 - 103 for financial disclosure information.

JOHN BORDER MEMORIAL LECTURE

Sigvard T. Hansen, Jr., MD
Professor, Director of the Sigvard T. Hansen, Jr., MD Foot and Ankle Institute,
University of Washington, Seattle, Washington, USA

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 413.

Defining the Role of Examination Under Anesthetic in Determining the Need for Surgical Stabilization after Traumatic Pelvic Ring Injuries

H. Claude Sagi, MD; *Franco M. Coniglione, DO; Jason H. Stanford, DO;*
Orthopedic Trauma Service, Tampa General Hospital, Tampa, Florida, USA

Purpose: This study was undertaken to describe the technique and results of stress examination of pelvic ring injuries using fluoroscopy under anesthesia to determine stability and the need for fixation.

Methods: Pelvic ring injuries that were classified as having "incomplete" disruption of the posterior pelvic ring (OTA 61-B) on plain radiographs and CT were included in this analysis. All patients were anesthetized and placed in the supine position for stress examination of the pelvic ring consisting of internal rotation, external rotation, and push-pull of the lower extremities. Fluoroscopic imaging using AP, inlet, and outlet projections for each manipulative maneuver as described above was performed. The classification of the pelvic ring injury was then further defined by the amount of rotational instability in the axial and sagittal planes and translational instability in the coronal plane. The decision to proceed with anterior and/or posterior operative stabilization was based on the suspected degree of pelvic ring instability from the results of the examination under anesthesia (EUA).

Results: 70 patients underwent EUA of their pelvic ring injuries by the senior author; 52 males and 18 females, with an average age of 35 years, comprised the study group. In all, 39 anterior-posterior compression (APC or OTA 61-B1) injuries and 31 lateral compression (LC or OTA 61-B2) injuries were evaluated. Of the 14 pelvic ring injuries initially classified as APC-1, 7 (50%) were deemed stable and treated nonsurgically, while the other 7 were felt to have sufficient instability requiring fixation based on EUA. Of the 23 injuries initially classified as APC-2, all but 1 required surgical fixation; 13 (57%) had anterior fixation alone, while 9 (39%) required anterior fixation with supplemental iliosacral screw placement based on EUA. Of the 19 injuries initially classified as LC-1, 12 (63%) were stable and treated nonsurgically, while 7 (37%) required surgical stabilization based on EUA. Of the 8 LC-2 injuries, 3 (38%) were treated nonoperatively, and 5 (63%) required stabilization. Of the 4 LC-3 injuries examined, all required surgical stabilization.

Conclusions: Static radiographs and CT of the pelvis inadequately define the full extent of instability with traumatic injuries to the pelvic ring. The high incidence of poor functional outcomes associated with pelvic fracture may be due, in part, to inadequate treatment of misdiagnosed injuries. Performing an EUA with fluoroscopy as described in this series revealed undiagnosed instability in 50% of presumed APC-1 injuries, 39% of APC-2 injuries, and 37% of LC-1 injuries. We conclude that pelvic EUA is an important diagnostic tool that can provide additional information regarding stability or instability of the pelvic ring that can help guide treatment and determine the need for surgical stabilization.

See pages 75 - 103 for financial disclosure information.

Outcome of Posterior Wall Fractures of the Acetabulum Treated Nonoperatively after Diagnostic Screening by Dynamic Stress Examination under Anesthesia

Charles S. Grimshaw, MD; *Berton R. Moed, MD;*
St. Louis University School of Medicine, St. Louis, Missouri, USA

Purpose: Dynamic stress fluoroscopy under general anesthesia has been advocated as a clinical measure of hip stability and congruence in posterior wall acetabular fractures. Open reduction and internal fixation is indicated if the joint is shown to be unstable, while nonoperative management is selected if the joint is found to be stable. However, outcome of hip function after using nonoperative treatment based on this diagnostic examination has yet to be documented. The purpose of this study was to establish the predictive value of dynamic stress fluoroscopic examination under general anesthesia for these fractures by evaluating functional and radiographic outcome after nonoperative treatment of fractures found to be stable by this examination.

Methods: 21 consecutive patients shown to have stable hip joints after dynamic stress fluoroscopy under general anesthesia for an isolated posterior wall fracture were treated nonoperatively. Three patients were lost to follow-up, leaving 18 for study. At follow-up, patients underwent clinical and/or radiographic evaluation. Patients were evaluated radiographically for hip joint congruence and posttraumatic arthritis. Hip function was determined using the modified Merle d'Aubigné clinical score.

Results: Clinical follow-up was obtained on all 18 available patients at a minimum of 2 years (mean 40 months), with an average modified Merle d'Aubigne score of very good and no one having a less than good clinical outcome. 15 of these 18 patients had radiographic evaluation at a minimum of 2 years (mean 41 months), demonstrating a congruent joint with a normal joint space and no evidence of posttraumatic arthritis. Of the three patients not having final follow-up radiographs, two were incarcerated at the time of clinical evaluation, preventing radiographic examination. The third patient was completely asymptomatic but refused follow-up radiographs.

Conclusions: Hip joint stability determined by dynamic stress fluoroscopy under general anesthesia after isolated posterior wall acetabular fracture is predictive of maintained hip joint congruity, excellent radiographic outcome, and a good to excellent clinical outcome with nonoperative 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 413.

Operative Fixation versus Reconstruction with THA for Acute Acetabular Fractures in the Elderly Population

Michael J. Weaver, MD[1,2]; *Micah Miller, BS*[2]; *David Lhowe, MD*[2];
Malcolm Smith, MD[2]; *Mark S. Vrahas, MD*[1,2];
[1]*Brigham and Women's Hospital and Massachusetts General Hospital, Boston, Massachusetts, USA;*
[2]*Massachusetts General Hospital, Boston, Massachusetts, USA*

Purpose: The purpose of this study is to compare the short-term outcomes of open reduction and internal fixation (ORIF) and acute reconstruction with total hip arthroplasty (THA) in the management of acetabular fractures in patients over 65 years of age.

Methods: We reviewed a consecutive series of patients treated over a 7-year period at our institution with either ORIF or reconstruction with a THA for an acute acetabular fracture. All patients were at least 65 years old at the time of injury. Patients were interviewed and radiographs were examined. Validated outcome scores including the Harris hip score and Short Form 36 (SF-36) were collected.

Results: 73 patients were included in the study, 33 treated with ORIF and 40 treated with THA. Mean follow-up was 21 months. The mean age in the ORIF group was 73 years (range, 65-88). The mean age in the THA group was 79 years (range, 68-89). The most common fracture patterns included anterior column/posterior posterior wall fractures (27%), transverse/posterior wall (18%) and anterior column/posterior hemitransverse (15%). One-year mortality was similar between those treated with ORIF (15%) and THA (23%, $P = 0.43$). There was a trend toward a higher rate of reoperation in the ORIF group (30%) compared to the THA group (15%, $P = 0.12$). There were 3 (8%) deep infections in the THA group and 4 (12%, $P = 0.50$) in the ORIF group. Seven (21%) of the patients treated initially with ORIF went on to develop posttraumatic arthritis and underwent eventual THA. Four (10%) of the patients who underwent THA had at least 1 dislocation, and 2 (5%) went on to recurrent instability requiring further surgery. Harris hip scores of the uninjured limb were similar between those treated with ORIF (mean 82) compared to those treated with THA (81, $P = 0.83$). There was a trend toward improved Harris hip scores in the injured limb in those treated with THA (mean 82) compared to ORIF (63, $P = 0.06$). There were significantly better SF-36 bodily pain scores in the THA group (mean 48) compared to the ORIF group (39, $P = 0.04$). There was also a trend toward improved physical summary scores in the THA group (mean 43) compared to the ORIF group (35, $P = 0.15$).

Conclusion: ORIF and reconstruction with THA are options in the treatment of acute fractures of the acetabulum in the elderly population. THA appears to compare favorably to ORIF, with a similar rate of complication, but with improved pain scores. There is a significant rate of conversion of ORIF to THA. Both treatments are associated with high rates of morbidity and mortality in this population.

See pages 75 - 103 for financial disclosure information.

Sequential Duplex Ultrasound Screening for Deep Venous Thrombosis in Asymptomatic Patients with Acetabular and Pelvic Fractures Treated Operatively

Berton R. Moed, MD; *John R. Miller, BS*;
St. Louis University School of Medicine, St. Louis, Missouri, USA

Purpose: The timing of ultrasound screening for the diagnosis of proximal deep vein thrombosis (DVT) in asymptomatic trauma patients has been inconsistently described (eg, within 3 days of hospital admission or in the 24 hours before discharge from the hospital, etc). The purpose of this study was to examine the utility of sequential scans obtained preoperatively and before hospital discharge in asymptomatic patients with acetabular and/or pelvic fractures treated operatively.

Methods: In 2003, a screening protocol for DVT was begun for asymptomatic patients with acetabular and/or pelvic fractures treated operatively. Duplex ultrasound screening was employed, along with color flow and spectral techniques. No attempt was made to assess the pelvic veins. Scans were to be obtained the evening before or the morning of surgery and then the day before planned discharge from the hospital. Preoperative patients whose screening studies were positive for proximal DVT were to receive an inferior vena cava filter. Postoperative patients whose studies were positive were to have anticoagulation. A protocol for DVT prophylaxis was also instituted. Of 334 sequential patients, 105 were excluded due to a breach of protocol (no preoperative and/or postoperative study), the insertion of a prophylactic inferior vena cava, or the occurrence of a symptomatic pulmonary embolism (PE) or DVT prior to preoperative scanning. Therefore, 229 patients were available for study.

Results: There were 35 patients (15%) with a proximal asymptomatic DVT. 16 (7%) were diagnosed preoperatively and received an inferior vena cava filter. 19 (8%) were diagnosed postoperatively and received therapeutic anticoagulation. In addition, two patients (1%) had a postoperative symptomatic PE diagnosed the day following surgery. In both of these patients, a postoperative ultrasound was subsequently obtained and was interpreted as negative for DVT. Fatal PE did not occur.

Conclusions: Sequential ultrasound scanning for DVT according to a set protocol appears to be an improvement over the use of a single preoperative or a single postoperative (prehospital discharge) scan. Preoperative scanning decreases the risk of operating on a patient with an asymptomatic DVT; the predischarge scan decreases the risk of sending a patient home with an untreated DVT. Therefore, we recommend obtaining sequential scans preoperatively and before hospital discharge in these high-risk asymptomatic patients with operatively treated acetabular and/or pelvic fractures. However, patients may remain at risk for PE propagating from an undiagnosed pelvic vein thrombosis. If magnetic resonance venography (MRV) is to be used to detect asymptomatic pelvic DVT, the findings of this study suggest that MRV should be performed in a similar sequential fashion.

- 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 413.

Use of Temporary Partial Intrailiac Balloon Occlusion for Decreasing Blood Loss during Open Reduction and Internal Fixation of Acetabular and Pelvic Fractures

Justin C. Siebler, MD*; Thomas DiPasquale, MD; H. Claude Sagi, MD;*
Florida Orthopaedic Institute, University of South Florida, Tampa, Florida, USA

Purpose: This is a report on the technique, effect on blood loss, and complications of temporary partial intrailiac balloon occlusion (TPIIBO) during open reduction and internal fixation of pelvic and acetabular fractures.

Methods: We conducted a retrospective review of skeletally mature patients having surgical treatment of traumatic pelvic or acetabular fractures. All patients refused allogeneic blood transfusion and were enrolled in a prospective database for placement of a TPIIBO. Immediately preceding surgery, the patient is taken to the interventional radiology suite. An inflatable balloon is placed, via the contralateral femoral artery, into the common iliac artery ipsilateral to the pelvic or acetabular injury. An arterial line is placed into the posterior tibial or dorsalis pedis artery of the ipsilateral extremity to monitor blood flow to the distal extremity. During the course of the operative procedure, the anesthesiologist intermittently inflates and deflates the balloon at 10-minute intervals. The balloon is removed at the termination of the surgical procedure. Individual records were reviewed for estimated blood loss (EBL) and complications. EBL was compared to the average EBL for similar cases and approaches performed by the same surgeons at the same institution.

Results: We report on 10 patients operated for pelvic or acetabular fractures with TPIIBO. Average blood loss for anterior approaches was 365 mL with the intrailiac balloon (range, 175-600 mL) and 795 mL without the balloon (range, 125-2500 mL) ($P < 0.001$). Average blood loss for posterior approaches was 575 mL with the balloon and 445 mL without the balloon (not significant). One complication occurred (10%) in a patient with an anterior column fracture who developed an arterial thrombus and an ipsilateral ischemic extremity intraoperatively. The vascular surgical service successfully performed a thrombectomy and he had no further sequelae.

Conclusions: TPIIBO appears to decrease the overall average blood loss for anterior pelvic and acetabular surgical procedures. Its effect on blood loss for posterior acetabular procedures is undetermined. We report one complication of arterial thrombus that required intraoperative thrombectomy and resulted in no adverse outcome. We feel the use of TPIIBO may be beneficial in reducing blood loss during anterior pelvic or acetabular procedures for those patients who are opposed to allogeneic blood products.

See pages 75 - 103 for financial disclosure information.

Adaptive Prophylaxis Against Heterotopic Ossification Based on Body Habitus

***Waleed F. Mourad, MD*[1]**; *Satya Packianathan, MD*[1]; *Walid Waked, MD*[2];
Rania A. Shourbaji, BS[3]; *Zhen Zhang, MS*[1]; *Majid A. Khan, MD*[1];
Matt L. Graves, MD[1]; *George V. Russell, MD*[1];
[1]*University of Mississippi Medical Center, Jackson, Mississippi, USA;*
[2]*Yale University School of Medicine, New Haven, Connecticut, USA*
[3]*Jackson State University, Jackson, Mississippi, USA*

Purpose: Our objective was to retrospectively analyze the impact of differences in body habitus by using the World Health Organization criteria for body mass index (BMI) as a surrogate marker for risk of heterotopic ossification (HO) in patients who underwent open reduction and internal fixation (ORIF) for traumatic acetabular fractures followed by radiation therapy (XRT) ± indomethacin.

Methods: This is a single-institution retrospective analysis of medical records and radiographs of 395 patients with traumatic acetabular fractures. All patients were treated with ORIF followed by XRT ± indomethacin. All patients received postoperative XRT within 72 hours; 700 cGy was prescribed in a single fraction with fields that included the soft tissues around the proximal femur and acetabulum without bone shielding. The patients were separated into 4 groups based on their BMI: underweight group (BMI<18.5), normal weight group (BMI 18.5-24.9), overweight group (BMI 25-29.9), and obese group (BMI ≥30). HO was assessed during scheduled follow-up with standard radiographs. The end point of this study was to evaluate the efficacy of XRT ± indomethacin in preventing HO in patients with different BMIs.

Results: Analysis of BMI showed an increasing incidence of HO with increasing BMI: BMI <18.5, 0 of 6 patients (0%); BMI 18.5 to 24.9, 6 of 105 (5.7%); BMI 25 to 29.9, 22 of 117 (18.8%); and BMI ≥30, 51 of 167 (30.5%). A logistic regression analysis showed that the correlation between odds of HO and BMI is significant ($P < 0.0001$). As the BMI increases, the risk of HO and Brooker class 3 and/or 4 HO increases. On average, there appears to be a 10% increase in the odds of developing HO with each unit increase in BMI. The 95% confidence interval for the odds ratio is 1.06 to 1.14. The χ^2 square test shows no significant difference among all other factors and HO (race, XRT ± indomethacin, gender, causes and types of fracture, and surgical exposures).

Conclusion: Despite similar surgical treatment and prophylactic measures (XRT ± indomethacin), the risk of HO significantly increases in patients with higher BMI after traumatic acetabular fractures. Modifications such as increased radiation dose or fractionated radiation treatment need to be investigated in clinical trials.

- 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 413.

Minimally Invasive Surgery (MIS) Reduction and Stabilization with Percutaneous Pedicle Screw and Rod Fixation without Arthrodesis for Unstable Spinal Fractures: Early Experience and Results

Sean Owen, MD; *Dirk Alander, MD*;
St. Louis University Hospital, St. Louis, Missouri, USA

Background: The recent advent of MIS percutaneous pedicle screw fixation techniques and hardware have allowed the initial stabilization of thoracolumbar fractures in polytrauma patients, in an application similar to external fixation in so called "damage control orthopaedics." These early successes of MIS pedicle screw fixation for polytrauma patients as well as the ability to minimize the loss of spinal motion, operative trauma, and operative time has prompted its use as definitive treatment for isolated spinal trauma in our institution.

Methods: After IRB approval, the trauma registry at our Level 1 trauma center was reviewed. The charts of patients who had incurred thoracolumbar or proximal thoracic fractures and were treated with MIS fixation from January 2008 to November 2009 were evaluated retrospectively for mechanism of injury, fracture location and type, age and gender of patient, timing of fixation, associated injuries, and occupation. Operative reports were reviewed for blood loss, operative time, and any complications. Initial and follow-up radiographs were reviewed for maintenance of fracture reduction. Outpatient questionnaires were reviewed for patient satisfaction and perception of spinal motion. All patients were scheduled for elective removal of hardware at 4 to 6 months after initial fixation. Patients who had undergone MIS fixation were included as long as they had at least 3 months' follow-up after removal of their hardware.

Results: 20 patients underwent MIS pedicle screw fixation and met our follow-up criteria. Patient ages ranged from 18 to 79 years, with 16 males and 4 females. The majority of fractures were either thoracolumbar junction (T11-L2) or proximal thoracic (T6 and above). Most injuries were high-energy (motor vehicle accident, motorcycle collision, fall >10 ft). Eight patients had single-level injuries, while 12 had multilevel. Three Chance-type injuries were treated; the remainder were either compression or burst fractures (Denis criteria). Fractures were percutaneously reduced and stabilized. All but three patients were treated within 3 days of injury. Nine subjects were multitrauma patients, while 11 had solitary spinal injuries. All operative times ranged from 1 to 2 hours, and all operative blood losses were less than 50 cc. There were no operative complications in either the initial fixation or elective hardware removal. In follow-up, all patients had significant relief in back pain by their first follow-up visit after fixation. There were no hardware complications; all hardware was uneventfully removed on an outpatient basis. After removal, 18 of our subjects had no significant loss of reduction. The 2 patients had less than 10° of increased kyphosis through the adjacent discs spaces. There was no evidence of spinal instability after hardware removal. Pain relief was consistent, with minimal narcotic need by 3 months. Subjectively, patients consistently had a sense of significantly improved spinal motion after hardware removal.

Conclusion: Definitive MIS pedicle screw fixation presents an attractive alternative to traditional fusion with instrumentation for unstable spinal fractures. All fractures healed in this study. Clinical spinal motion was maintained and there was high patient satisfaction.

See pages 75 - 103 for financial disclosure information.

Our early series demonstrates maintence of spinal stability, leading to excellent clinical results while minimizing complications in both polytrauma patients and those patients with isolated spinal 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 413.

Percutaneous Posterior Instrumentation after Unstable Thoracolumbar Fractures: Prospective Analysis of Two Systems

(FDA=Non-U.S. research conducted within guidelines of my country)

Oliver Gonschorek, MD; *Stefan Hauck, MD; Thomas Weiß, MD; Volker Bühren, MD;*
Department of Spine Surgery, BGU Murnau, Murnau, Germany

Purpose: Posterior instrumentation is a common operative therapy to reduce and stabilize unstable thoracolumbar fracture types A3 and B according to the OTA classification. Percutaneous systems may reduce the morbidity and blood loss, but until now the reduction tools were poor. In this study, two new percutaneous systems are presented and compared.

Methods: Between January and December 2008, 54 patients with A3- and B-type fractures were treated with a percutaneous internal fixator from posterior and prospectively recorded. Fractures were classified according to the OTA classification. Clinical and radiological controls were performed postoperatively, after 3, 6, and 12 months. End-plate angle measurements were performed to determine initial reduction and loss of reduction after 1 year. Inclusion criteria were A3-type and B-type fractures according to the OTA classification. Exclusion criteria were age <18 years and metastatic fractures.

Results: 54 patients were included in the study. They were treated with the S4FRI system (Aesculap; n = 33, group A) and the Longitude system (Medtronic; n = 21, group B), respectively. Fractured vertebrae were from T4 to L3. There was no significant difference in both groups concerning age (mean age in group A, 47 years; in group B, 45 years), gender, operating time (A, 90 minutes; B, 92 minutes), and blood loss (A, 82 mL; B, 78 mL). Posttraumatic end-plate angle was 12° in both groups (A, 0°-21°; B, 4°-30°). Significant reduction was obtained in both groups to an end-plate angle of 6° ($P < 0.001$) without significant difference between groups A and B. After 1 year, we observed a loss of reduction in 14 patients (A, n = 8; B, n = 6), with a mean of 7° (end-plate angle: A, 7.2°; B, 6.6°). 12 of 14 patients were treated with polyaxial screws; none of them received reconstruction of the anterior column.

Conclusion: Percutaneous instrumentation is a safe method to treat unstable spine fractures of the thoracolumbar region. The new systems even provide reduction tools. However, there was a significant loss of reduction after 1 year if polyaxial screws were used and no anterior reconstruction was performed. Further analysis has to be performed for the combination of combined posterior and anterior spine reconstruction using minimal invasive methods (percutaneous posterior and thoracoscopical anterior).

See pages 75 - 103 for financial disclosure information.

Spine Damage Control: A Safe and Effective Treatment Modality for Unstable Spine Fractures in Multiply Injured Patients

Philip F. Stahel, MD; *Michael A. Flierl, MD; Ernest E. Moore, MD;*
Kathryn M. Beauchamp, MD;
Denver Health Medical Center, Denver, Colorado, USA

Purpose: The ideal timing and modality of spine fracture fixation in multiply injured patients remains controversial. While the concept of "damage control orthopaedics" has been widely implemented for pelvic and long-bone fractures, a "spine damage control" (SDC) approach for unstable spine injuries in polytrauma patients remains largely unexplored. This prospective study was designed to evaluate the safety and efficacy of a mandatory institutional SDC protocol for multiply injured patients with unstable spine fractures.

Patients and Methods: Our institutional SDC protocol mandates operative stabilization of unstable spine fractures within 24 hours of admission, followed by a delayed completion fusion, if indicated, once patients are fully resuscitated. From October 2008 to October 2009, 50 consecutive polytrauma patients with unstable spine fractures were prospectively entered into a spine database. 19 patients were treated by SDC, while 31 patients underwent definitive operative spine fixation in a delayed fashion (>24 hours, "delayed surgery" [DS] group). The two cohorts were analyzed for demographics, length of operative time, intraoperative blood loss, total hospital length of stay, ventilator-dependent days, and postoperative complications.

Results: Both cohorts were comparable with regard to age, spine fracture level, amount of intraoperative blood loss, and injury severity score. The mean time to initial spine fixation was significantly decreased in the SDC group (14.4 ± 1.2 hours vs 95.9 ± 20.4 hours, $P < 0.01$). The SDC cohort had significantly reduced mean operative time (2.7 ± 0.3 hours vs 3.5 ± 0.3 hours, $P < 0.05$), significantly reduced mean length of hospital stay (17.1 ± 2.5 days vs 31.4 ± 6.6 days, $P < 0.05$), ventilator-dependent days (2.3 ± 1.3 days vs 8.4 ± 2.2 days, $P < 0.05$), and incidence of urinary tract infections (5% vs 22%, $P < 0.05$). The SDC group furthermore displayed a nonsignificant trend towards reduction of pulmonary complications (16% vs 23%, $P = 0.72$) and pressure sores (6% vs 0%, $P = 0.52$), compared to the DS cohort. The lack of statistical significance is likely due to a type II error related to the small sample size in the subgroups.

Conclusion: A standardized SDC approach represents a safe and efficacious treatment strategy for multiply injured patients with unstable spine fractures. Larger multicenter trials will have to be designed to formally validate the safety and efficacy profile related to the implementation of an institutional SDC protocol.

- 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 413.

See pages 75 - 103 for financial disclosure information.

Custom Fixed-Angle Plating of Complex Olecranon Fractures: A Preliminary Report of Efficacy of a New Technique

Bruce H. Ziran, MD[1]; *B. Hileman, MD*[2]; *M. K. Barrette-Grishow, MD*[2];
[1]*Atlanta Medical Center, Atlanta, Georgia, USA;*
[2]*St. Elizabeth Health Center, Youngstown, Ohio, USA*

Purpose: Olecranon fractures that are not suitable for tension band methods are usually treated with plates. Most available plates are designed to sit dorsally on the ulna and/or wrap over the extensor mechanism. These plates are often irritative and require removal. We have modified standard 3.5-mm plates to create a fixed angle (90°) that sits on the lateral surface of the ulna and under the triceps tendon. This report describes the technique and preliminary results.

Methods: Inclusion criteria were patients who had distal extension or comminution of olecranon fractures not suitable for tension band wiring, and requiring a plate for fixation. A 3.5-mm reconstruction plate (RP) or dynamic compression plate (DCP) was contoured to fit along the lateral border of the ulna and beneath the triceps tendon insertion on the olecranon. Long medullary screws were incorporated through the end hole of the plate when possible. The plate was placed below the subcutaneous ridge of the ulna to avoid irritation. Standard postoperative evaluations were performed until healing.

Results: 10 patients (7 males and 3 females) met inclusion criteria. All patients had other associated injuries (ipsilateral and other extremities). The mean age was 44 years (range, 31-85 years), with mean follow-up of 10 months. OTA fracture types were 2-A1.2, 3-A1.3, 3-B1.3, and 2-C3.1. Implants were three 3.5-mm DCPs and seven 3.5-mm RPs. All fractures healed. Mean range of motion was 16° (range, 0°-40°) extension and 125° (range, 100°-135°) flexion. There were no fixation failures, extensor mechanism problems, neurological lesions, or irritation from hardware.

Conclusion: The custom contoured plates provided excellent fixation without the problems associated with dorsally placed plates. Because of the cross-sectional moment of inertia, the plate was mechanically optimized and immediate motion was possible. The slightly oblique lateral orientation of the plate allowed good fixation of most fragments, including some coronoid segments, and the use of a long medullary screw was possible, theoretically enhancing construct stability. This method provided a novel adjunct for treatment of such complex 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 413.

Attitude Toward Exercising Through Pain After Radial Head Fracture

Thierry G. Guitton, MSc; ***David C. Ring, MD, PhD****;*
Harvard Medical School, Orthopaedic Hand and Upper Extremity Service,
Massachusetts General Hospital, Boston, Massachusetts, USA

Purpose: The purpose of this prospective study was to test the hypothesis that confidence in the role that painful stretches may play in recovery leads to greater motion and decreased disability 1 month after radial fracture.

Methods: 71 patients with an isolated type 1 or type 2 radial head fracture seen within 14 days of injury were enrolled prospectively. They completed the Pain Catastrophizing Scale (PCS) and Center for Epidemiologic Studies Depression Scale (CES-D) and were asked to rate their agreement with a statement regarding pain and recovery from their injury on a 5-point Likert scale. One month later, patients completed the Disabilities of the Arm, Shoulder and Hand questionnaire and elbow and forearm motion were measured with a goniometer.

Results: Four patients (5.6%) strongly disagreed with the role of pain in recovery, 5 (7.0%) disagreed, 6 were neutral (8.0%), 30 agreed (42.3%), and 26 strongly agreed (36.6%). There was a statistically significant difference between patients in these categories in age (P = 0.031), CES-D (P = 0.047), and 1-month postinjury elbow extension (P = 0.050) and forearm rotation (P = 0.017). There was a significant correlation between agreement with the role of pain in recovery and PCS (rho = –0.256, P = 0.031).

Conclusion: We found that a patient's paradigm with respect to the role of pain in recovery from their radial head fracture predicted motion 1 month after injury. It is notable that these paradigms had a small but significant correlation with depressive symptoms and pain catastrophizing. The key may be to help our patients change their mindset from vulnerability to recovery, seeing a painful exercise more as a useful stretch exercise and the postexercise pain more as that rewarding ache after a great workout.

See pages 75 - 103 for financial disclosure information.

Simple Olecranon Fractures: What Determines Long-Term Outcome?
(FDA=Non-U.S. research conducted within guidelines of my country)
*Hendrik Jan Flinterman, MSc[1]; Job N. Doornberg, MD, PhD[1,2]; Thierry G. Guitton, MSc[1]; J.Carel Goslings, MD, PhD[3]; **David C. Ring, MD, PhD**[4]; Peter Kloen, MD, PhD[2];*
[1]Orthotrauma Research Center Amsterdam (ORCA), Academisch Medisch Centrum, Amsterdam, The Netherlands;
[2]Afdeling Orthopedie, Academisch Medisch Centrum, Amsterdam, The Netherlands;
[3]Afdeling Heelkunde, Academisch Medisch Centrum, Amsterdam, The Netherlands;
[4]Orthopaedic Hand and Upper Extremity Service, Massachusetts General Hospital and Harvard Medical School, Boston, Massachusetts, USA

Background: Although the standard of care for decades, the objective and subjective long-term outcome after tension band wiring for common simple olecranon fractures are unknown. In order to manage patients' expectations, it is useful to know if patients lose motion over time, experience more pain, develop radiographic evidence of arthrosis, and need to undergo hardware removal or require additional operations after a simple fracture of the olecranon.

Purpose: The purpose of this retrospective study was to evaluate long term (12-30 years' follow-up) objective and subjective outcomes in a consecutive series of patients with standardized outcome instruments. We hypothesized that patients with simple olecranon fractures have little or no objective functional impairment in later life and therefore subjective factors are the strongest determinants of outcome.

Methods: 38 patients with an average age at time of injury of 31 years (range, 10-72 years) were evaluated an average of 22 years (range, 14-33) after open reduction and internal fixation of a simple olecranon fracture (Mayo type I or type II-A). At long-term follow-up, patients were evaluated using 3 physician-based evaluation instruments (Mayo Elbow Performance Index (MEPI); American Shoulder and Elbow Surgeons Questionnaire (ASES), and the Broberg and Morrey Elbow Scores (B&M), and an upper extremity–specific health status questionnaire (Disabilities of the Arm, Shoulder and Hand [DASH]). Multivariable analysis of variance and multiple linear regression modeling were used to identify the degree to which various factors affect variability in the scores derived with these measures.

Results: At long-term follow-up, all fractures healed without significant loss of alignment. The mean arc of elbow flexion was 141° (range, 95°-160°). Hardware was removed in 31 patients (80%). Radiographic arthrosis was observed in 30% of patients and scored as mild in 23% of patients. Three patients had ulnar nerve dysfunction at the final evaluation. The final functional results according to the MEPI were rated as excellent or good in 37 patients (95%) and fair in 2 patients. The average MEPI score was 97 points, and the median DASH score was 1 point. 32 patients (82%) considered themselves completely pain-free. Bivariate analysis revealed pronation-supination arc, age at the time of injury, and time since surgery to be correlated with DASH scores. Pain, as rated according to the scales used in the ASES, and range of motion were independent predictors of patient-based outcome. In multivariable analysis, flexion-extension and age at the time of trauma predicted 40% of the DASH

- 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 413.

scores. Pain and posttraumatic arthrosis were independent predictors of both MEPI and B&M scores in the multivariable models, which respectively explained 80% and 97% of the variation in scores.

Conclusions: As expected, 22 years after a simple olecranon fracture 95% of patients have a satisfactory outcome according to physician-based MEPI and patient-based DASH scores, despite removal of symptomatic hardware in the majority of patients. It is remarkable that pain did not explain any of the variation in DASH scores in Dutch patients while pain seems to be the most important predictor of perceived disability in United States–based studies. Pain and arthrosis are important predictors of the objective outcomes of MEPI and B&M.

See pages 75 - 103 for financial disclosure information.

Prevention of Iatrogenic Damage of the Axillary Nerve in Proximal Humeral Surgery by Defining a Radiographic Safe Zone Preoperatively

(FDA=Non-U.S. research conducted within guidelines of my country)

***Hilco P. Theeuwes, MD*[1]**; *Jan-Willem Potters*[1]; *Victor A. de Ridder, MD*[2]; *Gert Bessems, MD*[1]; *Bert Kerver, MD*[2]; *Gert J. Kleinrensink, MD*[1];
[1]*Erasmus Medical Center, Rotterdam, The Netherlands;*
[2]*Sint Franciscus Hospital, Rotterdam, The Netherlands*

Background: Fractures of the proximal humerus are responsible for 4% to 5% of all fractures. The most extensively used operative devices are plate osteosynthesis and intramedullary nail fixation with a proximal locking bolt. Both devices can cause iatrogenic injury of the axillary nerve.

Purpose: The purpose of this anatomical study is to define a safe zone preoperatively with radiological parameters.

Methods: The following procedure was performed in 10 embalmed shoulders. First, the deltoid muscle was dissected from the clavicle. Then the axillary nerve was identified together with its branches and was marked with clips and radio-opaque wires. The muscle was then reattached to its anatomical position. Standard AP radiographs were made with the forearm in endorotation position and exorotation. With these radiographs, the distance between the cranial tip of the humeral head and the axillary nerve and its branches was measured.

Results: The median distance from the cranial tip of the humeral head to the axillary nerve is 52 mm (standard deviation, 4.5 mm; range, 48-58 mm) measured on the AP radiograph in 90° exorotation. The mean number of branches to the deltoid muscle is three. The distances vary from 23 to 78 mm. The median distance from the first proximal branch measured from to the humeral head is 36 mm (n = 10; range, 24-48 mm), to the second branch, 54 mm (n = 10; range, 40-66 mm); to the third branch, 47 mm (n = 6; range, 45-52 mm); and to the fourth branch, 73 mm (n = 3; range, 58-78 mm).

Conclusion: There are many variations in the course of the axillary nerve and its branches. With the insertion of an intramedullary nail from the proximal side of the humerus or by placing a locking plate and screws, the surgeon has to reckon with the course of this clinically important nerve. It is unsafe to place the locking bolts in the zone between 24 mm and 78 mm from the humeral head with the arm in 90° exorotation. The greatest chance to damage the main branch of the axillary nerve is in the zone between 48 and 58 mm. By determining the risk zone preoperatively with radiographic imaging, axillary nerve damaging can hopefully be avoided.

Discussion: This study provides a method to avoid damage to the axillary nerve and its branches. In contrast to the existing literature, the appropriate location is measured from the tip of the humeral head. There are several reasons to use the humeral head instead of the acromion. First, the distance between the humerus and the acromion can vary due to the preceding trauma, relaxation of the deltoid muscle, or by manipulation of the arm. Secondly, from an anatomical perspective, the position of the axillary nerve is determined by the position of the humerus due to the connection to the deltoid muscle.

- 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 413.

Do Traction Views of Distal Radius Fractures Influence Fracture Characterization and Treatment?

Elan Goldwyn, MD; *Robert V. O'Toole, MD; Raymond Pensy, MD; Jordan Hoolachan, BS; Renan C. Castillo, PhD; Christopher LeBrun, MD; Theodore T. Manson, MD; Jason W. Nascone, MD; Marcus F. Sciadini, MD; W. Andrew Eglseder, MD;*
R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland Medical School, Baltimore, Maryland, USA

Purpose: Our center utilizes a protocol in which all distal radius fractures are evaluated with traction radiographs prior to splinting. Although there are some preliminary data supporting the use of CT scans to evaluate distal radius fractures, no data are available regarding the much cheaper alternative of traction films. Our hypothesis was that traction radiographs change inter- and intraobserver variability for both injury description and treatment plans.

Methods: Radiographs from 50 consecutive patients with distal radius fractures that met inclusion criteria at a single Level 1 trauma center were used to create 2 image sets for each patient. Set 1 included injury and splint radiographs and set 2 had the images from set 1 plus traction radiographs. The image sets were stripped of all demographic data, and presented in random order to 7 fellowship-trained (5 trauma, 2 hand) orthopaedic surgeons. The surgeons independently answered 10 questions for each of the 100 image sets regarding the description of the injury (eg, "Is the fracture intra-articular?") and the management of the patient (eg, "Operative or nonoperative treatment?"). Analyses used kappa statistics, which correct for chance agreement, to evaluate interobserver variability. Intraobserver variability was assessed using McNemar tests, and adjusted for clustering using the Durkalski method.

Results: Traction films improved the level of agreement between surgeons (interobserver) for 6 of the 10 questions. When comparing each surgeon to himself (intraobserver variability), two of the questions were significantly changed. The observation of intra-articular fragments requiring reduction increased with the use of traction films from 38.3% to 53.1% ($P < 0.05$), while the need to obtain a CT scan for further evaluation decreased from 21.7% to 5.1% ($P < 0.001$) when using traction films. No other question reached statistical significance.

Conclusion: As has been previously shown with CT scans, traction films appear to affect surgeons' interobserver variability when evaluating distal radius fractures. Additionally, traction films had a large effect on the surgeons' ability to detect intra-articular fragments requiring reduction, as well as the need for additional information from a CT scan. These data indicate that traction films may provide some benefits of CT scans at a fraction of the cost and argue for further research comparing CT scans and traction films of the distal radius.

See pages 75 - 103 for financial disclosure information.

Results of a New Multidirectional Intramedullary Implant Treating Transverse and Comminuted Olecranon Fractures and Nonunions

Scott G. Edwards, MD[1]; *Evan Argintar, MD*[1]; *Thomas F. Varecka, MD*[2];
[1]*Georgetown University Hospital, Washington, DC, USA;*
[2]*University of Minnesota, Minneapolis, Minnesota, USA*

Purpose: Hardware irritation and removal has been a common complication of traditional olecranon fixation. The theoretical advantages of intramedullary nailing for olecranon fractures is less risk of soft-tissue irritation and resulting hardware removal. The purpose of this study is to evaluate a new multidirectional intramedullary implant indicated for both transverse and comminuted olecranon fractures. This is the first clinical report of this particular type of implant.

Methods: 28 consecutive patients with displaced olecranon fractures underwent open reduction and internal fixation using a multidirectional intramedullary implant. Of the 28 fractures, 15 were transverse, 7 were comminuted, 3 of which also involved the coronoid, and 6 were nonunions. Average patient age was 45 years (range, 25-65 years). Patients were immobilized for 3 to 5 days postoperatively, after which motion was allowed. Strengthening was initiated at 6 weeks. Motion was measured at 4 weeks and 8 weeks. Strength was tested at 8 weeks using a triceps extension maneuver with resistance. Radiographs were taken at each follow-up visit until union. Operative time, complications, and subjective complaints were noted.

Results: Average operative time was 25 minutes. At 4 weeks, patients demonstrated average extension-flexion of 20º to 115º with full supination and pronation compared to the contralateral side. At 8 weeks, all patients were within 10º of full extension-flexion and were able to extend 85% of weight compared to the contralateral side. All fractures progressed to radiographic union by 6 weeks. There were no incidences of infection, triceps extension problems, or hardware failure or irritation. No patients were lost to follow-up.

Conclusions: This new multidirectional intramedullary implant appears to be a safe and effective method to stabilize transverse and comminuted olecranon fractures and nonunions. It allows for early motion for both stable and unstable fracture patterns without loss of fixation. Good outcomes in terms of motion, strength, and union may be expected within 8 weeks after 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 413.

Surgeon Perceptions of Patient Outcomes Regarding Proximal Ulna Internal Fixation

Scott G. Edwards, MD[1], *Thomas F. Varecka, MD*[2], *Mark S. Cohen, MD*[3];
[1]*Georgetown University Hospital, Washington, DC, USA;*
[2]*University of Minnesota, Minneapolis, Minnesota, USA;*
[3]*Rush Medical Center, Chicago, Illinois, USA*

Purpose: This study was undertaken to define actual removal rates of proximal ulna fixation, assess patient overall satisfaction with their fixation, and compare these realities with current surgeon perception.

Methods: 556 surgeons from 3 orthopaedic subspecialty societies completed an online survey investigating their beliefs regarding proximal ulna internal fixation. 273 patients who underwent internal fixation for proximal ulna fractures at 3 trauma centers during 2003-2005 were retrospectively evaluated in a chart review. These patients were contacted by phone and asked questions regarding their proximal ulna fixation. Patient-reported results were compared to surgeon perceptions.

Results: 67% of surgeons believe their fixation removal rates are the same as other surgeons, while 31% believe their rates are lower. The majority of surgeons (71%) believe that patients require removal of hardware less than 30% of the time. Actual patient removal rates were 82%. The majority of these patients (68%) elected to remove their hardware between 2 and 5 years after implantation. 74% of patients report that the surgeons who eventually removed their fixation were not the surgeons who implanted the fixation. 35% of patients reported that they were never offered removal as an option. Of the patients who still retain their hardware, 92% reported irritation; 54% of these patients plan on having it removed sometime in the future.

Discussion/Conclusion: Most surgeons vastly underestimate the actual irritation of fixation and consequent removal rates (73%-84%). Most patients elect to remove hardware several years after implantation and choose a different surgeon to perform the removal, which may lead the implanting surgeons to believe that their patients are more satisfied than they really are. Even patients who do not elect to remove their fixation appeared to be bothered by its presence. The authors challenge surgeons to become more aware of this problem in their practices.

See pages 75 - 103 for financial disclosure information.

Latent Class Analysis to Determine the Accuracy of Diagnostic Tests for Suspected Scaphoid Fractures

Geert A. Buijze, MD[1] (Netherlands Organisation for Scientific Research);
Wouter H. Mallee, MD[2]; Frank J.P. Beeres, MD, PhD[3]; Steven J. Rhemrev, MD[3];
Tim Hanson, PhD[4]; Wesley O. Johnson, PhD[4]; C. Niek van Dijk, MD, PhD[2];
***David C. Ring, MD, PhD**[1];*
[1]Massachusetts General Hospital, Harvard Medical School,
Boston, Massachusetts, USA
[2]Orthopaedic Research Center Amsterdam, Amsterdam, Netherlands
[3]Medical Center Haaglanden, The Hague, Netherlands
[4]University of California, Davis, California, USA

Background: Latent class analysis can be used to study diagnostic performance characteristics when there is no consensus reference standard. This study used data from two prospective cohort studies of the triage of suspected radiographically occult scaphoid fractures to compare the diagnostic performance characteristics calculated using standard formulas (with a reference standard) and latent class analysis (with no reference standard).

Methods: One prospective cohort of 34 patients had both MRI and CT and the other cohort of 78 patients had MRI, bone scintigraphy, and several physical examination tests. The diagnostic values calculated by latent class analysis were compared to those calculated using reference standards.

Results: In the first trial, the sensitivity (Se) and specificity (Sp) of both the CT in the scaphoid planes (Se: 0.78 vs 0.67; Sp: 1.0 vs 0.96) and the MRI (Se: 0.8 vs 0.67; Sp: 0.93 vs 0.89) were systematically slightly superior in the latent class analysis than the reference standard calculations, and the prevalence was slightly higher (18.9% vs 17.6%). The reference standard (6-week radiography) scored relatively inferior diagnostic values in the latent class analysis (Se: 0.8; Sp: 0.97). In the second trial, the latent class analysis sensitivity and specificity were slightly inferior (Se: 0.97 vs 1.0; Sp: 0.86 vs 0.89) for bone scintigraphy, whereas for the MRI, the sensitivity was substantially superior and the specificity was slightly inferior (Se: 0.75 vs 0.96; Sp: 1.0 vs 0.99). Motion and strength test sensitivities of these five tests ranged between 0.68 and 0.71 in the latent class analysis versus a sensitivity of 1.0 with the reference standard.

Conclusions: The results of the latent class analysis for the three main diagnostic modalities (MRI, CT, and bone scintigraphy) were closer to the average diagnostic values found in the literature (based on variable reference standards) than the results with the use of an arbitrary reference standard. Latent class analysis suggested that the most commonly used reference standard (6-week radiography) was less accurate than the diagnostic modalities that were being evaluated, and may therefore not be a reliable reference standard. Our investigation suggests that latent class analysis can be a valuable tool for studying diagnostic accuracy study in the absence of a consensus reference standard.

- 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 413.

Articular Cartilage Skiving: The Concept Defined

Richelle Takemoto, MD; Mark Gage, BS; Leon Rybak, MD; ***Kenneth A. Egol, MD***
NYU Hospital for Joint Diseases, New York, New York, USA

Purpose: "Skiving" is a verb of Scandinavian origin that means "to remove the surface of". It has not yet been defined or evaluated in the orthopaedic literature, but is used in common orthopaedic vernacular to describe disruption of the intra-articular cartilage without gross joint penetration. The purpose of this study was to define the radiographic parameters of skiving and compare radiographs (both standard and specialized anatomic views) with CT for accuracy in determining joint skiving.

Methods: Eight human cadaver specimens were implanted with a fixed-angle volar plate and screws placed through the plate in one of three patterns: (1) no articular screw penetration, (2) intra-articular screw penetration, or (3) articular cartilage disruption without obvious intra-articular screw penetration (skiving). Radiocarpal arthrotomies were performed to definitively assess the position of the screws about the joint. Standard AP, PA, oblique, and lateral radiographs as well as specialized anatomic tilt PA, oblique pronated, and anatomic tilt lateral views were obtained. CT using 0.4-mm thickness slices was performed and images reconstructed in the sagittal and coronal planes. 12 observers reviewed each set of radiographs and CT scans. Readers evaluated the radiographs and CT scans and were asked to report whether or not articular skiving had occurred. A number between 1 and 10 was assigned to represent the degree of certainty of their assessment. The sensitivity, specificity, and accuracy were determined for each radiographic modality. Using coronal and sagittal CT reconstructions, a single senior radiology attending (L.R.) measured the distance between the tip of the screws judged at arthrotomy to be penetrating or skiving to the surface of the adjacent subchondral plate.

Results: The sensitivity, specificity, and percent correct interpretations were 53%, 83%, and 60%, respectively, for standard and anatomic tilt radiographs; and 100%, 72%, and 69% for CT with 0.4-mm thickness slices. Radiographs were found to be less sensitive, but more specific than CT. Screws defined as penetrating the articular surface protruded an average distance of 2.3 mm beyond the subchondral plate (range,2-2.6 mm), whereas those found to be skiving the surface of the joint protruded an average of 1.4 mm (range, 1-1.8 mm) beyond the subchondral plate on CT.

Conclusion: Radiographs, including anatomic tilt views, have greater specificity but lower sensitivity in determining the presence or absence of skiving as compared to CT. CT, on the other hand, although more sensitive than plain radiographs, suffers from low specificity. This result suggest that the surgeon relying on plain radiographs may miss cases of skiving and the surgeon using CT alone may be taking back too many patients for unnecessary exploration. A combination of plain radiographs and CT should be used when evaluating these patients for the presence of skiving.

See pages 75 - 103 for financial disclosure information.

Accuracy of Detecting Screw Penetration of the Radiocarpal Joint following Volar Plating Utilizing Plain Radiographs versus Computed Tomography

Richelle Takemoto, MD; Mark Gage, BS; Leon Rybak, MD; ***Kenneth A. Egol, MD***
NYU Hospital for Joint Diseases, New York, New York, USA

Purpose: The objective of this study was to compare standard and specialized plain radiographs with CT for their ability to detect screw penetration of the distal radius articular surface in volar plating.

Methods: Eight human cadaveric specimens were implanted with a fixed-angle volar plate and five screws. The decision to penetrate the joint with screws was assigned randomly. Radiocarpal arthrotomies were performed to definitively assess the joint for penetration. Three groups were evaluated: (1) no articular screw penetration, (2) intra-articular screw penetration, and (3) articular cartilage disruption without obvious intra-articular screw penetration. Radiographs including standard AP, PA, oblique, and lateral views as well as anatomic tilt PA, 45° oblique pronated, and anatomic tilt lateral views were obtained of each specimen. CT using 0.4-mm thickness slices were obtained and images were reconstructed in the sagittal and coronal planes. 12 observers reviewed each set of radiographs and CT scans. The radiographs and CTs were evaluated based on whether or not articular penetration occurred. A number between 1 and 10 was assigned to represent the degree of certainty of each observer's assessment. The sensitivity, specificity, and accuracy of each radiographic modality were evaluated.

Results: The sensitivity, specificity, and percent correct interpretations were 88%, 69.4%, and 81%, respectively, for standard and anatomic tilt radiographs; and 98%, 61%, and 84% for CT with 0.4-mm thickness cuts. CT was found to be much more sensitive in detecting screw penetration than plain radiographs, although the specificity and accuracy of the two tests were almost equivalent. The kappa statistic demonstrated "almost perfect interobserver agreement" based on CT readings, but only "substantial interobserver agreement" based on plain radiographs.

Conclusion: CT is more sensitive and achieves a higher kappa statistic than plain radiographs in detecting radiocarpal screw penetration after volar plating. However, plain radiographs are just as specific and accurate as CT in detecting screw penetration and can be used to rule out screw penetration.

- 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 413.

Increased Dorsal Flexor Pollicis Longus Pressure by Volar Plating of the Distal Radius: Effect of Plate Position and Profile

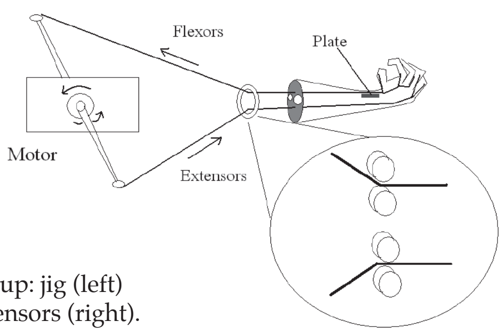
Meir Marmor, MD; *Amir Matityahu, MD; Suleiman Lapalme, BA; Hyun Kyu Han, MD; Jennifer M. Buckley, PhD; Lisa Lattanza, MD;*
University of California San Francisco, San Francisco, California, USA

Purpose: This study examined the dorsal pressure on the flexor pollicis longus (FPL) tendon caused by volar plating of the distal radius. We hypothesized that plate position beyond the watershed line of the distal radius as well as increased plate thickness (profile) will increase pressure on the FPL tendon.

Methods: Seven intact cadaveric forearms were harvested and the distal radii were plated using a standard volar approach. The forearms were mounted to a jig, which allowed cyclical full flexion and extension of the thumb. The wrist was fixed at 25° or 60° of extension. A Tekscan sensor was attached to the plate and used to measure the peak contact pressure (PCP) between the plate and the FPL tendon. Testing was repeated with the plate just proximal to and 4 ± 1mm distal to the watershed line. In each position, plate profile was increased by lifting the plate 1 mm and 2 mm off the bone.

Results: Increasing wrist extension from 25° to 60° did not affect tendon-plate contact pressures in all plate positions($P > 0.10$). When placed proximal to the watershed line, increasing plate prominence did not influence PCP (0.42 ± 0.9 MPa vs 0.29 ± 0.58 MPa, 0.07 ± 0.07 MPa when 1-, 2-mm proud). Moving the plate distal to the watershed line increased contact area between the tendon and the plate by 23.2% ($P < 0.05$) with a similar PCP (0.42 ± 0.9 MPa vs 0.34 ± 0.64 MPa, $P > 0.10$). However, PCP increased when the plate was both distal and 1 mm (0.29 ± 0.58 MPa vs 0.36 ± 0.67 MPa, $P = 0.06$) or 2 mm (0.07 ± 0.07 MPa vs 0.51 ± 0.79 MPa, $P = 0.04$) elevated.

Conclusion: The thickness of volar plates placed proximal to the watershed line of the distal radius does not influence FPL dorsal tendon pressures. However, when a volar plate is placed distal to the watershed line, increased thickness of the plate significantly increases dorsal FPL tendon pressure and the contact area between tendon and plate. Therefore, volar plates should be placed up to but not distal to the watershed line of the distal radius. This may help avoid the complications of tendon ischemia, irritation, and/or rupture.



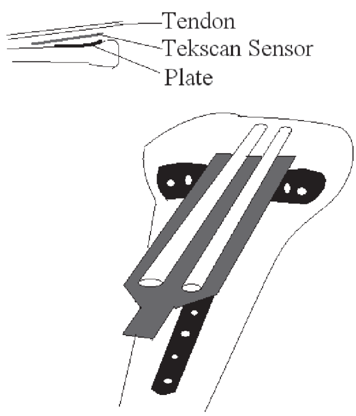


Fig. 1 Test set up: jig (left) and pressure sensors (right).

See pages 75 - 103 for financial disclosure information.

Bacterial Adherence on Suture Materials

Brendan D. Masini, MD; *Daniel J. Stinner, MD; Scott M. Waterman, MD; Joseph C. Wenke, PhD;*
US Army Institute of Surgical Research, Fort Sam Houston, Texas, USA

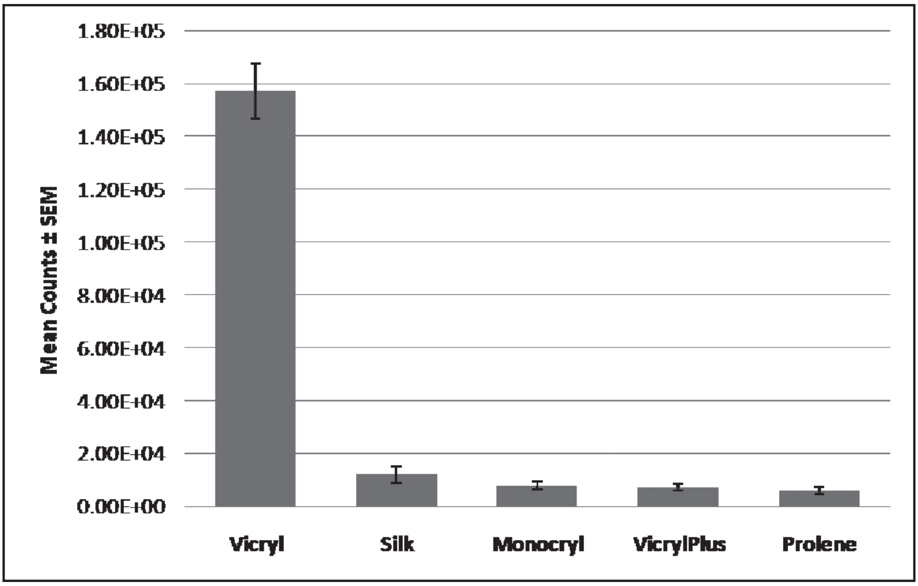
Purpose: Wound management is ubiquitous in trauma surgery. It follows that wound infections are widespread and problematic for all surgeons. Whether a practitioner is managing complex penetrating trauma or a minor laceration, there is a need for suture closure. Suture material is a surgeon-dependent variable and, while little objective data exist to guide the choice of suture, it is possible that this variable has a significant role in wound infection management. This study evaluates the bacterial adherence to commonly used suture materials with a bioluminescent in vitro model. The hypothesis was that braided suture materials have greater bacterial adherence.

Methods: 11 strands each of size 2-0 commercially available absorbable monofilament, absorbable braided, nonabsorbable monofilament, nonabsorbable silk, and antimicrobial impregnated, absorbable braided suture were immersed in a broth of *Staphylococcus aureus* (lux), which was genetically engineered to emit photons. After 12 hours in the broth, sufficient time for biofilm formation, the suture strands were irrigated with low-pressure normal saline and imaged with a photon-capturing camera system yielding a total residual bacterial count.

Results: The absorbable braided suture had the highest mean total counts and was statistically significant in its increased bacterial adherence versus all other tested suture materials. No other suture material was significantly different than any other, including the antimicrobial-impregnated absorbable braided suture.

Conclusions: Absorbable braided suture should not be used in the closure of contaminated wounds or in wounds that may be at higher risk for developing infection. This is consistent with current anecdotal clinical experience. In addition, the removal of all braided suture from infected wounds is an important part of débridement. The antibiotic-impregnated absorbable braided suture was similar to monofilament sutures; however, it should be used with caution in contaminated wounds as it will likely behave as its untreated counterpart as antibiotic elution diminishes over time. The physical properties required of the suture should guide selection; however, among sutures with similar physical properties, especially in the setting of wounds at risk for infection, the affinity for bacterial adherence should be taken into account.

- 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 413.



See pages 75 - 103 for financial disclosure information.

Bacterial Contaminant on Lead Garments in the Operating Suite

Brian F. Grogan, MD; *William C. Cranston, PA-C, MEd; Donna M. Lopez, RN;*
Christopher Furbee, PA-C; Clinton K. Murray, MD; Joseph R. Hsu, MD;
Skeletal Trauma Research Consortium (STReC);
Brooke Army Medical Center, San Antonio Uniformed Services Health
Education Consortium, Fort Sam Houston, Texas, USA

Purpose: This study tested the hypothesis that clinically relevant bacterial isolates exist on shared-use protective lead garments used in the operating suite at our institution.

Methods: All of the shared-use protective lead garments (vests, skirts, and thyroid shields) used in the operating room at our institution were collected and sampled. Designated 5 × 5-cm areas were sampled using premoistened swabs. The areas sampled were selected because of their proximity to the edges of coverage by a sterile surgical gown and/or their proximity to the skin of the surgeon or operating suite staff. Samples were taken from vests midline at the collar and hem on the front and back. Skirt samples were obtained from the midline at the waist and hem on the front and back. Thyroid collars were sampled in the midline at the center of the collar on the front and back. No attempt outside of the normal hospital protocol was made by operating suite staff or housekeeping staff to clean or sanitize the garments prior to culture collection. The usual cleaning protocol is spot-cleaning of gross contamination as needed and weekly cleaning with Metrex CaviWipes Disinfecting Towelettes on Friday nights. Sample collection was conducted on a Thursday night. Swabs were sent to the clinical laboratory for bacterial isolation, identification, and comparison with historical clinical isolates. All isolates were identified using the lab's standard microbiological techniques. We planned to compare the genotypic relatedness of clinically relevant isolates recovered from the garments to a repository of isolates previously collected from infected surgical patients.

Results: Of 182 total collected swabs, bacteria were isolated on only 5 (2.7%) of the samples. Coagulase-negative staphylococcus alone was identified on 3 samples. The remaining 2 samples grew coagulase-negative staphylococcus and gram-positive rods. The collection sites for these isolates were from the lead apron, midline, bottom outer surface (3), lead thyroid shield midline, inner surface (1), and lead skirt midline, bottom inner surface (1). Since the identified isolates represent common skin flora, they were not sent for further antimicrobial susceptibility testing or genetic characterization.

Conclusion: Over 97% of the collected samples were negative for bacterial growth. The remaining isolates were consistent with common skin flora. No multidrug-resistant bacteria such as methicillin-resistant *Staphylococcus aureus*, or gram-negative bacteria such as *Escherichia coli, Acinetobacter, Klebsiella,* or *Pseudomonas* were identified on any garments. No link between isolated organisms and historical patient-infected isolates was established. Standard cleaning procedures currently in place at our institution appear to be an effective way to prevent growth of bacteria on shared-use protective lead garments used 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 413.

Δ The Effects of Hypothermia and Mediators on Skeletal Muscle Function in Ischemia-Reperfusion Injury

Daniel Stahl, MD; *Nicholas Souder, MD; Binu Tharakan, PhD;*
Robert Probe, MD; Russell Ward, MD;
Scott & White Hospital/Texas A&M Health Sciences Center, Temple, Texas, USA

Purpose/Background: Ischemia reperfusion injury can have detrimental results on skeletal muscle. We have shown that vessel permeability can be minimized in a hypothermic setting and also by administrating the nitric oxide synthase (NOS) stimulator, L-arginine, at physiologic temperatures. The purpose of this study was to examine and compare skeletal muscle contractility following an ischemia-reperfusion insult during hypothermic conditions, warm conditions, and also with the administration of L-arginine at physiologic temperatures. We hypothesized that hypothermia and L-arginine administration will also demonstrate protective effects to skeletal muscle contractility.

Methods: Using Sprague-Dawley rats, the extensor digitorum longus muscle was rotated on its vascular pedicle to a thermo-controlled stage. Ischemia was established using an atraumatic femoral artery tourniquet. Muscle contractility was then quantified by using a tissue bath stimulator with force transducers. Contractility was determined after reperfusion with sham rats and also during warm and hypothermic conditions, and the administration of NOS inducers (L-arginine) at warm conditions.

Results: Warm reperfusion resulted in marked decrease in muscle contractility compared with sham animals. Local hypothermia showed statistically significant preservation of contractility compared to the sham group. This protective effect was recapitulated by the application of NOS inducers (L-arginine) at warm conditions.

Conclusions: These findings demonstrate that hypothermia and L-arginine are protective of skeletal muscle contractility following an ischemia reperfusion injury. The results presented may have profound effects on future therapeutic recommendations and suggest possible pathways for clinical intervention to modulate ischemia reperfusion injury, which is commonplace in orthopaedic trauma and reconstructive surgery.

Δ OTA Grant
See pages 75 - 103 for financial disclosure information.

Preliminary Evaluation of Blood Serum Levels of Procollagen Type I N-Terminal Propeptide (PINP) as an Indicator of Fracture Healing

Travis A. Burgers, PhD[1]; *Marlon O. Coulibaly, MD*[2]; *James Mason, PhD*[1];
Debra L. Sietsema, PhD[1,3,4]; *Bart Williams, PhD*[1]; *Clifford B. Jones, MD, FACS*[1,3,4];
[1]*Van Andel Research Institute, Grand Rapids, Michigan, USA;*
[2]*Grand Rapids Medical Education and Research Center, Grand Rapids, Michigan, USA;*
[3]*Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA;*
[4]*Michigan State University, Grand Rapids, Michigan, USA*

Purpose: Femoral shaft fractures are common and the development of nonunions occurs in 1% to 25% of patients. Nonunion diagnosis is partially based upon radiographic imaging, which can be inconclusive secondary to imaging and remodeling limitations. Newer methods to diagnose nonunion allow for early treatment, which can potentially prevent lengthy disability and extensive reconstructive surgery. This study was designed to examine whether procollagen type I N-terminal propeptide (PINP), a blood serum marker, can be used as a measure of fracture healing and metabolism.

Methods: 12-week-old male and female C57/BL6 mice were used in this study. A closed middiaphyseal femoral fracture was induced after retrograde insertion of a 25G intramedullary pin under sterile conditions (group 1) (Fig. 1). An age- and gender-matched group without fracture served as a control group (group 2). Blood collection in each animal was conducted before fracture and on days 7 and 11 postfracture. Serum analysis for PINP levels were performed using a commercially available rat/mouse PINP enzyme immunoassay. Statistical significance was based on Student *t* tests with significance level at $P < 0.05$.

Fig. 1 *Fracture induced in mouse femur.*

Results: Group 1 included 3 male and 4 female animals with a weight of 21.8 ± 3.2 g (average ± standard deviation). Group 2 included 4 males and 4 females with a weight of 23.4 ± 3.4 g. There was no significant difference in baseline demographic data between groups. Serum PINP levels before fracture and at day 7 postfracture showed no significant differences between groups ($P > 0.05$). Significant differences in PINP expression between group 1 and group 2 at day 11 postfracture were noted ($P = 0.020$) and corresponded to radiographic callus formation. Group 1 showed higher concentrations of PINP (group 1, 24.7 ± 4.6 ng/mL; group 2, 15.9 ± 3.7 ng/mL). On day 11 postfracture, the PINP level in both the males and females was significantly higher in group 1 than in group 2 (male: group 1, 24.9 ± 1.8 ng/mL; group 2, 13.7 ± 2.5 ng/mL; $P = 0.041$; female: group 1, 29.3 ± 3.6 ng/mL; group 2, 18.1 ± 3.6 ng/mL; $P = 0.008$).

Conclusion: PINP has potential as a blood serum measure for proper healing when applied at the correct time interval. Early after fracture (day 7), no significant difference was measured in PINP concentration between mice with fractured and intact femurs. Later after fracture (day 11), significantly higher concentrations of PINP in mice were measured, reflecting collagen type I synthesis and callus formation. Further studies are needed to investigate the optimum timing interval and concentration threshold; to correlate to callus size and remodeling; and to correlate patient size, sex, and concentration of PINP to fracture results (healed, delayed, or nonunion).

- 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 413.

Real-Time Monitoring of BMP Signaling during Weight Sharing of Tibia and Fibula with an External Fixator

(FDA=Non-U.S. research conducted within guidelines of my country)

Job N. Doornberg, MD, PhD[1]; *Rutger van Bezooijen, PhD*[2]; *Ivo Que, MSc*[2];
Erik Kaijzel, PhD[2]; *Clemens W.G.M. Löwik, PhD*[2]; *Peter Kloen, MD, PhD*[1];
[1]*Orthotrauma Research Center, Amsterdam, The Netherlands;*
[2]*Leids Universitair Medisch Centrum, Leiden, The Netherlands*

Background: A growing body of evidence indicates that mechanical cues modulate the development and repair of skeletal tissue by regulating gene expression. For example, BMP-3 is upregulated with mechanical stimulation. Mechanical cues can selectively modulate osteogenesis in vivo and suggest a potential basis for treatment of fractures. A limitation of existing data is that these studies are limited to the analysis of fixed material. We hypothesize that mechanical unloading of tibia and fibula due to weight "sharing" in an external fixator results in decreased BMP (bone morphogenetic protein) transcriptional activity as compared to the full weight-bearing contralateral limb.

Methods: The murine model used in this study facilitates real-time monitoring of BMP Smads transcriptional activity. Transgenic BRE:gfp reporter mice were obtained from the Hubrecht Institute (courtesy of Professor Christine L. Mummery). The expression of green fluorescent protein (GFP) reveals sites where BMP Smad-dependent transcriptional activity is present. The GFP signal was measured under general anesthesia using noninvasive IVIS 200 Spectrum. GFP signal was quantified using Living Image software. Nine BRE-GFP mice were used. Mice were allowed unrestricted activity. A mini-external fixator fixed to the proximal and distal tibia was applied under general anesthesia on day 0. The animals were permitted full weight bearing and unrestricted activity after awakening from anesthesia. The GFP signal of tibia and fibula in bilateral limbs was measured on days 1, 3, 7, 10, and 14 after application of the external fixator.

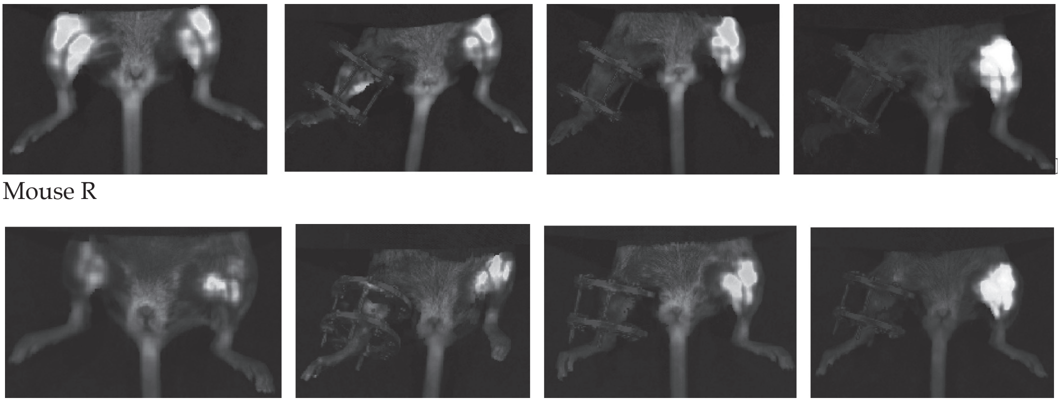
Results: Baseline measurements of the GFP signal ranged from 6.8 × 10e9 photons to 3.1 × 10e10 photons between individual mice. After application of the external fixator, the GFP signal of the unloaded tibia and fibula decreased in all mice to on average 87% of baseline on day 1 (standard deviation [SD] ± 23%, $P = 0.07$), 71% on day 3 (SD ± 31%, $P < 0.05$), 71% on day 7 (SD ± 41%, $P < 0.05$), 80% on day 10 (SD ± 41%, $P = 0.09$), and 71% on day 14 (SD ± 23%, $P < 0.01$). In the contralateral nonoperated limb, the GFP signal increased to an average 129% on day 1 (SD ± 88%, $P = 0.17$), 154% on day 3 (SD ± 85%, $P < 0.05$), 164% on day 7 (SD ± 105%, $P = 0.05$), 150% on day 10 (SD ± 58%, $P < 0.05$) and 172% on day 14 (SD ± 82%, $P < 0.05$).

Conclusions: Real-time monitoring of BMP signaling during unloading of the mouse tibia and fibula by means of weight sharing with application of an external fixator reveals decreased BMP transcriptional activity. This might affect bone fracture healing when a fixator is applied for external fixation of a fracture. Real time monitoring of BMP transcriptional activity of the contralateral nonoperated limb shows increased expression of BMP, probably due to increased compensatory weight bearing.

See pages 75 - 103 for financial disclosure information.

Figures:

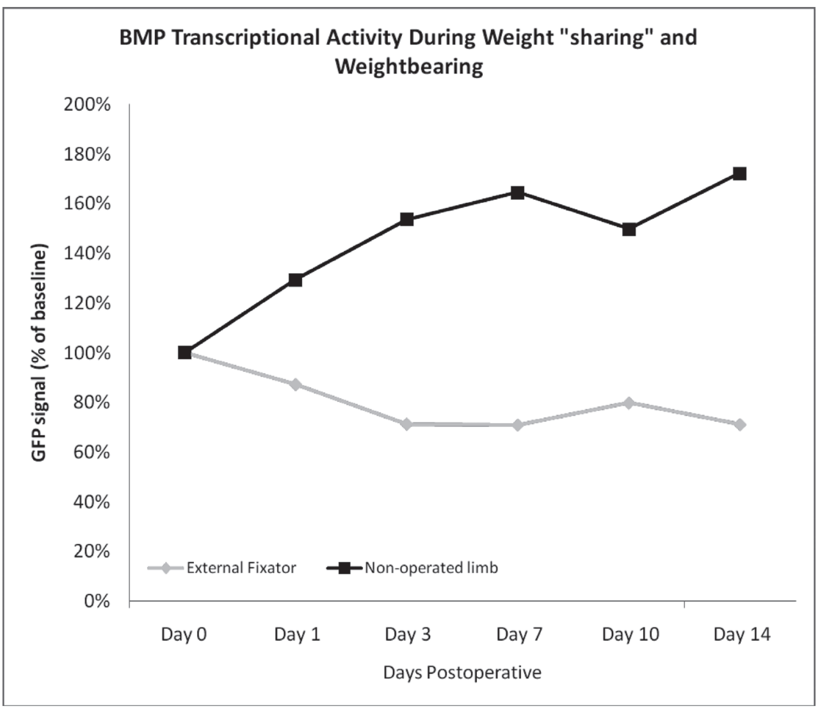
Preop Day 0 Day 3 Day 14



Mouse R

Mouse zero

Green fluorescent protein (GFP) signal before and after application of an external fixator to evaluate BMP transcriptional activity during weight "sharing" of tibia and fibula with the fixator. One can appreciate that after application of the external fixator, the GFP signal of the unloaded tibia and fibula decreased over time. In contrast, the GFP signal in the contralateral nonoperated limb increased. This experiment shows in vivo that weight "sharing" results in decreased BMP signaling, while simultaneous increased weight bearing of the contralateral results in increased BMP transcriptional 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 413.

Atorvastatin Is Beneficial for Muscle Reinnervation after a Complete Sciatic Nerve Section in Rats

(FDA=Non-U.S. research conducted within guidelines of my country)

Jonah Hebert-Davies, MD; *Fredric-Charles Cloutier, MD; Dominique Rouleau, MD; Pierre Beaumont, MD; Eric Beaumont, PhD;*
Université of Montréal, Division Chirurgie Orthopédique, Hôpital du Sacré Cœur, Montréal, Québec, Canada

Purpose: Nerve regeneration and functional recovery are often incomplete after peripheral neurotmetic lesion. The aim of this study was to determine if the systemic administration of atorvastatin is effective in promoting functional muscle reinnervation.

Materials: Female Sprague-Dawley rats were used in this study. A complete right sciatic nerve section using scissors was done. End-to-end microsuture repair (0-180°) was performed in every nerve and fibrin glue was added. Two groups were studied: (1) sutures (S) + fibrin glue (F) only, and (2) S + F + atorvastatin administration for 14 days. The left uninjured hindlimb was used for the (3) control group. Five months later, the sciatic nerve and the gastrocnemius muscle were dissected to perform in vivo electrophysiological measurements.

Results: 16 rats were used in this study. Electromyographic activity and muscle force were measured following the nerve stimulation proximal to the lesion site and compared between groups. The group with S + F alone (1) (0.77 mV; 28.56g) was significantly lower compared to the atorvastatin group (2) (2.91 mV; 85.1g) and the control group (3) (3.29 mV; 77.14g).

Conclusion: Five months after a neurotmetic lesion, the recovery is incomplete when using S + F only. Furthermore, the systemic administration of atorvastatin for 14 days postlesion is beneficial in reestablishing the muscle force and the electromyographic activity at the uninjured level.

See pages 75 - 103 for financial disclosure information.

Multiplanar Fixation of a Locking Plate in the Diaphysis Improves Construct Strength

Patrick J Denard, MD[1]; Josef Doornink, MS[2]; Steven M. Madey, MD[2];
Daniel C. Fitzpatrick, MD, MS[3]; ***Michael Bottlang, PhD[2]****;*
[1]Department of Orthopaedics and Rehabilitation, Oregon Health & Science University, Portland, Oregon, USA;
[2]Legacy Biomechanics Laboratory, Portland, Oregon, USA;
[3]Slocum Center for Orthopaedics, Eugene, Oregon, USA

Purpose: Diaphyseal fixation using locking plates shows higher than expected failure rates. This may be secondary to weakness in torsion because of the uniplanar screw configuration seen in most plating systems. Multiplanar diaphyseal fixation using a staggered screw hole configuration may improve the torsional strength of diaphyseal fixation of both unicortical and bicortical constructs. This biomechanical study evaluated plate fixation in validated osteopotoric and nonosteoporotic surrogates of the femoral diaphysis.

Methods: Generic custom manufactured titanium plates were applied to validated osteoporotic and normal bone diaphyseal surrogates. Plates were secured using either unicortical or bicortical screws in either a uniplanar or multiplanar configuration. Five specimens in each group were loaded to failure in torsion. The primary outcome measure was construct strength as assessed by the peak torsional moment. Construct failure modes were also recorded.

Results: In osteoporotic bone, multiplanar fixation was 32% stronger (P = 0.001) than uniplanar fixation when unicortical screws were used and 9% stronger (P = 0.02) when bicortical screws were used. In nonosteoporotic bone, multiplanar fixation was 55% stronger (P < 0.001) than uniplanar fixation when unicortical screw were used and 42% (P < 0.001) stronger when bicortical screws were used.

Conclusion: Multiplanar fixation improves torsional strength in diaphyseal bone relative to a uniplanar screw configuration in both osteoporotic and normal bone. Unicortical multiplanar screw fixation is equivalent to bicortical multiplanar screw fixation in nonosteoporotic bone. Unicortical screw fixation is much weaker than bicortical screw fixation in osteoporotic bone regardless of screw configuration and should be avoided. To improve torsional strength of locked diaphyseal fixation, we recommend obtaining multiplanar fixation with a plate that employs a staggered screw hole arrangement. The choice between unicortical versus bicortical screw fixation should be driven by bone quality, with bicortical screw fixation favored in osteoporotic bone.

- 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 413.

Increased Expression of Bone Sialoprotein is Associated with Early, Increased Mineralization by Young, but not Aged, Adipose-Derived Multipotential Progenitor Cells

***Patrick W. Whitlock, MD*[1]**; *Thorsten M. Seyler, MD*[1]; *David R. Marker, BS*[2]; *Casey L. Northam, BS*[1]; *Thomas L. Smith, PhD*[1]; *Lawrence X. Webb, MD*[3];
[1]*Wake Forest University Health Sciences, Winston-Salem, North Carolina, USA;*
[2]*Johns Hopkins University, Baltimore, Maryland, USA;*
[3]*MCMG/Mercer University, Macon, Georgia, USA*

Purpose: The use of adipose-derived multipotential progenitor cells (ADMPPCs) in conjunction with growth factors and a matrix or scaffold to regenerate bone is an area of intense interest because it has the potential to heal large bony defects and fracture nonunions commonly seen in trauma patients. If ADMPPCs are to be used clinically in patients of all ages, an understanding of how aging affects the osteogenic potential of these cells is required. The null hypothesis of this study was that there would be no difference in the ability of aged and young ADMPPCs to undergo osteogenic differentiation and to produce mineralization in vitro.

Methods: ADMPPCs were isolated from the inguinal fat pad of 4-month-old (young, n = 3) and 28-month-old (aged, n = 3) Fisher F344 rats using an approved ACUC (Animal Care and Use Committee) protocol. Proliferation of cells was assessed after 1, 2, 4, 6, and 8 days in culture. At 7, 14, and 21 days, osteogenic differentiation and mRNA expression of genes of interest were analyzed. Statistical significance was determined by Student *t* test, $P < 0.05$. All data were reported as the mean ± SEM (standard error of the mean).

Results: Young ADMPPCs (37,979 ± 8214 cells per well) proliferated at a greater rate than those from aged donors (19,271 ± 1166 cells per well) at day 4; $P < 0.05$. Both groups reached confluency and did not differ in cell number at day 8. Metabolic activity (MTS) was greater in the young versus aged cells both using the raw data ($abs_{490} = 0.513 \pm 0.020$ vs 0.335 ± 0.020), and that normalized to DNA content ($abs_{490} = 0.288 \pm 0.015$ vs 0.235 ± 0.014), $P < 0.05$. A significant increase in mineralization, assessed using the alizarin red assay, was observed at day 7 for young ($abs_{540} = 0.017 \pm 0.0008$, abs 540 nm) compared to aged cells ($abs_{540} = 0.013 \pm 0.0011$, abs 540 nm), $P < 0.05$. Significantly greater mRNA expression of bone sialoprotein was observed in young (2746 ± 407) compared to aged cells (1140 ± 393) at 21 days, $P < 0.05$.

Conclusion: In humans, young trauma patients and elderly, osteoporotic patients represent two distinct and clinically relevant populations in which bone regeneration using ADMPPCs may prove useful. Results of the present study suggest that young cells are capable of mineralization more quickly after differentiation than aged cells. This difference observed at day 7 may be due to the temporally associated increase in bone sialoprotein expression and that protein's role in the initial nucleation and mineralization of hydroxyapatite. Further studies are currently investigating the ability of these two populations of cells to mineralize scaffolds in vitro and in vivo.

See pages 75 - 103 for financial disclosure information.

An Analysis of Strategies to Increase External Fixator Stiffness: Is Double Stacking Really Worth the Money?

***Sara Strebe, MD*[1]**; *Robert V. O'Toole, MD*[1,2]; *Hyunchul Kim, MS*[2]; *Adam H. Hsieh, PhD*[2];
[1]*R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland Medical School, Baltimore, Maryland, USA*
[2]*Orthopaedic Mechanobiology Lab, Department of Bioengineering, University of Maryland, College Park, Maryland, USA*

Background/Purpose: External fixation spanning the knee is commonly performed to provide temporary fracture fixation. Keeping pins away from future surgical wounds creates a long distance to span with poor ability to resist deforming forces. Previous analyses from the 1980s identified factors increasing fixator stiffness (pin diameter, distance of frame to bone, distance between pins and fracture), but these factors are typically already optimized by the clinician. Our goal was to compare the mechanical benefit and cost of three commonly used strategies available to clinicians to increase external fixator stiffness.

Methods: A knee-spanning external fixator model was constructed using ultra-high molecular weight polyethylene pipe as a bone model, and a standardized Synthes external fixator. Stiffness was measured using an MTS machine in the linear portion of the force displacement curve for anterior-posterior (AP) bending, medial-lateral (ML) bending, torsion, and axial compression. We studied three variations from the standard construct: double stacking (adding a second set of pin-bar clamps and bars onto the existing pins), adding a cross-link between bars, and adding an additional oblique pin. Additional costs for each modification were also determined from 2010 list prices.

Results: Double stacking of the external fixation frame had the largest effect on stiffness with significant increases in AP bending (109% increase), torsion (35%), ML bending (22%), and compression (16%, all $P < 0.05$). Addition of an oblique pin increased axial compression (37%) and torsional stiffness (20%, $P < 0.004$). Addition of a cross-link increased only torsional stiffness (14%, $P < 0.05$). All other comparisons were not significant ($P > 0.60$). The baseline cost of the fixator was $6474 and additional costs were: oblique pin, 15%; cross-link, 28%; and double stacking, 84%. For the parameters with significant improvement in stiffness, the cost per 10% increase in stiffness ranged from $265 (cross-pin) to $3398 (double stacking) in axial loading.

Conclusion: All three techniques increased stiffness in torsion to varying degrees, but only double stacking increases stiffness in all four testing modalities ($P < 0.05$). An oblique pin adds more stiffness than double stacking in axial loading at relatively low cost, but confers no benefit in bending. Double stacking is most effective in providing resistance to bending, particularly in the AP plane. Clinicians can use these data to help guide the most cost-effective strategy to increase construct stability based on the plane in which stability is needed.

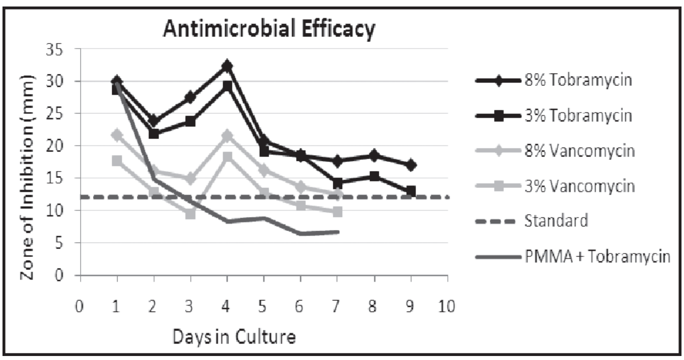
- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 413.

•In Vitro Antibiotic Elution Profile: Adhesive Polyurethane Bone Cement Compounded with Tobramycin/Vancomycin

Josh Murphy, MD[1]; *Eric Kolb, MS*[2]; *Naresh Akkarapaka, MS*[2]; *Martin Franzus, MS*[1]; *Thomas Moore, MD*[3]; *Timothy Ganey*[1];
[1]*Atlanta Medical Center, Atlanta, Georgia, USA;*
[2]*Doctors Research Group, Southbury, Connecticut, USA;*
[3]*Emory University, Atlanta, Georgia, USA*

Purpose: The goals of this study were to evaluate whether in vitro antimicrobial activity of tobramycin and vancomycin was retained after the antibiotics had been compounded with a closed-pore, porous foam bone cement and to determine the duration over which sustained release offered antibiotic potency. A structural bone graft with in situ curing properties that sustains antibiotic delivery would offer distinct advantages to trauma applications where complicated injuries and wound contamination present challenging conditions for surgical care.

Methods: Using the Kirby-Bauer method for antimicrobial efficacy, small antibiotic-impregnated wafers were placed onto a culture plate inoculated with *Pseudomonas aeruginosa* for the tobramycin assay and *Enterococcus faecalis* for the vancomycin assay. If the bacteria are sensitive to the antibiotic, a clear ring, or zone of inhibition, surrounds the wafer. The polyurethane foam carrier (Kryptonite Bone Cement, Doctors Research Group) was prepared per the manufacturer's instructions and, while in the liquid state, compounded with 3% and 8% vancomycin or tobramycin (0.5 g and 1.25 g per 10-cc kit), consistent with the dosing of US Food and Drug Administration (FDA)-cleared polymethylmethacrylate (PMMA) bone cements. The compound was molded to form 6-mm diameter × 2-mm thick wafers and the specimens were stored at room temperative for approximately 6 weeks prior to testing. Ten wafers and standards (tobramycin [10 ug/mL] and vancomycin [30 ug/mL]) were positioned on a bacteria plate and incubated overnight. The zones of inhibition were then measured to the nearest millimeter. Wafers that demonstrated antibiotic sensitivity were replanted in the same relative location on a fresh lawn of bacteria. This cycle was repeated every 24 hours until the wafer measured less effective than the standard.



Results: Both concentrations of tobramycin-impregnated wafers exhibited sustained bacterial resistance through 9 days. Similarly, vancomycin-dosed wafers at 8% concentration demonstrated inhibition greater than or matching the standard for 7 days, with the lower concentration wafers falling below the standard more abruptly (see figure). The inflection noted on day 4 is a result of inverting the wafers, which exposed a new surface for antibiotic elution. Data from a project of comparable design

See pages 75 - 103 for financial disclosure information.

with PMMA-impregnated cements demonstrated a loss of antimicrobial efficacy below the standard after 3 days.

Conclusion: The sustained potency demonstrated by the tobramycin-impregnated material, and to a lesser degree the vancomycin material, offers promise that these unique adhesive and porous materials also might provide protection from infection in trauma applications. In this in vitro study, Kryptonite Bone Cement exceeded the standard potency of the control to a greater degree and for a longer time than the current gold standard cements while at the same time providing a structural adjunct to the bone repair process.

- 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 413.

The Influence of Rotation on Femoral Neck-Shaft Angle Measurements in the Anatomic, Varus Malreduced, and Shortened Proximal Femur

Amir Matityahu, MD; *R. Trigg McClellan, MD; Meir Marmor, MD;*
University of California San Francisco, San Francisco General Hospital,
Orthopaedic Trauma Institute, San Francisco, California, USA

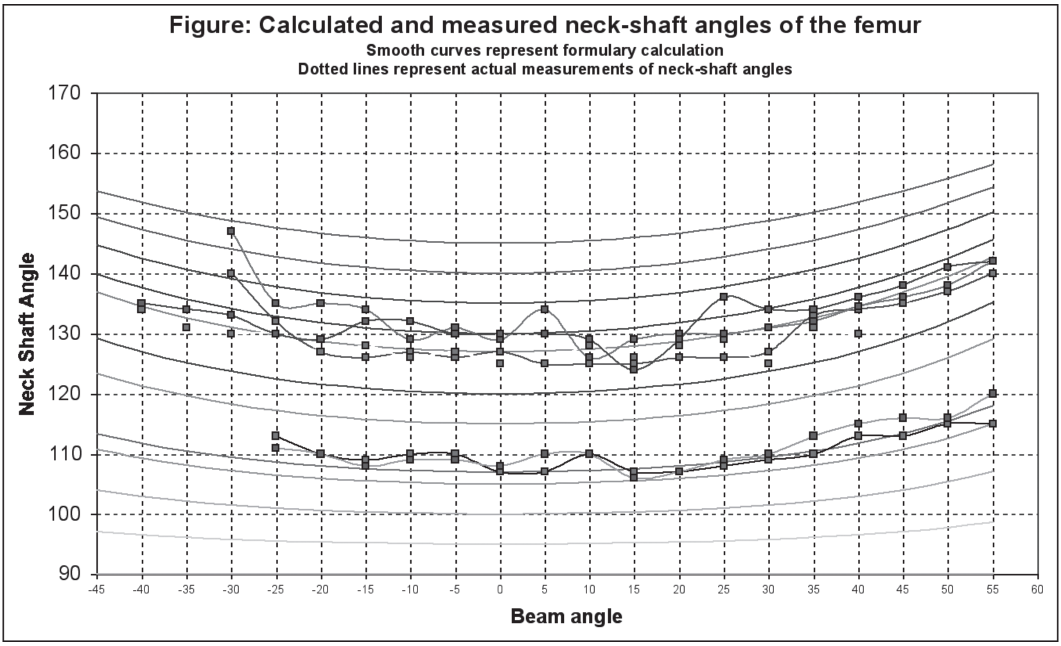
Purpose: Varus and malreduction of peritrochanteric fractures may lead to failures of fixation. In order to quantify the actual angle of the neck relative to the shaft (NSA), x-ray measurements have to be performed with the femur internally rotated to compensate for proximal femoral external rotation and version. Because most of our patients have radiographs taken with the femur in an externally rotated manner, the purpose of this study was to define the utility of in situ NSA measurements on the AP radiograph.

Methods: First, CT scans of 10 patients (20 hips) undergoing abdominal CT scans were assessed for the in situ rotation of the femoral neck relative to the scanner table. Then, femoral neck-shaft x-ray angles (NSA) of 3 Sawbones with intertrochanteric osteotomies were measured after they were subjected to anatomic reduction (AR), varus malreduction of 20° (VM), and shortening malreduction of 10 mm (SM). The proximal femurs were then rotated in 5° intervals from 45° of internal rotation to 50° of external rotation and radiographs performed. Two independent trauma-trained orthopaedic surgeons measured the femoral NSA using well-established techniques.

Results: The calculated CT angle of the neck of the femur relative to the scanner bed in the 10 patients' 20 hips averaged 23.4 ± 9.9° of external rotation. The measured NSA was 128° for the AR femur, 107.5° for the VM femur, and 127.5° for the SM femur. NSA measurements varied less than 5° with the beam angle less than 30° of external rotation but drastically increase with continued external or internal rotation for all groups. At 50° of external rotation, the average NSA was 137.5° for the AR femur, 115.5° for the VM femur, and 140.5° for the SM femur. At 30° of internal rotation, the average NSA was 143.5° for the NM femur, 131.5° for the SM femur, and 116.0° for the VM femur (Figure). The measured NSAs, when the femur is rotated, were correlated to the angles predicted from the following formula: NSA= $90 + \tan^{-1}$[vertical height/(offset*cos(beam angle))].

Conclusions: In the supine patient, if the femoral neck is externally rotated less than 30° relative to the AP x-ray beam, the NSA measurement error is within 5°. Therefore, when measuring the NSA of the proximal femur after reduction of proximal femur fractures, orthopaedic surgeons can rely on the NSA measurement derived from a plain AP radiograph.

See pages 75 - 103 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 413.

A New Effective Surgical Treatment for Displaced Femoral Neck Fractures

Antonio Moroni, MD; *Martha Hoque, PhD; Giovanni Micera, MD; Riccardo Orsini, MD; Fabrizio Sinapi, MD; Lucia Calbucci, MD; Elena Maccagnan, MD; Sandro Giannini, MD; Bologna University, Rizzoli Orthopaedic Institute, Bologna, Italy*

Purpose: There is currently no consensus on the best treatment for displaced femoral neck fractures and none of the available surgical options are optimal. With fixation, there is a high rate of postoperative revision due to avascular necrosis and nonunion. With hemiarthroplasty, a progressive deterioration is observed in the clinical results due to acetabular cartilage wear. Total hip arthroplasty, on the other hand, is linked to a relatively high incidence of dislocation. The purpose of this study was to assess the effectiveness of a novel surgical concept comprising the implantation of a polycarbonate-urethane acetabular component and a large-diameter metal head connected to a femoral stem.

Methods: 224 displaced femoral neck fractures were treated with an acetabular polycarbonate-urethane component, a large-diameter metal head, and either cemented (192) or uncemented femoral stems (32). The mean patient age was 83 years (range, 65-96). The acetabular component was fixed into a groove made with a special tool. No acetabular bone reaming was required.

Results: Rehabilitation was fast. There were no major complications and, in particular, no postoperative dislocations were reported. At a minimum follow-up of 2 years, radiographs showed good implant stability. The mean Harris hip score was 58 points after 1 month, increasing to 80 points at 2 years ($P < 0.05$). The range of motion was the same as in the intact hip. Only one patient was revised because of non–implant-related pain. This patient complained of pain in the surgically treated limb that was in actual fact related to spinal stenosis. Upon retrieval of the acetabular component, the synovial fluid appeared normal, and no adverse tissue reaction was observed. There was minimal wear on the articulating side of the component but backside wear was more severe.

Conclusion: The results of this study show that this new arthroplasty technology involving the use of a polycarbonate-urethane acetabular component in combination with large-diameter metal heads has the potential to revolutionize the surgical treatment of displaced femoral neck fractures. It combines the advantages of a low risk of dislocation and acetabular bone preservation associated with hemiarthroplasty, together with the same good functional results of total hip arthroplasty.

See pages 75 - 103 for financial disclosure information.

The Rate of Contralateral Proximal Femur Fracture Following Closed Reduction Percutaneous Pinning (CRPP) versus Arthroplasty in Treatment of Femoral Neck Fractures

Christopher D. Souder, MD; *Michael L. Brennan, MD; Kindyle Brennan, PhD; Christopher Chaput, MD; Johnathan Williams, BS;*
Scott & White Memorial Hospital, Temple, Texas, USA

Background: As the population ages, the number of proximal femoral fractures seen each year is expected to increase. Subsequent contralateral hip fractures have been reported to occur in as much as 11.8% of these patients after surgical fixation of the initial fracture, but it is unknown if this rate is similar between patients treated with different surgical procedures. The purpose of this study was to compare the rates of subsequent contralateral hip fracture in patients initially treated with closed reduction percutaneous pinning (CRPP) versus arthroplasty.

Methods: A retrospective comparative study was performed at a single institution where electronic medical records and digital radiographs of 1177 patients who underwent CRPP or arthroplasty for repair of a proximal femur fracture were reviewed. For the primary outcome of subsequent fracture, logistic regression model of analysis was applied. Age, gender, presence of diabetes, smoking history, and bisphosphonate use were recorded and analyzed independently using χ^2 or *t* tests.

Results: 495 patients treated with CRPP and 682 patients treated with arthroplasty met inclusion criteria. Patients who underwent CRPP were 2 times more likely to have a subsequent contralateral femur fracture compared to those who underwent arthroplasty (odds ratio, 2.106 and 1.000 (95% confidence interval, 1.351-3.232), respectively ($P = 0.0010$), with a contralateral fracture rate of 10.10% for CRPP and 5.57% for arthroplasty ($P = 0.0035$). Age ($P = 0.0001$), gender ($P = 0.0169$), and smoking grade ($P = 0.0161$) were found to be significantly different between the two surgical groups. The association between CRPP and increased rate of contralateral fracture was independent of the secondary variables.

Conclusion: Patients receiving CRPP as the initial treatment were found to have an increase risk of incurring a subsequent contralateral hip fracture when compared to patients undergoing treatment with arthroplasty. This information should be considered when trying to prevent future fractures and calculating overall costs associated with a particular surgical 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 413.

Assessment of Local Bone Quality and Implant Anchorage in the Humerus: Correlation Between High-Resolution CT Data and Mechanical Measurements

(FDA=Non-U.S. research conducted within guidelines of my country)

Damiano Schiuma[1]; Stefano Brianza, PhD[1]; Andrea Tami, PhD[1]; Karsten Schwieger, PhD[1];
Götz Röderer, MD[2]*; Alexander Scola, MD[2]; Florian Gebhard, PhD[2];*
[1]AO Research Institute, Davos, Switzerland;
[2]Ulm University, Department of Orthopaedic Trauma, Ulm, Germany

Purpose: Surgical treatment of proximal humerus fractures can be difficult due to osteoporotic bone quality that promotes high rates of postoperative fragment dislocation. Locking devices are beneficial because they create higher mechanical strength. Still, 6% to 13% of the patients treated with these devices sustain secondary fragment dislocation. In the present study, a mechanical system for intraoperative determination of the local bone quality in the proximal humerus is introduced to further improve the surgical treatment of this demanding fracture.

Methods: Five human humeri were stripped of all soft tissues and instrumented with a PHILOS plate (Synthes) fixed only by the three most distal screws. Using a peripheral quantitative CT (pQCT) (XtremeCT, SCANCO Medical) local bone mineral density (BMD) (mg HA/cm^3) was determined along the screws' directions (n = 6) of the plate, at 82-μm resolution, in a cylindrical volume of interest (VOI) (length 25 mm × 0.4 mm) at 3-mm subchondral distance. DensiProbe (AO Research Institute) assessed the breakaway torque in the same VOI (Fig. 1). Correlation between breakaway torque and BMD in the same VOI was determined by Pearson correlation coefficient.

Results: The mean BMD was 73.7 ± 47.8 mg HA/cm^3. The handling of DensiProbe revealed no technical problems. The mean torque was 0.276 ± 0.20 Nm. The Pearson correlation coefficient was R^2 = 0.7825 (Fig. 2).

Conclusions: DensiProbe is the first mechanical system allowing direct determination of the local bone quality in the proximal humerus. The correlation between breakaway torque registered with DensiProbe and BMD measured with pQCT is high. The results of this in vitro study suggest that intraoperative in vivo application is possible. Further evaluations need to be performed to elucidate the tool capabilities in assessing local bone quality and its relation to mechanical stability of an in vivo fracture fixation.

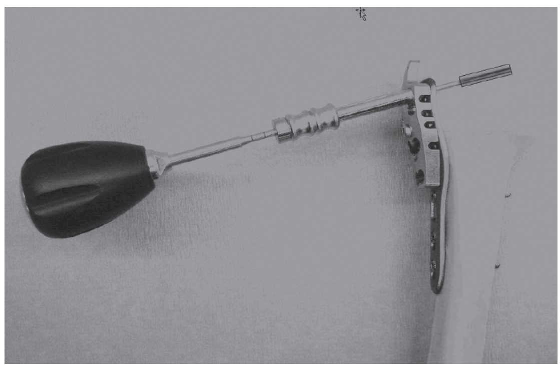


Fig. 1 *DensiProbe inserted via PHILOS aiming device.*

See pages 75 - 103 for financial disclosure information.

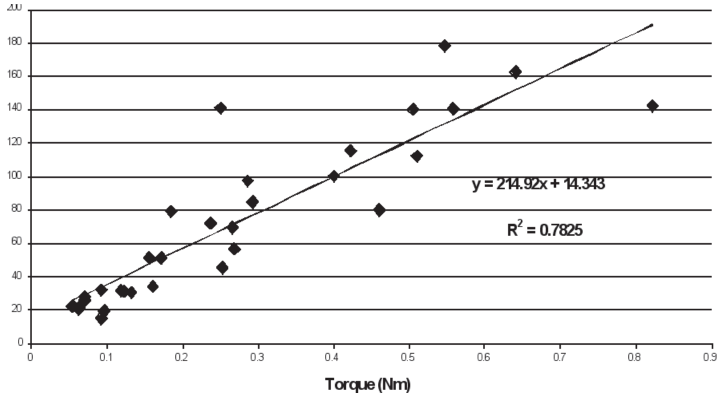


Fig. 2 *Correlation torque (Nm) versus BMD (mg HA/cm³).*

- 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 413.

Comanagement of Geriatric Patients with Hip Fractures: A Retrospective, Controlled, Cohort Study

Gregory J. Della Rocca, MD, PhD, FACS*; Kyle C. Moylan, MD; Brett D. Crist, MD, FACS; Yvonne M. Murtha, MD; David C. Mehr, MD;*
University of Missouri, Columbia, Missouri, USA

Purpose: The objective of this 3-year cohort study is to characterize a new multidisciplinary method of managing geriatric hip fracture patients, and describe early results. As hip fractures affect over 300,000 patients annually in the United States alone, and hip fracture incidence is increasing as the population ages, novel methods of management that may improve outcomes in these patients are worthwhile to investigate. Direct medical costs associated with hip fractures annually in the United States exceed $11 billion.

Methods: The hip fracture pathway represents a comanagement protocol for hip fracture patients aged 65 years or older, and was established in collaboration between the departments of orthopaedic surgery, internal medicine, community and family medicine, anesthesiology, emergency medicine, nursing, and rehabilitation services. All hip fracture patients presenting to our center were admitted to one of two primary care geriatric services, with orthopaedic consultation on arrival. Standardized admission orders and preoperative clearance methods were utilized, with the intention of hip fracture fixation in as expeditious fashion as possible. Primary care management of patients continued in the postoperative period through discharge from the hospital. Three cohorts of patients were utilized. Cohort 1 (control) represented 1 year of hip fracture patient admissions (31 patients) prior to implementation of the hip fracture pathway; cohorts 2 and 3 (58 and 57 patients, respectively) each represented consecutive years of hip fracture patient admissions under the hip fracture pathway. Data points included age, gender, pre-existing comorbidities (such as coronary artery disease), mortality, rate of ICU admission, lengths of ICU and hospital stays, delay from admission to operating room, and cost of hospital admission.

Results: There were no differences in age, gender distribution, or comorbidity distribution between the three cohorts. In-hospital mortality rates did not vary between cohorts with the numbers available. In cohort 1, only 72% of patients received surgical fixation within 48 hours; this number increased to 91% and 83% for cohorts 2 and 3, respectively. ICU admissions decreased from 68% in cohort 1 to 27% in cohort 3, and length of ICU stay decreased from 7.1 days in cohort 1 to 2.4 days in cohort 3. Total hospital stay decreased from 9.87 days in cohort 1 to an average of 7.13 days in cohorts 2 and 3. Direct hospital costs per patient decreased from $31,117 for cohort 1 to $18,552 for cohort 3.

Conclusions: Implementation of a comanagement protocol for care of geriatric hip fracture patients, consisting of admission to a geriatric primary care service, standardized preoperative clearance regimens, expeditious surgical fixation, and continued primary geriatric care postoperatively, resulted in reductions in lengths of stay, ICU admissions, delay from admission to operating room, and hospital costs per patient. On an annualized basis, this represented a savings of over $700,000 for our institution.

See pages 75 - 103 for financial disclosure information.

Intramedullary Nailing Is Superior in Pertrochanteric Hip Fractures with a Detached Greater Trochanter

(FDA=Non-U.S. research conducted within guidelines of my country)

Henrik Palm, MD; *Michael Krasheninnikoff, MD; Steffen Jacobsen, MD; Kim Holck, MD; Charlotte Lysén, MD; Peter Gebuhr, MD;*
Copenhagen University Hospital of Hvidovre, Hvidovre, Denmark

Purpose: In recent years the use of intramedullary nails (IMN) for the treatment of pertrochanteric hip fractures has gained prominence vis-à-vis conventional, sliding compression hip screws (SHS). The empirical background for the development is, however, scarce. A previous series of ours suggested that the use of SHS were not adequate in situations with a detached greater trochanter where it often led to a fractured lateral femoral wall and nonhealing in a maximum telescoped screw position. We hypothesized that IMN would be the superior implant in these specific circumstances.

Methods: Retrospectively, we examined 311 consecutive patients treated in our department between 2002 and 2008, with either a short intramedullary nail (IMHS, Smith & Nephew) or a sliding compression hip screw mounted on a 4-hole sideplate (HipLOC, Biomet), for an OTA type 31A1-2 pertrochanteric fracture with a detached greater trochanter. The status of the lesser trochanter was assessed preoperatively and the integrity of the lateral femoral wall, fracture reduction, and position of the implants were assessed postoperatively. Reoperations due to technical failure were recorded for 1 year postoperatively.

Results: Six (4%) of 158 patients operated with IMN had to be reoperated compared to 22 (14%) in the SHS group of 153 patients ($P = 0.001$). Multivariate logistic regression analysis showed that the groups were comparable in regard to demographic and biomechanical parameters. The lateral femoral wall was more frequently fractured during SHS implantation (n = 42), than in the IMN group (n = 9) ($P < 0.001$).

Conclusions: IMN had a lower reoperation rate than the SHS among these pertrochanteric hip fractures with a detached greater trochanter. IMN left more lateral femoral walls intact.

- 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 413.

The "Wedge Effect" after Intramedullary Hip Screw Fixation for Osteoporotic Intertrochanteric Fractures

Emil Azer, MD[1]; *Steven S. Sands, DO[1]; Peter A. Siska, MD[1]; Gary S. Gruen, MD[1]; Hans-Christoph Pape, MD[2]; Ivan S. Tarkin, MD[1];*
[1]University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA;
[2]RWTH Aachen University, Aachen, Germany

Purpose: Intramedullary (IM) hip screw (IMHS) fixation of selected unstable intertrochanteric (IT) fractures is a popular strategy. However, the nail itself has the potential to induce deformity of the proximal femur. Specifically, relative lateralization of the femoral shaft can occur due to the "wedge effect" created by the proximal portion of the IM implant.

Methods: Radiographic analysis was performed to determine whether a significant degree of shaft lateralization occurs with the use of IMHS for IT fractures. A retrospective review of all IT fractures (OTA 31-A1, A2) treated with IMHS was performed over a 3-year period. All fractures were treated by a fellowship-trained orthopaedic traumatologist, well versed in IM nailing techniques. Patients selected for detailed radiographic analysis had adequate postoperative films, which could be used for side-to-side comparison (unaffected vs operative). The perpendicular distance between a line drawn from the lateral femoral cortex to the center of the femoral head on both the operative and unaffected sides was measured. This distance represented the effective abductor lever arm (EALA). The difference in the EALA between the operative and unaffected sides was measured and recorded.

Results: A total of 258 patient records were reviewed. Of those records, 55 patients satisfied the inclusion criteria. The mean age was 76.9 years. All radiographs demonstrated either an increase or no change in the EALA. Of the 55 patients, there was a mean increase in EALA of 8.4 mm.

Conclusion: Although IMHS fixation devices are an effective method in treating unstable IT hip fractures, there appears to be a net lateralization of the femoral shaft, resulting in a net increase in the EALA. Potential implications of the "wedge effect" include an alteration in hip biomechanics and ultimate functional result.

See pages 75 - 103 for financial disclosure information.

•The Effect of Intramedullary Bone-Graft Harvesting on Torsional Strength in Normal and Osteoporotic Femurs

Jason Lowe, MD; *William Carson, PhD; Ferris Pfeiffer, PhD;*
Gregory J. Della Rocca, MD, PhD, FACS; Yvonne M. Murtha, MD; Brett D. Crist, MD;
University of Missouri, Columbia, Missouri, USA

Purpose: Our objective was to predict when using negative-pressure intramedullary reaming to harvest bone graft will significantly reduce torsional strength in normal and osteoporotic femurs.

Methods: Because the femur is not a straight tube, an analytical model was developed to evaluate the eccentric nature of the femur as it relates to torsional strength. Torsional strength $T_s = G\tau_s{}^*\tau_s$ is shear stress on thinnest bone. G = S*E. Size factor S is a function of periosteal diameter d_p and endosteal diameter ratio d_e/d_p. Eccentricity factor E is a function of d_e/d_p and eccentricity ratio e/d_p. Twenty matched fresh-frozen cadaveric femurs—4 pairs with normal bone mineral density (BMD), 3 osteopenic, and 3 osteoporotic—were evaluated. Each pair underwent plain radiographs and CT scanning. The right femur functioned as the control group. The left femur was reamed with a single-pass reamer (1.5 mm larger than d_e measured from radiograph), and then underwent repeat CT scanning. Each femur underwent torsional testing to failure. Applied torque T_s and axial force F_a at the fracture were determined. Periosteal and endosteal circles were fit tangent to the thinnest wall of the CT scan's cross-section at fracture location, from which d_p, d_e, and e were measured; and d_e/d_p, e/d_p, $2J/d_p$, E, and G were calculated. Maximum shear stress $\tau_s = T_s/G$ and axial stress F_a/area at fracture cross-section were calculated and used to determine the bone's effective tensile strength. Student *t* (two-tail, unequal variance) was used to determine significance, $P < 0.05$.

Results: The analytical model predicted increasing sensitivity to torsional strength reduction by over/eccentric reaming for femora with increasing d_e/d_p >0.4. Compared to normal BMD femurs, the unreamed osteoporotic femurs were found to statistically have: (a) same d_p but higher d_e/d_p >0.7 ratio; and (b) lower torsional strength T_s as a result of combined lower S (wall thickness), E (more sensitive to eccentricity), G (S and E simultaneously contribute), and bone tensile strength. With the reamer size used, reaming did not significantly affect the torsional stiffness for any group as shown by an increase of d_e. Effective tensile strength correlated linearly to BMD. The d_e/d_p ratio correlated to BMD in an inverse linear fashion. T_s correlated to G in linear fashion within a group of femurs having similar bone tensile strength (normal, osteoporotic), and thus G after/before reaming would predict strength reduction.

Conclusion: Osteoporotic femurs were found to have significantly lower torsional strength and were more sensitive to over/eccentric reaming than normal femurs due to their higher d_e/d_p ratio. Clinically, caution should be used when considering harvesting intramedullary bone graft from femurs with d_e/d_p >0.7 (osteoporotic).

- 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 413.

Impact of Guideline Implementation by a Fracture Nurse on Subsequent Fractures and Mortality in Patients Presenting with Nonvertebral Fractures

(FDA=Non-U.S. research conducted within guidelines of my country)

Kirsten M.B. Huntjens, MD; *Tineke van Geel, MSc, PhD; Piet P. Geusens, MD, PhD; Joop van den Bergh, MD, PhD; P.R.G. Brink, MD, PhD; B. Winkens, MSc, PhD; P. Willems, MD; S.H. van Helden, MD, PhD;*
Maastricht University Medical Centre, Maastricht, The Netherlands

Purpose: The impact of systematic implementation of guidelines on fracture prevention is unknown. The aim of this study was to determine the impact of guideline implementation on subsequent fracture incidence and mortality in patients presenting with a nonvertebral fracture (NVF).

Methods: This was a comparison of two fracture patients cohorts (intervention and preintervention). In the intervention group (2004-2006; n = 1339), a dedicated fracture nurse offered bone and fall-related risk evaluations and treatment according to available guidelines to all consecutive patients older than 50 years presenting with an NVF. In the preintervention group (1999-2001; n = 1921), no preventive fracture care was organized. The 2-year absolute risk (AR) and additional hazard ratios (HR, with 95% confidence interval [CI]) of subsequent NVFs and mortality were calculated for and between both groups by multivariable Cox regression, including age, sex, and baseline fracture location.

Results: After the intervention, the risk was reduced by 35%(HR, 0.65; 95% CI,0.50-0.83; AR from 9.9% to 6.6%) for subsequent fractures and 33% (HR, 0.67; 95% CI,0.55-0.81; AR from 17.9% to 11.6%) for mortality. The risk of subsequent fractures was dependent on female sex (HR, 1.39; 95% CI, 1.01-1.92) and age (HR, 1.03; 95% CI, 1.02-1.05). For mortality, this was age (HR 2.32 to 4.00, depending on age), male sex (HR 2.04; 95% CI, 1.68-2.48), and major fractures (HR, 3.67; 95% CI, 2.56-5.26; not constant over time). Subsequent fractures and mortality were highest immediately after the fracture and remained lower at almost all time points after intervention.

Conclusions: Systematic implementation of guidelines for fracture prevention by a dedicated fracture nurse immediately after an NVF was associated with a significant reduction of the 2-year risk of subsequent NVF and mortality.

See pages 75 - 103 for financial disclosure information.

High-Energy Trauma and Clavicle Fractures: A Marker for Death in the Elderly?

Julie M. Keller, MD; *Marcus F. Sciadini, MD; Robert V. O'Toole, MD;*
RA Cowley Shock Trauma Center, Department of Orthopaedics,
University of Maryland School of Medicine, Baltimore, Maryland, USA

Purpose: Little is known regarding the outcome of geriatric patients with high-energy orthopaedic injuries. Previous studies have suggested an association between clavicle fractures and mortality in high-energy trauma patients. Our hypothesis was that clavicle fractures are associated with a high rate of death in geriatric patients sustaining high-energy trauma.

Methods: Patients injured from high-energy trauma (motor vehicle collisions, falls from height; no low-energy falls) with at least one orthopaedic injury were identified from a prospectively collected database at a Level 1 trauma center between January 2004 and July 2009. Our study group was patients age ≥65 years (n = 611) with at least one orthopaedic injury and the control group was those younger than 65 years (n = 6564). All patients with and without clavicle fractures were identified. Our primary outcome was in-patient mortality recorded in a prospective database. Analysis was performed using the Fisher exact test and Student *t* test.

Results: The mortality rate for geriatric patients with clavicle fractures after high-energy trauma was 23% (23 of 101), which was roughly double the rate observed in geriatric patients without clavicle fractures (12%, 63 of 510; $P = 0.02$). The death rate in young patients with clavicle fractures (6.9%, 54 of 776) is also higher than those without clavicle fractures (4.6%, 266 of 5788; $P = 0.006$), although as would be expected, these death rates are lower than the geriatric group ($P < 0.001$). All 23 geriatric patients who died had associated thoracic trauma, and brain injury was present in 13. The major contributing cause(s) of death in geriatric patients with clavicle fracture was brain injury in 12, respiratory failure in 7, hemorrhagic shock in 6, and cardiac failure in 3. Geriatric patients with clavicle fractures had an average admission injury severity score (ISS), Glasgow coma scale (GCS), and brain, thorax, and lower extremity abbreviated injury scores (AIS) that were all worse when compared to old or young patients without clavicle fractures ($P < 0.05$), but similar to young patients with clavicle fractures.

Conclusions: Geriatric patients with clavicle fractures after high-energy trauma have a 23% mortality rate, which is significantly higher than that of elderly or young patients with comparable mechanisms of injury but no clavicle fracture. Young patients with clavicle fractures have similarly severe systemic injuries, but much lower mortality (6.9%, $P < 0.001$). Based upon results from similar studies of younger trauma patients, we expected an association between clavicle fractures and mortality in the elderly. However, the twofold increase to 23% was much more than anticipated. Clinicians should be aware that clavicle fractures are a marker for severe injury in trauma patients in general, and the combination of advanced age, high-energy mechanism, and clavicle fracture appears to produce a strikingly elevated death 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 413.

Functional Outcomes Following Intramedullary Nailing of Trochanteric Hip Fractures: A Pilot Multicenter, Randomized Controlled Trial

(FDA=Non-U.S. research conducted within guidelines of my country)

Mohit Bhandari, MSc, MD, FRCSC[1]; Alicja Bojan, MD[2]; Carl Ekholm, MD, PhD[2]; Ole Brink, MD, PhD, MPA[3]; Anthony Adili, MD[4]; Sheila Sprague, MSc[1]; Nasir Hussain[1]; Anders Joensson, MD, PhD[5] on behalf of the REGAIN Investigators; ***Emil H. Schemitsch, MD****;*
[1]McMaster University, Hamilton, Ontario, Canada;
[2]Sahlgrenska University Hospital, Mölndal, Sweden;
[3]Aarhus University Hospital, Aarhus, Denmark;
[4]St. Joseph's Hospital, McMaster University, Hamilton, Ontario, Canada;
[5]Stryker Osteosynthesis, Schönkirchen, Germany

Purpose: The popularity of intramedullary nails (IMN) for trochanteric hip fractures has grown substantially with little supportive evidence that IMN are superior to conventional sliding hip screws (SHS). We aimed to assess the impact of SHS or IMN on functional outcomes and rates of reoperation in elderly patients with fractures.

Methods: We conducted a multicenter, pilot randomized trial including 3 clinical sites across Sweden, Denmark, and Canada. We randomized 85 elderly patients with stable and unstable trochanteric hip fractures to either SHS or IMN. The primary outcome, revision surgery, was independently adjudicated at 1 year. Secondary functional outcomes included the Parker Mobility Score (PMS), the Merle d'Aubigné score, the Short Form-12 (SF-12), and the EuroQuol EQ-5D.

Results: 85 patients were enrolled. 15 patients died prior to the 1-year follow up. Across treatment groups, patients did not differ in age, gender, and fracture type. The overall revision risk was 11.6% (8 of 69) and did not differ significantly between groups (IMN, 5; SHS, 3). Patients treated with IMN had significantly higher Merle d'Aubigné function subscores at 6 (P = 0.01) and 12 months (P = 0.05). Gamma3 nails approached significantly higher scores in the PMS at 6 (P = 0.08) and 12 months (P = 0.056). Nonsignificant differences were identified in the SF-12 and EQ-5D quality of life measures; however, in both scores, the Gamma3 nail trended to higher scores than the SHS.

Conclusion: Our findings of early functional gains without increased risk of revision surgery support the increased popularity of IMN for the management of trochanteric hip fractures in elderly patients.

See pages 75 - 103 for financial disclosure information.

Total Knee Arthroplasty for the Treatment of Complex Fractures of the Tibial Plateau in the Elderly

(FDA=Non-U.S. research conducted within guidelines of my country)

Panayiotis Christofilopoulos, MD; *Constantinos Roussos, MD; Florence Unno-Veith, MD; Alexandre Lädermann, MD; Richard Stern, MD; Robin Peter, MD;*
Division of Orthopaedics and Trauma Surgery, University Hospitals of Geneva, Geneva, Switzerland

Hypothesis: Total knee arthroplasty (TKA) is a good option for the treatment of complex tibial plateau fractures in the elderly.

Methods: This was a prospective analysis of consecutive cases including patients over 65 years of age with a tibial plateau fracture classified according to AO/OTA as 41B-41C, or Schatzker II-VI. TKA was performed with the PFC Sigma cemented total knee prosthesis (DePuy). In all cases, the tibial component was a stemmed type. Augmentation by one-third tubular plates (Synthes) was performed in two cases. One patient received a tibial tray with a titanium augment. According to standard TKA protocols, physiotherapy was started on the first postoperative day and continued for 6 weeks. Patients were asked to return for follow-up at regular intervals. Outcome measures included physical and radiographic evaluation, the American Knee Society Score (AKSS), the Western Ontario and McMaster Universities (WOMAC) score, and the Short Form 12-item Survey (SF-12).

Results: Between 2007 and 2009, 7 consecutive patients, 5 women and 2 men with a mean age of 76.6 years (range, 65-84 years) with complex tibial plateau fractures were treated by primary TKA. Surgery was performed at a mean of 4 days following the fracture (range, 2-8 days). All 7 patients had uneventful healing of their surgical incisions and there was no superficial or deep infection. Six of seveb patients were followed up at regular intervals. One patient traveled abroad and only returned for follow-up at 6 months postoperative. The mean knee range of motion was –5° to 120° in all six patients who followed our protocol. The patient who was lost to follow-up for 6 months did not receive close physiotherapy and had a relative limitation of motion (–10° to 90°). The AKSS score revealed a mean total knee score of 86 and mean total functional score of 85. The WOMAC score results were a mean WOMAC D = 84.1 and mean WOMAC F = 83.3. The SF-12 results were a mean physical component summary score of 38.3 and mean mental component summary score of 50.0. Six of seven patients were satisfied with their outcome and regained their pre-injury joint mobility and level of independence.

Conclusion: We believe that TKA for treatment of complex tibial plateau fractures in the elderly is a good therapeutic option. It offers rapid rehabilitation of the patients comparable to that following primary TKA performed for osteoarthritis. Further studies are necessary with larger numbers of patients to validate the results of our small study.

- 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 413.

Implant Standardization for Hemiarthroplasty: Implementation of a Pricing Matrix System at a Level 2 Community-Based Trauma System

***Peter L. Althausen, MD, MBA*[1]**; *Daniel Coll, MHS, PA-C*[2]; *Eric M. Boyden, MD*[1]; *Timothy J. O'Mara, MD*[1]; *Timothy J. Bray, MD*[1];
[1]*Reno Orthopaedic Clinc, Reno, Nevada, USA;*
[2]*Renown Regional Medical Center, Reno, Nevada, USA*

Purpose: As the average life expectancy in the United States increases, geriatric fractures are becoming more frequent. The incidence of displaced femoral neck fractures requiring hemiarthroplasty is growing. Advancements in arthroplasty technology have resulted in multiple stem options and escalating implant costs. However, most elderly patients with hip fractures do not need high-demand implants. Several studies have shown the benefits of implant standardization for total hip arthroplasty but no study to date has demonstrated the benefits of implant standardization for hip fracture care. Our purpose was to achieve this goal.

Methods: In January 2009, our institution implemented a matrix pricing system for bipolar and monopolar hip prostheses. A low-demand, cobalt-chrome grit-blasted stem that could be placed in either a cemented or uncemented manner was chosen. The price was set at $1400 for bipolar and $1000 for unipolar implants. Prior to matrix pricing, the average implant cost was $3700. Just two of seven implant companies agreed to this matrix and only their fracture stems were utilized during the study period. Concern was raised by local orthopaedic surgeons that implant restriction might result in increased complication rates. To address these issues and evaluate its economic effect on the hospital, data were collected on all hemiarthroplasty patients for the year prior to and the year following the implementation of the matrix. A chart review was initiated to record complication rates, length of stay, and operative times. Hospital financial records were accessed to determine operative costs, and total hospital charges.

Results: Review of our institutional database identified 113 patients treated with hemiarthroplasty in 2008 and 117 treated in 2009. There were no significant differences in age, sex, comorbities or fracture pattern between the two groups. No increase in operative time, estimated blood loss, complication rate, leg-length discrepancy, or dislocation rate was observed. Overall our hospital realized a 37% reduction in implant costs, resulting in $285,100 savings for the calendar year.

Conclusions: Implementation of a matrix pricing system for hemiarthroplasty in the treatment of femoral neck fractures has been a very successful endeavor at our institution. Hospital implant costs were decreased significantly without any associated increase in complication rate or length of stay. A portion of savings from such a change can be reinvested in the hospital trauma program to support OTA/American Academy of Orthopaedic Surgeons (AAOS) position statement guidelines.

See pages 75 - 103 for financial disclosure information.

Osteosynthesis of AO/OTA 44-B (Danis-Weber B) Fractures in Older Patients: A New Technique Allowing Early Weight Bearing

Mathieu Assal, MD; ***Panayiotis Christofilopoulos, MD****; Anne Lübbeke, MD, DSc; Richard Stern, MD;*
Division of Orthopaedics and Trauma Surgery, University Hospitals of Geneva, Geneva, Switzerland

Hypothesis: A new technique for open reduction and internal fixation of AO/OTA 44-B (Danis-Weber B) fractures will allow for early ambulation without loss of reduction.

Methods: All patients over 70 years of age with closed displaced AO/OTA 44-B (Danis-Weber B) fractures were eligible. Patients who refused or were unable to participate were excluded. *Surgical Technique.* The fibula fracture is reduced and a 2.5-mm threaded guidewire is placed through the tip of the lateral malleolus into the medullary canal of the proximal fragment. The distal hole of a one-third tubular plate is converted into two small hooks that are impacted into the tip of the lateral malleolus. A minimum of two screws proximal and two screws distal to the fracture are used to fix the plate to the fibula, with the distal screws not penetrating the medial cortex of the lateral malleolus. Polymethylmethacrylate (PMMA) is introduced into the screw holes prior to screw insertion through the plate. If the syndesmosis "hook test" is positive, two smooth Kirschner wires are passed from the fibula into the tibia. Any medial and/or posterior malleolar fractures are reduced and fixed in standard fashion. Following suture removal, patients are permitted to ambulate weight bearing as tolerated in a removable orthosis. Outcome measurements included clinical and radiographic control, and the American Orthopaedic Foot & Ankle Society (AOFAS) ankle-hindfoot score modified with respect to previous level of function in this older population, meaning if the patient returned to the same level of functioning as before the fracture, this was counted as maximum activity for function even if there was a preexisting limitation.

Results: Between December 2006 and April 2008, 36 patients were enrolled, 31 women and 5 men, with a mean age of 79.6 years (range, 70-97 years). The minimum follow-up was 12 months in 27 patients, and 6 months in 3 patients who died before the 1-year follow-up. Of the remaining 6 patients, 3 died before the 3-month follow-up visit and 3 patients refused follow-up. Of the 30 patients seen at a minimum of 6 months postoperative, all fractures healed with no loss of reduction, and all except one patient returned to their previous level of functioning with a mean modified AOFAS ankle-hindfoot score of 91.3 (range, 69-100). One-third of patients reported occasional pain while the others were asymptomatic. There were two infections. An 83-year-old diabetic woman developed a small amount of wound drainage at 4 months postoperative. She was treated with débridement, antibiotics, and early removal of the hardware with no further wound problems and an AOFAS score of 100. The other patient was a 92-year-old woman with preexisting arterial insufficiency and small ulcers over the tips of the second and third toes. She developed breakdown over the lateral and medial wounds, and over the metatarsal heads secondary to a splint. The fractures healed with no loss of position, but repeated débridement and hardware removal did not achieve full wound healing and she remained with several small open wounds requiring daily dressing changes.

• 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 413.

Conclusion: This technique provides excellent stability to start early weight bearing without secondary loss of reduction. While a similar technique has been previously described, there was no use of PMMA to augment screw and wire fixation and patients were not permitted immediate full weight bearing. Careful attention must be paid to patients with preexisting vascular insufficiency and diabetes to avoid wound complications. This technique allows a fragile patient population to regain functional independence very rapidly after an ankle fracture.

See pages 75 - 103 for financial disclosure information.

Quantitative Assessment of the Vascularity of the Talus Using Gadolinium-Enhanced MRI

***Anna N. Miller, MD*[1]**; *Mark L. Prasarn, MD*[2]; *Jonathan P. Dyke, PhD*[3];
David L. Helfet, MD[1]; *Dean G. Lorich, MD*[1];
[1]*Orthopaedic Trauma Service, Hospital for Special Surgery, New York, New York, USA;*
[2]*Orthopaedic Trauma Department, University of Rochester, Rochester, New York, USA;*
[3]*Citigroup Biomedical Imaging Center, Weill Cornell Medical College; New York, New York, USA*

Purpose: We utilized 10 pairs of fresh-frozen cadaver limbs to study the arterial anatomy of the talus with gadolinium-enhanced MRI. The use of gadolinium-enhanced MRI for the evaluation of the arterial supply of the talus has not been previously reported. Our hypothesis was that gadolinium-enhanced MRI would be able to specifically delineate the contribution of the 3 main arteries to the talar vascular supply.

Methods: The study was performed using gadolinium-enhanced MRI in addition to gross dissection following latex injection. MRI proved useful in the present study to confirm the presence of specific arterial branches in situ, as well as to demonstrate the rich anastomotic network in and around the talus. We further examined the MRI studies to delineate the quantitative contribution of each of the 3 main arteries to the talus and, more specifically, to each quadrant of the talus. The talus was divided into quadrants as follows: anteromedial (0), anterolateral (1), posterolateral (2), and posteromedial (3).

Results: A branch to the medial talar neck that has not previously been identified is described; this was found in 75% of the specimens. In this study, the peroneal artery was found to contribute 16.9% of the blood supply to the talus; the anterior tibial artery, 36.2%; and the posterior tibial artery, 47.0%. The contribution of the anterior tibial artery was highest in quadrant 0, versus quadrants 1, 2, and 3, in which the posterior tibial artery contribution was highest. The peroneal artery never had the highest contribution in a quadrant, but was more prominent in quadrants 0 and 3.

Conclusion: A thorough understanding of the anatomy and meticulous dissection are essential to prevent unnecessary further injury to the vasculature when treating fractures of the talus, and this study gives insight to vascular injuries common in talus fractures. In addition, the exact contribution of each artery is delineated, which could help with prognosis in talar fracture patterns.

- 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 413.

A New Ankle-Spanning Fixator Construct for Distal Tibia Fractures: Optimizing Visualization, Minimizing Pin Problems, and Protecting the Heel

Bruce H. Ziran, MD[1]; *T. Morrison, MD*[2]; *R. C. Kinney, MD*[1];
[1]*Atlanta Medical Center, Atlanta, Georgia, USA;*
[2]*St. Joseph Hospital, Warren, Ohio, USA*

Purpose: Traditional ankle frames utilize transcalcaneal pins, with or without incorporation of the foot. Potential problems include loosening, infection, and pressure issues of the heel. The orientation of the transcalcaneal pin is along the plane of motion and may result in loosening and exudative issues. We have utilized a different fixation construct where two pins are placed from the posterior calcaneus, one anterolaterally directed and the other anteromedially directed.

Methods: All ankle frames used by the senior authors were treated with the following technique. One calcaneal pin enters posteromedially and is directed anterolaterally toward the calcaneocuboid joint. The other pin enters posterolaterally and is directed anteromedially toward the sustentaculum. Both pins remain within the calcaneal body. A U-shaped fixator bar is attached to these two pins and then connected to a tibial fixator that is based anteriomedially. We retrospectively reviewed all cases using this technique between 2005 and 2009. Inclusion criteria were adults with intent for short-term (damage control) purposes. Exclusion criteria were reconstructive cases, infections, and neoplasm. Outcome evaluation included pin-tract problem (Checketts and Otterburn criteria), pin cohesion in calcaneous, pressure sores, stability, time in frame, visualization of ankle, and patient tolerance. Pin cohesion in calcaneus was determined by whether the pin required a subjective initial torque to loosen from bone.

Results: 39 patients met inclusion criteria with 40 frames placed for 6 ankle dislocations, 3 subtalar dislocations, 6 open pilon fractures, 18 closed pilon fractures, and 7 open ankle fractures. Pin-site complications included one Checketts grade 2 pin in the dislocation, as well as one Checketts 2 pin and two Checketts 3 pins in the fractures, all of which responded well to local pin care. Mean duration of pin placement was 8 days (range, 2-180 days). The other complication was one subtalar dislocations associated with a mangled forefoot that eventually resulted in a below-knee amputation. Patients tolerated the fixator well and there were no iatrogenic neurovascular or musculotendinous injuries due to pin placement. None of the pins required premature removal and the heel was successfully elevated for all cases.

Conclusion: This construct provides a new and acceptable method for spanning the ankle. It improved visualization, elevated the heel, and was not associated with any serious pin-tract problems. A more comparative series would be warranted, but the success of this method has prompted us to change our practice of ankle-spanning frames.

See pages 75 - 103 for financial disclosure information.

22-Year Follow-up of Pronation-Eversion Type III-IV (AO/OTA Type C) Ankle Fractures: A Retrospective Cohort Study

(FDA=Non-U.S. research conducted within guidelines of my country)

***Christian Donken, MD*[1]**; *Michael Verhofstad, PhD*[2]; *Kees van Laarhoven, PhD*[1];
[1]*Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands;*
[2]*St. Elisabeth Hospital, Tilburg, The Netherlands*

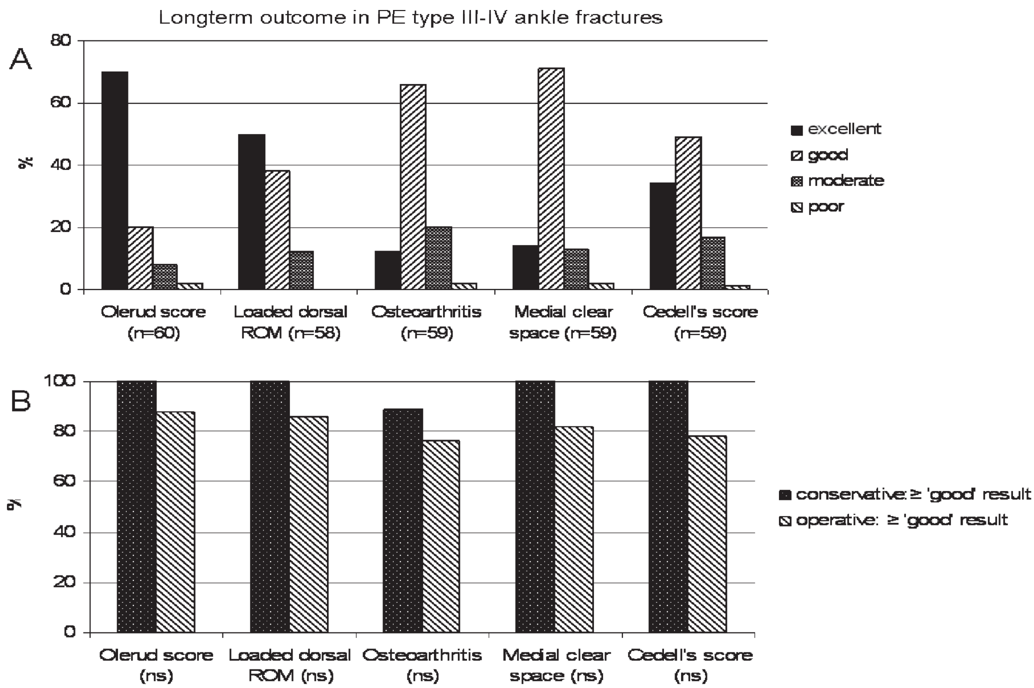
Purpose: This is an evaluation of long-term results after protocolled treatment of pronation-eversion (PE) type III-IV (AO/OTA type C) ankle fractures, in which "stable" fractures were treated conservatively and "unstable" fractures were treated with open reduction and internal fixation.

Methods: All 98 patients in our hospital with a PE III-IV ankle fracture between 1985 and 1990 were treated according to a strict treatment protocol. Stable fractures with tibiotalar congruity were treated conservatively, whereas osteosynthesis was performed in unstable fractures to restore tibiotalar congruity. At follow-up, all patients were approached to participate in this study. Outcome parameters were (1) a functional outcome questionnaire (Olerud score), (2) physical evaluation (loaded dorsal range of motion [ROM]), (3) radiological signs of instability (medial clear-space widening), (4) radiological anatomical result (Cedell score), and (5) posttraumatic long-term damage (osteoarthritis). Statistical analysis was conducted with the Fisher exact test and Mann-Whitney *U*, both two-tailed.

Results: After a median of 22 years, follow-up was achieved in 95% (n = 60). Only 4 patients (7%) had a true PE III injury, of whom 2 received internal fixation. Five patients (8%) had sustained an unclear injury (in between PE III and IV), of whom 3 were operated. 51 patients (85%) had a PE IV injury of whom 46 (90%) underwent surgery. Overall, "excellent" or "good" results were found in 78% to 90% (Fig. A). Patients who received an operative treatment scored equally well as those who received conservative treatment (Fig. B; ns = not significant).

Discussion: Based on the intention-to-treat principle, this stratified treatment protocol that aims to maintain or restore tibiotalar congruity seems justified for PE III-IV fractures since the very long-term outcome is excellent or good in the majority of patients despite the additional soft-tissue damage induced by internal fixation in the PE IV 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 413.



See pages 75 - 103 for financial disclosure information.

High-Energy Navicular Body Fractures: Results of Open Reduction and Internal Fixation Using Minifragment Plate Fixation

Jason M. Evans, MD[1]; *Daphne M. Beingessner, MSc, MD, FRCSC*[2];
Julie Agel, MA[2]; *Stephen Benirschke, MD*[2];
[1]*University of Texas Health Science Center, San Antonio, Texas, USA;*
[2]*Harborview Medical Center, University of Washington, Seattle, Washington, USA*

Purpose: The purpose of this study was to assess the ability of miniplate fixation in navicular fractures to restore medial column stability, maintain reduction to union, and determine the impact this approach may have on the development of avascular collapse of the navicular. We hypothesize that comminuted fractures of the navicular can be safely reduced and maintained to union with minifragment plate fixation with a low incidence of avascular collapse.

Methods: 30 patients with a navicular fracture were identified in a retrospective chart review at a Level 1 trauma center. 24 patients were available for review. All had been treated with open reduction and internal fixation using minifragment plate fixation through one or two incisions. Data collected included patient age, mechanism, associated midfoot and hindfoot injuries, time from injury to definitive fixation, evidence of infection, hardware failure, development of arthrosis, navicular collapse due to avascular necrosis, and need for hardware removal or salvage fusion.

Results: All fractures healed. No patient developed a deep infection. There was no loss of reduction. Isolated broken screws were evident in three patients (12.5%), with no plate breakage, and no implant failure by pull-out. Four patients (17%) underwent plate removal for painful prominent hardware following fracture healing. Four patients (17%) developed radiographic arthrosis of the talonavicular joint. One patient (4%) had radiographic avascular collapse evident at 6 months and was treated with plate removal and orthotics.

Conclusions: Minifragment fixation is a good alternative to independent lag screws for rigid stabilization of navicular body 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 413.

Socioeconomic Sequelae of Orthopaedic Trauma

David A. Volgas, MD; *Rena L. Stewart, MD;*
University of Alabama at Birmingham, Birmingham, Alabama, USA

Background: Patients who are victims of orthopaedic trauma are subject to lengthy recovery periods resulting in the inability to work, while being burdened with the cost of their medical care. As far as we know, there are no studies reporting directly on the financial impact of orthopaedic trauma on patients and their families.

Purpose: The purpose of this study is to report on the financial impact of orthopaedic trauma to our patients and how it affects their personal financial well-being.

Methods: A prospective observational study of patients with traumatic orthopaedic injuries at the University of Alabama at Birmingham medical center between 2007 and 2009 was conducted. Participants were evaluated during regular follow-up appointments over a 14-month time period. At the initial follow-up, participants were asked to fill out an evaluation of their preinjury financial status and then at subsequent visits were asked to evaluate their postinjury financial status. Outcomes assessed include type of financial assistance required postinjury, need to sell valuable assets, and participants' perception of their postinjury financial stability.

Results: Preinjury, 24% of the 177 participants required some type of public financial assistance (SSI [supplemental security income], WIC [Women, Infants, and Children] assistance, food stamps, etc). In the postinjury period, this increased to 62%, with 38% selling a valuable possession to meet their financial needs. Among married participants, 23% relied on public assistance preinjury compared with 66% postinjury with 29% selling a valuable asset. 20% of single participants relied on public assistance preinjury, 46% postinjury, and 44% sold a valuable asset. We also evaluated the effect of preinjury income level with a majority of participants earning less than $80,000 per year. The greatest effect of injury was seen in the $60-$80 K, income range with 14% requiring public assistance preinjury compared to 86% postinjury, and in the $40-$60 K income group, with none requiring preinjury public assistance but 61% requiring assistance postinjury. Education level was also studied, with the percentage of college-educated participants requiring public assistance increasing from 11% preinjury to 55% postinjury and those with high school education going from 27% preinjury to 68% postinjury.

Conclusions: Significant orthopaedic injuries such as pilon fractures, which will require at least 3 months to heal, carry a very significant "second injury"—financial hardship—for patients. Since social security disability payments do not begin for 12 months in most cases, patients are left with a financial burden that lasts far longer than the orthopaedic injury. This information will be presented to government officials with the hope that some form of public assistance (short-term disability, loan relief, etc) might lessen the permanent impact of these injuries.

See pages 75 - 103 for financial disclosure information.

The Incidence of Wound Complications following Open Reduction and Internal Fixation of Calcaneal Fractures: A Comparison of Static versus Dynamic Retraction

Megan Brady, MD; *David Brokaw, MD;*
OrthoIndy, Indianapolis, Indiana, USA

Background: Wound complications can be a major problem following open reduction and internal fixation (ORIF) of calcaneal fractures. The rate of serious infections following surgical treatment of closed fractures ranges from 0 to 20%, with an incidence of 19% to 31% associated with open fractures. Wound complications require additional treatment, including prolonged antibiotic treatment, surgical irrigation and débridement, soft-tissue coverage, or amputation. Past studies have shown that smoking, diabetes mellitus, and open fractures are associated with higher rates of wound complications. Two types of retraction (static and dynamic) have been used for exposure. Static retraction is performed by placing Kirschner wires into the lateral process of the talus to retract the soft-tissue flap. Dynamic retraction is performed by an assistant retracting the flap during surgery. The purpose of this study was to determine if a difference in wound complications exists based on the type of retraction, static or dynamic, used during surgical treatment.

Methods: A retrospective chart review was performed on 360 consecutive calcaneal fractures that were treated at a Level 1 trauma center from 2002 to 2007. Of the 360 total fractures, 177 were treated with ORIF by fellowship-trained orthopaedic trauma surgeons. Some surgeons used static retraction of the soft-tissue flap, while others used dynamic retraction. All fractures requiring surgical treatment were classified as closed or open (utilizing the Tscherne or Gustilo classification) and fracture type. Patient variables, including diabetes mellitus, tobacco use, corticosteroid use, or peripheral vascular disease were documented. Time from injury to surgical intervention, as well as tourniquet time, was also documented. All patients received perioperative antibiotics and all open fractures were treated emergently with surgical irrigation and debridement, and intravenous antibiotics. The incidence of wound complications following ORIF of calcaneal fractures was determined through a retrospective chart review. Wound complications were divided according to type of treatment required; oral antibiotics and local wound care only versus surgical irrigation and débridement with intravenous antibiotics. The incidence of wound complications based on retraction type was determined.

Results: Wound complications developed in 30 (17%) of the 177 patients treated with ORIF. 8.8% of fractures treat with dynamic retraction developed wound complications compared to 22% of those treated with static retraction. This difference was statistically significant, with $P < 0.028$. Patients treated with static retraction were 2.9 times more likely to develop wound complications, which was independent of patient risk factors. Wound complications ranged from wound necrosis requiring local wound care and oral antibiotics, to deep infection requiring surgical irrigation and débridement with prolonged intravenous antibiotics.

Conclusions: Wound complications are a major factor in the decision to treat calcaneal fractures. Static retraction is associated with a significantly higher incidence of wound complications following ORIF of calcaneal fractures. Independent of pre-existing risk factors, patients treated with static retraction were 2.5 times more likely to develop postoperative wound 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 413.

Do Educational Handouts Work after Ankle Fracture?
Results of a Randomized Controlled Trial

(FDA=Non-U.S. research conducted within guidelines of my country)

Joshua Mayich, MD[1]; William McCormick, MD[2]; Christina A. Tieszer, MSc[3]; Abdel Lawendy, MD, FRCSC[3]; ***David W. Sanders, MD, MSc, FRCSC[3]****;*
[1]*Queen's University, Kingston, Ontario, Canada;*
[2]*University of Ottawa, Ottawa, Ontario, Canada;*
[3]*London Health Sciences Centre, London, Ontario, Canada*

Purpose: Educational handouts designed for patients are promoted as a tool to educate, increase satisfaction, and potentially improve outcome. However, the value of these educational handouts as an adjunct to standard surgical care has not been formally assessed after ankle fracture. The purpose of this study was to compare standard postoperative care following surgically treated rotational ankle fracture to care supplemented with the use of adjunctive educational handouts.

Methods: 51 patients who sustained a rotational ankle fracture requiring open reduction and internal fixation were randomized to receive either standard care (group S) for an ankle fracture, or to additionally receive the American Academy of Orthopaedic Surgeons' handout on "ankle fractures" and a handout describing appropriate mobilization exercises (group H). Standard care included follow-up visits at 2, 6, and 12 weeks postoperatively in a busy orthopaedic fracture clinic, including brief instructions on mobilization exercises. A bulky plaster-reinforced dressing was used for immobilization for the first 2 weeks following surgery, followed by a removable boot. Range-of-motion exercises were encouraged after the first 2 weeks and weight bearing was encouraged 6 weeks after surgery. Surgeons and outcome assessors were blinded to treatment group. Patients completed functional outcome assessment (Olerud-Molander ankle score), objective measurement of ankle motion, and visual analog scale questions related to satisfaction at 6 and 12 weeks after surgery.

Results: The groups were equivalent with respect to fracture type and complication rate. Three patients, all in group S, were lost to follow-up. Group H patients had higher satisfaction scores at 3 months (9.2 vs 6.3; $P < 0.01$). Group H patients demonstrated improvements in work/activity ability at 6 weeks ($P = 0.01$), but this benefit was not sustained at 3 months ($P = 0.24$). No differences in motion or other functional outcome scores were noted.

Conclusions: Educational handouts designed for patients can be helpful in providing patients with accessible information in the postoperative period. The use of an educational handout was a valuable tool to improve patient satisfaction, and may have the potential to improve outcome.

See pages 75 - 103 for financial disclosure information.

Fixing the Almost-Healed Ankle Fracture: Is the Surgery, Reduction, and Complication Different from Acute Open Reduction and Internal Fixation?

Serdar Toker, MD; *Steven J. Morgan, MD*; ***David J. Hak, MD***;
Denver Health, Denver, Colorado, USA

Purpose: This study was designed to compare the accuracy of postoperative reduction, technical difficulties, and surgical complications between patients undergoing ankle fracture open reduction and internal fixation (ORIF) acutely versus in a delayed fashion.

Methods: A retrospective analysis of a prospective trauma registry was performed to identify patients whose ankle fracture was fixed in a delayed manner. A cohort of patients matched for age, sex, and fracture who underwent acute ORIF (2 weeks or less from injury) was also obtained. The following data were collected: injury mechanism, fracture type, length of surgery, postoperative radiological measurements including medial clear space, talar tilt, lateral-medial malleolar tip distances (LMMTD), complications, and follow-up condition including pain and range of motion. We identified 23 patients whose fracture was surgically treated greater than 25 days following injury. All of these patients had been managed in a posterior splint prior to surgical treatment. In 20 cases, the reason for delay to surgery was due to access and personal issues, while in 3 patients the surgery was delayed due to the soft-tissue condition or other medically related issues. Statistical analysis was performed by independent-sample *t* test.

Results: The mean delay from injury to operation was 38.6 days (range, 25-73 days). There was no significant difference in the mean length of operative time between the delayed and acute treatment groups (76 vs 87 minutes). A significant difference in the mean LMMTD was found between the delayed and acute treatment groups. The mean LMMTD on the mortise view was 9.8 mm in the delayed treatment group and 11.7 mm in the acute treatment group ($P < 0.05$). Postoperative medial clear space measurements were less than 4 mm in all patients. The mean value was 2.7 mm in the delayed treatment group and 2.7 mm in the acute treatment group ($P > 0.05$). No talar tilt was detected in either group. The mean follow-up time for all patients was short, with a mean of 12.3 weeks (range, 6-28 weeks). At last follow-up, the mean documented dorsiflexion was not significantly different between the delayed and acute treatment groups (10° vs 12°), nor was the documented plantar flexion (28° in both groups). There were 7 complications in the delayed treatment group compared with 3 in the acute treatment group, but given the small sample size this difference was not significant ($P > 0.05$). There were no wound healing problems in either group. There was no loss of reduction in either group, but one patient in the delayed treatment group underwent reoperation due to delayed union and hardware irritation. There was one delayed union in the delayed treatment group. Hardware irritation was noted in five patients in the delayed treatment group, compared with two in the acute treatment group. There was one transient neuropathy in the delayed treatment group and one deep vein thrombosis in the acute treatment group.

Conclusion: We found that achieving anatomic fibular length was the most difficult barrier when performing delayed ORIF of ankle fractures. However, short-term clinical outcomes do not seem to be influenced by the inability to regain full length. There was no difference in the duration of surgery or postoperative complications following delayed treatment of 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 413.

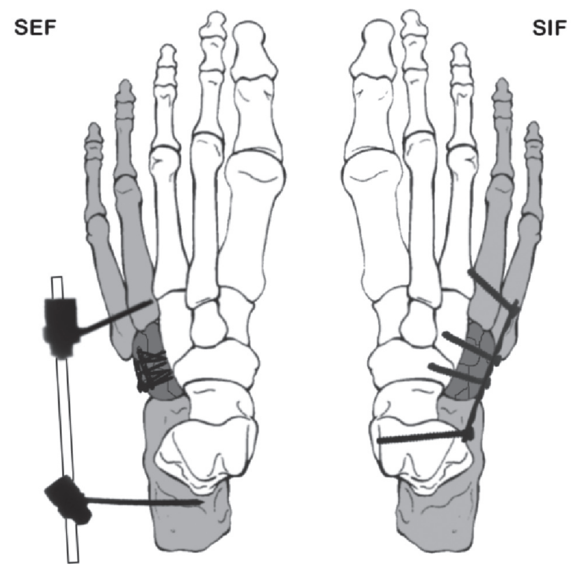
Adjunctive Spanning Fixation Treatment of Displaced Cuboid Fractures: Results and Complications

*Marlon O. Coulibaly, MD[1]; **Clifford B. Jones, MD, FACS[2]**; Debra L. Sietsema, PhD[2]; Donald R. Bohay, MD[2]; John G. Anderson, MD[2]; James R. Ringler, MD[2];*
[1]Grand Rapids Medical Education and Research Center, Grand Rapids, Michigan, USA;
[2]Orthopaedic Associates of Michigan, Michigan State University, Grand Rapids, Michigan, USA

Purpose: Cuboid fractures (CFs) are uncommon, and articular compromise and capsuloligamentous instability are common findings, leading to lateral column instability, deformity, and patient disability. A displaced CF with an unstable lateral column requires aggressive operative treatment. The purpose of this study was to analyze the clinical outcome of patients treated for unstable CF with adjunct internal (SIF) or external (SEF) spanning technique to open reduction and internal fixation (ORIF).

Methods: A retrospective analysis was undertaken on a cohort of 27 patients diagnosed with 28 CF and treated with SIF or SEF between March 2002 and June 2007 at a Level 1 teaching trauma center. Outcomes included fracture reduction quality, functional ability (pain, level of activity, shoewear, return to work), and complications.

Results: 16 (59.3%) males and 11 (40.7%) females had a mean age of 42 years (range, 16-63 years) and body mass index of 26.9 (range, 18.7-42.8). The mechanism of injury included motor-vehicle accidents (MVA, 17 of 27), crush injuries (2), motorcycle accidents (1), falls from height (1), and all-terrain vehicle accidents (1). There were 3 open injuries and all had associated foot injuries. AO/OTA classification was 6 (21%) Type A, 10 (36%) Type B, and 12/28 (43%) Type C fractures. Treatment was 14 SIF and 14 SEF using 2.0 plates (25 28, 89.3%) and 2.7 (3 of 28, 10.7%) plates. No primary arthrodesis was performed. Bone grafts were required in 22/28 (78.6%) cases. Reduction was two excellent, seventeen good, seven satisfactory, and one bad. Complications included 24 posttraumatic osteoarthrosis (OA), 13 hardware irritations, 3 equinus contractures, 3 loosening, and 1 superficial infection. Hardware (plates) was removed in 13 SIF and 4 SEF. 17 of 27 (63.0%) patients had persistent pain. 17 of 27 (63.0%) patients returned to their previous level of activity. 5 of 28 (17.9%) feet required customized shoewear. Satisfactory or bad reduction was related to the inability to return to full level of activity ($\rho = -0.625$, $P = 0.001$).



Conclusion: Adjunct internal and external spanning techniques ensure alignment, fracture fixation, and joint reconstruction, resulting in a stable lateral column of the foot. Complication rate is in conjunction with injury severity; however, SIF requires hardware removal to avoid hardware complications.

See pages 75 - 103 for financial disclosure information.

Is Surgeon's Training More Important than Injury Pattern in Determining Operative versus Nonoperative Treatment of Calcaneal Fractures?

John Y. Kwon, MD; Amna Diwan, MD; Aron T. Chacko, BS;
Paul T. Appleton, MD; ***Edward K. Rodriguez, MD****;*
Beth Israel Deaconess Medical Center. Harvard Medical School, Boston, Massachusetts, USA

Purpose: There appears to be a lack of consensus regarding indications for operative care of calcaneal fractures. We hypothesize that different patient-based variables such as smoking history, diabetes, or occupation may influence treatment decisions possibly more so than the nature of the injury itself. The goals of our study were to: (1) determine if lack of consensus truly exists, (2) determine which factors most influence orthopaedic surgeons when choosing a treatment algorithm, and (3) determine if there is difference in treatment algorithm based on fellowship training and frequency of treatment of these injuries.

Methods: Practicing orthopaedic surgeons of various backgrounds and training were administered an electronic survey. The survey consisted of clinical vignettes and questions regarding fellowship training, demographics, and frequency of treatment of calcaneal fractures. Orthopaedic surgeons were asked to weigh the importance of patient-based variables in determining operative versus nonoperative treatment.

Results: 375 orthopaedic surgeons responded to our survey (183 foot and ankle fellowship–trained (FA), 61 trauma fellowship–trained (TF), 14 both trauma and foot and ankle trained, and 117 neither fellowship trained (NFT). FA- and TF-trained surgeons felt that articular involvement, calcaneal deformity, and diabetes mellitus are more important factors in determining treatment than NFT surgeons. NFT surgeons felt that articular involvement was the most important variable determining operative versus nonoperative treatment, while FA and TF surgeons felt that calcaneal deformity was more important with articular involvement second. Surgeons treating more calcaneal fractures (>4 per month) tend to treat operatively, and weigh smoking, alcohol use, and medical comorbidities as more important factors in making a decision than do surgeons who treated less than 1 fracture per month. For patients with an uncomplicated medical history, there was general consensus on treatment as guided by the Sanders/OTA classification. However, for those with a complex medical history, fracture pattern was less likely to define a treatment protocol. There were differences in operative versus nonoperative treatment based on the surgeon's fellowship training.

Conclusion: In cases where there was articular involvement with displacement at either end of the spectrum of severity (Sanders 1 or 4), there was generalized agreement between surgeons regarding management (>90% recommending the same treatment). When additional confounding variables were added, the agreement on management of the various fracture patterns decreased. This was found to be the case only in the presence of factors considered to be of moderate or greater importance, which vary with type of fellowship training. Surgeons who see more calcaneal fractures in their practices are more likely to pursue operative intervention. Treatment decisions and the importance of different variables influencing these decisions varied based on fellowship training of the 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 413.

When Is Plate Fixation for Unstable Isolated Fibular Fractures Cost-Effective? Results from a Multicenter Randomized Control Trial

***Gerard P. Slobogean, MD, MPH*[1]**; *David W. Sanders, MD, MSc, FRCSC*[2];
Canadian Orthopaedic Trauma Society;
[1]*University of British Columbia, Department of Orthopaedics, Vancouver, British Columbia, Canada;*
[2]*University of Western Ontario, Division of Orthopaedic Surgery, London, Ontario, Canada*

Purpose: A recent multicenter randomized control trial (RCT) failed to demonstrate superior quality of life at 1 year following open reduction and internal fixation (ORIF) compared to nonoperative treatment for unstable isolated fibular fractures. Given the popularity of ORIF for these fractures, we sought to determine the parameters when ORIF might be considered a cost-effective treatment.

Methods: A decision tree was used to model the results of a multicenter trial comparing ORIF versus nonoperative treatment for isolated fibular fractures. Utilities (a measure of preference for a health state) were obtained from the subjects' Short-Form-6D scores and used to calculated Quality Adjusted Life Years (QALYs). Probabilities for each strategy were taken from the 1-year trial end point. Costs were obtained from the Ontario Case Costing Initiative. Sensitivity analysis was performed for all model variables to determine when ORIF is a cost-effective treatment (incremental cost per QALY gained <$75,000).

Results: Nonoperative management was the preferred treatment during the 1-year time horizon. The nonoperative treatment strategy had an average cost of $2128 ± $1984 for an average gain of 0.72 ± 0.00 QALYs. ORIF had an average cost of $6343 ± $893 for an average gain of 0.74 ± 0.02 QALYs. The incremental cost-effectiveness ratio for the ORIF treatment was $216,106 per QALY. ORIF becomes the preferred treatment at extreme values for its costs (<$2300) and its effectiveness (QALY >0.80).

Conclusions: Short-term follow-up does not support the cost-effectiveness of ORIF for unstable isolated fibular fractures; however, if ORIF results in a sustained increase in QALYs gained compared to nonoperative treatment, then it will likely reach the cost-effective threshold. Long-term follow-up and additional modeling of the incidence of posttraumatic ankle arthrosis remains necessary.

See pages 75 - 103 for financial disclosure information.

A Primary Report of the Supercutaneous Calcaneal Locking Plate to Treat Calcaneal Fracture

(FDA=Non-U.S. research conducted within guidelines of my country)

Guo-zhu Zhang, MD; *Xie-yuan Jiang, MD; Man-yi Wang;*
Department of Orthopaedic Trauma, Beijing Jishuitan Hospital, Beijing, China

Objective: Our objective was to study the advantages and disadvantagse of the supercutaneous calcaneal locking plate to treat calcaneal fractures.

Methods: Between October 2007 and June 2008, 12 cases of calcaneal fractures with the follow-up data were treated with a supercutaneous calcaneal locking plate. According to the Sanders classification system of calcaneal fracture, 8 cases were type IIA, 1 case was type IIB, 1 case was type IIC, 1 case was type IIIAC, and 1case was type IV. All the cases were fresh fractures. The skin incision was made from the distal tip of the fibula to the base of the fourth metatarsal. The posterior facet and anterior tuberosity could then be observed directly and the articular fragments be reduced anatomically. Then the reduced calcaneous was fixed by a supercutaneous calcaneal locking plate. Bone union could be expected 3 months after the operation by observing the CT scans and radiographs and then the supercutaneous plates and screws were removed in clinic.

Results: The average time of follow-up was 16 months (range, 12-20 months). There was no infection of the incisions and the pin holes. The reduction of the articular surface and bone union were good. One type IIA showed lateral wall exostosis resulting in peroneal tendinitis and stenosis followed by obviously walking pain. The preoperative radiograph showed that the Böhler angle of the 12 cases was 11.9° ± 9.4°and the Gissane angle 86.8° ± 7.7°. The postoperative radiograph demonstrated that Böhler angle was 29.4° ± 7.0° and the Gissane angle was 115.8° ± 7.7°; the difference was statistically significant ($P < 0.01$). According to the ankle hindfoot clinical rating system of the American Orthopaedic Foot & Ankle Society (AOFAS), the average score was 91 points (range, 68-100 points). Eight cases were excellent, three cases were good, and one was poor.

Conclusion: Using a supercutaneous calcaneal locking plate to treat calcaneal fractures can limit the injury, lower the rate of skin infection, and gain satisfactory reduction of the articular surface and stable fixation with good results of follow-up. The fixation can be removed without rehospitalization; is a less painful, cheaper treatment; and provides another choice for the treatment of displaced intra-articular calcaneal 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 413.

The Impact of CT Scans on the Treatment of Lisfranc Injuries

Lance E. LeClere, MD, LT MC USN; *Michael T. Mazurek, MD, CDR MC USN; Anthony I. Riccio, MD, LCDR MC USN; Nelson S. Saldua, MD, LCDR MC USN; Ryan P. Ponton, MD, LT MC USN;*
Naval Medical Center San Diego, San Diego, California, USA

Purpose: The current body of literature contains little information on the utility of CT scans in devising treatment plans for Lisfranc injuries. The purpose of this study was to determine if the addition of a CT scan changes the treatment plan for Lisfranc injuries.

Methods: Plain radiographs and CT scans of 30 Lisfranc injuries were retrospectively examined by six reviewers during three separate blinded review sessions. Studies reviewed during these sessions consisted of (1) plain films only, (2) CT scans only, and (3) plain films and CT scans simultaneously. During each session, reviewers determined diagnosis, preferred treatment method, preferred construct, and postoperative weight-bearing plan for each patient. Overall rates of change in diagnosis and treatment were calculated between each session. For treatment plan, rates of major change were calculated. Major changes were defined as a change from operative to nonoperative or vice versa, change from fusion to fixation or vice versa, or the addition or subtraction of three or more points of fixation.

Results: The overall rate of change was 85.6% for diagnosis, 84.2% for treatment plan, and 87.7% for postoperative weight-bearing plan. A major change in treatment plan was made in 20.8% of cases with the addition of a CT scan.

Conclusion: The addition of a CT scan can result in a major change in the treatment plan for Lisfranc injuries in a significant number of patients and can serve as a valuable imaging modality for treating surgeons.

See pages 75 - 103 for financial disclosure information.

Surgeon Practices Regarding Operative Treatment of Posterior Malleolus Fractures

Michael J. Gardner, MD; *Philipp N. Streubel, MD; Jeremy McCormick, MD; Sandra Klein, MD; Jeffrey E. Johnson, MD; William M. Ricci, MD; Washington University School of Medicine, St Louis, Missouri, USA*

Purpose: Management of posterior malleolus fractures continues to be a source of intensive debate among orthopaedic surgeons, as the available literature is inconclusive regarding ideal treatment. The purpose of the present study is to determine the current practice among orthopaedic surgeons regarding the management of posterior malleolus fractures.

Methods: Members of the OTA and the American Orthopaedic Foot & Ankle Society (AOFAS) were invited to participate in a web-based survey. Initial questions evaluated surgeon fellowship training, years of practice, and number of ankles operated per month. Five ankle fracture cases with variations in posterior malleolus fragment size, displacement, and comminution were presented to assess respondents' rationale for indications for fixation, reduction techniques, surgical approaches, and types of fixation. Standard radiographic views and axial and sagittal reconstruction CT scans were available for each case. We hypothesized that indications for fixation would be homogenous for large and small fragments, but that greater variability would exist for intermediate-sized fragments. We also predicted variable treatment approaches based on fellowship training, years of experience, and ankle fracture volume per month.

Results: Between October 2009 and January 2010, 401 respondents completed the survey. 98 (24%) respondents had received training in orthopaedic trauma, 199 (50%) in foot and ankle (F&A), and 6 (2%) in both orthopaedic trauma and F&A surgery. 95 (24%) had either no specialty training or training different from trauma and F&A surgery. A total of 255 respondents (64%) had been in practice for more than 10 years and 178 (44%) operated more than 5 ankle fractures per month. The most frequently reported indications for fixation were "depends on stability and other factors" (56%) and a 25% size threshold (29%). Trauma surgeons, those with <10 years experience, and those who treated >5 ankle fractures per month were significantly more likely to use factors other than size for indications ($P = 0.026$, <0.01, and <0.01 respectively). A fragment with 40% of the articular surface was indicated for fixation by 97% of respondents. For a posterior fragment with 20% articular involvement and a small osteochondral fragment, fixation was deemed necessary by 44% of respondents. A posterior fragment with 10% articular involvement would be fixed by 9%. There were no differences in fellowship training, years of practice, or ankle fracture volume per month in these cases. For a fracture involving 15% of the articular surface with comminution extending to the posteromedial rim, 45% indicated that fixation was necessary. A larger proportion of trauma-trained surgeons considered fixation necessary compared to F&A-trained surgeons in this case ($P = 0.028$). When posterior malleolus fixation was indicated, direct open reduction using the flexor hallucis longus–peroneal tendon interval was the preferred approach in all cases. Trauma-trained surgeons were significantly more likely to choose antiglide plate fixation ($P < 0.05$). F&A training, or no or other fellowship training, was associated with the preference for screw-only fixation ($P < 0.05$). Surgeons who had been in practice for >10 years were also more likely to use screw fixation only ($P < 0.001$).

• 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 413.

Conclusion: In this large survey study of trauma and F&A surgeons, significant variation existed regarding all aspects of posterior malleolar ankle fracture treatment. In the presence of large (~40%) and small (~10%) posterolateral fragments, most surgeons agree regarding indications for treatment, regardless of training or experience. However, for intermediate-sized fragments, significant variability in indications and fixation exists, which depends on both subspecialty training and experience. Clearly, high-quality prospective studies are necessary to determine the optimal treatment of the posterior mallelous fragment in ankle fractures.

See pages 75 - 103 for financial disclosure information.

Impact of Location of Osteochondral Lesion of Talus on Outcomes in Ankle Fractures

***Omesh Paul, MD*[1]**; *Sreevathsa Boraiah, MD*[2]; *Keith Hentel, MD*[3]; *Robert J. Parker, BS*[1]; *Elizabeth M. Morris, BA*[1]; *David L. Helfet, MD*[1]; *Dean G. Lorich, MD*[1];
[1]*Hospital for Special Surgery, New York, New York, USA;*
[2]*Westchester Medical Center, Valhalla, New York, USA;*
[3]*New York Presbyterian Hospital, Weill Cornell Medical Center, New York, New York*

Purpose: Damage to the articular surface of talus is a notable source of residual pain after operative fixation of the ankle fractures. Topography of the talar cartilage varies due to dissimilar strain patterns at different regions of the talar dome. Literature reports different morphology and etiology for the medial- and lateral-sided chondral lesions but the effect of location of the osteochondral lesion of talus on outcomes is not well studied. We hypothesized that location of the articular chondral defect has significant effect on functional outcomes.

Methods: Preoperative MRI scans were analyzed to evaluate 188 patients with ankle fractures who were managed operatively from 2004 to 2008 with a minimal follow-up period of 1 year. Ligamentous structures and talar cartilage were evaluated; the latter using cartilage-specific sequences. 50 patients with 54 chondral lesions were identified and graded according to the modified Cheng classification. Multivariate regression analysis was performed to correlate the location of osteochondral lesion of talus with ligamentous injuries and outcomes. Fisher exact *t* test was used to compare medial- and lateral-sided lesions. Functional outcomes were assessed using the Foot and Ankle Outcome Score (FAOS), Olerud Molander Ankle Score (OMAS), Modified Weber, and American Orthopaedic Foot & Ankle Society (AOFAS) score.

Results: Average age was 52 years (range, 32-86 years) with an average follow-up of 26 months (range, 12-36 months). There were 33 (61%) lateral- and 21 (39%) medial-sided lesions. The majority of lesions were in the posterolateral (37%) region, followed by the anteromedial (22%) portion of the talar dome. Injury to the anteroinferior tibiofibular ligament ($P = 0.05$), posteroinferior tibiofibular ligament ($P = 0.03$), and lateral ($P = 0.02$) and posterior ($P = 0.03$) malleolus fractures significantly predicted the lateral-sided lesions, suggesting traumatic etiology. Grading of the osteochondral lesions had no effect on the functional outcomes ($P > 0.05$). Lateral-sided lesions were associated with lower scores on the sports and recreation subscale of FAOS ($P < 0.0001$). OMAS, Modified Weber, and AOFAS scores did not show any significant difference in outcomes between the lateral- and medial-sided lesion ($P > 0.05$).

Conclusion: Preoperative MRI can provide vital information for establishing the treatment protocol for osteochondral lesions. Operative management may be more beneficial in patients with lateral-based lesions and in patients with increased athletic demand.

- 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 413.

Plain Radiographs versus CT after Open Reduction and Internal Fixation of Tibial Pilon Fractures: What Are We Missing?

Justin Knight, MD[1]; *Lauren Hinojosa, MD*[1]; *Florian Nickisch, MD*[2]; *Rahul Banerjee, MD*[1];
[1]*University of Texas Southwestern Medical Center, Dallas, Texas, USA;*
[2]*University of Utah, Salt Lake City, Utah, USA*

Purpose: Past studies have suggested that anatomic reduction of the articular surface does not correlate with patient outcomes after open reduction and internal fixation (ORIF) of tibial pilon fractures. However, these studies are based on postoperative plain radiographs. Our hypothesis is that plain radiographs and fluoroscopy underestimate the severity of articular incongruency after ORIF when compared to postoperative CT scan.

Methods: Intraoperative fluoroscopy, postoperative plain radiographs, and postoperative CT scans were reviewed by a blinded reviewer in 24 patients who underwent ORIF of a tibial pilon fracture. The articular reduction was judged based on articular step-off and articular gap, each of which was measured using a digital imaging software package. For each imaging modality, the reviewer determined whether the articular reduction was anatomic (<2 mm displacement), fair (2-4 mm displacement), or poor (>4 mm displacement). The worst (highest) measurement of either the step-off or gap was used to categorize each patient's images.

Results: Of the 24 patients, there was one AO/OTA 43B1 fracture, two 43B3 fractures, six 43C1 fractures, six 43C2 fractures, and nine 43C3 fractures. Fluoroscopic images demonstrated anatomic reduction in 13 patients, fair reduction in 6 patients, and poor reduction in 4 patients. Plain radiographs showed 10 anatomic, 6 fair, and 3 poor articular reductions. Articular reduction could not be judged in 5 of the sets of plain radiographs due to surgical implants that obscured the articular surface. CT scan demonstrated 4 anatomic, 12 fair, and 8 poor reductions. The assessment of articular reduction correlated between all 3 imaging modalities in only 8 of 24 cases (33%). In 10 cases (42%), the CT assessment suggested a worse articular reduction than the assessment on either fluoroscopy or plain radiograph. In one case, the CT assessment demonstrated a better reduction than the assessment on fluoroscopy or plain radiograph. In the remaining 5 cases, the reduction assessed by CT was equivalent to either the fluoroscopic or plain radiograph assessment, but not both. In 4 cases (17%), the CT scan demonstrated an inaccurate reduction of the syndesmosis, which was not seen on either the fluoroscopy or the plain radiograph.

Conclusion: Fluoroscopic and plain radiographic assessment of articular reduction after ORIF of pilon fractures is inaccurate when compared to postoperative CT scan. Past studies, which have failed to show a correlation between anatomic articular reduction and clinical outcome, have used plain radiographs. Our study suggests that this method of assessment is limited and therefore, the importance of anatomic reduction in the clinical outcome of operative treatment of pilon fractures may not be accurately described in the literature.

See pages 75 - 103 for financial disclosure information.

Does Supplemental Perioperative Oxygen Decrease Surgical-Site Infection in At-Risk Fractures? Results of a Double-Blind Randomized Controlled Trial

***Alec Stall, MD*[1]**; *Rishi Gupta, MD*[1]; *Mary Zadnik Newell, OT*[1]; *Emily Hui, MPH*[1];
Renan C. Castillo, PhD[2]; *Robert V. O'Toole, MD*[1];
[1]*R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland Medical School, Baltimore, Maryland, USA;*
[2]*Johns Hopkins Bloomberg School of Public Health, Department of Health Policy and Management, Baltimore, Maryland, USA*

Background: Elevated intraoperative fraction of inspired oxygen has been shown to reduce surgical-site infection (SSI) in a meta-analysis of randomized controlled trials of over 3000 general surgery patients. It is unknown if this benefit applies to orthopaedic fracture patients.

Purpose: Our purpose was to evaluate the efficacy of high fractional inspired oxygen in the perioperative period to decrease the rate of SSI following open reduction and internal fixation of high-energy lower extremity fractures.

Methods: Our study design was a prospective randomized double-blind treatment trial. Patients sustaining high-energy tibial plateau, tibial pilon, and calcaneus fractures treated in a staged fashion were enrolled. Enrolled patients were randomized to either the control or treatment arm and were blind to their treatment as was the treating surgeon. Patients in the treatment arm received 80% oxygen intraoperatively and for 2 hours afterward. The control group received 30% oxygen over the same time period. Patients were followed for a minimum of 12 weeks postoperatively. The primary outcome was the presence of clinically significant SSI as defined by the Centers for Disease Control. Wounds were evaluated by a member of the research team who was blinded to the patients' treatment group. A planned interim analysis was performed using O'Brien-Fleming boundaries, with alpha set to 0.005 for this analysis. Infection rates were compared using the Fisher exact test.

Results: The study population included 172 patients with 183 eligible injuries: 60 tibial plateau, 69 tibial pilon, and 54 calcaneus fractures. The overall rate of postoperative SSI was 18.6% (16 of 86) in the control group and 10.3% (10 of 97) in the treatment group (P = 0.14). There were no observed complications in the treatment group. Using the currently observed proportions to estimate subsequent results, conditional power for the remainder of the study is 89%.

Conclusion: On the basis of the results of this study, the use of a high fractional inspired concentration of oxygenation (FiO_2) during the perioperative period is safe and may reduce the rate of SSIin patients undergoing operative fixation of high-energy lower extremity trauma. The efficacy of supplemental perioperative oxygen cannot be statistically confirmed nor excluded on the basis of this current study due to the small number of total events (infections). Given the safety, low cost, ease of implementation, and potential large benefit of this intervention, further study with a larger patient population in a multicenter trial 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 413.

Syndesmotic Reduction: Can Accuracy Be Improved with Intraoperative 3D Imaging?

***Roy I. Davidovitch, MD*[1]**; *Kenneth A. Egol, MD*[1]; *Meir Liebergall, MD*[2]; *Amal Khoury, MD*[2]; *Rami Mosheiff, MD*[2]; *Yoram A. Weil, MD*[2];
[1]*NYU Hospital for Joint Diseases, New York, New York, USA;*
[2]*Hadassah Hebrew University Hospital, Jerusalem, Israel*

Purpose: This study was designed to evaluate if syndesmotic reduction and fixation is more accurate utilizing the isocentric C-arm with 3-dimensional imaging (ISO-C-3D) as compared to standard intraoperative fluoroscopy for unstable ankle fractures with an unstable syndesmotic complex.

Methods: Over a 1-year period, 36 unselected consecutive patients with unilateral unstable ankle fractures with an associated syndesmotic disruption (AO/OTA 44B and C) were enrolled in a multicenter IRB-approved prospective study, in 2 Level 1 trauma centers. In center A, all patients underwent open reduction and internal fixation of the ankle fracture and syndesmotic fixation utilizing standard intraoperative fluoroscopic imaging. In center B, the ISO-C-3D was utilized exclusively. Fellowship-trained trauma surgeons performed all procedures and all patients underwent postoperative bilateral ankle CT scans utilizing a standardized research protocol limited to axial cuts through the level of the syndesmosis. The scans were evaluated by surgeons at each institution comparing the operative to the uninjured side. The results of each treatment modality were then compared with regard to adequacy of reduction. In all cases, the surgeons were satisfied with the radiographic appearance of the ankle mortise before they left the operating room. The postoperative rehabilitation protocol was standardized at both centers.

Results: 19 patients underwent syndesmotic repair utilizing standard fluoroscopy and 17 utilizing the ISO-C-3D. Each ISO-C-3D scan lasted 2 minutes with a few minutes of calibration time prior to scan. At both centers, age (mean, 37.3 years; range, 22-69), sex, and mechanisms of injury (high- or low-energy) were equivalent ($P > 0.05$). OTA fracture codes (3, 44B; 6, 44C1; 16, 44C2; and 11, 44C3) as well as number of open fractures were evenly distributed ($P > .05$). At center B, all syndesmotic fixation was routinely removed at 90 days. At center A, one patient underwent removal of hardware due to pain. Comparison of syndesmotic reduction was performed relative to the uninjured side. At center A, 6 of 19 (31.6%) were considered malreduced while at center B, 2 of 17 (11.8%) were considered malreduced ($P = 0.16$). Types of malreduction in group A were anterior or posterior subluxations within the incisura with some overcompression. In group B, the malreductions were noted in rotation only, and were noticed intraoperatively but accepted by the surgeons after several reduction attempts.

Conclusion: A trend toward more accurate reductions of the syndemosis was noted with usage of intraoperative ISO-C-3D scanning, although this did not reach statistical significance. This serves as the basis for further study to evaluate the utility of this modality. The functional outcome implications of syndesmostic malreductions are to be further studied.

See pages 75 - 103 for financial disclosure information.

Prospective Comparison of Locked Plates versus Nonlocked Plates for the Treatment of High-Energy Pilon Fractures

Theodore T. Le, MD; ***Namdar Kazemi, MD***; *Gene Lee, BS*;
Michael T. Archdeacon, MD, MSE; John D. Wyrick, MD;
University of Cincinnati Academic Health Center, Cincinnati, Ohio, USA

Purpose: We undertook this study to compare the radiographic findings of patients with high-energy pilon fractures treated with locked versus nonlocked plates. Our null hypothesis is that there would be no significant difference in the incidence of loss of reduction between nonlocked and locked plates in the treatment of high-energy pilon fractures.

Methods: A prospective treatment protocol on patients with high-energy pilon fractures treated at a Level 1 trauma center between December 2005 and December 2008 was established and followed. Patients were randomized to either locking or nonlocking devices according to their medical record number. At latest follow-up (minimum of 6 months), radiographic outcomes were assessed. Mortise and lateral radiographs of the ankle at latest follow-up were compared to radiographs at the time of surgery and assessed for loss of reduction, which was defined as an angle measurement ≥5°.

Results: From December 2005 to December 2008, 58 patients were randomized to receiving either a locked or a nonlocked plate. Radiographic measurements at a minimum of 6 months were available in 21 (36%) patients. Fracture classification included 12 OTA 43-C3, 3 43-C2, 5 43-B3, and 1 43-A3 fractures. Mechanisms of injury included 7 falls from a height greater than 10 feet, 7 falls from standing, 5 motor vehicle accidents, and 2 twisting mechanisms. 12patients had nonlocking constructs and 9 patients had locking constructs. The mean interval to latest radiographic follow-up was 24.9 months (range, 6-42). On the mortise view, 5 of 9 (56%) from the locking group demonstrated loss of reduction compared to 3 of 11 (27%) from the nonlocking group (mortise view not available in 1 patient). This difference was not statistically significant. On the lateral view, 4 of 9 (44%) from the locking group demonstrated loss of reduction compared to 3 of 12 (25%) from the nonlocking group; this was also not statistically significant. There were no soft-tissue complications that required surgical intervention. Complications included one infected nonunion in the nonlocking group compared to one mechanical complication requiring hardware removal, one failed syndesmosis fixation requiring revision, and one infected malunion in the locking group.

Conclusions: The staged protocol for the treatment of high-energy pilon fractures has overcome the soft-tissue complications previously encountered. However, our preliminary data show that locking constructs have not changed the overall outcome of high-energy pilon fractures in terms of maintaining reduction. Due to the current number of patients in this study, it would be difficult to draw conclusions on the superiority of one system over the other.

• 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 413.

An Investigation of Multiligamentous Knee Injury Patterns and Associated Morbidities from a Level 1 Trauma Referral Center

Jeffrey D. Watson, MD; *Edward H. Becker, MD; James C. Dreese, MD;*
University of Maryland, R Adams Cowley Shock Trauma Center, Baltimore, Maryland, USA

Purpose: Multiligamentous knee injuries are challenging to evaluate and treat. The objective of this study was to review the data for a large population of patients seen at a single trauma center to characterize the ligamentous injury patterns and describe the associated morbidities to the affected limb and whole body. To our knowledge, this is the largest and most comprehensive study of multiligamentous knee injuries to date.

Methods: We identified 102 patients (106 knees) with multiligamentous knee injuries and/or knee dislocations by ICD-9 diagnoses within a large regional trauma referral center from 2000 to 2008. Ligamentous injury patterns were verified by MRI and confirmed by a single fellowship–trained sports medicine orthopaedic surgeon. Isolated anterior cruciate ligament (ACL)/medial collateral ligament (MCL) injuries were excluded. Data were obtained from the medical record using a predefined protocol to include trauma and orthopaedic examinations, radiographic findings, and ancillary studies. All vascular injuries, nerve injuries, associated fracture patterns, and whole-body morbidities were recorded.

Results: The mean age was 27 years; 74% were male. 31% of patients were dislocated on arrival. Four patients (4%) had bilateral multiligamentous knee injuries. Motorcycle collisions (29%), motor vehicle accidents (23%), pedestrians struck by a motor vehicle (23%), and sports injuries (8%) were the most common mechanisms of injury. The incidence of ligamentous injury was ACL, 90%; posterior cruciate ligament (PCL), 79%; posterolateral corner (PLC), 74%; and MCL, 27%. Injury patterns included ACL/PCL/PLC (43%), ACL/PCL/MCL (17%), ACL/PLC (17%), PCL/PLC (7%), ACL/PCL/PLC/MCL (4%), and ACL/PCL (4%). 21% of patients had ipsilateral tibial plateau fractures and 12% suffered ipsilateral femoral fractures. Arterial injury (19%), peroneal nerve injury (26%), and compartment syndrome (16%) were common injuries to the affected limb. Severe closed head injury was present in 9%, symptomatic pulmonary embolism in 5%, and 2% expired.

Conclusion: In our trauma center, nearly half of all multiligamentous knee injuries involved the ACL/PCL/PLC and 21% had associated ipsilateral tibial plateau fractures. Peroneal nerve injury (26%) was more common than previously reported in the literature (5%-20%), while vascular injury was similar to prior studies. We found a substantial incidence of associated morbidities to the whole body. These results prove that concomitant injuries are common among patients presenting with multiligamentous knee injuries.

See pages 75 - 103 for financial disclosure information.

Δ Posteromedial Tibial Plateau Fracture Stability May Depend on its Morphology and Knee Flexion Angle

Igor Immerman, MD*; Christopher Bechtel, BS; Yildirim Gokce, MS; Yonah Heller, BS; Peter S. Walker, PhD; Kenneth A. Egol, MD;*
NYU Hospital for Joint Diseases, New York, New York, USA

Purpose: The posteromedial fragment in tibial plateau fractures is considered unstable and requires specific fixation. However, if not loaded by the femur, it may remain stable and not require additional fixation. Our purpose was to determine the size of the posteromedial fragment that would remain unloaded by the femoral-tibial contact area, as a function of fracture line orientation and knee flexion angle.

Methods: Seven human cadaveric knees with intact capsule and ligaments were mounted in a mechanical rig and flexed from 0 to 30°, 90°, 105°, and 120° of flexion. The fiducial points and articular surfaces were digitized, and 3-dimensional software models of the knees at each flexion angle were created. The femoral-tibial contact areas were determined using the software under high- and low-load conditions. Posteromedial fragments of various sizes and fracture line orientations relative to the posterior femoral condylar axis (PFCA) were modeled, and their locations relative to contact areas were determined.

Results: The size of unloaded fragments decreased with increased flexion angle. Fragments occupying 60% of medial plateau were loaded at all angles, but fragments with 30% of the plateau became loaded at 90° under high load and 120° under low load. Fracture line orientations of 0 to 20° external rotation relative to PFCA allowed for the largest fragments to remain unloaded.

Conclusion: The size of posteromedial tibial plateau fracture fragment that remains unloaded by the femur varies with knee flexion angle and fracture line orientation. This may have implications for the management of posteromedial tibial plateau fractures. Specifically, these unloaded fracture fragments may be inherently stable and therefore may not require fragment-specific fixation.

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 413.

Knee Joint Extensor Mechanism Disruption: Better to Fracture the Patella or Rupture the Tendon?

Nirmal C. Tejwani, MD; *Nicole Montero, BS; Christopher Bechtel, BS;*
Michael Walsh, PhD; Kenneth A. Egol, MD;
NYU Hospital for Joint Diseases, New York, New York, USA

Summary/Purpose: There are no significant differences in medium- to long-term outcomes between patients who sustain bony disruption as opposed to ligamentous injury when the extensor mechanism of the knee is injured. The purpose of this study was to compare outcomes following surgical repair of knee extensor mechanism disruption caused by either bony disruption (patella fractures) or ligamentous injury (quadriceps and patella tendon ruptures).

Methods: 90 patients were identified who underwent 93 surgical repairs for extensor mechanism disruption, either bony or tendinous. Of these, 47 (50%) were patella fractures, 34 (37%) were quadriceps ruptures, and 12 (13%) were patella tendon ruptures. All patients were evaluated at 6 and 12 months, and were tested for range of motion, gait, quadriceps circumference and strength, Short Form-36 (SF-36), Lysholm, and Tegner outcome scores by independent observers. Radiographs of the knee were obtained to assess healing, post-traumatic arthritis, and heterotopic ossification. Data were analyzed by Student *t* test and Fisher exact test to compare outcomes between the two cohorts. A *P* value of <0.05 was considered significant.

Results: A minimum of 12 months of follow-up (range, 12-81 months) was available for 74 patients (82%). Patella fractures were seen more commonly in women ($P < 0.001$) and patients were younger ($P < 0.001$), with no difference in body mass index. At 1-year follow-up, there were no significant differences noted with respect to gait, knee range of motion, radiographic arthritis, Tegner, Lysholm, or SF-36 scores.

Discussion/Conclusion: At a mean of 28 months after injury of the knee extensor mechanism, there are no significant differences in outcomes between patients who sustain bony disruption as opposed to ligamentous injury. Women appear to be more likely to sustain a patella fracture than injury of the patella or quadriceps tendon.

See pages 75 - 103 for financial disclosure information.

Functional Outcomes of Operative Fixation of Patella Fractures

Omesh Paul, MD[1]; *Sreevathsa Boraiah, MD[2]; Gina Sauro, DPT[3]; Elizabeth M. Morris, BA[1]; Robert J. Parker, BS[1]; David L. Helfet, MD[1]; Dean G. Lorich, MD[1];*
[1]Hospital for Special Surgery, New York, New York, USA;
[2]Westchester Medical Center, Valhalla, New York, USA
[3]New York Presbyterian Hospital–Weill Cornell Medical Center, New York, New York, USA

Purpose: Our objective was to evaluate the functional outcomes of patients with isolated operatively treated patella fractures.

Methods: We identified 84 patients who underwent operative intervention for patella fracture from our institution between 2005 and 2008. A total of 66 patients with a minimum 1-year follow-up were evaluated. Clinical, radiographic, and functional data of interest were analyzed. Preoperative CT scans were used to classify the fracture patterns in accordance with the current AO/OTA classification system and to plan the treatment strategy. Articular reduction of the fracture fragments was achieved by complete exposure of the articular surface. Functional outcomes were evaluated with the Short Form-36 version 2 (SF-36 v2), Knee Outcome Survey (KOS) and Lower Extremity Functional Scale (LEFS). Multivariate regression analysis was performed to find out which factors determine the outcomes. Balance and strength-based analysis was available for 20 (30%) patients at 3-, 6-, and 12-month follow-up visits.

Results: Average patient age was 57 years (range, 26-89 years). The most common mechanism of action was fall from a standing height (84%). Mean follow-up was 2.3 years (standard deviation [SD] = 1.3). All patients healed radiographically at an average of 4 months (SD = 1.2) with an average articular step-off of 1.1 mm (SD = 1.3). Average thigh atrophy was 1.2 cm (SD = 1.5) when compared to the contralateral healthy side. 23 patients (35%) reported difficulty in performing daily activities, especially related to standing from sitting position and going up or down stairs. 13 patients (20%) required removal of hardware. There were no complications related to surgery. Balance-based analysis revealed significant asymmetry (transfer of weight toward the control side) during activities like standing from sitting position (6%) or going up or down stairs (17%). Strength-testing analysis showed a trend of continuous improvement. There was an isometric extension, extension power, and extension endurance deficit of 27, 34 and 34% at the 1-year follow-up visit, respectively. Average thigh atrophy was 1.2 cm (SD = 1.5). Average KOS and LEFS functional score was 72 (min 0, max 100) and 62.8 (min 0, max 80), respectively. The mean normalized SF-36 physical component summary (PCS) and mental component summary (MCS) scores were 42 and 48, respectively. Functional outcomes were independent of the articular step-off ($P = 0.73$).

Conclusion: Significant functional impairment persists despite emphasis on the articular reduction during operative fixation of the patella fractures. The etiology of this deficit remains unclear. Our data suggest that physiotherapy plays a vital role in determining the outcomes. An aggressive and prolonged physiotherapy regimen tailored to reduce tracking problems may help in improving 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 413.

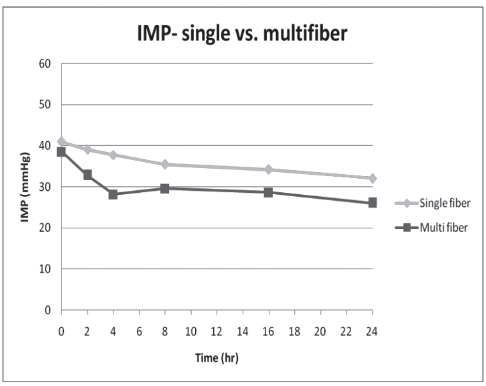
•Rationale for Tissue Ultrafiltration as a Potential Treatment for Impending Acute Compartment Syndrome: Increased Fluid Removal Is Associated with Lower Intramuscular Pressure

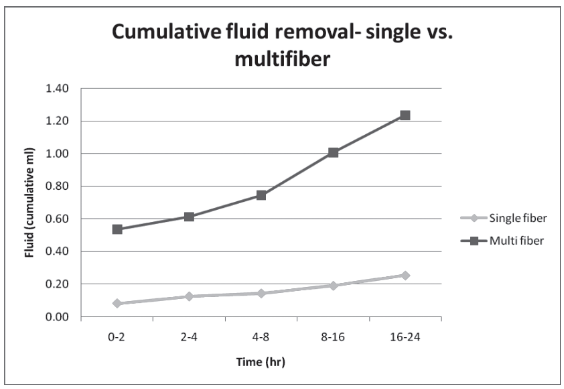
Andrew H. Schmidt, MD; *Rick Odland, MD, PhD;*
Hennepin County Medical Center, Minneapolis, Minnesota, USA

Background: Removal of interstitial tissue fluid by tissue ultrafiltration (TUF) has been shown to lower intramuscular pressure (IMP) in animal models and in humans with tibia fractures. Prior to performing a randomized clinical trial of TUF in humans, a study was done in adult patients with isolated tibia fractures requiring surgery to optimize fluid removal by investigating various suction and TUF catheter design parameters, while continuously measuring IMP with a fiberoptic transducer.

Methods: 21 patients were recruited at 6 sites. The patients were all enrolled in phase 1 of a 2-phase clinical trial of TUF. The objective of the first phase was to identify the manner of TUF that produced the greatest volume of fluid removal. All patients had a set of TUF/pressure-monitoring catheters inserted in the anterior compartment of the injured leg at the conclusion of a surgical intervention and were monitored/treated for 24 hours. Patients received either single- or multifiber TUF catheters, and were treated with either continuous or intermittent vacuum, thus creating four groups. The interstitial fluid that was removed was collected and its volume measured, and continuous monitoring of IMP was performed.

Results: Patients treated with a multifiber catheter had greater fluid removal than those treated with single-fiber catheters (1.24 ± 0.63 mL vs 0.25 ± 0.21 mL). Similarly, patients with constant vacuum had greater fluid output than those treated with intermittent vacuum (1.71 ± 0.60 mL vs 0.77 ± 0.28 mL). For both groups, greater fluid output was associated with lower IMP.





Conclusion: The finding of lower IMP in patients with the highest volume of interstitial fluid removal supports the rationale for using TUF to lower IMP in patients with extremity injury. Further work is justified to determine whether lower IMP improves outcome by reducing muscle damage, and whether acute compartment syndrome can be avoided.

See pages 75 - 103 for financial disclosure information.

Fibular Head Osteotomy: A New Approach for the Treatment of Lateral or Posterolateral Tibial Plateau Fractures

(FDA=Non-U.S. research conducted within guidelines of my country)

***Baoqing Yu, MD*[1]**; *Kaiwei Han, MD;*
Department of Orthopaedics, Changhai Hospital, The Second Military Medical University, Shanghai, China

Purpose: A variety of surgical approaches have been employed previously for the open reduction and internal fixation of fractures of the lateral and posterolateral tibial plateau. However, the commonly used lateral approach does not provide adequate exposure and access to the posterolateral aspect of the lateral tibial plateau. We developed a new approach with osteotomy of the fibular head to solve this problem and report its preliminary result.

Methods: 82 patients with lateral or posterolateral tibial plateau fractures had been treated by this approach. According to the fractures, partial or full heads of the fibula were removed, and knee joint function, including stability of the knee, was evaluated by radiographic and physical examinations.

Results: All 82 cases were followed for a mean of 3.2 years (range, 2.0-5.6 years). In each case, the fractures were completely healed and knee joint function was restored. No infection or skin and bone necrosis were found. After 1 year following the operation, functional assessment of the knee joints by Rasmussen's functional grading system revealed a mean score of 27.9 (range, 24-30). In addition, the radiological assessment by Rasmussen's anatomical grading system resulted in a mean score of 16.8 (range, 14-18). Six patients experienced occasional pain or bad weather pain around knee joints, three of whom had lateral-longitudinal instability of knee joint and three lost height of the tibial plateau.

Conclusions: The new approach provides excellent visualization, which can facilitate the reduction and internal fixation for lateral or posterolateral tibial plateau fractures, and shows encouraging results.

Level of Evidence: Therapeutic level IV.

- 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 413.

Retrospective Study of Type III Open Fractures: Do Negative Pressure Dressings Safely Allow for Delayed Flap Coverage?

Jason Halvorson, MD[1]; *Eben A. Carroll, MD*[1]; *Lisa K. Cannada, MD*[2];
William T. Obremskey, MD[3]; *Steven A. Olson, MD*[4]; *Langdon Hartsock, MD*[5];
Brenda Kulp, RN[1]; *Lawrence X. Webb, MD*[6]; *Southeastern Fracture Consortium;*
[1]*Wake Forest Baptist Hospital, Winston-Salem, North Carolina, USA;*
[2]*Saint Louis University, St. Louis, Missouri, USA;*
[3]*Vanderbilt University Medical Center, Nashville, Tennessee, USA;*
[4]*Duke University Medical Center, Durham, North Carolina;*
[5]*Medical University of South Carolina, Charleston, South Carolina, USA;*
[6]*Medical Center of Central Georgia, Macon, Georgia, USA*

Purpose: Previous studies have shown that delay in soft-tissue coverage of severe open fractures may be complicated by higher infection rates. The question of safe prolongation of flap coverage by the use of negative pressure dressings for open fractures is unresolved. We hypothesize that use of negative pressure dressings in type III open tibia fractures will prolong the timetable for flap coverage within which complications are minimal.

Methods: A multicenter retrospective review of 5 Level 1 trauma centers was completed over a 5-year period. Eligible patients were those with type III open tibia fractures initially treated with negative pressure dressing. 149 patients met these criteria, with subsequent chart review focusing on the timing and type of flap coverage with respect to fracture healing and complications, usng both 3 and 7 days as cut-offs for evaluation.

Results: The original 149 patients with an average age of 40 years were followed for an average of 31 months. Infection rate for those undergoing coverage within 3 days was 27%, whereas infection rate with coverage after 3 days was 31% (not significant). Infection rate for those undergoing coverage within 7 days was 23%, whereas infection rate with coverage after 7 days was 37% (not significant). Rates of fracture union as well as amputation were also found to be not statistically significant in either the 3-day cut-off or 7-day cut-off coverage period.

Conclusions: Incidence of infection in open fractures treated with negative pressure dressing was similar whether the fractures were covered before or after 3 days and before or after 7 days. Furthermore, rates of fracture union as well as rates of limb salvage appear similar between time periods as well. The use of negative pressure dressings in severe open fractures may, therefore, allow the clinician a prolonged timetable of flap coverage with minimal risk of increased complication.

See pages 75 - 103 for financial disclosure information.

A Novel Technique for Reduction and Immobilization of Tibial Shaft Fractures: The Hammock

Sanjit R. Konda, MD*; Charles J. Jordan, MD; Roy I. Davidovitch, MD; Kenneth A. Egol, MD;*
NYU Hospital for Joint Diseases, New York, New York, USA

Purpose: Our objective is to describe a novel technique for the acute reduction and splinting of tibial shaft fractures. This method utilizes a "hammock" constructed of stockinette that allows a single consulting orthopaedic physician to rapidly reduce and place a long-leg plaster splint or cast on a patient.

Methods: This technique was performed on 12 consecutive patients with diaphyseal tibial fractures. Translation, angulation, and shortening of the fracture were documented in AP and lateral views of the injured tibia and these parameters were compared against values measured after the hammock technique was used to reduce and splint the fracture to determine the efficacy of this novel splinting technique.

Results: 12 diaphyseal tibial fractures (OTA classification: 4, 42-A; 7, 42-B; 1, 42-C) were splinted with the hammock technique by a single orthopaedic surgeon. Nine fractures underwent definitive fixation with intramedullary nails and 3 fractures were treated nonoperatively and converted from a splint to a cast at 2 weeks postinjury. Pre-hammock reduction average values for fracture displacement in the AP plane for translation, angulation, and shortening were 10.5 mm (53.1%), 12.0°, and 9.4 mm, respectively. Post-hammock reduction average values for fracture displacement in the AP plane for the same parameters were 8.7 mm (44.4%), 4.2°, and 7.9 mm, respectively. Pre-hammock reduction average values for fracture displacement in the lateral plane for translation and angulation were 4.9 mm and 8.7°. Post-hammock reduction average values for fracture displacement in the lateral plane for the same parameters were 4.9 mm and 2.0°.

Conclusions: The "hammock" technique for tibial shaft fractures is able to achieve the goals of reduction and immobilization in a rapid fashion when help is not available. We have found this technique to be especially useful in the following situations: (1) an unconscious or intubated patient who cannot respond appropriately to commands, (2) spine-injured patients in whom moving is contraindicated, (3) multiply injured patients in whom moving would be too painful, (4) obese patients with heavy extremities, and (5) when an assistant is unavailable to help apply the splint.

- 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 413.

The Somatic Pre-Occupation and Coping (SPOC) Questionnaire Predicts Functional Recovery in Tibial Fracture Patients

(FDA=Non-U.S. research conducted within guidelines of my country)

The SPRINT (Study to Prospectively Evaluate Reamed Intramedullary Nails in Tibial Fractures) Investigators and the Medically Unexplained Syndromes Study Group[1]
The writing group (Jason Busse, PhD [chair]; Mohit Bhandari, MD; Gordon H. Guyatt, MD; Diane Heels-Ansdell, MSc; Abhaya V. Kulkarni, MD; Scott Mandel, MD; David W. Sanders, MD; ***Emil H. Schemitsch, MD****; Marc Swiontkowski, MD; Paul Tornetta, III, MD; Eugene Wai, MD; and Stephen D. Walter, PhD) assumes responsibility for the overall content and integrity of the manuscript. Drs Bhandari and Guyatt, as Principal Investigators, had full access to the study data and take responsibility for its integrity.*
[1]*McMaster University, Hamilton, Ontario, Canada*

Purpose: Our objective was to explore the role of patients' beliefs and attitudes toward their likelihood of recovery from severe physical trauma.

Methods: We developed and validated an instrument designed to capture the impact of patients' beliefs and attitudes towards functional recovery from injury—the somatic pre-occupation and coping (SPOC) questionnaire. At 6 weeks after surgical fixation, we administered the SPOC questionnaire to 359 consecutive patients with operatively managed tibial shaft fractures. We constructed multivariable regression models to explore the association between SPOC scores and functional outcome at 1 year, as measured by return to work and Short Form 36 (SF-36) physical component summary (PCS) and mental component summary (MCS) scores.

Results: In our adjusted multivariable regression models that included preinjury SF-36 scores, SPOC scores at 6 weeks postsurgery accounted for 18% of the variation in SF-36 PCS scores and 18% of SF-36 MCS scores at 1 year. Our adjusted analysis found that for each 14-point increment in SPOC score (14 points being one-half the standard deviation of the aggregate score) at 6 weeks, the odds of returning to work at 12 months decreased by 40% (odds ratio = 0.60; 95% confidence interval, 0.50-0.73). In all models, 6-week SPOC scores were a far more powerful predictor of functional recovery than age, gender, fracture type, smoking status, or the presence of multitrauma.

Conclusion: The SPOC questionnaire is a valid measurement of illness beliefs and attitudes in tibial fracture patients and is highly predictive of their long-term functional recovery. Future research should explore whether these results extend to other trauma populations and if modification of unhelpful illness beliefs is feasible and would result in improved functional outcomes.

See pages 75 - 103 for financial disclosure information.

Do Surgeon and Center Volumes Impact the Outcomes of Closed Tibia Fractures?

(FDA=Non-U.S. research conducted within guidelines of my country)

***Marc Swiontkowski, MD*[1]**, *for the SPRINT (Study to Prospectively Evaluate Reamed Intramedullary Nails in Patients with Tibial Fractures) Investigators;*

[1]*Department of Orthopedics, University of Minnesota, Minneapolis, Minnesota, USA*

Purpose: The outcomes of highly technical interventions such as laparoscopic cholecystectomy and coronary artery bypass grafting have been shown to be impacted by surgeon and center volumes. This relationship has also been reported in hip and knee arthroplasty. Our hypothesis was that the clinical and functional outcomes of closed tibia fractures treated with intramedullary nails would be impacted by center and surgeon volumes.

Methods: 813 patients with closed tibia fractures were obtained from the SPRINT study, a multicenter, multinational randomized controlled trial on the management of tibia fractures with reamed and unreamed nails. Using multiple regression, we examined the effect of center and surgeon volume (categorized as high, moderate, or low), and geographic differences by country (Canada, USA, and The Netherlands) on health-related quality of life at 1 year and the SPRINT primary end point (revision surgery to gain union). Our measures of quality of life are the Physical Component Score for the Short-Form 36 Health Survey Questionnaire and the Function and Bother domains of the Short Musculoskeletal Function Assessment (SMFA). We adjusted for age, gender, isolated fracture versus multitrauma, and baseline quality of life in our models.

Results: Patients treated by moderate-volume surgeons had a reduced risk of reoperation compared to patients treated by low-volume surgeons (odds ratio = 0.54; 95% confidence interval [CI], 0.33-0.89; $P = 0.02$). This relationship did not hold between high-volume surgeons and low-volume surgeons. No effects by surgeon volume were seen on the other outcomes. Patients treated at moderate-volume centers were found to have poorer quality of life at 1 year than patients treated at low-volume centers, based on the SMFA Bother score (difference = 7.33; 95% CI, 2.65-12.01). However, this effect was not seen with the other outcomes. Statistically and clinically significant differences were identified for two of our adjustment factors. Patients with isolated fractures have better quality of life at 1 year, based on all three measures ($P < 0.001$). Older patients have poorer SMFA Function scores at 1 year than younger patients ($P < 0.001$). Finally, there were no significant differences based on the country in which the patient was treated.

Conclusion: The traditional volume versus outcome relationship between centers and surgeons treating closed tibial fractures with intramedullary nailing does not hold. This may be because our indicators of surgical experience (in this situation volumes of patients treated in the SPRINT trial only) are not indicative of the overall volume experience for centers or surgeons. An alternative conclusion would be that intramedullary nail fixation for tibial shaft fractures is a straightforward procedure that can be reproducibly taught to trainees such that the principles and technical skills needed to successfully perform the procedure are retained throughout one's career. Further analyses of the volume versus outcome equation in other areas of orthopaedic trauma surgery would be advisable.

- 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 413.

Round Peg in a Triangular Hole: Is Preoperative Radiographic Determination of Tibial Isthmal Diameter Accurate?

Brandon Steen, MD; Michael Kindya, BS; ***Paul Tornetta, III, MD****;*
Boston University Medical Center, Boston, Massachusetts, USA

Background: Fractures of the tibial shaft are relatively common injuries with potential for serious adverse consequences. Excessive reaming of the tibial canal may have potentially significant adverse affects on the endosteal blood supply of the injured bone. Thus, minimally reamed and unreamed nails are most commonly used. Attentive preoperative planning is important to prevent instrumentation with too large a first-pass reamer or unreamed nail. Because the internal shape of the tibia most closely represents a triangle, static measurements on plain films may be inaccurate in predicting the available area for a round implant.

Purpose: The primary objective of this review was to determine whether preoperative radiographs accurately predicted the actual size of the canal as it relates to nail placement, and whether the AP or lateral film was more accurate in measuring the true isthmal diameter of the tibia.

Methods: Retrospective analysis was undertaken on all primary tibia fractures that underwent intramedullary nailing over a 5-year period. All surgeons followed a protocol in which nail diameter was chosen to be equivalent to or 0.5 mm less than the diameter of the first reamer that obtained cortical chatter. Reaming began at 2 mm less than the smallest measurement of diameter on the AP and lateral radiographs. Thus, the implanted nail size is an accurate measure of the "diameter" of the tibia at the isthmus. The diameter of the tibia at the isthmus was electronically measured using standard measurement tools on a picture archiving and communication system without magnification on the preoperative AP and lateral radiographs. The radiographic diameter was compared with the implanted nail width as a surrogate for actual diameter. Patients undergoing secondary procedures and patients whose canals were large enough that no cortical chatter was obtained during nailing were excluded.

Results: 166 of 273 patients with primary tibia fractures met criteria for inclusion in the study. The tibial diameter on the AP and lateral radiographs averaged 11.3 ± 1.7 mm and 10.2 ± 1.2 mm, respectively. The radiographically measured isthmus was more narrow on the lateral view in 88% of tibiae (146 of 166). The average difference between nail diameter and AP and lateral radiographic canal diameter were 2.1 ± 1.3 mm and 1.1 ± 0.7mm, respectively (*P* value <0.001). The radiographically measured (predicted) diameter tended to overestimate the actual available space for nailing, and this was most evident on the AP radiograph (table).

See pages 75 - 103 for financial disclosure information.

Table 1: Distribution of Radiographic Measurements

Diameter	Number of Patients	
	AP	Lateral
Predicted > actual	143	108
Equivalent	18	46
Actual > predicted	5	12

Discussion: Insertion of unreamed or limited reamed nails is an attractive approach for treatment of tibia fractures. Misinterpretation of the canal diameter preoperatively may lead to intraoperative difficulty in passing the initial reamer using a minimal reaming technique and possible nail incarceration using an unreamed technique. This study demonstrates that the lateral radiograph is typically a more accurate representation of the actual canal diameter than is the AP radiograph. We suggest that the first-pass reamer or an unreamed nail be chosen that is at least 2 mm narrower than the isthmal diameter measurement on the lateral radiograph to achieve easy passage.

• 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 413.

Distal Tibial Fractures Treated by Intramedullary Nailing Are at Increased Risk of Malunion and Complication When Compared with Diaphyseal Tibial Fractures

Barton Simon, MD; Martin Marsh, MD; Paul Harwood, MD; ***Peter V. Giannoudis, MD****;*
Academic Department Orthopaedic Trauma Surgery, Leeds University, Leeds, United Kingdom

Purpose: This study was designed to examine rates of radiological malunion and complications following intramedullary fixation of distal tibial fractures and compare them to those seen following similar treatment of diaphyseal tibial fractures.

Background: Recent changes in tibial nail design have led to their use in treating increasingly more distal fractures. These procedures are technically challenging and may be associated with an increased risk of malreduction or early loss of position due to lack of construct stability. Patients with tibial fractures united with >5° of malalignment have been shown to be at increased long-term risk of developing osteoarthritis of the knee and ankle.

Methods: 100 sequential patients undergoing intramedullary nailing of tibial fractures were identified. Radiographs were reviewed to measure fracture level and pattern, nail position, and alignment in the AP and lateral projections. Patients were divided into two groups, fractures involving the distal one-fourth of the tibia, and fractures that did not. Those involving the proximal one-third were excluded. Primary outcome measures were alignment of the fracture on initial postoperative radiographs and at union. Secondary outcome measures included the rate of secondary procedures to obtain union. Variables related to the nailing procedures were also recorded. Statistical analysis was undertaken using Microsoft Excel. The Fisher exact test was used to examine for differences in dichotomous data, nonparametric methods were used to evaluate numerical data, and significance was set at the $P < 0.05$ level.

Results: 44 patients were identified in each group; 5 with fractures extended into the proximal one-third were excluded, leaving 88 in total. Remaining patients did not have radiographs to union. Distal fracture patients group were older (median 25 vs 40 years, $P < 0.005$), but there were no other significant differences in demographics between groups. Fracture extent was significantly more distal in the distal group (33% vs 21% of tibial length from plafond, $P < 0.0001$). The distal group had a higher degree of malalignment following nailing (AP: median 3.2° vs 1.6°, $P < 0.001$; lateral: 4.25° vs 2.45°, $P < 0.005$). A nonsignificant trend toward increased rates of malalignment >5° was observed (AP: 14% vs 2%, $P = 0.12$; lateral: 30% vs 15%, $P = 0.18$). All these findings were also the case at union. Increased risk of revision surgery in the distal group was also observed (7.6% vs 23.8%), although again this did not reach statistical significance ($P = 0.09$). No parameter related to nailing technique, including entry point, distal nail position, length, locking options used, or distance of the nail tip from the tibial plafond, could be significantly associated with malalignment on multivariate analysis.

Conclusions: Distal one-fourth tibial fractures were associated with a high rate of complications requiring revision surgery and a higher risk of malalignment than diaphyseal fractures. Although some of the factors approached rather than attained statistical significance, this is likely to represent a type II error. As other factors related to the fracture or nailing were

See pages 75 - 103 for financial disclosure information.

not associated with malunion or failure of treatment, this may be related to reduction. We recommend careful consideration be given to treatment options available to these patients and that if intramedullary nailing is selected then this should be undertaken by a surgeon with adequate training and experience in dealing with these difficult 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 413.

Gait Parameter Differences Between Standard and Ertl Transtibial Amputees

Todd Fellars, LT MC USN; *Anthony I. Riccio, LCDR MC USN;*
Joseph Carney, LCDR MC USN; Michael T. Mazurek, CDR MC USN; Marilynn Wyatt, PT;
Naval Medical Center San Diego, San Diego, California, USA

Purpose: The objective of this study was to determine if any differences in gait parameters exist in military personnel following a standard transtibial amputation versus an Ertl amputation osteoplasty.

Methods: An IRB-approved retrospective review of gait analysis data for all unilateral traumatic transtibial amputees at a single military treatment facility was performed. Patients unable to ambulate without an assistive device, those who had been ambulating independently for less than 6 months, and those with any contralateral lower extremity arthrodesis were excluded from analysis. Ten patients met inclusion criteria. Five had undergone standard transtibial amputation and five had undergone an Ertl amputation osteoplasty. Gait parameters and ground reaction forces at a self-selected and fast walking pace were compared between amputee groups. Gait parameters for both groups were also compared to a cohort of nonamputee normal controls. A 3-way analysis of variance and Student *t* test were performed to identify any statistically significant differences between the three groups.

Results: No statistically significant gait parameter differences were identified between standard transtibial amputees and Ertl osteoplasty amputees at either fast or self-selected walking speeds. Vertical ground reaction force generation during stance of both involved and uninvolved extremities did not differ significantly between the two amputation groups. When compared to normal controls, both standard transtibial and Ertl amputees demonstrated statistically significant increases in step length with their prosthetic limb ($P < 0.05$). All amputees demonstrated a shortened stance phase on their involved extremity when compared to normal controls ($P < 0.05$).

Conclusions: With no significant gait parameter differences between standard transtibial and Ertl osteoplasty amputees, the increased time required to perform an Ertl procedure may not provide a measurable ambulation benefit in a young military population. Furthermore, these data suggest that military below-knee amputees should possess similar gait mechanics to normal controls independent of the type of amputation technique utilized.

See pages 75 - 103 for financial disclosure information.

Does the Wound Vacuum-Assisted Closure Affect Free Flap Survival in Lower Extremity Trauma?

William M. Reisman, MD*; Patrick M. Osborn, MD; John D. Carew, PhD; Michael J. Bosse, MD; Stanley B. Getz, MD;*
Carolinas Medical Center, Charlotte, North Carolina, USA

Objectives: Open lower extremity fractures as a result of high-energy trauma pose a complex problem to orthopaedic surgeons. Historically, early soft-tissue coverage has been the advocated treatment course and has been shown to result in higher rates of successful free-tissue transfer. The advent of vacuum-assisted closure (VAC) has revolutionized the care of traumatic wounds. Over the past decade, the application of the VAC has become commonplace in the management of these high-energy lower extremity wounds. Wound VAC treatment is known to increase the formation of granulation tissue, reduce edema, promote a favorable vascular bed, and may act as a barrier to colonization by bacteria. It has been suggested that VAC therapy can prevent the need for formal soft-tissue coverage or allow for the delay of definitive closure. There is no definitive evidence that VAC treatment can supplant adequate débridement or safely delay definitive wound coverage. In this study, we seek to determine the survival rate as well as factors affecting the survival of free flaps used for lower extremity trauma at our institution before and after the implementation of the wound VAC.

Methods: From 1999 through 2009, patients treated by a single plastic surgeon were identified at a Level 1 trauma center using ICD-9 codes. After determination of the cohort that received free soft-tissue transfer for lower extremity trauma, we recorded patient demographics, medical comorbidities, mechanism of injury, fracture site, and timing and number of débridements. We also recorded the type of flap, the site and type of anastomosis, as well as complications, the days to fracture fixation, days to flap coverage, use of VAC therapy, and free flap survival.

Results: 68 patients underwent free soft-tissue transfer after lower extremity trauma from 1999 through 2009. 28 free flaps were performed during the time period prior to the implementation of the wound VAC at our institution. 40 free flaps were performed after a VAC was used on the wound. The average time to soft-tissue coverage was 7.2 days in the group that did not receive VAC therapy and 11.2 days in the group in which a VAC was used prior to soft-tissue coverage ($P = 0.015$). In the group in which a VAC was not used, there were 2 free flap failures giving a failure rate of 7.1% (2 of 28). The group in which a VAC was utilized had 13 failures for a failure rate of 32.5% (13 of 40). This was statistically significant ($P = 0.017$, odds ratio = 6.1, 95% confidence interval: 1.2, 61). Logistic regression model identified only one factor, smoking, that was predictive of failure across both groups ($P = 0.022$).

• 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 413.

VAC used	No	Yes
Total free flaps performed	28	40
Average days to free flap	7.2	11.2 (P = 0.015)
Rate of free flap failure	7.1% (2/28)	32.5% (13/40) (P = 0.017)

Conclusion: We found a significantly higher rate of failure in those free flaps that received a wound VAC prior to definitive coverage. Those patients who received a wound VAC also had a significant delay in time to coverage. The average time to free soft-tissue coverage was prolonged into a time frame that historically results in higher failure rates. We are unable to definitively say whether the higher failure rates at our institution are secondary to this delay in time to coverage or due to the use of the VAC itself. However, the data do not support that the VAC is capable of safely delaying definitive soft-tissue coverage. We recommend that surgeons continue to perform adequate wound débridement and perform early soft-tissue coverage.

See pages 75 - 103 for financial disclosure information.

Incremental Cost of Fracture Non-Union in Patients with Tibia Fracture and Internal Fixation Surgery

Xue Song, PhD[1]*; Nianwen Shi, PhD*[1]*; Nicole Yurgin, PhD*[2]*; Alan Oglesby*[2]*;*
Ricardo Dent, MD[2]*; Mohit Bhandari, MD*[3]*;*
[1]*Thomson Reuters, Cambridge, Massachusetts, USA;*
[2]*Amgen Inc, Thousand Oaks, California, USA;*
[3]*Department of Clinical Epidemiology and Biostatistics, McMaster University, Hamilton, Ontario, Canada*

Purpose: Few analyses have quantified the cost of fracture nonunion. This retrospective claim-based cohort study estimated medical cost associated with fracture nonunion among tibia fracture patients who underwent internal fixation.

Methods: Patients of 18+ years with internal fixation for tibia fracture during the period from July 2001 through October 2007 were identified from the MarketScan Commercial and Medicare Supplemental Databases of Thomson Reuters. The date of the first internal fixation was set as the index date. Patients were required to have a tibia fracture diagnosis within 7 days from the index date and required to have continuous insurance coverage for at least 6 months prior to (preperiod) and 60 days after (postperiod) the index date. Patients were excluded if they had confounding conditions that could lead to unusually high costs (eg, HIV, cancer, etc), were on hormone deprivation therapy in the preperiod, had other fractures in pre- or postperiod, or were not discharged from hospital within 30 days after surgery. Patients were followed from surgery date up to 18 months or until death, end of continuous enrollment, or end of the study period (December 31, 2007), whichever occurred first. Patients with diagnosis indicative of nonunion in the postperiod (ICD-9 code 733.81) were classified into the nonunion cohort (NU) and those without diagnosis or procedure of nonunion and malunion were selected into the normal healing cohort (NH). Total medical costs (including all inpatient costs, all outpatient costs, and outpatient pharmacy costs) were assessed. Generalized linear models were used to adjust patient demographic and clinical characteristics between the NU and NH cohorts to estimate differences in postperiod total medical costs associated with the nonunion outcome.

Results: 8,546 patients met the study criteria and the nonunion rate was 8.5% (n = 723). The average length of follow-up was 436 days (standard deviation [SD] 149) for NH patients and 460 days (SD 133) for NU patients. The NU cohort had a higher proportion of men (62% vs 51%), was 2 years younger (48.3 vs 50.4), and had a higher rate of open fracture (46.2% vs 26.1%) than the NH cohort ($P < 0.001$ in all cases). No significant differences were found in preperiod clinical characteristics; however, per-patient total medical costs in the 6 month preperiod were higher in the NU cohort ($5136 vs $3,942, $P < .001$). In the postperiod, average monthly costs were 170% higher for the NU cohort compared to the NH cohort ($4984 vs $2880, $P < 0.001$), with the highest costs occurring during the first month after internal fixation ($31,281 for the NU cohort vs $21,214 for the NH cohort). Among patients with 1-year follow-up, per-patient unadjusted total medical cost was $58,960 and $30,591 during the first year after internal fixation surgery for the NU and NH cohorts, respectively. After adjusting for differences in demographics and clinical characteristics in the NU and NH cohorts, 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 413.

annual incremental cost associated with fracture nonunion was \$20,364 ($P < 0.001$). Inpatient treatments were the key component (\$12,132, $P < 0.001$) of this incremental cost.

Conclusion: This study estimated an incremental \$20,364 annual medical cost for each tibia fracture nonunion. Reducing the rate of tibia fracture nonunion could lead to substantial savings for the health care system.

See pages 75 - 103 for financial disclosure information.

Age-Related Patterns of Spine Injury following All-Terrain Vehicle Accidents in Children and Adolescents

Jeffrey R. Sawyer, MD; *Michael J. Beebe, MD; Norfleet Thompson, MD; Aaron T. Creek, MD; Matthew G. Yantis, MD; Derek M. Kelly, MD; William C. Warner, Jr, MD;*
Campbell Clinic, Memphis, Tennessee, USA

Purpose: All-terrain vehicle (ATV) accidents are a considerable source of morbidity for children and their use, as well as spine injures related to their use, continues to increase dramatically. The purpose of this study is to characterize spinal injuries in children and adolescents caused by ATV accidents.

Methods: An IRB-approved retrospective review of ATV-related spine injuries over a 5-year period at two pediatric trauma centers was performed. Records were evaluated for demographic factors, spine/associated injuries, surgical procedures, and hospital charges. Patients were divided into age groups based on American Academy of Orthopaedic Surgeons (AAOS) ATV use guidelines (<16 years, ≥16 years).

Results: We identified 52 spine injuries in 29 patients (1.8/patient). The mean age was 15.8 years (range, 6-18 years). There were 14 females (48%) and 15 males (52%). Multiple spine injuries were common: 45% of patients had >1 spinal injury (range, 1-5). There were 7 cervical (14%), 22 thoracic (42%), 16 lumbar (31%), and 7 sacral fractures (14%). Compression/burst fractures were the most common injuries (31%). One patient (3%) died after admission. Associated injuries were common: 6 patients (21%) had closed head injury or skull fracture, 6 (21%) had intrabdominal injuries, and 3 (10%) had thoracic injuries. There were 9 patients (31%) with 1, 6 patients (21%) with 2, and 1 patient (3%) with 3 associated injuries. Age-related patterns of injury existed: older children had a lower pediatric trauma score ($P = 0.004$) and were more likely to sustain a thoracic spine fracture ($P = 0.012$), There was a higher rate of closed head injury and intrathoracic injury as well, but this did not reach statistical significance. Lumbar spine fractures ($P < 0.001$) were more common in younger children. There were 4 patients (14%) with a neurologic deficit: 1 with complete paraplegia and 3 with partial. Spinal surgery was required in 7 patients (24%). The mean length of stay was 5 days and mean hospital charges were $74,907 (total of $2,172,293).

Conclusion: ATV-related spinal trauma is associated with a high rate of morbidity and mortality and multiple injuries, both intra- and extraspinal, are common. Age-related patterns of injury exist. To our knowledge, this is the first study to specifically characterize the nature of spinal injuries in children injured in ATV accidents and will serve as the basis for future study in order to improve treatment of children injured in such accidents. We hope this will also raise awareness of the high rate of morbidity associated with ATV accidents in children and adolescents in order to develop improved injury-prevention strategies.

- 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 413.

Pediatric Cubitus Varus Correction by Computer-Guided Circular External Fixation

John E. Herzenberg, MD[1]; *Mohan V. Belthur, MD*[2]; *Christopher Iobst, MD*[3]; *Gaurav Jindal, MD*[4]; *Noam Bor, MD*[5];
[1]*Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore, Baltimore, Maryland, USA;*
[2]*Texas Children's Hospital and Shriners Hospital for Children, Houston, Texas, USA;*
[3]*Miami Children's Hospital, Miami, Florida, USA;*
[4]*Pushpanjali Crosslay Hospital, Ghaziabad, India;*
[5]*Emek Medical Center, Afula, Israel*

Purpose: Malunion (cubitus varus) is a common complication of supracondylar elbow fractures, potentially resulting in cosmetic problems, impaired function, and malpractice claims. Reported methods of correcting cubitus varus involve complex wedge osteotomies that have a high complication rate and require a large exposure and challenging fixation. The purpose of this study was to determine whether correction can be achieved with a simple percutaneous osteotomy and gradual correction with circular external fixation.

Methods: Seven patients underwent treatment for deformity correction at two centers: three patients were treated by the attending surgeon at the first institution and four were treated by the attending surgeon at the second institution. All patients had an extension-type supracondylar fracture during childhood. Three were treated with half-pins in the distal segment, and four were treated with wires. The average age at surgery was 10 years (range, 5-21 years).

Results: Average preoperative carrying angle was 20° varus (range, 10°-30°). Average postoperative carrying angle was 4° valgus (range, 0°-7°). Average preoperative and postoperative range of motion were the same (133°). Average external fixation time was 10 weeks (range, 9-12 weeks). No major or neurovascular complications were encountered. All patients were happy with the final appearance.

Conclusion: The method presented in this case series is a safe, accurate, and reliable method to correct cubitus varus deformity after pediatric supracondylar fracture. We report a new pattern of distal humeral fixation that allows for a very distal metaphyseal osteotomy, close to the apex of the deformity. This biplanar delta configuration straddles the olecranon fossa and is appropriate for children and adults. The technique presented is predictable, effective, well-tolerated, adjustable, and technically easier than large open osteotomies.

See pages 75 - 103 for financial disclosure information.

Composite Playground Safety Measure to Correlate the Rate of Supracondylar Humerus Fractures with Safety: An Ecologic Study

*Min Jung Park, MD, MMSc[1]; **Keith Baldwin, MD, MPH, MSPT[1]**; Nomi Weiss-Laxer, MA[2]; Jennifer Christian, Pharm D[2]; Julia Katarincic, MD[3]; Craig Eberson, MD[3]; Michael J. Mello, MD, MPH[2,4]; David A. Spiegel, MD[5]*

[1]Department of Orthopaedic Surgery, Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania, USA;
[2]The Injury Prevention Center at Rhode Island Hospital, Department of Emergency Medicine, Warren Alpert Medical School of Brown University, Providence, Rhode Island, USA;
[3]Department of Orthopedic Surgery, Warren Alpert Medical School of Brown University, Rhode Island Hospital, Providence, Rhode Island, USA;
[4]Department of Community Health, Brown University, Rhode Island Hospital, Providence, Rhode Island, USA;
[5]Department of Orthopedic Surgery, Children's Hospital of Philadelphia, Philadelphia, Pennsylvania, USA

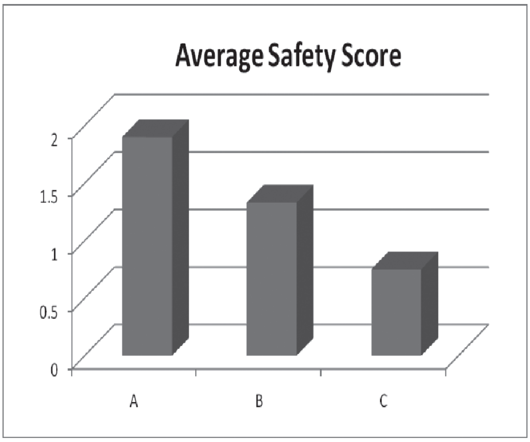
Purpose: More than 200,000 children are injured at playgrounds in the United States each year. We aim to define a composite measure of playground safety and utilize this instrument to correlate the incidence of supracondylar humerus fractures with playground safety in an ecologic study design.

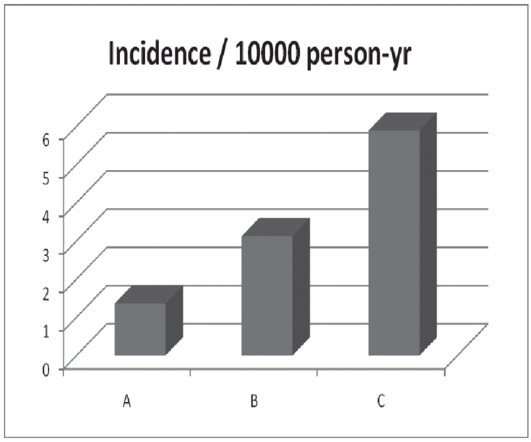
Methods: We utilized a novel "overall safety rating," defined as a composite of three previously validated instruments (National Program for Playground Safety [NPPS] safety score, surface depth compliance, and the use zone compliance), to measure the overall safety of all playgrounds within a region. The regions were rated from most to least safe based on average playground safety as measured by this new method. The incidence of supracondylar fractures was calculated using Hasbro Children's Hospital Emergency Department data and state of Rhode Island Census data from 1998 to 2006.

Results: Compared to the neighborhood deemed the safest, the least safe area had 4.7 times greater odds of supracondylar humerus fracture. Overall composite safety score of the district was linearly correlated with the injury rate observed in the population at risk ($R = 0.98$; P value, 0.04).

Conclusions: Using our novel composite playground safety score, we found that the incidence of supracondylar humerus fractures was increased in districts with playgrounds with lower scores, suggesting that improvements in playground infrastructure may potentially reduce the incidence of supracondylar humerus fracture in children. The novel composite playground safety score, incorporating the NPPS score, surface depth, and the use zone compliance, demonstrates inverse-linear correlation to the rate of supracondylar 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 413.





The average composite safety score incorporating NPPS report card, surface depth, and the use zone compliance.

The incidence of supracondylar fractures in each zip code

See pages 75 - 103 for financial disclosure information.

Nonoperative Treatment of Both-Bone Forearm Shaft Fractures in Children: Predictors of Early Radiographic Failure

Eric N. Bowman, MPH[1]; *Charles T. Mehlman, DO, MPH*[2]; *Christopher J. Lindsell, PhD*[1]; *Junichi Tamai, MD*[2];
[1]*University of Cincinnati, College of Medicine, Cincinnati, Ohio, USA;*
[2]*Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio, USA*

Purpose: Forearm shaft fractures are the third most common fracture in children. Although closed reduction with casting is the preferred treatment, outcomes remain variable. The purpose of this study was to identify factors associated with failure of nonoperative treatment for pediatric complete forearm shaft fractures, and explore the time frame in which failure is likely.

Methods: Males younger than 18 and females younger than 17 years of age who were treated for complete both-bone forearm shaft fracture between January 2005 and January 2008 were included. An orthopaedic surgeon evaluated all radiographs to confirm diagnosis. Fractures were classified as proximal, middle, or distal, based on an equal one-third division of the shaft. The threshold for acceptable angulation for males <10 and females <8 was as follows: 10° proximal third, 15° middle third, 20° distal third; for females ≥8 and males ≥10, 10° at all levels. Angulation was measured at initial presentation and at weekly intervals for 4 weeks postfracture. AP measurements accounted for the natural bow of the radius. Multivariate logistical regression analysis was performed to identify predictors of failure.

Results: Of the 321 patients identified, 282 underwent closed reduction and casting. The average age of patients was 8.5 years; 63% were male. 51% of patients exceeded angulation criteria within the follow-up period. Of those who failed, most (55%) failed by the end of the first week, and 95% failed by 3 weeks, as shown in Figure 1. Multivariate logistical regression revealed that failure was greater in patients ≥10 years (odds ratio [OR] = 2.79; 95% confidence interval [CI], 1.47-5.29), those with proximal radius fractures (OR = 6.81, 95% CI, 3.28-14.14), and those with initial ulna angulations <15° (OR = 2.94; 95% CI, 1.49-5.83).

Conclusion: Those children 10 years or older, with proximal-third radius fractures, and ulna angulation <15° seem to be at highest risk for failure. Since the majority of failures occur early, early surgical decision making is encouraged.

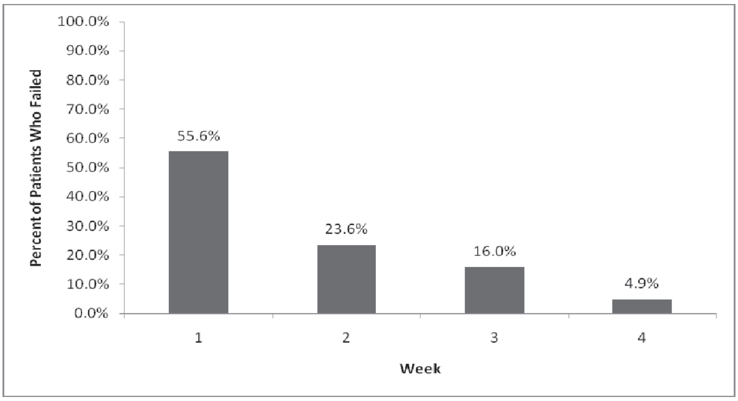


Fig. 1
Week of first radiographic evidence of failure for those who eventually failed at follow-up.

- 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 413.

Nerve Injuries Associated with Pediatric Supracondylar Humeral Fractures: A Meta-Analysis

Jessica C. Babal, BS[1]*; Charles T. Mehlman, DO, MPH*[2]*; Guy Klein, BS*[3]*;*
[1]*University of Cincinnati, College of Medicine, Cincinnati, Ohio, USA;*
[2]*Cincinnati Children's Hospital, Cincinnati, Ohio, USA;*
[3]*Ohio University, College of Osteopathic Medicine, Athens, Ohio, USA*

Purpose: The purpose of our study was to conduct a meta-analysis of the literature describing displaced pediatric supracondylar humeral fractures—specifically, to determine the risk of traumatic neurapraxia in extension-type versus flexion-type supracondylar fractures and to assess the risk of iatrogenic neurapraxia caused by pin fixation.

Methods: A comprehensive literature search was performed to identify studies reporting the incidence of nerve injury associated with displaced pediatric supracondylar fractures of the humerus. Subgroup analysis of included articles was performed to evaluate the risk for iatrogenic neurapraxia associated with lateral-only or medial/lateral percutaneous pin fixation. Meta-analysis of all data pools was subsequently performed in order to generate weighted event rates of neurapraxic injury.

Results: Data from 5148 patients with 5154 fractures were pooled for meta-analysis. Among these patients, traumatic neurapraxia occurred at a weighted event rate of 11.3%. Representing 34.1% of all nerve injury associated with extension-type fractures, the anterior interosseous nerve presented with greatest incidence, while the ulnar nerve represented 91.3% of all flexion-type nerve injuries. Iatrogenic neurapraxia induced by lateral-only pinning occurred at a weighted event rate of 3.4%, while the introduction of a medial pin elicited iatrogenic neurapraxia at a weighted event rate of 4.1%. Lateral pinning carried increased risk for median neuropathy, and the medial pin significantly increased the risk for ulnar nerve injury.

Conclusion: This is the largest pooled meta-analysis to assess the risk of nerve injury associated with displaced supracondylar fractures of the humerus in children. For extension-type neurapraxia, the risk of anterior interosseous nerve injury ranks highest, while ulnar nerve injury was the most common among flexion-type neurapraxia. We confirm that medial pinning carries the greatest overall risk of nerve injury associated with lateral-only pinning; however, we suggest that lateral pinning may carry significant risk to the median nerve.

See pages 75 - 103 for financial disclosure information.

Combat Extremity Trauma: Resource Utilization Beyond Initial Hospitalization

Brendan D. Masini, MD; *Brett D. Owens, MD; Joseph C. Wenke, PhD; Joseph R. Hsu, MD;*
US Army Institute of Surgical Research, Fort Sam Houston, Texas, USA

Purpose: Previous investigations have demonstrated the predominance of extremity wounds in combat trauma as well as the resource burden borne by initial hospitalization for these injuries. These resource requirements may be underestimated as many combat casualties require multiple hospitalizations for the care of their injuries. In addition, multiply injured patients may require initial care of head or abdominal injuries, but long-term care for their extremity injuries. Furthermore, rehospitalization is a predictor for poor outcome, portending higher rates of disability for these soldiers. This study investigates the rehospitalization of combat casualties with a hypothesis that extremity injuries cause the greatest number of admissions and require the greatest resources to treat.

Methods: The Department of Defense (DoD) Medical Metrics (M2) database was queried for hospital admissions data, including Diagnosis Related Group (DRG) and length of stay, of a previously published cohort of soldiers wounded in Iraq and Afghanistan between October 2001 and January 2005, identified from the Joint Theater Trauma Registry. Admissions data were collected through February 2008. The body region injured was assigned using ICD-9 codes, which were corroborated with Joint Theater Trauma Registry injury mechanisms and descriptions for accuracy, consistent with previous publications from this cohort. Hospitalizations were defined as separately billable inpatient episodes at military medical treatment facilities. Resource utilization costs were calculated using the 2008 DoD billing calculator and DRG data.

Results: Of 3,102 casualties in this time period, 1566 were combat-wounded and evacuated from theater. 1,336 of these had admissions data and were included in this study. 2,899 hospitalizations were identified, with an average 2.2 per soldier (range, 1-12). The initial hospitalization of each soldier was excluded from analysis, leaving 1563 rehospitalizations. 67% of soldiers had a rehospitalization and 26% a third admission episode. 64.5% of rehospitalizations were for extremity injurie,s making up 69.3% of all rehospitalization days. Approximately 15% of all readmissions were for wound débridement. The 10 most common DRGs for readmission encompass extremity injuries. Total resources for rehospitalization were $43.8 M, with extremity injuries accounting for 68.4%.

Conclusions: Extremities are the most common body region injured on the battlefield. These injuries have been shown to result in the greatest long-term disability and require the greatest resource utilization for initial treatment. This study demonstrates that extremity injuries also require the greatest inpatient resource utilization beyond the initial treatment period. This is a marker both for increased disability for these patients as well as greater outpatient resource utilization. This study adds weight to the growing body of evidence that combat extremity injuries require the greatest utilization of medical resources in all phases of combat casualty care.

- 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 413.

An Analysis of the Transition in Orthopaedic Trauma Fellowships from 2000 to 2010

Gilbert R. Ortega, MD, MPH; *Karl Bergmann, MD;*
Sonoran Orthopaedic Trauma Surgeons, Scottsdale Osborn Trauma Center, Scottsdale, Arizona, USA

Background: In 1998, the Orthopaedic Trauma Association (OTA) shared an initiative based on the "recruitment and retention of young orthopaedic trauma surgeons." The initiative included guidelines for improving academic and clinical orthopaedic trauma training of residents and fellows. In 2005, 4% of the graduating US residents went into an orthopaedic trauma fellowship. In 2007, the OTA realized that there were approximately 90 orthopaedic trauma fellowship applications accounting for 18% of the 2007 graduating orthopaedic residents.

Purpose: The aim of this study was to analyze the increase in the number of orthopaedic trauma fellowships from 2000 to 2010. We evaluated demographic shifts, whether academic (university affiliation) or private practice, any transition in fellowship directors, and online jobs available for graduating fellowship-trained orthopaedic traumatologists.

Methods: We examined the American Academy of Orthopaedic Surgeons (AAOS) Post-graduate Orthopaedic Fellowship 2000 Handbook and the current OTA website's directory of orthopaedic trauma fellowships. We evaluated fellowship geographic locations and type of fellowship program (academic vs private), number of fellowships available, type of training advertised in fellowship descriptions, and trauma director shifts in location. Through the use of online job placement sites including those offered by the OTA, AAOS, and *The Journal of Bone and Joint Surgery (JBJS),* we also searched for advertisements seeking a fellowship-trained orthopaedic traumatologist.

Results: The number of orthopaedic trauma fellowships available increased from 31 in 2000 to 81 in 2010. The number of academic fellowships increased from 28 in 2000 to 71 in 2010, while the number of private practice setting fellowships increased from 3 to 10. Geographically, the highest number of fellowships in 2010 is in the Pacific and Midwest. The most common type of training offered in all programs in 2000 and 2010 was complex trauma, while the least common type of training was deformity correction. Only 9 (33%) of the 27 trauma directors in 2000 were still listed as directors in 2010. Of the following online searches, the total number of orthopaedic employment jobs advertised since April 2009 are: OTA, 10; AAOS, 13; and JBJS, 37. After control of job advertisement overlap among the 3 sites, there were a total of 45 unique advertisements offered for a fellowship-trained orthopaedic traumatologist.

Conclusion: Our analysis shows an increase in the number of orthopaedic trauma fellowships from 2000 to 2010 with a predominantly academic-type fellowship. It appears that the OTA's initiative in the late 1990s has been successful over 10 years in increasing the number of fellowship-trained orthopaedic traumatologists. We believe the increase in orthopaedic trauma fellowships helps improve the public's need for access to an orthopaedic traumatologist.

See pages 75 - 103 for financial disclosure information.

Battlefield Orthopaedic Injuries Cause the Majority of Long-Term Disabilities

CPT Jessica D. Cross, MD[1,2]; *COL James R. Ficke, MD*[2]; *MAJ (P) Joseph R. Hsu*[1,2], *MD;*
CPT Brendan D. Masini, MD[2]; *Joseph C. Wenke, PhD*[1];
[1]*US Army Institute of Surgical Research, Fort Sam Houston, Texas, USA;*
[2]*Brooke Army Medical Center, Fort Sam Houston, Texas, USA*

Introduction: Orthopaedic injuries comprise 54% of combat wounds sustained in Operation Iraqi Freedom and Operation Enduring Freedom. Previous investigations have demonstrated the burden of extremity trauma in terms of hospital resource utilization and projected disability payments; however, there is no study evaluating the long-term source of physical disability for these patients.

Purpose: This paper aims to identify those unfitting conditions that result in disqualification from continued service that exist among a cohort of war-wounded service members.

Methods: 464 warriors from a previously published larger cohort of combat-injured patients went before the Army's Physical Evaluation Board (PEB) to determine disability from disqualifying injuries sustained between October 2001 and January 2005. Their records were queried in the PEB database to determine board results and the codes indicating unfitting conditions. The PEB records were then reviewed to determine specific injuries and persistent diagnoses related to their unfitting conditions. Musculoskeletal-related conditions were then further classified into percentages of disability, and overall impact to the Army population.

Results: 450 warriors' board results were included, revealing that 69% of unfitting conditions as a result of combat wounds were orthopaedic in nature. The most frequent unfitting diagnosis was degenerative arthritis; however, amputation had the greatest impact when the warrior's disability rating (a percentage) was taken into account. Of the warriors who were evacuated from theater with a primary diagnosis of head, thorax, or abdomen injury, but who also had an orthopaedic injury, 84% had an orthopaedic diagnosis as their primary unfitting condition.

Discussion: While 54% of combat wounds in our current conflicts are to the extremities, 69% of the conditions disqualifying from continued service on active duty are orthopaedic in nature. This significant impact of disability related to orthopaedic conditions highlights the importance of further research into improved care for musculoskeletal trauma and to minimize the tremendous loss of fighting strength.

- 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 413.

Analysis of Radiation Exposure to the Orthopaedic Trauma Patient during their Inpatient Hospitalization

Mark L. Prasarn, MD; *Elizabeth Martin, MD; Michael Schreck, BA; John Wright, MS; Per-Lennart Westesson, MD; Thomas Morgan, PhD; Mark Gestring, MD; Mark Rechtine, MD; University of Rochester/Strong Memorial Hospital, Rochester, New York, USA*

Purpose: There has been considerable concern regarding radiation exposure to both the patient and treating surgeon and the possible risk of resulting malignancy. We sought to analyze the total effective dose of radiation that a cohort of orthopaedic trauma patients are exposed to during their inpatient hospitalization and determine risk factors for greater exposure levels.

Methods: Following approval from the Institutional Review Board, a search was conducted of a Level 1 trauma center database for radiation exposures to patients over a 1-year period. Patients were included if they had an ICD-9 code from 805 to 828 indicating a fracture involving the trunk (805-811) or extremities (812-828). We compared the total effective radiation dose in various injury patterns as well as those considered to be polytrauma patients to those who were not according to their injury severity score (ISS).

Results: The records of 1357 trauma patients were available for review. The average patient age was 40.6 years and the mean ISS was 14.1. The average effective radiation dose for all patients during their hospitalization was 31.6 mSv. There was a statistically significant difference in radiation exposure between patients with an ISS greater than 16 (48.6 mSv) versus those with an ISS ≤16 (23.5 mSv) ($P < 0.001$). Patients with spine trauma can be expected to get >15 mSv more radiation than nonspine patients ($P < 0.001$), and those spinal injuries with neurologic deficits had even greater exposure than those without ($P < 0.02$). Extremity injuries received the least amount of radiation, spine-only patients were next, then finally spine and extremity injury patients had the greatest exposures. Having a spine fracture, a pelvic fracture, a chest-wall injury, or a long-bone fracture were all risk factors for having more than 20 mSv of effective dose exposure. Patients under the age of 18 years did receive less radiation than the remainder of the cohort.

Conclusions: The average orthopaedic patient receives a total effective radiation dose of more than 30 mSv, much greater than is considered acceptable as a maximum permissible annual dose by the International Commission on Radiological Protection (20 mSv). These findings indicate that the average trauma patient (in particular those with polytrauma or fractures involving the spine, pelvis, chest wall, or long bones) is exposed to high levels of radiation during their inpatient hospitalization. The treating physicians of such patients should take into consideration the large amounts of radiation their patients receive just during their initial hospitalization, and be prudent with the ordering of imaging studies involving radiation exposure.

See pages 75 - 103 for financial disclosure information.

Fluid Lavage of Open Fracture Wounds (FLOW): A Randomized Blinded, Multicenter Pilot Trial

Brad Petrisor, MD*, for the FLOW Pilot Study Investigators;*
Department of Surgery, Division of Orthopaedic Surgery, McMaster University, Hamilton, Ontario, Canada

Purpose: The optimal choice of irrigating solution or irrigating pressure in the initial management of open fracture wounds remains controversial. The FLOW study compared the effect of castile soap versus normal saline, and low- versus high-pressure pulsatile lavage on 1-year reoperation rates in patients with open fracture wounds.

Methods: We conducted a multicenter, blinded, 2 × 2 factorial, pilot randomized trial of 111 patients with open fracture wounds receiving either castile soap solution or normal saline and either high- or low-pressure pulsatile lavage. The primary outcome, reoperation within 1 year, included infections, wound-healing problems, and nonunions. Secondary outcomes included all operative and nonoperative infections, wound-healing problems, nonunion, and functional outcomes. We followed the intention-to-treat principle.

Results: 89 patients (80.2%) completed the 12-month follow-up. As anticipated in this small-sample–size pilot study, results were compatible with substantial benefit and substantial harm: the hazard ratio (HR) for reoperation with castile soap was 0.77 (95% confidence interval [CI], 0.35-1.69; $P = 0.52$; with low pressure lavage, the HR for the risk of reoperation was 0.56 (95% CI, 0.25-1.27; $P = 0.17$. Secondary outcomes showed a significant relative risk reduction for nonunion of 63% in favor of castile soap ($P = 0.036$), and a trend for a relative risk reduction for nonunion of 44% in favor of low-pressure lavage ($P = 0.22$).

Conclusion: The FLOW pilot study suggests the possibility of an important reduction in reoperation rates for both castile soap and low-pressure pulsatile lavage. Our findings provide compelling rationale for continued investigation in a pivotal FLOW trial of 2280 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 413.

The Evaluation of a New Measure for Assessing Healing in Lower Extremity Fractures
(FDA=Non-U.S. research conducted within guidelines of my country)

Mohit Bhandari, MD[1]; Scott M. Wasserman[2]; Nicole Yurgin, PhD[2]; Ricardo Dent, MD[2], Sheila Sprague, MSc[1]; ***Brad Petrisor, MD[1]****;*
[1]McMaster University, Hamilton, Ontario, Canada;
[2]Amgen Inc, Thousand Oaks, California, USA

Purpose: Assessing fracture healing in clinical trials is a largely subjective process and there are no validated measures for determining healing in tibial shaft fractures. The recently developed Functional Index for Intramedullary Nailed Tibial Fractures (FIX-IT) measure provides a standardized approach to assess weight bearing and pain in lower extremity fractures. These domains were chosen based on a thorough review of the literature that found that the most common criteria to define fracture healing were: absence of pain or tenderness when weight bearing, absence of pain or tenderness on palpation or examination, and the ability to bear weight. The objective of the current study was to evaluate interrater reliability and construct validity of the FIX-IT measure.

Methods: A cross-sectional study of 50 patients with lower extremity (tibia and femur) fractures across different stages of healing was conducted in 2009. This was a nonrandom, convenience sample and patients were recruited from a single site in Canada. The clinicians were asked to assess whether the items of FIX-IT were "essential," "useful," or "not needed" to provide preliminary construct validity of the FIX-IT measure. FIX-IT is a clinical outcomes assessment measure for which patients are asked to bear weight on the fractured limb through two procedures (single-leg standing and ambulation) and pain is assessed through two procedures (pressing directly on the fracture site and by applying stress to the fracture site). There are four response options for each of the four procedures ranging from 0 to 3. The total FIX-IT score is the sum of all four of the procedure scores. The total score ranges from 0 to 12, with higher scores representing less pain and a greater ability to bear weight. Patients were independently assessed using the FIX-IT measure by two orthopaedic surgeons, one orthopaedic fellow, two orthopaedic surgical trainees (residents), and two research coordinators. Interrater reliability of the raters' scores was assessed using interclass correlation coefficients (ICCs). Convergent validity was evaluated by Pearson correlations between FIX-IT and the Short Form 36 (SF-36) physical component summary, physical function subscale, and role-physical subscale scores.

Results: For interrater reliability, the ICCs ranged from 0.637 to 0.915, depending on the procedure and the rater groups. The overall interrater reliability for the total FIX-IT score was 0.879 (95% confidence interval, 0.828-0.921). All of the clinicians rated each of the four procedures as either "essential" or "useful." The correlations between the FIX-IT score and the SF-36 ranged from 0.682 to 0.770 for the physical component summary score, from 0.681 to 0.758 for the physical function subscale, and from 0.677 to 0.786 for the role-physical subscale.

Conclusions: In a cohort of 50 patients with lower extremity fractures in different stages of healing, the FIX-IT score had high interrater agreement across multiple examiners. In terms

See pages 75 - 103 for financial disclosure information.

of content of the score, clinicians rated all of the procedures evaluated in FIX-IT as useful in measuring healing for tibia fracture patients. Moreover, FIX-IT scores correlate with the physical scores of the SF-36. Although additional research is needed to fully validate FIX-IT, the results of this study suggest the potential for FIX-IT to be a reliable clinician measure to evaluate healing in lower extremity 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 413.

Outcomes of Treatment of Traumatic Morel-Lavallée Lesions with Negative Pressure Wound Therapy (NPWT)

***Robert N. Reddix, Jr, MD*[1,2]**; *Rajesh R. Gandhi, MD, PhD, FACS*[2];
[1]*University of North Texas Health Science, Fort Worth, Texas, USA;*
[2]*John Peter Smith Hospital, Fort Worth, Texas, USA*

Purpose: The Morel-Lavallée lesion is a closed internal degloving injury associated commonly with pelvic trauma. Since 2007, we have managed these injuries with a protocol of serial open irrigation and débridements, followed by application of negative pressure wound therapy (NPWT) using vacuum-assisted closure (VAC) until primary closure of the lesion is performed. We have experienced zero complications or postclosure infections with this protocol. The purpose of this study is to report our results, characterize our patient population, and to share our technique with other surgeons who might encounter these lesions.

Methods: Utilizing our institution's trauma registry, we identified patients with Morel-Lavallée lesions who presented to our Level 1 trauma center from August 1, 2007 to August 1, 2009. We retrospectively reviewed the patient medical records to identify sex, injury severity score, mechanism of injury, injuries, complications while an inpatient, mortality, location and size of the lesion, number of procedures required, duration of NPWT, and any complications encountered related to the Morel-Lavallée lesion. Our outcome of interest was the development of a postoperative wound infection or complication of any type. Our technique involves standard irrigation and débridement with low-pressure lavage and débridement of nonviable-appearing tissue. At the end of the procedure, a surgical sponge or knife is used to abrade the surfaces of the lesion until punctuate bleeding is observed. For larger lesions, the sponge is then contoured to involve approximately two-thirds of the lesion's volume, with one end extending from the lesion. The TRAC pad (KCI) is connected in standard fashion and our machine is set at 125 mm Hg continuous setting. If needed, in 48 hours the patient is brought back to the operating room and the process repeated with reduction of the sponge depth. The process is repeated until the lesion can be closed primarily.

Results: We identified 10 patients ranging from 18 to 54 years of age with 10 lesions ranging in size from 18 to 225 cm^2. All patients had a minimum of 6 weeks follow-up (range, 6-60 weeks). Our patients needed a mean of 2.7 procedures to close their wounds (range, 1-9) and underwent NPWT for a mean of 10.1 days (range, 3-26 days). There were zero postoperative infections and zero complications associated with this technique.

Conclusion: Our protocol of serial open irrigation and debridements, followed by application of NPWT using VAC, represents an attractive alternative to treatment of the Morel-Lavallée lesion.

See pages 75 - 103 for financial disclosure information.

The Influence of Hemorrhagic Anemia on Fracture Healing

***Thomas F. Varecka, MD*[1]**; *Lindsay Wiesner, MD*[2];
[1]*Hennepin County Medical Center, Minneapolis, Minnesota, USA;*
[2]*Creighton University School of Medicine, Omaha, Nebraska, USA*

Background: Severe trauma, accompanied by long-bone fractures, frequently results in hemorrhage and blood volume depletion. However, little appears in the literature regarding the influence of hemorrhagic anemia, as measured by peripheral hemoglobin levels, and impairment of healing (nonunion, delayed union) of these fractures. In 2002, our institution redefined acceptable thresholds for red cell replacement as a hemoglobin (Hgb) of ≤8 grams percent (gm %), versus previous thresholds of ≤10 gm %, thus limiting the frequency and amounts of red cell replacement administered following trauma.

Hypothesis: Posttraumatic hemorrhagic anemia adversely affects bone healing; redefining replacement thresholds further negatively influences fracture healing.

Methods: Charts of all discharged patients with long-bone, diaphyseal fractures, admitted to a Level 1 trauma center between 1997 and 2007, were reviewed to determine the incidence of impaired fracture healing. Exclusion criteria included: skeletally immature patients, those who died in hospital, incomplete medical or radiographic records. Charts were reviewed for development of anemia (Hgb ≤10 gm % vs Hgb ≤8 gm %), need for transfusions, quantity of blood administered, and fracture healing.

Results: Inclusion criteria were met by 734 patients, with 627 (700 total fractures) having adequate follow-up. Analysis included fracture sites (tibia, femur, humerus, forearm), hemoglobin levels, duration of the anemic state, use of tobacco, use of nonsteroidal medication, open versus closed fractures, and age.When anemia was defined as Hgb ≤10 gm %, 65.7% of all fracture patients developed anemia. Of these, 81.5% healed their fractures versus 88.8% of the nonanemic patients ($P = 0.013$). When anemia was redefined as Hgb ≤8 gm %, there was a marked decrease in the number of patients categorized as being anemic (35.9%), of whom 81.3% healed their fractures. This compares to 86.2% of nonanemic patients who healed their fractures ($P = 0.0409$). The development of anemia most highly influenced healing rates of the tibia: the ≤10 gm % group had a healing rate of 69.4% versus the nonanemic group with 86.9% ($P = 0.0020$). When anemia was redefined as ≤8 gm %, the healing rate was 60.6% versus 84.7% for nonanemic patients ($P = 0.0001$). When considering femur fractures, at Hgb ≤10 gm %, there was also a statistically significant difference in healing rates ($P = 0.0082$). This significance was lost when levels ≤8 gm % were analyzed, although a strong trend toward nonhealing still existed ($P = 0.0843$). When age and anemic status were analyzed concomitantly, a profound influence was noted. Regardless of fracture site, when patients >46 years of age developed anemia, they were 62% less likely to heal their fractures ($P = 0.0003$). In femur fracture patients, development of anemia resulted in an incremental 36% reduction in healing for every 10-year increase in age ($P = 0.0010$).

Conclusions: Our study does not attempt to implicate anemia as the only cause of failures in fracture healing. The depressed hemoglobin levels may simply serve as a marker for some other, and as yet undefined, healing anomaly coexistent with anemia. Nonetheless, a

- 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 413.

statistically significant difference exists in long-bone healing rates between patients developing posttraumatic anemia and those who do not (hypothesis accepted). Healing of the tibia and, to a lesser extent, the femur are both negatively influenced, regardless of what hemoglobin value is used to define anemia, or what transfusion threshold is used (hypothesis accepted). This is the first evidence-based review to suggest hemorrhagic anemia adversely affects fracture healing.

See pages 75 - 103 for financial disclosure information.

Self-Efficacy and Coping following Limb Trauma

Elizabeth Sinclair, MA[1]; ***Mary Zadnik Newell, OTR/L, MEd***[1]; *Nathan M. Parmer, PsyD*[2]; *Renan C. Castillo PhD*[3]; *Stephen T. Wegener, PhD*[2,3]; *Ellen J. MacKenzie, PhD*[3]; *Andrew N. Pollak, MD*[1];
[1]*R Adams Cowley Shock Trauma Center, Department of Orthopaedics, University of Maryland Medical School, Baltimore, Maryland, USA;*
[2]*Department of Physical Medicine and Rehabilitation, Johns Hopkins School of Medicine, Baltimore, Maryland, USA;*
[3]*Center for Injury Research & Policy, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA*

Purpose: Numerous studies have shown that patient psychosocial characteristics are the most important predictor of successful outcomes following orthopaedic trauma. Self-efficacy for return to usual activities, in particular, has been shown to strongly predict higher levels of function and increased likelihood of return to work. One factor hypothesized to affect self-efficacy following trauma may be the patient's coping style. Coping styles refer to the strategies people use to address problems. These coping strategies may be classified into four main types: avoiding the problem (Avoidance), seeking assistance with the problem (Support), recognizing and attending to the problem (Acceptance), and taking action to address the problem (Active). This study sought to identify coping strategies that are related to the maintenance or development of high levels of self-efficacy.

Methods: This was a prospective cohort study at one Level 1 trauma center. Participants completed baseline measures during initial admission following severe limb trauma and at 6- to 12-month follow up. Analysis included two-tailed *t* test with unequal variances. Measures included a general self-efficacy scale (baseline and 6-12 months), and the Brief COPE Inventory at 6 to 12 months. The COPE inventory measures coping strategies (how a person handles a problem) and categorizes them into the four main strategies described above.

Results: A total of 106 adults (mean age, 39 years) participated in the study. Individuals with high self-efficacy (≥ 7 of 10 at baseline and maintained at follow-up, or who achieved this level at follow-up) had higher levels of Acceptance coping ($P < 0.02$) and lower levels of Avoidance coping ($P < 0.001$). There were no differences in Support ($P > 0.3$) or Active coping ($P > 0.3$).

Conclusions: As hypothesized, individuals who maintained or developed high levels of self-efficacy used more Acceptance and less Avoidance coping. Contrary to expectation, Support and Active coping strategies were not predictive of maintenance or development of self-efficacy. These results suggest cognitive behavioral interventions for trauma survivors should focus on the development of these specific types of coping styles. Further research is needed to develop and validate the effectiveness of such programs in improving trauma 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 413.

Clinical Management of Radial Nerve Palsy (RNP) Associated with Humeral Shaft Fracture

(FDA=Non-U.S. research conducted within guidelines of my country)

Bo-song Zhang, MD; *He Liang, MD; Man-yi Wang, MD;*
Department of Orthopaedic Trauma, Beijing Jishuitan Hospital, Beijing, China

Purpose: This study was designed to clinically evaluate the effectiveness of the early surgical nerve exploration versus the nonsurgical nerve observation for the treatment of radial nerve palsy (RNP) associated with humeral shaft fractures. The hypothesis was that the early surgical nerve exploration and open reduction of the humeral shaft fractures improved the clinical results for this RNP compared to that of the nonsurgical nerve observation and closed reduction.

Methods: From March 1995 to October 2005, 708 cases of humeral shaft fractures were treated. There were 93 RNPs associated with humeral shaft fractures and 86 RNPs were adequately followed up. The average age was 34 years (range, 15-66 years). According to the treatment methods, the patients were divided into 2 groups: group A, 52 cases treated with the early surgical nerve exploration + open reduction and plating of the humeral shaft fractures; and group B, 34 cases treated with the nonsurgical nerve observation + closed reduction and plaster/small splint/nailing of the fractures. The follow-up parameters included recovery rate, initial recovery time, and full recovery time of the radial nerve.

Results: The overall prevalence of RNP associated with humeral shaft fracture was 13.1%. The mean follow-up period was 31.24 months (range, 6-103 months). In group A during the early surgical nerve exploration, 2 (3.9%) were found to have a neurotmesis; 1 (1.9%), nerve defect; 8 (15.4%), entrapped within the fracture fragments; 27 (51.9%), contused; and 14 (26.9%), intact. There were only 4 (7.7%) cases required secondary surgery and the final results showed that 50 (96.2%) cases had complete radial nerve recovery. In group B, 30 (88.2%) cases recovered spontaneously; 4 (11.8%) required late surgery, in which 3 neurotmeses and 1 nerve defect were found. The final results showed that 33 (97.1%) cases had complete radial nerve recovery. The differences between the groups in recovery rate, initial recovery time, and full recovery time of radial nerve function were of no statistical significance: 96.2% versus 97.1% ($P = 0.688$), 5.31 ± 4.06 versus 4.50 ± 3.87 weeks ($P = 0.359$), and 14.68 ± 8.21 versus 11.58 ± 8.71 weeks ($P = 0.097$), respectively.

Conclusion: The early surgical radial nerve exploration and open reduction of the humeral shaft fractures do not improved the clinical results for this RNP compare to that of the nonsurgical nerve observation and closed reduction of the humeral shaft fractures. If no contraindications exist, nonsurgical radial nerve observation as the primary treatment of RNP associated with humeral shaft fractures is recommended.

See pages 75 - 103 for financial disclosure information.

Treatment of Lower Extremity Segmental-Defect Nonunions with Reamer-Irrigator-Aspirator Bone Graft

Robert Garrison, MD; *Ryan Butterworth, BS; Paul Stafford, MD; Brent Norris, MD;*
University of Oklahoma School of Medicine, Tulsa, Oklahoma, USA

Background: The incidence of nonunion in long-bone fractures varies but is significantly increased when a segmental defect is present. Although the treatment of nonunions without bone defect varies, most surgeons advocate early staged bone grafting of fractures with segmental defects. While iliac crest bone graft (ICBG) is the historical gold standard for autogenous graft, a new reamer-irrigator-aspirator (RIA) device allows surgeons to acquire autogenous graft from the femoral medullary canal. Our early clinical experience suggests that RIA bone graft is equal to or better than ICBG for treating segmental-defect fracture nonunions. The purpose of our study is to document the union rate and need for secondary surgical procedures of segmental-defect long-bone nonunions treated with autogenous RIA graft.

Methods: We performed a retrospective cohort study of patients with segmental-defect long-bone nonunions treated between August 2007 and July 2009. Two trauma fellowship–trained surgeons used a standardized protocol for evaluation and treatment of all patients. IRB approval was attained prior to data collection. We recorded demographic data including age, sex, mechanism of injury, location of nonunion, type of nonunion (segmental or nonsegmental), number of previous surgeries, and open versus closed fracture. We also obtained pertinent surgical data from the operative note including but not limited to estimated blood loss, intraoperative cultures, size of defect, volume of graft harvested, use of adjunctive osteogenic material (bone morphogenetic protein [BMP]), and complications. Postoperative data points included wound complications, pain at the donor site, time to full weight bearing, and radiographic evaluation.

Results: During the study period, 42 patients with nonunion of a lower extremity long bone were identified. We excluded 13 patients from our initial cohort—3 patients with pathologic fractures, 10 patients with seam nonunions—and 1 patient was lost to follow-up. The remaining 28 patients had a total of 30 segmental-defect long-bone nonunions. Defect size ranged from 1 to 10 cm. 22 patients were male, 6 were female, and the mean age was 42.8 years. 19 of the nonunions were in the tibia and 11 occurred in the femur. 18 of the nonunions were initially open fractures—12 tibias and 6 femurs. On average, 2.8 previous surgeries had been performed. RIA was used in 24 of the 30 nonunions (80%). Intraoperative cultures were taken in 23 of the 30 nonunions (77%); of those, 4 were positive (4%). We used adjunctive material (BMP and/or other graft extender) in 25 of 30 cases (83%). At 6 months, 21 of the 30 nonunions were healed (5 of 11 femur nonunions, 16 of 19 tibia nonunion). At last follow-up, 27 of 30 segmental-defect nonunions were healed (10 of 11 femurs, 17 of 18 tibia). Of the remaining three, one is pending further bone grafting, one required a below-knee amputation for chronic deep infection, and one was lost to follow-up.

Conclusion: We used RIA graft in 80% of our segmental-defect nonunions. At final follow-up, 90% were healed. By use of a standardized protocol, adherence to the principles of nonunion surgery, and use of RIA graft, we have shown these challenging cases can be treated with acceptable and excepted 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 413.

Morbidity at the Donor Site After Anterior Iliac Crest Bone Graft for Fracture Nonunion

Bryan J. Loeffler, MD; James F. Kellam, MD; Stephen H. Sims, MD; ***Michael J. Bosse, MD****;*
Department of Orthopaedic Surgery, Carolinas Medical Center, Charlotte, North Carolina, USA

Purpose: Varying incidences of complications associated with iliac crest bone graft donor sites have been reported; however, a large, prospective study of orthopaedic trauma patients undergoing nonunion treatment has not been previously performed. This prospective study was conducted to determine the incidence of pain and complications at the iliac crest donor site in trauma patients undergoing treatment of nonunion. The study hypothesis is that pain and complication rates are significantly lower in this population than previously reported.

Methods: Patients undergoing anterior iliac crest bone grafting (n = 80) for nonunion treatment were prospectively enrolled in an IRB-approved study. Questionnaires containing visual analog scales (VAS) for pain and satisfaction with cosmesis of the donor site were completed by patients at 2 weeks, 6 weeks, 3 months, and 1 year postoperatively. The questionnaires also asked patients to record altered sensations at the donor site and use of narcotic pain medication. All autografts were cancellous or corticocancellous grafts; there were no structural, tricortical grafts. Autograft was harvested from the anterior iliac crest by either a trap-door method (n = 48) or as a corticocancellous graft from the inner table (n = 32). Complications at the iliac crest donor site were prospectively recorded. Repeated-measures analysis of variance tests and Cochran Q tests were performed to determine if VAS and percentage values, respectively, changed over the four time points.

Results: The study results are summarized in Table 1. At 3 months postoperatively, there was only one patient (1.7%) with a pain VAS greater than 5 on a scale of 10. There were three (3.8%) deep donor-site infections, which were successfully treated with irrigation, débridement, and antibiotic treatment. There were five lateral femoral cutaneous nerve palsies; four were completely resolved by 3 months postoperatively, and one was lost to follow-up. There were no other complications.

Table 1. Time Period After Iliac Crest Bone Graft and Questionnaire Results

	2 Weeks	6 Weeks	3 Months	1 Year	*P* Value
Pain (mean VAS; out of 10)	3.86	1.6	1.07	0.79	0.004*
Percentage of patients with moderate or severe pain (VAS >3)	48.7%	18.8%	10.0%	7.7%	0.011*
Percentage of patients reporting altered sensations at or around the incision	54.0%	32.8%	28.4%	15.4%	0.008*
Cosmesis satisfaction (mean VAS; out of 10, with 10 = completely satisfied)	7.83	8.11	8.24	8.34	0.082

*Significant.

See pages 75 - 103 for financial disclosure information.

Conclusions: Anterior iliac crest bone grafting for nonunion is a well-tolerated procedure with significantly lower donor-site morbidity than has been previously reported. There were few complications, which were successfully managed. Significant, persistent pain at the iliac crest donor site is rare.

- 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 413.

BMP-7 versus BMP-2 for the Treatment of Nonunion

Janet D. Conway, MD; *Stacy C. Specht, MPA; Alexandra Bauernschub;*
Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore,
Baltimore, Maryland, USA

Purpose: Subjects underwent treatment with either bone morphogenetic protein (BMP)-7 or BMP-2 after developing nonunion. The purpose of our study was to compare the results of treatment with BMP-7 and BMP-2.

Methods: We conducted a retrospective study of 175 subjects (214 limb segments) who underwent treatment for nonunion between 2001 and 2008 and received either BMP-7 (76 units) or BMP-2 (138 units). Nonunion originated in the tibia (n = 78), femur (n = 66), or humerus (n = 70). The results, including weight-bearing status, healing time, and complication rates, were compared.

Results: *Results of BMP-7.* 76 units of BMP-7 were used in each of 63 subjects (average age, 46 years; 76 limb segments). 69% of limb segments fully healed at an average of 30 weeks (range, 7-92 weeks) after surgery. 76% of limb segments were weight bearing at an average of 23 weeks (range, 2-54 weeks) after surgery. 17% of limb segments had a complication requiring additional surgery. Average follow-up was 31 weeks (range, 2-73 weeks). *Results of BMP-2.* 138 units of BMP-2 were used in each of 112 subjects (average age, 37 years; 138 limb segments). Full healing occurred in 93% of limb segments at an average of 19 weeks (range, 6-85 weeks) after surgery. 88% of limb segments were weight bearing at an average of 15 weeks after surgery (range, 2-53 weeks). Nine percent of limb segments had a complication requiring additional surgery. Average follow-up was 15 weeks (range, 3-54 weeks). *Overall Results.* A significant difference was observed between groups in relation to weight bearing and healing time. The BMP-7 and BMP-2 groups were able to fully weight-bear at an average of 23 and 15 weeks, respectively ($P = 0.001$). Furthermore, the BMP-7 and BMP-2 groups healed at an average of 30.4 and 19.0 weeks, respectively ($P = 0.001$). Additionally, more of the BMP-2 limb segments are healed (93%) than those in the BMP-7 group (69%) ($P = 0.001$). Limb segments in the BMP-2 group also had a lower complication rate (9%) compared with the complication rate (17%) in the BMP-7 group.

Conclusion: Subjects who received BMP-2 for the treatment of nonunion healed more quickly, were able to weight-bear sooner, and had a lower complication rate than those who underwent treatment with BMP-7.

See pages 75 - 103 for financial disclosure information.

Intramedullary Skeletal Kinetic Distractor (ISKD) for Posttraumatic Limb-Length Discrepancy

***John E. Herzenberg, MD*[1]*; Gaurav Jindal, MD[2]; Mohan V. Belthur, MD[3]; Dror Paley, MD[4]; Stacy C. Specht, MPA[1];*
[1]Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore, Baltimore, Maryland, USA;
[2]Pushpanjali Crosslay Hospital, Ghaziabad, India;
[3]Texas Children's Hospital and Shriners Hospital for Children, Houston, Texas, USA;
[4]Paley Advanced Limb Lengthening Institute, St. Mary's Hospital, West Palm Beach, Florida, USA

Purpose: Limb lengthening with external fixation can cause scarring, pin-site infections, and pain. Lengthening with an internal device is an alternative to external fixation and can be used to correct posttraumatic limb-length discrepancy (LLD). The purpose of this study was to determine whether lengthening with the Intramedullary Skeletal Kinetic Distractor (ISKD) (Orthofix) is safe and effective.

Methods: Prospective study was conducted of 28 patients with posttraumatic LLD who underwent 23 femoral and 5 tibial lengthening procedures with the ISKD.

Results: Average age at surgery was 35 years (range, 13-55 years). Average follow-up was 18 months (range, 6-40 months). Average length obtained was 32 mm (range, 6-58 mm). 18 of 28 devices have been electively removed. Seven additional procedures were required (average, 0.25 per patient). Complications included one premature consolidation, two partial unions, and two nonunions. Reosteotomy was required for premature consolidation. Both patients with partial union healed after undergoing percutaneous marrow grafting; one also underwent exchange nailing. All patients achieved desired amount of lengthening except two patients whose limbs failed to lengthen postoperatively (one with a stiff oblique hypertrophic nonunion and one with acute correction of varus malunion). These two patients had a final LLD of 11 mm and 20 mm. Both patients experienced nonunion but the limb eventually healed after exchange nailing. There were no infections, nerve injuries, soft-tissue contractures, stress fractures after nail removal, or mechanical failures of the device. A quality-of-life questionnaire (Enneking score, maximum of 30 points) was administered preoperatively and at 6 months postdistraction; the scores of 17 patients who completed the postoperative questionnaire improved by an average of 4 points.

Conclusion: The ISKD is a safe and effective device for limb lengthening in cases of posttraumatic LLD. We recommend that for most cases, angular malunions and nonunions be treated first, with ISKD lengthening as a secondary, staged 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 413.

Bilateral Transfemoral/Transtibial Amputations Due to Battle Injuries

Paul J. Dougherty, MD[1]; *Lynne V. McFarland, PhD*[2]; *Douglas G. Smith, MD*[3];
Gayle Reiber, PhD[2,3];
[1]*University of Michigan, Ann Arbor, Michigan, USA;*
[2]*Veteran's Administration Puget Sound Health Care System, Seattle, Washington, USA;*
[3]*University of Washington, Seattle, Washington, USA*

Purpose: Our objective was to compare outcomes between patients from the Vietnam War and Operation Iraqi Freedom/Operation Enduring Freedom (OIF/OEF) who sustained a bilateral transtibial and transfemoral level amputation.

Methods: After IRB approvals, we studied service members with bilateral amputations involving transtibial/transfemoral (TT/TF) levels associated with battlefield injuries from the Vietnam War and the OIF/OEF. Subjects were identified from the Veteran's Administration and military databases and surveyed during 2007-2008 to determine their surgical history, presence of other medical problems, health status, quality of life, function, and prosthetic use.

Results: There were 501 subjects in the Vietnam group and 541 in the OIF/OEF group. The survey response rate was 62%. TT/FF limb loss was reported in 13 (4.3%) of 298 in the Vietnam group and 11 (3.8%) of 283 in the OIF/OEF group. Average age at follow-up was 60.6 (±2.2) years for the Vietnam group and 27.5 (±4.7) years for the OIF/OEF group. The average number of surgeries per limb after initial amputation was 1.7 (±1.9) for the Vietnam group and 8.36 (±7.9) for the OIF/OEF group (P = 0.0002). Excellent, very good, and good self-reported health was similar in both groups: 46.2% for the Vietnam group and 54.6% of OIF/OEF (P = 0.85). Excellent, very good, and good self-reported quality of life was also similar in both groups: 69% for the Vietnam group and 72% in the OIF/OEF group (P = 0.85). Level of function was higher in the OIF/OEF group, with 4 of 11 reporting participation in high-impact activities and none in the Vietnam group (P = 0.018). All in the OIF/OEF group use prostheses, whereas one patient in the Vietnam group has abandoned prosthetic use. Average number of prostheses received since 13 months after amputation is 14.8 ± 10.1 for the Vietnam group (average 39 years after amputation) and 3.6 ± 4.7 for the OEF/OIF group (average 3 years after amputation) (P < 0.001). Average number of prostheses currently used is 2.1 ± 0.9 for the Vietnam and 6.1 ± 4.5 for OIF/OEF group (P = 0.008). Average prosthetic satisfaction (scale, 0-10) was 6.5 ± 3.1 for the Vietnam group and 7.8 ± 3.0 for the OIF/OEF group (P = 0.058). All those surveyed in the OIF/OEF group use a wheelchair, compared to 10 of 13 from the Vietnam group (P = 0.085).

Conclusion: This is the first clinical report on TT and TF bilateral lower extremity amputations. OIF/OEF service members, while younger, report higher levels of function and greater use of prosthetic devices than those from the Vietnam War. Both groups report similar quality of life and self-reported health.

See pages 75 - 103 for financial disclosure information.

•Comparison of Bone-Grafting Modalities for Surgical Revision of Fracture-Nonunions in Long Bones: A Retrospective Analysis of 152 Consecutive Patients

*Michael A. Flierl, MD[1]; **Philip F. Stahel, MD**[1]; Allison E. Williams, ND, PhD[2];*
Gabrielle Peacher, BA[1]; Erin E. Ross, BS[1]; Andrea J. Baron, MS[1];
Steven J. Morgan, MD[1]; Wade R. Smith, MD[3];
[1]Denver Health Medical Center, University of Colorado Denver, School of Medicine, Denver, Colorado, USA;
[2]Department of Veterans Affairs Eastern Colorado Health Care System, University of Colorado Denver, School of Medicine, University of Colorado College of Nursing, Denver, Colorado, USA;
[3]Geisinger Medical Center, Danville, Pennsylvania, USA

Purpose: Fracture-nonunions of long bones represent a significant clinical challenge. Recent data have questioned the role of autologous bone grafting as the classic "gold standard" adjunct for surgical revision of nonunions, in light of the availability of new bone substitutes and recombinant pharmacological agents with osteoinductive properties. The present study was designed to compare healing times and complication rates in 152 consecutive patients treated by surgical revision for fracture-nonunions of long bones using either (1) autograft, (2) allograft, (3) autograft/allograft combined, or (4) recombinant bone morphogenetic protein (BMP)-2 with or without bone grafting, as determined by surgeons' preference.

Patients and Methods: This was a retrospective review of a prospective database that includes all patients admitted to our Level 1 trauma center for surgical treatment of long-bone fracture-nonunions between January 1, 1998 and December 31, 2009 (n = 373). Of these, 152 patients (84 males, 68 females) required adjunctive bone grafting for nonunions of the tibia (n = 77), femur (n = 43), or humerus (n = 32). Nonunions of the forearm (n = 7) were excluded. Patients were stratified into the following cohorts for analysis, based on the bone-grafting modality: autograft (n = 93), allograft (n = 30), allograft in combination with autograft (n = 12), and BMP-2 (n = 17; BMP-2 alone [n = 6] or combined with a bone substitute [n = 11]). The indication for the use of BMP-2 in this study was "off-label." The primary outcome parameter was time to union. Secondary outcome parameters consisted of complication rates, the need for revision surgeries, and revision bone grafting. Descriptive statistics were performed to summarize demographic and clinical variables, and to evaluate distributional characteristics of continuous variables. Kruskal-Wallis tests, Mann-Whitney *U* tests, and χ^2 tests were applied, as appropriate. Data are expressed as mean ± standard deviation. Statistical significance was defined at $P < 0.05$.

Results: Patients in the autograft group had the shortest time to union (209 days; 95% confidence interval [CI], 180-237 days), compared to the allograft group (492 days; 95% CI, 338-646 days), the autograft + allograft cohort (429 days; 95% CI, 120-737days), and the BMP-2 cohort (234 days; 95% CI, 163-306 days). Differences in time to healing were significant between the autograft and allograft cohorts ($P < 0.001$), and allograft and BMP-2 cohorts ($P = 0.031$). Furthermore, the autograft group had a significantly lower incidence of surgical revision rates (15%) and need for revision bone grafting (9%) compared to the allograft group (50% and 37%, respectively), the allograft + autograft group (25% and 25%, respectively), and the BMP-2 cohort (24% and 18%, respectively; $P < 0.01$). The 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 413.

rates related to the incidence of ongoing infection or a new-onset postoperative infection was significantly higher in the allograft cohort (37%), compared to BMP-2 (24%), autograft (13%), and autograft/allograft combination (8.3%; $P < 0.05$).

Conclusion: Based on these data, autologous bone grafting appears to represent the most efficient and safest adjunct for bone grafting of fracture-nonunions in long bones. BMP-2 failed to improve the time to union, the requirement for revision surgery, or to reduce the incidence of postoperative complications. Prospective randomized studies are required to further clarify the role of BMP-2 in nonunion revision surgery at a higher confidence level.

See pages 75 - 103 for financial disclosure information.

Single-Incision versus Dual-Incision Fasciotomy for Tibial Compartment Syndrome

Scott W. Zehnder, MD*; Michael R. Berry, MD; J. Tracy Watson, MD;*
Saint Louis University School of Medicine, Department of Orthopaedics,
St. Louis, Missouri, USA

Purpose: Emergent fasciotomy through dual medial/lateral incisions or a single lateral incision is necessary to prevent ischemic myonecrosis in the setting of tibial compartment syndrome. Following decompression, successful wound closure can be problematic, often requiring multiple débridements and possible split-thickness skin grafting (STSG). The purpose of this study was to evaluate a prospective protocol and review the results of two fasciotomy techniques to determine if fasciotomy through a single lateral incision increases the need for secondary procedures and/or STSG to achieve competent wound closure.

Methods: We reviewed trauma records and identified patients who underwent four-compartment fasciotomy at our Level 1 trauma center from July 2003 to December 2008. Patients requiring fasciotomy were selected for each treatment group by surgeon randomization. Outcomes analyzed included number of débridement procedures prior to closure or grafting, time to wound closure, length of hospitalization, and the necessity of STSG.

Results: 98 patients underwent 100 fasciotomies and were available for long-term follow-up. 47 fasciotomies were performed through a dual medial/lateral approach, while 53 were performed through a single lateral incision. 17 wounds, 8 (17.0%) in the dual-incision group and 9 (17.0%) in the single-incision group, required STSG. Mean time until wound closure was 8.0 (±4.8) days in the single-incision group and 7.4 (±4.2) in the dual-incision group (P = .526). There were no significant differences between the two groups with regard to number of irrigation and débridement procedures, length of hospitalization, and the necessity for STSG. All wounds healed clinically following closure or STSG.

Conclusions: Fasciotomy by single or dual incision is an effective means of relieving elevated compartmental pressures as a result of lower extremity trauma. Both methods allow wound closure at similar time intervals and have a similar incidence of STSG. The perceived additional iatrogenic soft-tissue trauma caused by release of the deep compartments from the lateral side does not appear to have a significant impact on wound closure or eventual 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 413.

Periosteal Fibular Bone Bridging (a Modified Ertl Procedure) for Transtibial Amputation

Steven J. Morgan, MD; *Chengla Yi, MD; Justin Newman, MD; Andrea J. Baron, MS;*
Denver Health Medical Center, Denver, Colorado, USA

Purpose: The goal of any amputation surgery is to create a functional, painless limb. The Ertl procedure and variation of this technique creates a bone synostosis between the tibia and fibula with the advantage of stabilizing the fibula as well as increasing the surface area of bone for weight bearing. However, the fibular strut graft of the traditional Ertl technique is not a vascularized free cortical graft and prolongs the fusing time of tibia-fibula bone bridging through covering with osteoperiosteal flaps. Our objective is to describe our technique of transtibial amputation using an attached periosteal fibular strut bridge between the end of the tibia and fibula and our preliminary experience with this method.

Method: Inclusion criteria consisted of patients who underwent below-knee amputation due to traumatic injury. Our technique was performed with a posterior myocutaneous flap. The length of the tibia was 12 to 15 cm to allow the creation of a well-padded posterior gastrocnemius myocutaneous flap. The fibula was cut several centimeters distal to the tibia cut. A small saw was used to transect the fibula, separating it longitudinally into medial and lateral halves. A cut at the tibia level was made in the fibula, proximally, leaving the lateral periosteum intact. The fibula was flipped up 90° on the distal end of the tibia. Drill holes were made on the tibia and the fibula. Nonabsorbable sutures were used to tie the fibula to the tibia with the fascial attachments.

Results: Below-knee amputations with this modified Ertl technique were performed on 8 out of a total of 38 cases between January 2005 and June 2008. There were 7 males and 1 female with a mean age of 37.8 years (range, 19-60 years). Of this patient population, four patients presented with distal tibial osteomyelitis or infected nonunion after a traumatic episode. Four patients sustained a severely mangled lower extremity due to trauma that was not salvageable. The mean operative time was 117.5 minutes (range, 40-162 minutes). One case required the surgeon to perform a more proximal transtibial amputation that was not amenable to an osteomyoplasty because of a subsequent postoperative infection. The other patients had primary healing of the wound. After postoperative rehabilitation, the other seven tibial-fibular bone bridge patients were using their prostheses. We have had no complaints of sustained pain within the residual limbs. To date, no patient has shown evidence of graft loosening or diastasis between the distal tibia and fibula. During the follow-up period, we witnessed apparent radiographic union of the bone bridge.

Conclusions: The modified Ertl procedure of fibular strut–attached periosteal structure potentially preserves viability of the graft and facilitates bony union. Based on our preliminary experience, this is an effective and simple method to secure the fibular bone bridge. It has the theoretical advantage of shortening the time of bone synostosis and prosthetic fitting, decreasing fibular instability as well as accelerating rehabilitation.

See pages 75 - 103 for financial disclosure information.

Cost Effectiveness Analysis of Implant Selection in the Treatment of Extracapsular Hip Fractures

Adam M. Kaufman, MD; *Richard C. Mather, MD; Lori Orlando, MD; Michael P. Bolognesi, MD; Steven A. Olson, MD; Robert D. Zura, MD; Duke University Hospital, Durham, North Carolina, USA*

Background: The sliding hip screw (SHS) and the intramedullary hip screw (IMHS) are the two most commonly used implant designs for the fixation of extracapsular hip fractures. The utilization of the IMHS has increased dramatically in recent years, but the cost effectiveness of this trend is unknown. In this study, we compare the cost effectiveness of these two implants in this setting.

Methods: A Markov decision model was constructed for a cost-utility analysis of SHS compared to IMHS in patients with extracapsular hip fractures. Costs were estimated from the societal perspective with the use of average costs from this institution in US dollars. Effectiveness was expressed in quality-adjusted life years (QALY) gained. Principal outcome measures were average incremental costs, incremental effectiveness, incremental QALY, and net health benefits. The effect of three critical variables—periprosthetic femoral fracture, failure due to cut-out, and return of function—were specifically evaluated with extensive sensitivity analyses.

Results: In the base case, the SHS was both less costly and more effective with an average incremental cost of $1190 less than the IMHS, while providing a very small incremental QALY gain of 0.004 QALY, and therefore dominated the IMHS. However, sensitivity analysis revealed that IMHS becomes the preferred strategy if it confers 9 weeks faster recovery or greater than 4% of patients achieve a higher final functional outcome.

Conclusions: Both IMHS and SHS are cost effective in the treatment of extracapsular hip fractures. SHS is the dominant strategy, regardless of the incidence of periprosthetic hip fracture. Functional outcomes most profoundly affected the model's outcomes and remain a critical topic for future research.

Level of Evidence: Economic and decision analysis; Level II.

- 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 413.

Hip Fracture Fixation in Young Patients: Risk Factors for Failure

(FDA=Non-U.S. research conducted within guidelines of my country)

*Joseph Aderinto, MD; **Andrew D. Duckworth**; Simon J. Bennet; John F. Keating, MD;*
Edinburgh Orthopaedic Trauma Unit, Royal Infirmary of Edinburgh,
Edinburgh, Scotland, United Kingdom

Purpose: Reduction and fixation of displaced femoral neck fractures is the preferred treatment in young patients. However, in some patients, there may be premorbid conditions that predispose to fracture and poor outcome of fixation. The aim of this study was to document the epidemiology and risk factors for failure in young patients who undergo hip fracture fixation for a displaced femoral neck fracture.

Methods: We identified from a prospective database all patients 60 years of age or less with a displaced femoral neck fracture that was treated with three cannulated screw fixation. Demographic data, treatment, complications, and subsequent surgeries were recorded. We recorded all potential predisposing factors including chronic medical comorbidities, medications, alcohol excess, and smoking. The main outcome measures were union, fixation failure, non-union, and the development of avascular necrosis. Follow-up of up to 2 years was used to allow for detection of complications. Univariate and multivariate binary logistic regression analysis was used to determine significant ($P < 0.05$) predictors of failure.

Results: There were 152 patients identified; 78 (51%) were male and the mean age was 49 years (range, 17-60 years). Surgery was performed within 24 hours of admission in 55% of cases (range, 0-5 days). 21 patients were lost to follow-up, leaving a total of 131 patients (86%) for analysis. Union occurred in 93 patients (71%). Complications occurred in 38 patients (29%) at a mean time of 10 months (range, 0.5-39 months). Loss of fixation occurred in 16 patients (42%) and was the most common cause for failure. Nonunion occurred in 9 patients (24%) and avascular necrosis in 13 patients (34%). Predisposing causes for failure were found in 30 patients (79%). Univariate binominal logistic regression revealed that delay in time to fixation (>24 hours), renal failure, alcohol excess, and chronic respiratory disease were independent predictors of failure (all $P < 0.05$). These factors were all found to be significant on multivariate analysis. Carbamazepine therapy and patients with cerebral palsy were approaching significance ($P = 0.059$) as predictors of failure on univariate analysis.

Conclusion: Almost 80% of young patients with femoral neck fractures have premorbid conditions that predispose to fracture and poor outcome of fixation. Preexisting renal failure and a background of alcohol excess were most predictive for failure in this study. These patient subgroups require careful preoperative evaluation and should be counseled with regard to their increased risk of failure, with alternative treatment options considered.

See pages 75 - 103 for financial disclosure information.

Limb-Length Discrepancy in Comminuted Femoral Shaft Fractures following Intramedullary Nailing

Brent Anderson, DO; Anil Sethi, MD; Ashraf Elbanna, BS; Michael Liston, MD; Daniel Hoard, MD; ***Rahul Vaidya, MD****;*
Detroit Receiving Hospital, Detroit, Michigan, USA

Purpose: The purpose of this report is to evaluate the efficacy of a routine CT scanogram to assess limb-length discrepancy (LLD) on postoperative day 1 or 2 in patients of comminuted femoral shaft fractures treated with intramedullary nailing.

Method: 28 consecutive patients of comminuted femoral shaft fracture treated with intramedullary nailing were included in the study. All patients underwent a CT scanogram for evaluation of LLD on postoperative day 1 or 2. There were 15 patients with Winquist III and 13 with a Winquist IV fracture pattern. Following surgery, leg lengths of the operative and nonoperative extremity were measured from the CT scanograms using a computerized measuring ruler. If indicated, patients underwent limb-length equalization during the same admission. The intramedullary nail was unlocked, leg length restored, and static locking applied.

Results: An LLD of ≥15 mm was noted in eight patients. Tibia and femur lengths were also evaluated separately. Although none of the tibiae had a previous fracture, in only 3 patients were the tibiae of equal length. In 3 patients, an unequal tibia added significantly to the total LLD. In the remaining 2 patients, a tibial length discrepancy decreased the total LLD. The largest LLD noted on scanogram was 4 cm. Six patients underwent leg-length correction during the same admission. LLD >15 mm was considered for equalization.

Conclusions: LLD can be a source of dissatisfaction following surgery. Immediate correction saves cost, morbidity, and possible litigation. We recommend a postoperative scanogram costing $380 in all patients of comminuted femoral shaft fractures treated with intramedullary nailing. Tibial length discrepancy may contribute significantly to the LLD, prompting equalization surgery that may not be necessary if the femora alone were unequal.

- 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 413.

Complication Risk Following Treatment of Intracapsular and Extracapsular Hip Fractures in the Medicare Population

Arthur Malkani, MD[1]; *Colin Carroll*[1]; [1]*Craig S. Roberts, MD, MBA*[1]; *David Seligson, MD*[1];
Edmund Lau, MS[2]; *Judd Day, PhD*[2]; *Steven Kurtz, PhD*[2]; *Kevin Ong, PhD*[2]
[1]*University of Louisville, Louisville, Kentucky, USA;*
[2]*Exponent, Inc, Philadelphia, Pennsylvania, USA*

Purpose: This study was designed to: (1) evaluate the temporal trends in treatment patterns for intracapsular and extracapsular hip fractures; and (2) compare post-perative complication and mortality risk following internal fixation, hemiarthroplasty, and total hip arthroplasty (THA).

Methods: Hip fracture patients were identified from the 5% nationwide sample of the Medicare claims data (1998-2007), using ICD-9-CM codes 733.14, 820.0, and 820.1 (intracapsular), and 820.2 and 820.3 (extracapsular). Patients who were treated with internal fixation, hemiarthroplasty, or THA were included. The cumulative incidence of deep venous thrombosis (DVT), infection, mechanical complications, neurologic complications, pulmonary embolism, and cardiac complications were computed for up to 90 days postsurgery, while mortality, malunion/nonunion, conversion to hip replacement (revision THA for THA patients), and reoperation with a subsequent internal fixation were evaluated for up to 1 year postsurgery. Multivariate Cox regression (adjusted) was used to compare complication rates between the various treatment modalities.

Results: 40,852 intracapsular (33.7% internal fixation, 59.2% hemiarthroplasty, and 7.0% THA) and 48,948 extracapsular (90.1% internal fixation, 7.9% hemiarthroplasty, and 2.0% THA) patients were identified. The proportion of hemiarthroplasty to treat intracapsular fractures has been on the rise, compared with internal fixation. The treatment patterns for extracapsular fractures have been relatively unchanged. *Intracapsular Fractures*. Compared with internal fixation patients, hemiarthroplasty patients had a higher adjusted risk of cardiac complications (+18%) and infection (+76%) at 90 days, and death (+8%) and conversion to THA (+60%) at 1 year, but lower adjusted risk of mechanical complications (–25%) at 90 days, and malunion/nonunion (–85%) and reoperation with subsequent fixation (–93%) at 1 year. THA patients had a higher adjusted risk of DVT (+26%), infection (+120%), and mechanical complications (+47%) at 90 days, but lower adjusted risk of death (–20%), malunion/nonunion (–54%), and reoperation with subsequent fixation (-92%). The rate of reoperation was 22.3%. *Extracapsular Fractures.* The rates of complications for internal fixation patients were 5.1% (cardiac), 7.8% (DVT), 1.7% (infection), 2.5% (mechanical), 0.3% (neurologic), 2.1% (pulmonary embolism), 27.6% (death), 2.5% (malunion/nonunion), and 36.2% (reoperation).

Conclusion: Our data suggest that patient outcomes differed between treatment groups. Although hemiarthroplasty has been on the rise to treat intracapsular fractures compared with internal fixation, hemiarthroplasty patients encountered higher adjusted risk of cardiac complications and infection at 90 days and death. Extracapsular fractures have higher complications rates than expected. Additional studies need to be undertaken to minimize the high complication rates in this group of patients.

See pages 75 - 103 for financial disclosure information.

Does Time and Type of Fixation Matter in Femoral Shaft Fractures?

Brandon T. Bruce, MD[1]; *Michael J. Bosse, MD[2]; Ron Sing, DO[2]; Andrea Maslow, BS[2];*
[1]University of Kentucky, Lexington, Kentucky, USA;
[2]Carolinas Medical Center, Charlotte, North Carolina, USA

Purpose: Femoral nail fixation is one of the greatest achievements of orthopaedic surgery, but considerable debate remains concerning the optimal time for fixation and whether damage control should play a role in the management of these fractures. This controversy exists secondary to seemingly contradictory results in the literature concerning whether acutely performed intramedullary fixation results in pulmonary complications. Therefore, a large population of patients with femoral shaft fractures was identified so that subtle differences in outcomes could be shown to be significant.

Methods: A retrospective study was performed using data recorded in the National Trauma Data Bank (NTDB) between the years 2003 and 2007. A population was constructed consisting of patients age 18 years or older sustaining a femoral shaft fracture as identified by ICD-9 codes. Exclusion criteria included any patient with a proximal or distal femur fracture, those with a significant head injury (Head AIS [abbreviated injury scale] ≥3), and those in shock as defined by physiologic parameters included in the NTDB. The resulting population was then divided into eight groups based upon femoral fracture management and time to surgical intervention. These eight groups consisted of those treated nonoperatively within the first 24 and 48 hours; those treated with damage control (external fixation) within the first 24 and 48 hours; and those treated with internal fixation within the first 24 hours, within the first 48 hours, between 24 and 72 hours, and >72 hours after hospitalization. Time to fixation was defined as the time interval between emergency room presentation and the beginning of the surgical procedure. In an effort to further standardize the comparisons, the groups were divided based on Injury Severity Score (ISS) into those with an ISS <16 and those with ISS ≥16. These groups were then compared using logistic regression analyses while adjusting for propensity score risk to estimate odds ratios and 95% confidence intervals for the outcomes of pneumonia, medical complications, and mortality. In addition, linear regression analyses weighted by propensity score risk were used to estimate significant differences in ICU and ventilator days between the treatment groups.

Results: Our population consisted of 12,937 patients who sustained a femoral shaft fracture, of whom 2232 had an ISS ≥16. The initial analysis compared those treated nonoperatively in the first 24 or 48 hours to those treated with any type of surgical intervention. The nonoperative group regardless of ISS score had increased odds of pneumonia, medical complications, and mortality, as well as significantly increased ICU and ventilator days. The next analysis compared a group receiving damage control intervention to those receiving definitive internal fixation. In the group with an ISS ≥16, odds in the damage control group were increased for developing a medical complication; however, mortality and pneumonia odds were similar. Additionally, the damage control group had significantly increased ICU and ventilator days. The results comparing differences in the internal fixation groups with an ISS ≥16 showed that those receiving internal fixation in the first 24 hours were less likely to develop a medical complication and had significantly less ICU and ventilator days than those receiving internal fixation between 24 and 72 hours.

- 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 413.

Conclusion: Early definitive internal fixation is the most beneficial method of treatment in patients sustaining a femoral shaft fracture who can safely undergo a surgical intervention.

See pages 75 - 103 for financial disclosure information.

Transfer Patients Have Worse Observed and Expected Outcomes Compared to Nontransfer Patients After Treatment for Hip Fracture at a Regional Referral Center

Jimme K. Wiggers, MSc; Thierry G. Guitton, MSc; R. Malcolm Smith, MD; Mark S. Vrahas, MD; ***David C. Ring, MD, PhD****;*
Harvard Medical School, Orthopaedic Hand and Upper Extremity Service, Massachusetts General Hospital, Boston, Massachusetts, USA

Purpose: The purpose of this study was to compare the outcomes of patients aged 65 and older transferred to a tertiary care referral center for treatment of a hip fracture with the outcomes of nontransfer patients and test the null hypothesis that transfer patients have expected lengths of stay based on *All-Patient Refined Diagnosis-Related Groups* (APR-DRG) norms and actual observed lengths of stay comparable to nontransfer patients.

Methods: 123 consecutive patients that were transferred from another acute care facility or a skilled nursing facility were retrospectively compared to 283 consecutive nontransfer patients with respect to inhospital mortality, length of stay (LOS), excess days over the geometric mean LOS (GMLOS), and readmission rate as well as expected LOS (Exp LOS) and expected mortality (Exp Mort), based on APR-DRG norms.

Results: Transfer patients had significantly greater LOS (10.2 vs 9.6 days; $P < 0.05$), Exp LOS (9.7 vs 7.7 days; $P < 0.001$), Exp Mort (0.07 vs 0.03; $P = 0.004$), and excess days over the GMLOS (4.1 vs 3.3 days; $P = 0.025$) than nontransfer patients, near-significant greater inhospital mortality (9.8% vs 4.9%; $P = 0.069$), and comparable readmission rates. The differences in LOS and Exp LOS were nonsignificant in both transfer ($P = 0.49$) and nontransfer patients ($P = 0.10$).

Conclusion: Patients aged 65 and older transferred to a tertiary care facility for treatment of an acute hip fracture are sicker than nontransfer patients. Unadjusted data such as inhospital mortality may be misleading, but risk adjustment using the APR-DRG methodology may provide meaningful benchmarks.

- 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 413.

Does Late-Night Hip Surgery Affect Outcome?

Miguel A. Ramirez, MD; ***Edward K. Rodriguez, MD****; Lars C. Richardson, MD;*
Aron T. Chacko, BS; Paul T. Appleton, MD; Arun J. Ramappa, MD;
Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts, USA

Purpose: There is a perception that after-hours hip surgery may result in increased complication rates. Surgeon fatigue, decreased availability of support staff, and other logistical factors have been theorized to play an adverse role and often used as justification to delay surgery. However, there are few data supporting this perception in the hip fracture literature.

Methods: This is a retrospective study of 667 consecutive patients with intertrochanteric, subtrochanteric, or femoral neck fractures. Surgeries were stratified by time of incision into two groups: Day (07:00-17:59) and Night (18:00-06:59). Records were examined for procedure length, intraoperative blood loss, complications (nonunion, implant failure, infection, deep venous thrombosis [DVT], pulmonary embolus, refracture), reoperation, and mortality at 1 and 2 years after surgery.

Results: 401 patients were included in the Day group and 266 in the Night group. There were no differences in terms of age, gender, ethnicity, American Society of Anesthesiologists (ASA) status, total number of comorbidities, and fracture type between groups. Intertrochanteric fractures were 66% of all fractures, femoral neck fractures were 32%, and subtrochanteric fractures were 2%. There were no statistical differences in blood loss, transfusion requirements, surgical time, hospital stay, or complications between the two groups. Our postoperative infection rate was 4.6% in the Day group and 4.1% in the Night group. The reoperation rate was 5.5% in the Day group and 5.3% in the Night group. Mortality at 1 month, 1 year, and 2 years did not differ significantly between the two groups. However, mortality at 1 month postoperatively was 6.9% in the Day group and 9.1% in the Night group ($P = 0.27$).

Conclusions: There was no appreciable difference in outcomes when hip fracture patients were operated during after-hours versus daytime hours at our institution. While logistical and clinical support is often better at most institutions during daytime hours than it is after-hours, night-time hip surgery can be safe and need not be delayed in hip fracture patients who would otherwise benefit from prompt surgery.

See pages 75 - 103 for financial disclosure information.

Primary Determinants of Intraoperative Radiation Exposure during Proximal Femur Fracture Fixation

Michael Baratz, MD; Yue Yung Hu, MD; Aron T. Chacko, BS;
Paul T. Appleton, MD; ***Edward K. Rodriguez, MD, PhD****;*
Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA

Purpose: We undertook to evaluate intraoperative radiation use during surgical fixation of proximal femur fractures and to determine the primary determinants of total dose used. We hypothesized that body mass index (BMI), severity and location of the fracture, technique/implant used, patient positioning, time of day, and skill of the operative staff were independent determinants of intraoperative radiation use.

Methods: Total fluoroscopy time, peak kilovoltage (KVP), milliampere (mAmp), and cumulative dose (mrad-cm^2) were recorded prospectively for 84 patients with proximal femur fractures undergoing repair with either a cephalomedullary nail (63), a compression hip screw device (11), or percutaneous fixation with cannulated screws (10) by 2 trauma fellowship–trained surgeons at our institution. Fluoroscopy was performed by hospital-employed radiation technicians using a GE OEC C-arm. Patient records were then retrospectively reviewed to determine, for each case: fracture location and type (based on OTA classification), laterality, age, BMI, surgical position, presence of resident assistants and level of their training, implant used, time of surgery (day vs night), and treating surgeon. Univariate and multivariate analyses were performed using the Wilcoxon and analysis of variance tests and linear regression to determine which of these factors were significant determinants of total radiation exposure.

Procedure	Mean Radiation (mrad-cm^2 ± standard error)
Short cephalomedullary nail	918 ± 80
Long cephalomedullary nail w/freehand distal locking	1088 ± 176
Compression screw system	577 ± 240
Percutaneous fixation × 3 screws	416 ± 80
All surgeries	814 ± 71

Results: Mean radiation doses for each case type are tabulated above. After adjusting for other covariates, an increase of 47.9 ± 12.1 mrad-cm^2 was seen per each point increase in BMI across all cases (P = 0.0004). Intertrochanteric fractures repaired with a short cephalomedullary nail used 493.5 ± 195.1 more mrad-cm^2 than those repaired with a compression screw system (P = 0.01). Within the cephalomedullary nail group, surgeries done in the lateral position used 899.8 ± 202.4 mrad-cm^2 more than those done supine (P < 0.0001), and subtrochanteric fractures used 770.1 ± 225.1 mrad-cm^2 more than intertrochanteric and femoral neck fractures (P = 0.0012). Surgeries done after 6pm used an average of 871.4 ± 302.4 more mrad-cm^2 than surgeries done during normal daytime hours (P = 0.0056). One surgeon used an average of 529.5 ± 159.4 mrad-cm^2 more than the other (P = 0.0016). No significant differences were seen with regard to patient sex,

• 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 413.

age, severity of fracture (OTA type), laterality, or level of training of resident(s) assisting in the case.

Conclusion: The amount of intraoperative radiation exposure used in surgical fixation of proximal femur fractures is primarily determined by BMI, patient position, surgical technique used, timing of surgery, and individual surgeon performing the case. Surprisingly, OTA fracture type and the level of training of assisting residents do not seem to be significant determinants of total radiation used.

See pages 75 - 103 for financial disclosure information.

Financial Sustainability of Orthopaedic Traumatology: Effects of Patient Complexity on Payer Mix and Reimbursement Rates for Femoral Fractures

Nickolas J. Nahm, BS; Brendan M. Patterson, MD; ***Heather A. Vallier, MD****;*
MetroHealth Medical Center, Cleveland, Ohio, USA

Purpose: Regional trauma centers have been shown to provide superior services in treating injured people. Nevertheless, trauma centers struggle to remain economically viable. Nationally during the past 2 decades, over 60 trauma systems closed due to financial insolvency. Femur fractures represent an injury commonly treated at trauma centers. This study investigates the impact of patient complexity, defined by injury severity score (ISS) and trauma-related complications, on payer mix, charges, and collections associated with treatment of femoral fractures at a Level 1 trauma center. We hypothesized that patients with less injury severity would be underinsured, but that the entire service line would be profitable overall.

Methods: The medical and financial records of 421 adult patients presenting to a public, urban Level 1 trauma center between 2002 and 2006 with acute femoral fractures were reviewed. The hospital has an integrated economy where physicians are employed by the hospital. Charges and payments were determined for a period of 6 months after trauma and included all related inpatient and outpatient services. Facility and professional charges and collections were included. Payer groups included Medicare, Medicaid, commercial, managed care, workers' compensation, and self-pay.

Results: Mean payments (P) and charges (C) for patients with ISS <18 (n = 156) and ISS ≥18 (n = 265) were, per patient, $16,132 and $44,953 (P/C = 36%) and $54,469 and $121,050 (P/C = 43%), respectively. Compared with all patients seen in the entire hospital system, the payer mix in the study population had more commercial (27.8% vs 20.8%) and managed care (17.4% vs 7.5%) coverage and less Medicare and Medicaid. In addition, the largest payer group in the ISS ≥18 patients was commercial (28.3%). However, the ISS <18 group had more uninsured patients compared to the ISS ≥18 group (23.7% vs 12.5%, $P = 0.004$) and compared with the entire hospital (15.2%). Self-pay status was associated with a low reimbursement rate; collections primarily resulted from automobile insurance. However, patients with isolated femur fractures had mean revenue over expenses of $2500. Complications occurred in 13.3% of patients and were associated with greater mean charges: $184,880 versus $76,053 in patients with an uncomplicated course. However, reimbursement was higher in patients with complications during their course of care (P/C = 46%) versus no complications (P/C = 42%, $P < 0.001$).

Conclusions: The higher proportion of self-pay patients in the ISS <18 group suggests that less severely injured patients may have been sent to the trauma center for reasons of insurance status and not medical necessity. Despite these challenges to financial stability, treatment of patients with isolated femoral fractures was profitable. Streamlined processes of care within a high-volume trauma center and cost containment, including minimizing implant expenses, likely contributed to this finding. Favorable payer mix and greater reimbursement rates for complex patients with high ISSs may be an incentive for regional trauma centers to continue providing care for multiply injured patients. Complications increase both costs of

• 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 413.

care and percent reimbursement. Additional study of the relationship between charges and actual costs of care may further elucidate the impact of patient complexity on profitability and may enhance the capacity of physicians to negotiate for fair compensation.

See pages 75 - 103 for financial disclosure information.

Modifiable Postoperative Factors May Increase the Risk of Nonunion in Distal Femur Fractures Treated with Plate Fixation

Jonathan M. Gross, MD; *Fernando Serna, MD; Kyle Lybrand, BS; Xing Qiu, PhD; Catherine A. Humphrey, MD; John T. Gorczyca, MD;*
University of Rochester Medical Center, Rochester, New York, USA

Purpose: This review was undertaken to assess whether modifiable postoperative factors influence the need for second surgery to achieve union of distal femur fractures.

Methods: We retrospectively reviewed 145 skeletally mature patients with 148 supracondylar femur fractures (AO/OTA 32B1-3.3, 33A, and 33C) operatively treated at a Level 1 trauma hospital from January 1, 2001 through January 1, 2009. All charts were reviewed for a second surgery to achieve fracture union, age of the patient at the time of fracture, diabetes, smoking, nonsteroidal anti-inflammatory drug (NSAID) use, history of alcoholism, open versus closed fractures, multiple versus isolated fractures, and type of fixation (plate, nail, or external-fixator.) The second surgery was either autogenous bone grafting, revision of failed fixation, or both.

Results: Of the 149 fractures, 99 were treated with plate fixation, 45 with intramedullary rod fixation, and 5 with an external fixator. 27 (18%) of the fractures required a second surgery—22 (15%) in the plate group, 5 (3%) in the rod group, and none in the external fixator group. Analysis with a Fisher exact test demonstrated that only diabetes ($P = 0.009$) and use of plate fixation ($P = 0.019$) were independently associated with a second surgery. Subgroup analysis suggested that in the plate fixation group, open fracture (P = 0.0.034), diabetes ($P = 0.013$), and alcoholism ($P = 0.034$) were independently associated with a second surgery. Multivariate analysis of modifiable postoperative factors in this subgroup demonstrated some effect of smoking ($P = 0.035$) and NSAID use ($P = 0.027$.)

Conclusions: Modifiable postoperative factors have less overall effect on healing of distal femur fractures when compared to diabetes. When these fractures are stabilized with plate fixation, potentially modifiable factors such as alcoholism and, to a lesser extent, NSAID use and smoking have some association with need for further surgery to attain union. These patients might benefit from such knowledge when offered strategies to address smoking and alcoholism and surgeons might consider restricting NSAID use in 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 413.

Help versus Harm? The Effect of Training Femoral Neck Screw Insertion Skills to Surgical Trainees with Computer-Assisted Surgery: Comparison to Conventional Fluoroscopic Technique

Markku T. Nousiainen, MS, MEd, MD, FRCS(C)[1]; *Patrick Zingg, MD[1]; Daniel Omoto, MD[1]; Heather Carnahan, PhD[2]; Yoram A. Weil, MD[3]; Hans J. Kreder, MPH, MD[1]; David L. Helfet, MD[4];*
[1]Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada;
[2]University of Toronto, Toronto, Ontario, Canada;
[3]Hadassah University Hospital, Jerusalem, Israel
[4]Hospital for Special Surgery, New York, New York, USA

Purpose: This study attempted to determine if the form of feedback provided by computer-based navigation improves the learning of the placement of screws across a femoral neck fracture in the surgical trainee.

Methods: A prospective, randomized, appropriately powered, and controlled study involving 39 surgical trainees (first-year residents and fourth-year medical students) with no prior experience in surgically managing femoral neck fractures were used in the study. After a training session, participants underwent a pretest by performing the surgical task on a simulated hip fracture using fluoroscopic guidance. Immediately after, 20 participants were randomized into undergoing a training session using conventional fluoroscopy while the other participants were randomized into undergoing a training session using computer-based navigation. Immediate posttests and retention tests (4 weeks later) were performed. A transfer test was used after the retention test to assess the effect the type of training had on surgical performance; after performing the retention test, each group repeated the task but used the other technique to guide them (ie, those trained with fluoroscopy used computer navigation and vice versa).

Results: Screw placement was equal to the level of an expert surgeon with either training technique during the post-, retention, and transfer tests. Participants who trained with computer navigation took fewer attempts to position hardware and used less fluoroscopy time than those trained with fluoroscopy. When participants who trained with computer navigation reverted to conventional fluoroscopic technique at the transfer test, more fluoroscopy time and dosage were used. When participants who trained with fluoroscopy reverted to computer navigation at the transfer test, less fluoroscopy time and dosage were used.

Conclusion: Computer navigation does not harm the learning of surgical novices in this basic orthopaedic surgical skill. Training with computer navigation minimizes radiation exposure and decreases the number of attempts to perform the task. No compromise in learning occurs if a surgical novice trains with one type of technology and transfers to using the other.

See pages 75 - 103 for financial disclosure information.

The Value of Washers in Internal Fixation of Femoral Neck Fractures with Cancellous Screws: A Biomechanical Evaluation

Michael Zlowodzki, MD[1]; *Coen A. Wijdicks, MSc*[1]; *Bryan M. Armitage, MD*[2]; *Peter A. Cole, MD*[1];
[1]*University of Minnesota, Minneapolis, Minnesota, USA;*
[2]*University of Hawaii, Honolulu, Hawaii, USA*

Background/Purpose: Femoral neck fractures are a large clinical and economical problem with an estimated incidence of 150,000 per year in the US and a fixation failure rate of up to 40%. One of the most common fixation options for femoral neck fractures are multiple cancellous screws. A previous clinical study has shown the lack of washers to be the single largest predictor of fixation failure in the treatment of femoral neck fractures with cancellous screws (odds ratio, 11.2). This finding was somewhat surprising as washers do not prevent the screws from backing out and do not provide any increase resistance to varus collapse. Therefore, a follow-up biomechanical study was designed to test this observation. The purpose was to evaluate the maximal insertional torque of screws in osteoporotic bone with and without washers. We hypothesized that the lateral cortex of an osteoporotic proximal femur does not provide sufficient counter resistance for the screw heads to obtain maximum torque upon screw insertion in the femoral head and that the use of washers would increase screw purchase by providing a larger rigid surface area and subsequent higher counter resistance, thereby allowing a higher maximal screw insertion torque.

Methods: We used eight matched pairs of osteoporotic fresh-frozen human cadaveric femurs (age >70 years, all female). Two screws were inserted in each femur either with or without a washer and maximal insertional torque was measured using a 50-Nm torque transducer. The testing was performed using a customized device that allowed the torque transducer to apply a constant axial force and torque speed to the screws. A paired Student *t* test was used to compare the maximal screw insertional torque of screws with washers versus screws without washers in matched pairs.

Results: 15 out of 16 times, the maximal screw insertional torque was higher when a washer was used. The average maximal torque with a washer was 5.1 Nm compared to 3.1 Nm without a washer ($P < 0.001$).

Conclusion: We conclude that the addition of washers increases the maximal insertion torque of cancellous screws in the treatment of osteoporotic femoral neck fractures by providing counter resistance to the screw heads at an otherwise weak lateral cortex. We have demonstrated that the washer prevents the screw heads from penetrating the lateral cortex and provides for an improved purchase of the screws in the femoral head. As a clinical reference value for interpretation of this data, the limit of torque-limiting screwdrivers used with locking plates is set between 4 and 6 Nm. Therefore, the difference in insertion torques likely represents clinically relevant values. Since there is no apparent disadvantage in the use of washers and they are inexpensive and readily available, we advocate for their routine use until larger clinical studies disprove their efficacy.

- 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 413.

Role of Blocking Screws in the Management of Aseptic Femoral Shaft Hypertrophic Nonunion: A Primary Report of 15 Cases

(FDA=Non-U.S. research conducted within guidelines of my country)

Qiugen Wang, MD; ***Jian Lin, MD****; Qiulin Zhang, MD; Xiaopeng Hu, MD; Peng Li, MD;*
The First People's Hospital Affiliated to Shanghai Jiaotong University, Shanghai, China

Objective: This study was conducted to evaluate the efficacy and safety of the simple addition of blocking screws, a novel protocol for aseptic femoral shaft hypertrophic nonunions.

Methods: 15 patients (mean age, 45.9 ± 11.0 years) with femoral shaft nonunion were admitted to this study. They all met the inclusion criteria: radiographically typical hypertrophic nonunion, no signs of bone infection and no segmental bone loss, and the current nail was acceptable in length with no breakage. They failed to achieve healing by 22.4 months (range, 11-36 months) after primary nailing, and had undergone 2.3 previous surgeries (range, 1-4) before admission. Instead of exchanging nailing, all the patients had simple addition of blocking screws as the intervention. Main outcomes measurements included clinical and radiographic evidence of bone union, alignment, ambulation, and local pain.

Results: 12 nonunions (80%) healed 7 months (range, 5-9 months) after surgery without any further intervention. Only 3 cases (20%) failed, showing no obvious progress in healing within 6 months. They underwent exchanging nailing as further treatment, which finally succeeded. At the last follow-up (average, 32 months; range, 24-45 months), all patients were fully weight bearing without the use of assistive devices, and had improved their functional ambulatory status. There was no wound infection nor significant deformity. Average pain, as rated on visual analog scale, decreased from 8 of 10 before treatment to 1 of 10 after treatment.

Conclusions: According to the included cases, we can see that the addition of blocking screws may be simple and economic, yet safe and effective for certain patients. Even if this intervention fails, it yields no harm to subsequent management. However, further study is still needed to detect its definite indications.

See pages 75 - 103 for financial disclosure information.

Does a Trochanteric Lag Screw Improve Fixation of Vertically Oriented Femoral Neck Fractures?

Michael A. Hawks, MD[1]; *Hyunchul Kim, MS*[2]; *Joseph E. Strauss, DO*[1];
Bryant W. Oliphant, MD[1]; *Robert D. Golden, MD*[1]; *Adam H. Hsieh, PhD*[2];
Jason W. Nascone, 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]*Orthopaedic Mechanobiology Laboratory, Fischell Department of Bioengineering,*
University of Maryland, College Park, Maryland, USA

Purpose: A recent multicenter clinical study reported favorable outcomes of Pauwels III femoral neck fractures treated with a screw construct that utilized a lag screw perpendicular to the fracture line (trochanteric screw construct [TSC]). The purpose of this study was to compare the biomechanical performance of the TSC to the traditional inverted triangle (IT) screw construct in the treatment of simulated Pauwels III femoral neck fractures.

Methods: We tested two fixation constructs: three 7.3-mm cannulated screws placed in a traditional IT configuration, and two 7.3-mm cannulated screws across the superior portion of femoral neck supplemented by one fully-threaded 4.5-mm lag screw perpendicular to the fracture in superolateral to inferomedial orientation (TSC). Our fracture model was a vertically oriented femoral neck fracture. The two groups were tested in 9 matched pairs of nonosteoporotic human cadaveric femora. We used a previously described testing protocol that incrementally loaded the constructs along the mechanical axis of the femur to 1400 N. Those that survived incremental loading underwent cyclic loading at 1400 N at a frequency of 3 Hz. Stiffness, force at 3 mm of displacement, and survival of incremental loading protocol were recorded.

Results: The TSC group had a 70% increase in stiffness (261±29 N/mm vs 153±16 N/mm; $P = 0.026$) and a 43% increase in the force at 3 mm of displacement (620 N vs 435 N; $P = 0.018$) compared to the IT group. One TSC specimen survived incremental loading; none of the IT specimens survived.

Conclusion: This study suggests that using a trochanteric lag screw in vertically oriented femoral neck fractures provides a relatively large improvement in mechanical performance compared to the classic "inverted triangle" construct.

- 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 413.

Does the Location of a Ballistic Femur Fracture Predict the Presence of Arterial Injury?

Leah Gitajn, BS*; Paul Perdue, BS; John Hardcastle, MD; Robert V. O'Toole, MD;*
R Adams Cowley Shock Trauma Center, Department of Orthopaedics,
University of Maryland Medical School, Baltimore, Maryland, USA

Purpose: Arterial injury after ballistic femur facture is not always evident on physical examination. The purpose of the present study was to evaluate whether location of femur fracture helps predict arterial injury. We hypothesized that fracture in the distal portion of the femur is likely to be a marker for arterial injury.

Methods: The records of 96 consecutive patients with femur fractures from civilian gunshots were identified at a Level 1 urban trauma center from 2002 through 2007. All electronic medical records were reviewed to determine the presence or absence of arterial injury. All fracture lines were measured using computerized viewing software and recorded using a standard technique that measured the proximal, distal, and average location of the fracture as a function of the bone's overall length. Outcome measure consisted of presence or absence of arterial injury. Analyses were performed using Student *t* tests and the Fisher exact test.

Results: Location of any fracture line in the distal third of the femur was associated with increased risk of arterial injury ($P < 0.05$). The odds ratio for the presence of arterial injury when the proximal fracture line was in the distal third of the femur was 5.21 (95% confidence interval [CI], 1.49-18.19; $P < 0.05$) and was 5.9 (95% CI, 1.23-28.25; $P < 0.05$) when the distal fracture line was in the distal third of the femur.

Conclusions: Clinicians should be alerted that any fracture line located in the distal third of the femur after ballistic injury was associated with more than fivefold greater odds of having arterial injury, and likely warrants particularly careful evaluation regarding vascular injury. Rapid recognition of arterial injury is important to prevent limb ischemia and potential loss of limb, and our data demonstrate that the location of the fracture may be an important factor to help alert clinicians to a possible arterial injury after ballistic femur fracture.

See pages 75 - 103 for financial disclosure information.

Testing Tourniquet Application, Efficacy, and Failure

Claire F. Beimesch, MD*; Michelle Bramer, MD; David Hubbard, MD;*
West Virginia University Department of Orthopaedic Surgery, Morgantown, West Virginia, USA

Introduction: Tourniquets are used in combat as a first-line medic treatment, but their failure rate is around 30%. The CAT (combat application tourniquet) is the definitive tourniquet purchased by the military; the TK tourniquet has a similar ease of use and is one-tenth the cost. With TK improvement and continued conflicts, we felt a secondary tourniquet was a reasonable means of reducing combat mortality rates. Our hypothesis was that the CAT, TK4, and TK4L would have similar application profiles and failure rates, and that the secondary tourniquet model would lower these failure rates.

Methods: We recruited subjects between the ages of 18 and 35 years of age, who each received instruction in tourniquet design and application, analogous to the training received by army recruits. Tourniquets included the CAT, TK4, and TK4L. Tourniquets were each applied, and the popliteal pulse was located with vascular ultrasound. Each pulse was examined to confirm that occlusion was maintained after securing the tourniquet. Subjects were timed in three stages: initial application time (IAT), time to occlusion (TTO), and time to secure (TTS). Total application time (TAT) was calculated. For the two-tourniquet model, the first tourniquet (CAT) was applied normally and secured in place, then loosened until flow returned. The second tourniquet (TK4 or TK4L) was then applied proximal to the CAT until flow was again occluded. After each tourniquet application, the visual analog scale (VAS) was utilized.

Results: 48 subjects were included in final calculations. Subjects were 68% male and 32% female, with an average body mass index of 24. Compared to the TK4 and TK4L, the CAT tourniquet had a longer IAT (28.2 vs 16.2 and 12.2 seconds) and a shorter TTO (12.2 vs 22.4 and 21.6 seconds) and TTS (3.7 vs 11.5 and 10.4 seconds). The TAT and VAS scores between all tourniquets did not show any significant differences. With two tourniquet applications, there was a trend toward fewer failures with the CAT tourniquet with each successive application. The CAT had significantly faster TATs the second and third time used compared to the first time. The TK4 failed significantly fewer times between the first and second application. The TAT was significantly different between the first and second times. For two applications of the TK4L, failure rates trended down between the first and second applications. All times trended faster the second time. For tourniquet combinations, the TAT, VAS, and failure rates did not differ for all tourniquets.

Conclusions: The failure rate of all tourniquets applied was 27%. All tourniquets had similar pain scores and application times. With subsequent applications, subjects became more proficient at applying the tourniquets and had fewer failures. Our data show that increased cost may not mean lower failure rates or decreased application times.

- 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 413.

Effects of Computerized Physician Order Entry (CPOE) on Postoperative Antibiotic Administration Errors in Patients with Open and Closed Fractures

Michael J. Beltran, MD[1]; ***Cory A. Collinge, MD***[2];
[1]*US Army Institute of Surgical Research, San Antonio, Texas, USA;*
[2]*Harris Methodist Fort Worth Hospital, Fort Worth, Texas, USA*

Purpose: Our objective was to determine if implementation of computerized physician order entry (CPOE) affects postoperative antibiotic administration in orthopaedic trauma patients when compared to standard paper-based charting.

Methods: We retrospectively evaluated electronic medical records of patients with open fractures that were managed during the 1-year period prior to and 1 year after implementation of CPOE at our regional trauma center. We had previously used preprinted order sheets. A comparable cohort of consecutive closed fractures was also evaluated before and after CPOE initiation. All patients were managed by a single orthopaedic trauma surgeon. Demographics and injury characteristics were collected. Orders for pre- and postoperative antibiotic orders were assessed, along with documentation as to whether they were appropriately administered. Our protocol is for 24 hours of prophylactic antibiotic coverage after fixation of closed fractures and a minimum of 48 hours after fixation of open fractures or ongoing in patients with acute open wounds. We defined an antibiotic administration error as any missed dose of antibiotics during the period requested by the surgeon, or failure by the surgical team to initiate postoperative antibiotic orders.

Results: In the year prior to CPOE implementation, 74 acute open fracture surgeries were performed on 47 patients and 7 medication errors occurred (9.5%). Since CPOE, there were 50 operative procedures in 26 patients with open fractures and 3 errors occurred (6%) (P = 0.38). During the same period, 7 medication errors occurred in a cohort of 60 patients with closed fractures (11.7%). After CPOE, there were 5 errors in 60 closed fractures managed operatively (8.3%) (P = 0.40). All deviations in antibiotic dosing involved the failed administration of a single antibiotic dose and no patients went completely without antibiotics after surgery.

Conclusion: Implementation of CPOE does not significantly alter the number or severity of postoperative antibiotic administration errors compared to standard preprinted paper order sheets in orthopaedic trauma patients.

See pages 75 - 103 for financial disclosure information.

Δ Prevalence of Abuse and Intimate Partner Violence Surgical Evaluation (PRAISE): A Cross-Sectional Study at Two Fracture Clinics in Ontario

(FDA=Non-U.S. research conducted within guidelines of my country)

Mohit Bhandari,[1] MD, for the PRAISE Investigators; ***Emil H. Schemitsch, MD****;*
[1]McMaster University, Hamilton, Ontario, Canada

Purpose: Intimate partner violence (IPV), also known as domestic violence, is a pattern of coercive behaviors that includes repeated physical, sexual, and emotional abuse. Musculoskeletal injuries are common manifestations of IPV. We aimed to determine the proportion of women presenting to orthopaedic fracture clinics for treatment of orthopaedic injuries that have experienced IPV defined as physical, sexual, or emotional abuse within the past 12 months.

Methods: We completed a cross-sectional study of 282 injured women attending two Level 1 trauma centers in Canada. Female patients presenting to the orthopaedic fracture clinics completed two validated self-reported written questionnaires (Woman Abuse Screening Tool [WAST] and the Partner Violence Screen [PVS]) to determine the prevalence of IPV. The questionnaire also contained questions that pertain to the participant's demographic, fracture characteristics, and experiences with health care utilization.

Results: The overall prevalence of IPV (emotional, physical, and sexual abuse) within the last 12 months was 32% (95% confidence interval, 26.4%-37.2%) (89 of 282 women). One in 12 injured women disclosed a history of physical abuse (24 of 282 [8.5%]) in the past year. Seven women (2.5%) indicated the cause for their current visit was directly related to physical abuse, of whom five had fractures. We did not identify any significant trends in ethnicity, socioeconomic status, or injury patterns as markers of domestic abuse. Of 24 women with physical injuries, only 4 had been asked about IPV by a physician, none of whom were their treating orthopaedic surgeons.

Conclusion: Our study confirms a high prevalence of IPV among female patients with injuries attending orthopaedic surgical clinics in Ontario. Similar to previous research, our study found that women of all ages, ethnicities, social economic status, and injury patterns may experience IPV. Surgeons should consider screening all injured women for domestic violence in their clinics.

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 413.

Are Certain Fractures at Increased Risk for Compartment Syndrome after Civilian Ballistic Injury?

Thomas Meskey, BS; *John Hardcastle, MD; Robert V. O'Toole, MD;*
R Adams Cowley Shock Trauma Center, Department of Orthopaedics,
University of Maryland Medical School, Baltimore, Maryland, USA

Purpose: Compartment syndrome after ballistic fracture is uncommon but potentially devastating. Few data are available to help guide clinicians regarding risk factors for developing compartment syndrome after ballistic fractures. Our primary hypothesis was that ballistic fractures of certain bones would be at higher risk for development of compartment syndrome.

Methods: A retrospective review at an urban Level 1 trauma center from 2001 through 2007 yielded 650 patients with 938 fractures secondary to civilian gunshot wound. We reviewed all operative notes, clinic notes, discharge summaries, and data from our prospective trauma database. Compartment syndrome was defined as occurring if an attending orthopaedic surgeon diagnosed compartment syndrome and performed fasciotomy. We excluded all prophylactic fasciotomies. Radiographic analysis was performed for any fractures identified with increased risk to determine if certain locations carried elevated rates. Analyses were conducted to identify risk factors associated with development of compartment syndrome using the Fisher exact test for categorical data and Student *t* tests for continuous variables.

Results: 26 (2.8%) of 938 fractures were associated with compartment syndrome. Only fibular (11.6%) and tibial (11.4%) fractures had an incidence significantly higher than baseline for all ballistic fractures ($P < 0.001$). These associations held true even when combined tibia-fibula fractures were excluded ($P < 0.005$). Fractures of the proximal third of the fibula were more likely to result in compartment syndrome than fractures of middle or distal third ($P = 0.03$), as were fractures of the proximal third of the tibia ($P = 0.01$). No other demographic or injury parameters were associated with compartment syndrome.

Conclusion: Civilian ballistic fractures of the fibula and tibia are at increased risk for development of compartment syndrome that is roughly four times higher than the risk for ballistic fractures to other bones. We recommend increased vigilance when treating these injuries, particularly if the fracture is in the proximal aspect of the tibia or fibula.

See pages 75 - 103 for financial disclosure information.

A Predictive Model for Surgical-Site Infection Risk after Surgery for High-Energy Lower Extremity Fractures

***Ebrahim Paryavi, MD*[1]**; *Alec Stall, MD, MPH*[1]; *Rishi Gupta, MD*[1]; *Mary Zadnik Newell, OT*[1]; *Emily Hui, MPH*[1]; *Renan C. Castillo, PhD*[2]; *Daniel O. Scharfstein, ScD*[2]; *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]*Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA*

Purpose: There are no currently used scoring systems to predict the likelihood of surgical-site infection after orthopaedic fracture surgery. Our first hypothesis is that perioperative infection risk assessment scores from general surgery will not be predictive of infection after orthopaedic fracture surgery. Our second hypothesis is that risk factors for infection can be identified that can be used to create a new scoring system for orthopaedic fracture surgery.

Methods: This study is a secondary analysis of a prospective randomized treatment trial of staged open reduction and internal fixation of high-energy tibial plateau, pilon, and calcaneal fractures treated between 2007 and 2009 at a Level 1 trauma center. The study group had 137 patients with complete demographic and perioperative data including 2 scores from general surgery that are used to predict risk of surgical-site infection (NNISS [National Nosocomial Infections Surveillance System] and SENIC [Study on the Efficacy of Nosocomial Infection Control]), comorbidities, fracture classification (AO and Sanders), total tourniquet and operative time. The primary outcome variable was surgical-site infection as defined by Centers for Disease Control criteria and assessed prospectively by blinded research personnel. Bivariate and multiple logistic regression analyses of the database were performed to determine whether the NNISS and SENIC scores have any predictive value for infection and to identify factors that correlate with infection. The injury and treatment characteristics were used to identify risk factors for surgical-site infection.

Results: We found that there is little correlation between the surgical infection scores used in general surgery (NNISS, SENIC, or a combination score) and infection rate (odds ratios ranged between 1.2 and 1.6, with $P > 0.3$ for all). The relative odds of infection among patients with AO C3 or Sanders 4 fractures compared to injuries with lower fracture classifications was 7.2 (95% confidence interval [CI]: 2.0-26.6, $P = 0.003$). Increased operative time was also a risk factor, with an increased odds of infection of 17% per 30 minutes of additional operative time (95% CI: 1%-38%, $P = 0.05$). A score assigning two points for C3 or Sanders 4 and 1 point for surgical time >200 minutes predicted 2.3 times increased odds of infection per point in the score (95% CI: 1.4-3.8, $P = 0.001$).

Conclusion: The NNISS and SENIC scores were not useful in assessing risk of infection after operative treatment of calcaneus, plateau, and pilon fractures. We propose a new score that incorporates fracture classification and operative time as risk factors for infection. Further studies are needed to validate this scoring system.

- 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 413.

Modern Perspective on the Epidemiology and Patterns of Musculoskeletal Motorcycle Injuries

Sean Burns, MD; *Zbigniew Gugala, MD, PhD; Carlos Jimenez, MD; William Mileski, MD; Ronald W. Lindsey, MD;*
University of Texas Medical Branch, Galveston, Texas, USA

Background: Motorcycles have become an increasingly popular mode of transportation despite their association with a greater risk for injury compared with automobiles. Whereas the recent incidence of annual passenger vehicle fatalities in the United States has progressively declined, motorcycle fatalities have steadily increased for the last 11 years. Although motorcycle injuries (MIs) have been reported in the past, there has not been a published report on MIs in the United States during this 11-year period.

Purpose: This study was undertaken to provide a current epidemiological analysis of MIs in the United States and establish the most prevalent musculoskeletal and nonmusculoskeletal MI patterns.

Methods: The study data were derived from a prospectively collected injury database at a single Level 1 trauma center. The data sampling involved MI patients who were evaluated for the 10-year period ending August 31, 2008. This retrospective analysis included patient demographic and medical data, helmet use, Glasgow coma scale (GCS), injury severity score (ISS), length of hospital stay (LOS), specific injury diagnosis, and mortality. The patient and MI data were tabulated, statistically analyzed, and compared (Spearman correlation, Kruskal-Wallis tests, logistic regression).

Results: The study identified 1252 patients (5:1 male-female ratio; mean age, 36.0 [range, 4-83] years; 8:1:1 White-Black-Hispanic ethnic ratio) that were evaluated. Only 40.7% of patients wore helmets. At presentation, the average GCS was 13.9 ($\geq$13 = 1127; 9-12 = 13; $\leq$8 = 104), and the average ISS was 9.4 (median 5; range, 0-75). The patient mortality rate (at arrival and postadmission) was 4.4% (56 patients), and the average LOS was 4.4 days (median, 1; range, 0-121). The incidence of some common musculoskeletal MIs, such as tibia/fibula, spine, and forearm fractures (19.01%, 16.21%, and 10.14%, respectively) was consistent with previous reports; whereas the incidence of spine, skull, and face injuries (16.9%, 13.7%, and 8.9%, respectively) was much higher. Among the prevalent nonorthopedic MIs were concussion (21.09%), skull fractures (8.23%), face fractures (13.66%), and hemo- and pneumothorax (8.79%). Older age correlated with a higher ISS (r = 0.21, P < 0.0001) and a longer LOS (r = 0.22, P < 0.0001). Older patients were also less likely to wear a helmet (odds ratio [OR] = 0.99; 95% confidence interval [CI], 0.98-0.997), and were associated with a significantly higher risk of mortality (after adjusting for helmet use, OR = 1.03; 95% CI, 1.00-1.05). All patients without helmets had significantly lower GCS (P = 0.0001) and higher mortality (after adjusting for patient demographics, OR = 2.28; 95% CI, 1.13-4.58). They were also more likely to have a fracture of the skull (P < 0.001) and face (P < 0.001).

Conclusion: Compared with historical reports, the prevalence and pattern of musculoskeletal MIs continues to increase and/or change; however, this is not associated with an

See pages 75 - 103 for financial disclosure information.

increased inhospital mortality. The higher incidence of skull, spine, and face injuries in the study may be attributed to better injury detection (routine CT, MRI). Older MI patients are associated with higher risk for serious injury and mortality; this is further potentiated by not wearing a helmet.

- 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 413.

Propensity for Hip Dislocation in Gait Loading versus Sit-to-Stand Maneuvers: Implications for Redefining the Functional Weight-Bearing Dome of the Acetabulum during Activities of Daily Living

Amir Matityahu, MD; *Erik McDonald; Jennifer M. Buckley, PhD; Meir Marmor, MD;*
University of California, San Francisco, San Francisco General Hospital,
Orthopaedic Trauma Institute, San Francisco, California, USA

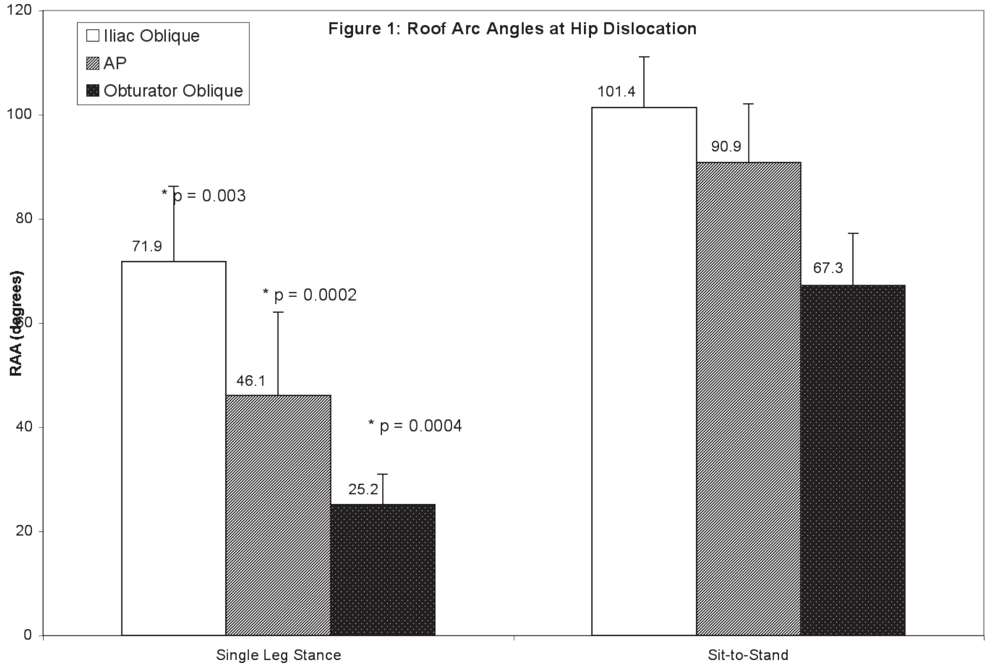
Purpose: This biomechanical study examined the current clinical guidelines for surgical intervention and fixation of transverse acetabular fractures. Studies have previously been limited to reflect acetabular biomechanical loading patterns during gait or standing. However, it is known that 40% of the day is spent in a sitting position and the force vectors projected from the femoral head to the acetabulum when moving from sitting to standing (STS) are markedly different than during standing, single-leg stance (SLS), or walking activities. Therefore, the purpose of this study was to investigate whether the hip joint is more unstable when tested during the sit-to-stand cycle as compared to SLS in the transverse fracture acetabular model.

Methods: Seven side-randomized fresh-frozen cadaveric hemipelvic specimens with proximal femurs were dissected of all soft tissues except for the acetabular labrum. A transverse acetabular osteotomy was created at the inferior-most aspect of the acetabulum. Sequential osteotomies were then performed in 5-mm increments proximally. The roof arc angle (RAA), distance from the roof to the transverse osteotomy (RTO), and reduction of articular surface area (RAS) were measured. A 1200-N load was then applied to the acetabulum simulating the STS cycle (15° abduction, 90° flexion) and SLS (15 ° abduction, 0° flexion). The above measurements were recorded when the femoral head dislocated from the hip joint.

Results: The average RTO where the hip joint became unstable was 11.5 ± 3.9mm in the SLS and 28.9 ± 3.4mm in the STS positions ($P < 0.001$). The average RAA when hip instability occurred in the SLS position was 71.9° in the iliac oblique, 46.1° in the AP, and 25.2° in the obturator oblique radiograph. The average RAA needed to dislocate in the STS position was 101.4° in iliac oblique, 90.9° in AP, and 67.3° in obturator oblique radiographic views (Fig. 1). There was a significant difference in the RAA between the SLS and STS in all radiographs ($P < 0.003$). The RAS needed to dislocate the hip was significantly less ($P = 0.003$) for the STS group (10.9%) than the SLS group (36.4%).

Conclusions: This study illustrates that there is a higher likelihood of hip instability with sit-to-stand maneuvers than SLS in simulated transverse acetabular fractures. The functional acetabular weight-bearing dome needed for stability of the hip during activities of daily living is larger then previously suspected.

See pages 75 - 103 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 413.

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*; Michael Khazzam, MD; Gregory J. Della Rocca, MD, PhD, FACS; Yvonne M. Murtha, MD; James P. Stannard, MD;*
University of Missouri, Columbia, Missouri, USA

Purpose: This trail was conducted to determine the effectiveness of using negative-pressure wound therapy (NPWT) over primarily closed surgical incisions used for 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 and initial power analysis, 63 patients who underwent a surgical exposure for hip, pelvis, or acetabular fracture surgery 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. 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 vacuum-assisted closure use, superficial and deep infection, skin maceration / wound breakdown, and drainage.

Results: 30 patients were randomized to the NPWT group and 33 patients to the standard dressing group. Rate of deep infection in the NPWT group was 1 of 30 (3%) and occurred in a patient with a BMI of 37.5 who underwent operative fixation of a T-type acetabular fracture utilizing a Kocher-Langenbeck approach and had an associated Morel-Lavallée injury. One NPWT patient (3%) had cellulitis associated with a Kocher-Langenbeck approach used for a posterior wall acetabular fracture and had a BMI of 54.8. Three NPWT patients (10%) had superficial wound infections that resolved with local wound care and oral antibiotics. These wounds included two Kocher-Langenbeck approaches for acetabular fractures and one posterior sacral approach for revision sacroiliac joint open reduction and internal fixation. The BMI of each patient was 38.6, 44, and 54.8. Two patients (6.1%) in the standard gauze group had deep infections requiring operative débridement—*Staphylococcus aureus* and *Pseudomonas*. Both patients had Kocher-Langenbeck approaches for acetabular fractures and had BMIs of 21.55 and 27.6. One patient had an associated Morel-Lavallée injury.

Conclusions: Although no significant differences were found between the two groups, trends noted include patients with infections in the NPWT group had higher BMIs and fewer deep infections. The standard gauze group typically had lower BMIs but had deep infections. Use of NPWT over primarily closed incisions in high-energy lower extremity injuries has been shown to decrease the days of postoperative drainage and potentially lower infection rates. Acetabular fracture care in morbidly obese patients has also been shown to have significantly higher risk of postoperative complications including infections. Therefore, patients, especially if obese, with high-energy hip and pelvic injuries, large surgical exposures, and postoperative anticoagulation therapy may benefit from the use of NPWT over primarily closed incisions by potentially decreasing the incidence of deep infection.

See pages 75 - 103 for financial disclosure information.

Relationship of the Anterosuperior Aspect of the Sacroiliac Joint to S1 and Resultant Placement of Iliosacral Screws

Brian M. Tonne, MD; *John H. Wilber, MD;*
Metrohealth Medical Center, Cleveland, Ohio, USA

Purpose: Sacral anomalies complicate iliosacral screw placement. We hypothesized that the cephalad relationship of the first sacral segment to the pelvis is a primary determinant of choice of level for iliosacral screw placement.

Methods: Patients were identified from a prospectively collected orthopaedic trauma database at a major Level 1 trauma center. IRB approval was obtained. Injury, operative, and postoperative radiographic studies were reviewed for evidence of sacral dysmorphism. We graded the cephalad location of S1on the outlet view by defining the relationship of the anterosuperior extent of the sacroiliac (SI) joint to the body of S1. A grade 0 sacrum was defined as one in which a transverse line originating at the anterosuperior point of the SI joint transected the superior endplate of S1 or above. In grade 1, 2, and 3 sacra, this line transected the upper, middle, and lower thirds of the body of S1, respectively. Thus, higher grades signify a progressively more cephalad location of S1 in relation to the SI joint and ilium. The grade was evaluated for predicting avoidance of S1 for the placement of iliosacral screws.

Results: 236 patients with pelvic ring injuries were identified over a 17-month period from January 2007 through May 2008. 53 patients (22%) underwent posterior fixation of the pelvic ring. There were 44 OTA 61C and 9 OTA 61B injuries. All patients were treated by one of five orthopaedic traumatologists and received at least one iliosacral screw. Additional fixation was placed at the operating surgeon's discretion. Dysmorphic features were noted in 47% of patients. S1 was avoided with primary screw placement in S2 in only 4 patients. All 4 patients had grade 3 sacra. In the two additional patients with grade 3 sacra, S1 screws were placed. One was noted on a postoperative CT scan to have an in-out-in placement. The second was noted to be placed with a very high obliquity. The sensitivity and specificity of a grade 3 sacrum for avoiding S1 were 100% and 96%, respectively. Positive and negative predictive values (PPV and NPV) were 67% and 100%, respectively. In contrast, identification of dysmorphism was 100% sensitive and 57% specific, with PPV 16% and NPV 100% for avoiding S1. Mamillary processes were 100% sensitive and 59% specific, with PPV 17% and NPV 100%. Presence of five sacral foramen was 75% sensitive and 80% specific, with PPV 23% and NPV 98%.

Conclusion: A grading system was developed in which increasing grade is associated with progressively more cephalad location of dysmorphic sacra. It was more accurate than identification of other aspects of sacral dysmorphism in predicting iliosacral screw placement. In grades 0 through 2 sacra, screws can generally be placed into S1. In grade 3 sacra, when the anterosuperior aspect of the SI joint is at the level of the lower third of the body of S1, strong consideration should be given to avoidance of placement into S1 in favor of S2, as in our series S2 appears to provide a more reliable target.

- 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 413.

Evaluation of the Use of C-Arm–Based Flat-Panel Technology in 3D Navigation in Comparison to 2D Navigation and Conventional Technique in Transiliosacral Screw Placement

(FDA=Non-U.S. research conducted within guidelines of my country)

Daniel Behrendt, MD[1]; *Joerg Boehme, MD[1]; Maria Mütze, MD[1]; Martin Koestler[2]; Hanno Steinke, PhD[3]; Christoph Josten, PhD[3];*
[1]Department of Trauma, Reconstructive and Plastic Surgery, University of Leipzig, Leipzig, Germany;
[2]BrainLAB AG, Feldkirchen, Germany;
[3]Institut of Anatomy, University of Leipzig, Leipzig, Germany

Purpose: In recent years there has been an increase in use of computer-assisted surgery in transiliosacral screw placement. Until now there were no studies using the flat-panel technology. In this study we investigated the effects of 3-dimensional (3D) navigation and flat-panel technology in transiliosacral screw placement.

Methods: 99 cannulated screws were placed in 15 human semicadaver models and 9 plastic pelvis models in 3D-navigated, 2-dimensional (2D)-navigated, and conventional Matta technique. The aim of this study was to evaluate accuracy (amount of exactly placed screws, mean deviation of tip placement, and misplaced screws per group), intraoperative time, and intraoperative radiation dose (fluoroscopy time, area dose product, and images per screw).

Results: The accuracy of 3D-navigated procedures is significantly higher ($P < 0.05$) than in the conventional technique. The highest misplacement rate was noted in the second screw inserted in S1. There is a significantly lower radiation dose in the navigated procedures ($P < 0.0001$) for the operation team. The intraoperative radiation dose is increased significantly from conventional method to 2D-navigated to 3D-navigated procedures for the patient ($P < 0.01$). There is a significant higher time per screw necessary for navigated procedures ($P < 0.001$).

Conclusion: The usage of flat-panel technology seems promising in 3D navigation. Our data show a benefit from using navigated procedures in transiliosacral screw placement, and indicate an advantage of the S1-S2 screw placement. The higher precision and lower radiation exposure for the operation team show that 3D navigation is superior to 2D-navigated procedures. In low bone quality, only the usage of 3D navigation increases the accuracy. The higher accuracy of the 3D-navigated procedures renders a postoperative routine CT scan obsolete, thus lessening the total radiation exposition of the patient.

See pages 75 - 103 for financial disclosure information.

Randomized Clinical Trial Comparing Pressure Characteristics of Pelvic Circumferential Compression Devices

Simon P. Knops, MSc; *Esther M.M. van Lieshout, PhD; W. Richard Spanjersberg, MD; Peter Patka, MD, PhD; Inger B. Schipper, MD, PhD;*
Department of Surgery-Traumatology, Erasmus MC,
University Medical Center Rotterdam, Rotterdam, The Netherlands

Purpose: The exerted pressure on the skin through immobilization with a pelvic circumferential compression device (PCCD) forms a potential risk factor for iatrogenic tissue problems. Tissue damage is thought to occur when pressures higher than 9.3 kPa are sustained continuously for more than 2 to 3 hours. The purpose of this randomized clinical trial was to quantify this pressure at the region of the greater trochanters (GTs) and the sacrum.

Methods: In a cross-over study, three different PCCDs (Pelvic Binder, SAM-Sling, and T-POD) were applied successively onto 80 healthy participants in random order. Measurements with the volunteer in supine position were performed on a spine board and on a hospital bed. The pressure was measured using a pressure mapping system. Both univariate and multivariate (body mass index, waist size, age) analyses were performed.

Results: All three PCCDs displayed unique pressure distributions (Fig. 1). On a spine board, the pressure exceeded 9.3 kPa at the GTs. Pressure at the GTs was highest with the Pelvic Binder, and lowest with SAM-Sling (Fig. 2). The pressure on the skin exceeded 9.3 kPa at the sacrum and was highest with the Pelvic Binder. The pressure at the sacrum and the GTs was reduced significantly upon transfer to a hospital bed.

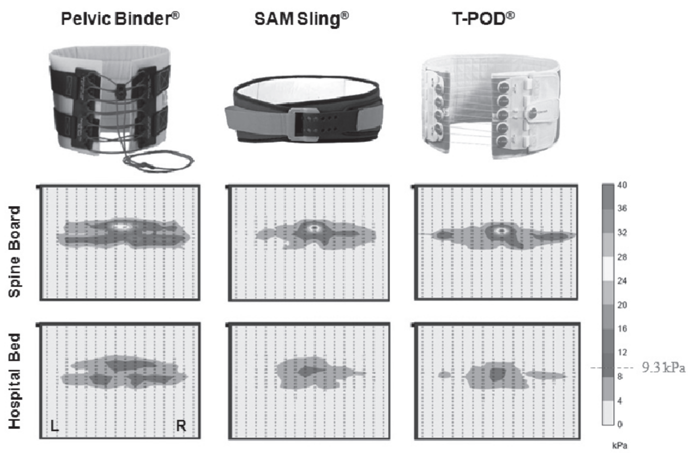


Fig. 1 *Visual representation pressure measurements.*

Conclusion: Patients with a pelvic fracture that is temporarily stabilized with a PCCD are at risk for developing pressure sores. The pressure on the skin exceeded the tissue-damaging threshold and is, besides PCCD type, influenced by body mass index, waist size, and age. Regardless of which PCCD trauma patients are stabilized with, early transfer from the spine board is of key importance to reduce the pressure to a level below the tissue-damaging threshold.

• 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 413.

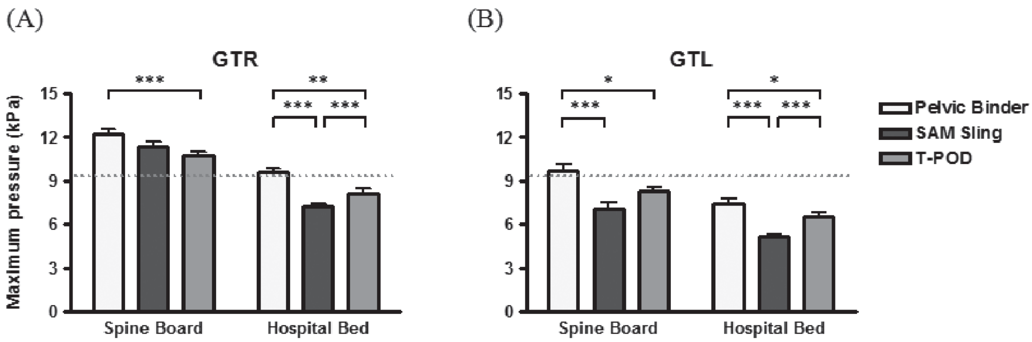


Fig. 2 *Exerted pressure (kPa) on the trochanters on a spine board and after a transfer to the hospital bed.*

See pages 75 - 103 for financial disclosure information.

Risk Factors Predisposing to Postoperative Infection after Pelvic/Acetabular Surgery

Daniel R. Dziadosz, MD*; Hassan R. Mir, MD; Cody Olson, DO;*
M. Principe; Henry Claude Sagi, MD;
Orthopaedic Trauma Service, Tampa General Hospital, Tampa, Florida, USA

Purpose: We sought to determine preoperative risk factors for postoperative infection following pelvic and acetabular surgery—more specifically, whether preoperative fever, leukocytosis, and ICU admission without a known source of untreated bacteremia are a contraindication to proceed with surgical reduction and stabilization of pelvic and acetabular fractures.

Methods: We used a Level 1 regional referral trauma center and database, 2 fellowship-trained orthopaedic trauma surgeons, and 597 skeletally mature patients who had operative fixation of their acetabular (353), pelvic (170), or both acetabular and pelvic (74) injuries between 2002 and 2007. A retrospective chart review was performed analyzing for the following variables: fever, serum and urine white blood cell count, ICU admission, previous infection, Morel-Lavallée lesions, pelvic arterial embolization, open fractures, cell saver, blood transfusions, subfascial drains, pre/postoperative antibiotic use, and obesity (body mass index >30). Open pelvic or acetabular fractures were excluded. Main outcome measure was diagnosis of postoperative wound infection (POWI). Patients with a diagnosis of POWI were then compared to a random 1:4 matched cohort of patients without a history of POWI. Statistical comparison of the two groups was performed using a Mann-Whitney test, Fisher exact tests, and odds ratio with 95% confidence intervals. Patients were grouped according to injury pattern, age, and surgical procedure.

Results: A total of 17 patients (2.8%) developed deep postoperative wound infections with 8 (2.3%) acetabular, 5 (2.9%) pelvic, and 4 (5.4%) pelvic/acetabular infections. A total of 97 patients met inclusion criteria for the matched comparison: 17 patients with POWI and 80 control patients without POWI. The median age of those patients with infection was 43 years (range, 31-69 years) and those without infection was 41 years (range, 24-71). Gender distribution was 77% and 74% male for the two groups, respectively. Statistical analysis revealed that none of the examined variables, with the exception of obesity (80% in POWI vs 34% in the uninfected, $P = 0.001$) were predictive of postoperative infection in pelvic and acetabular surgery. While the infection rate for dual approaches was double compared to acetabular or pelvic alone (5.4% vs 2.3% and 2.9%), this was not statistically significant ($P = 0.137$ and 0.46, respectively).

Conclusion: Based on the findings of this analysis, fever, elevated white count, ICU admission, Morel-Lavallée lesions, pelvic arterial embolization, open extremity fractures, cell saver, blood transfusions, subfascial drains, and pre/postoperative antibiotic use were not predictive of deep postoperative wound infection and should not be considered contraindications to surgery. However, patients with a body mass index >30 do have a significant increase in their risk of postoperative infection. Patients with both pelvic and acetabular fractures that require surgical treatment should be counseled that their risk for infection may be higher as well.

- 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 413.

Does Pain Correlate with Patient-Based Functional Outcome Scores after Pelvic and Acetabular Fractures?

Paul Tornetta, III, MD[1]; *Gillian L. Sembler Soles, MD*[1]; *Clifford B. Jones, MD*[2];
Debra L. Sietsema, PhD, RN;
[1]*Boston University Medical Center, Boston, Massachusetts, USA;*
[2]*Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA*

Background: The Short Musculoskeletal Function Assessment (SMFA) is a validated outcome instrument for a broad range of musculoskeletal disorders. It has been shown by others to be valid, reliable, and responsive with few floor or ceiling effects.

Purpose: The purpose of our study is to evaluate the correlation of a validated visual analog scale (VAS) for pain with the SMFA scores and subscores in patients treated operatively for pelvic and acetabular fractures.

Methods: A cohort of 24 patients with pelvic fractures and 25 patients with acetabular fractures treated operatively and followed for >6 months at a single institution comprise the study group. Standardized SMFA and VAS pain scores (10 points) were prospectively collected and retrospectively reviewed. We evaluated the correlation of the SMFA dysfunction and bother indices with the VAS for pain using the Pearson correlation matrix. In addition, the correlation of pain VAS with the subscales of the dysfunction index was determined.

Results: For pelvic fractures, the mean standardized dysfunction index score was 38.67 ± 17.25 and the mean bother index score was 31.97 ± 21.64. Mean pain score on VAS was 5.02 ± 3.23. Pain VAS had a significant correlation with the dysfunction index, daily function, emotional status, and arm and hand function ($P < 0.05$). No significant correlation was found between pain VAS and the bother index or mobility ($P = 0.06$ and 0.13, respectively). Pain VAS also did not demonstrate a significant correlation with SMFA question 46, "How much are you bothered by problems with stiffness and pain?" ($r = 0.298$, $P = 0.14$). For acetabular fractures, the mean dysfunction index score was 26.45 ± 19.51 and bother index was 27.30 ± 23.70, respectively. Mean pain score on VAS was 4.74 ± 3.05. Pain correlated with the dysfunction index, the bother index, and all subscores, including SMFA question 46 ($P < 0.05$).

Table 1: Correlation of SMFA With VAS, Pearson Correlation Coefficient (*r*).

	Dysfunction Index	Bother Index	Daily Function	Emotional Status	Arm and Hand	Mobility	SMFA Question 46
Pelvic fractures	*0.617	0.366	*0.615	*0.682	*0.582	0.302	0.298
Acetabular fractures	*0.757	*0.822	*0.668	*0.797	*0.426	*0.699	*0.848

*$P < 0.05$.

Conclusions: Our findings suggest that pain is an important factor in the explanation of the patient-based SMFA for patients with operatively treated pelvic or acetabulum fractures. We suggest that the use of a pain VAS or potentially a pain inventory is an important adjunct to other assessment tools and may be able to predict more complex outcome measures.

See pages 75 - 103 for financial disclosure information.

Predicting Blood Loss and Cell Saver Utility in Acetabular Fracture Surgery

Richard J. Jenkinson, MD*; Elliott Pally, MD; Andrew Urmson, MD; Robert Korley, MD; Hans J. Kreder, MD; David J.G. Stephen, MD;*
Sunnybrook Health Sciences Center, University of Toronto, Toronto, Ontario, Canada

Purpose: Our objective was to determine factors associated with increased blood loss and potential utility of red blood cell salvage and retransfusion with a cell saver device in acetabular fracture surgery.

Methods: 193 patients treated operatively for acetabular fracture fixation between 2000 and 2006 were identified at a single Level 1 trauma teaching hospital. Nine patients had missing blood loss data and were excluded. The medical records from the remaining 184 patients were reviewed and the subject of our analysis.

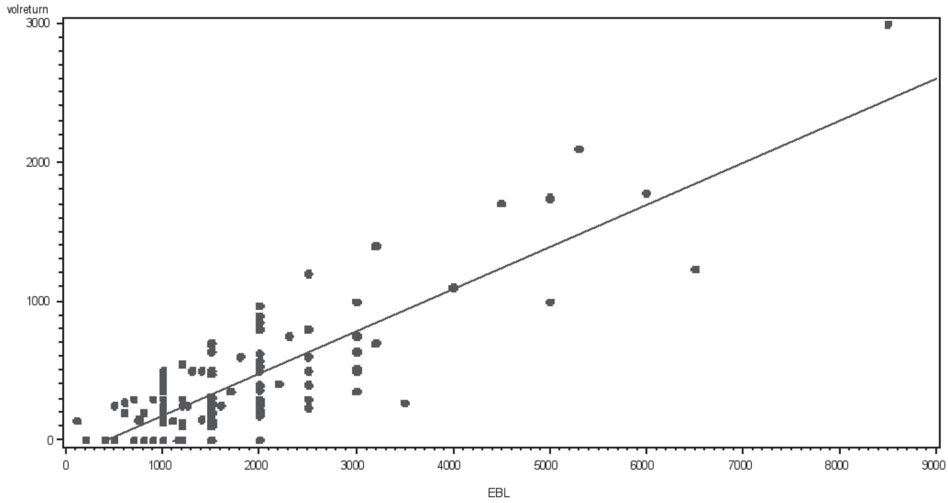
Results: Mean blood loss in our entire cohort was 1482 mL (range, 110-8500 mL; median value, 1175 mL). The cell saver was used at the discretion of the treating surgeons in 126 patients. The patients selected for cell saver use had a mean blood loss of 1769 mL compared to the non–cell saver patients of 856.9 mL ($P < 0.0001$). The cell saver patients had an average autologous blood return of 405 mL. Among the cell saver patients, we used linear modeling to explore the relationship between volume of blood returned and estimated blood loss. A linear model (Fig. 1) showed a highly significant correlation ($P < 0.0001$) and a strong relationship ($R^2 = 0.71$) between volume of blood loss and volume of reclaimed blood. From our linear model, we predict that the cell saver may begin to produce potential autologous product with greater than 438 mL of blood loss. Cell saver blood is relatively hemoconcentrated (hematocrit approximately 55); therefore we could predict potential reduction to allogenic blood if at least 200 mL of autologous blood is reclaimed. Based on our linear model, this value corresponds to 1100 mL of blood loss. Utilizing our cohort of 184 patients, a multivariable logistic regression model of blood loss of more or less than 1100 mL was used to explore potential factors that could predict utility of cell saver use. Age, sex, injury severity score, and surgical delay were not predictive of high blood loss. An anterior or extensile/combined surgical exposure was associated with increased likelihood of high blood loss (odds ratio 1.94; 95% confidence interval [CI], 1.05-3.66). When compared to an elementary fracture pattern, an associated fracture pattern was also associated with an increased blood loss (odds ratio 3.78; 95% CI, 1.54-7.44).

Conclusions: Patients who require an anterior or combined/extensile surgical exposure as well as patients with an associated fracture pattern have a greater chance of benefit from cell saver use compared to patients who require a single posterior approach and/or have an elementary fracture pattern

Future Directions: Further analysis to explore whether these patients receive less allogenic blood is ongoing. Prospective trials of cell saver use may wish to limit investigation to high-risk patients identified in this study.

• 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 413.

plot of volume of cellsaver blood returned vs EBL



See pages 75 - 103 for financial disclosure information.

Financial Impact of Operative Pelvic and Acetabular Trauma to a Level 1 Trauma Center

Jesse T. Torbert, MD, MS; Michael Mercincavage; ***Samir Mehta, MD****;*
University of Pennsylvania, Philadelphia, Pennsylvania, USA

Purpose: While orthopaedic trauma contributes to the academic mission of teaching institutions, its contribution to institutional revenue is often questioned. This study analyzes the economic impact of a pelvic and acetabular trauma surgeon to a Level 1 trauma center. Our hypothesis is that operative management of pelvic and acetabular fractures results in higher contribution margin when compared to all hospitalized orthopaedic surgical patients in our health system. In addition, we hypothesize that hospital charges and collections significantly outweigh surgical physician fee charges and collections.

Methods: A retrospective review of institutional finance reports and medical records for all patients requiring surgery for pelvic and acetabular trauma between August 31, 2007 and August 31, 2009 was performed. The first time point represented the addition of a pelvic and acetabular trauma surgeon, a service that did not exist previously. Before the addition of this surgeon, patients with surgical pelvic and acetabular injuries were transferred to other institutions. The primary outcome measure was contribution margin, which is net revenue minus variable costs. This measure of contribution is often used because it does not factor in the fixed costs of operating the hospital. The mean contribution margin for pelvic/acetabular surgical patients was compared to that of all hospitalized orthopaedic surgical patients in our health system. The hospital charges and collections were compared to surgical physician charges and collections. The orthopaedic trauma charge multiplier (the dollars of hospital charges created by a single dollar of orthopaedic surgical physician charges) and the orthopaedic trauma net revenue multiplier (the dollars of hospital collections created by a single dollar of orthopaedic surgical physician collections) were calculated.

Results: 65 patients were surgically treated for pelvic or acetabular trauma during the study. The average contribution margin for surgical pelvic/acetabular patients was $18,188 per patient. The average contribution margin for all hospitalized orthopaedic surgical patients in our health system was $4079. The average hospital charges and collections were $437,773 and $56,120 per patient, respectively. Surgical physician fee charges and collections were $7049 and $2467 per patient. The orthopaedic trauma charge multiplier was 62, and the orthopaedic trauma net revenue multiplier was 23.

Conclusion: Contribution margin from patients with operative pelvic/acetabular injuries was favorable compared to the average hospitalized surgical patient. Significant hospital charges ($28,460,000 total) and collections ($3,648,000 total) result from the presence of a pelvic and acetabular trauma surgeon, and these hospital charges and collections far outweigh those of the surgical physician charges and collections.

• 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 413.

Stress Radiograph to Detect the True Extent of Symphyseal Disruption in Presumed Anteroposterior Compression Type I Pelvic Injuries

Takashi Suzuki, MD[1]; Steven J. Morgan, MD[2]; Wade R. Smith, MD[3];
Philip F. Stahel, MD[2]; ***David J. Hak, MD[2]****;*
[1]Kitasato University Hospital, Sagamihara, Kanagawa, Japan;
[2]Denver Health Medical Center, Denver, Colorado, USA;
[3]Geisinger Medical Center, Danville, Pennsylvania, USA

Background: The differentiation between anteroposterior compression (APC)-I and APC-II pelvic fracture patterns is critical in determining operative versus nonoperative treatment. Prehospital and emergency department immobilization in binders and sheets can impact the initial radiographic appearance. We instituted a protocol in which a stress examination was performed for patients presenting with an APC-I injury diagnosed with static radiographs in order to reveal the true extent of the injury. We hypothesized that in some cases, the stress examination would change the classification from APC-I to APC-II and result in a change of treatment.

Methods: During a 4-year study period, we performed 22 stress radiographs in patients with a presumed APC-I injury that showed symphyseal diastasis ≥1.0 cm but <2.5 cm on initial AP radiographs of the pelvis or on axial images of the pelvis on CT scans. Any patients who showed widening of the posterior sacroiliac (SI) joint or posterior displacement of the ilium at the SI joint on CT scans or who had sustained concomitant fractures of any part of the pelvis were excluded. In the operating room, a radiopaque marker of known diameter was placed on the skin over the pubic symphysis. A direct anteroposterior load was manually applied to both anterior superior iliac spines and the diastasis of the pubic symphysis was measured on stress fluoroscopic images.

Results: There were 19 males and 3 females, with an average age of 45.5 years. The most frequent mechanism of injury was a ski / snowboard accident (5 patients), followed by a fall from a height (4 patients), and horseback riding accident (4 patients). The mean distance of symphyseal diastasis was 1.8 cm on the AP radiographs, 1.4 cm on the CT scans, and 2.5 cm on fluoroscopic images under a stress examination. Six of 22 patients (27.2%) demonstrated a symphyseal diastasis of more than 2.5 cm during the stress examination, which changed their treatment from nonoperative to operative.

Conclusion: Measurements of symphyseal diastasis can vary significantly depending on the radiographic modality (CT versus plain films) and during application of a stress force. Static radiographs or CT scans for differentiation between APC-I and APC-II injuries are unreliable and may be misleading. The observed 27 % rate of concealed APC-II injuries indicates that the use of stress examination under general anesthesia in the acute setting of pelvic injury can be beneficial in accurately diagnosing the severity of injury and choosing appropriate treatment.

See pages 75 - 103 for financial disclosure information.

Trends in Survival after Complex Pelvic Trauma: Results of a Nationwide Pelvic Registry

(FDA=Non-U.S. research conducted within guidelines of my country)

***Timothy Pohlemann, MD*[1]**; *Dirk Stengel, MD*[2]; *Florian Stuby, MD*[3]; *Georgios Tosounidis, MD*[1]; *Ulrich Stöckle, MD*[4]; *Hagen Schmal, MD*[5]; *Andreas Seekamp, MD*[6]; *Ulf Culemann, MD*[1];
[1]*Department of Trauma, Hand and Reconstructive Surgery, Saarland University, Saarbrücken, Germany;*
[2]*Center for Clinical Studies, University of Greifswald, Greifswald, Germany;*
[3]*Department of Trauma and Orthopaedic Surgery, Berufsgenossenschaftliche Unfallklinik, Tübingen, Germany;*
[4]*Department of Trauma and Orthopaedic Surgery, Technical University of Munich, Munich, Germany;*
[5]*Department of Trauma and Orthopaedic Surgery, University of Freiburg, Freiburg, Germany;*
[6]*Department of Traumatology, University of Schleswig-Holstein, Kiel, Germany*

Purpose: Pelvic ring fractures are still a challenge to receiving teams in emergency departments and represent a subgroup of patients accompanied by high rates of mortality, long-term patient disability, and treatment costs. Based on the data of a multicenter pelvic registry that has been functional since 1991, the long-term changes of prognoses were analysed in respect to fracture classification and a specific definition of a "complex pelvic injury" (CPI).

Methods: Between 1991 and 2006, within 3 subsequent collection periods in a nationwide, multicenter study, data of 5048 patients after pelvic ring and acetabular fractures could be enrolled according to approval of the institutional review boards. The subgroup of 510 patients fulfilling the definition of CPI (pelvic ring injury with significant peripelvic soft-tissue injury) were subject to statistical analyses with respect to baseline demographics, overall mortality, risk groups, and predictors (statistics: χ^2, analysis of variance, random-intercepts logistic regression models).

Results: The overall mortality after pelvic fractures in the observation period declined from 8.4% to 5.2% (odds ratio [OR], 0.96; 95% confidence interval [CI], 0.94-0.98; $P < 0.001$), whereas the risk of death did not decrease significantly after CPI (OR, 0.98; 95% CI, 0.94-1.02, $P = 0.311$) and even reached a plateau phase after 2004 with a predicted mortality of 18.3% (95% CI, 11.1%-25.4%). The parameter with positive effect on survival was external fixation, whereas increasing age, injury severity score, vascular injury, number of packed red cells, and emergency laparotomy had an adverse effect on prognoses.

Conclusion: Despite the rapid progress in the treatment of polytrauma patients, which resulted in reducing mortality rates over the last 20 years, CPI is not following this international trend and still remains a life-threatening injury with approximately 20% mortality. As clear reasons for this adverse trend cannot be identified at the moment, further multicenter investigations, preferably on an international scale, are to be 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 413.

Long-Term Sexual Dysfunction following Surgically Treated Displaced Pelvic Ring Injuries

Koye Odutola, MD; Richard Baker, MD; Jeremy Loveridge, MD; Rebecca Fox; M. Kelly; Anthony J. Ward, MD; ***Tim J.S. Chesser, MD***
Pelvic and Acetabular Reconstruction Unit, Frenchay Hospital, North Bristol NHS Trust, Bristol, United Kingdom

Purpose: This study was conducted to determine the long-term incidence and pattern of sexual dysfunction in patients with displaced pelvic ring injuries treated surgically and to investigate if there is a link between sexual and urinary dysfunction.

Methods: This was a retrospective study of all patients with pelvic ring fractures treated surgically from a single tertiary referral unit with a minimum 1-year follow-up. Sexual function was assessed using elements of the validated Sexual Function Questionnaire. Patients were also asked specifically about new-onset sexual and urinary dysfunction. Pelvic injuries were classified according to Young and Burgess.

Results: A response rate of 85% (151 of 178 patients) was achieved with mean follow-up of 5 years (range, 1-12 years). The mean age at injury was 40 years (range, 16-74 years) and 72% of patients were male. The pelvic injuries were 31% AP compression (APC) injuries, 37% lateral compression (LC) injuries and 32% vertical shear (VS) injuries. New sexual problems were reported in 32% of all patients (36% of males and 24% of females). In men, 31% reported erectile dysfunction (12% absolute impotence), 32% reported decreased arousal, and 21% reported ejaculatory problems. In females, 16% reported decreased arousal, 5% reported anorgasmia, and 3% reported painful orgasms. There were no reported cases of dyspareunia in the female patients. Significant new sexual problems developed in 48% of patients with APC, in 27% of those with LC, and in 53% of VS injuries ($P = 0.04$, χ^2 test). There was a 42% prevalence of significant new urinary dysfunction in the entire cohort, with a strong correlation with those suffering new sexual problems (gamma statistic, $P < 0.001$).

Conclusions: After surgically treated pelvic ring fractures, one-third of patients will suffer new onset of sexual dysfunction, with urinary dysfunction being more common in these cases.

See pages 75 - 103 for financial disclosure information.

The Fate of Plate Fixation of the Symphysis Pubis in Anterior Pelvic Ring Injuries

Stephen A.C. Morris, MD; Jeremy Loveridge, MD; Alex Torrie, MD; David Smart, MD; Richard Baker, MD; A. Oppy; Anthony J. Ward, MD; ***Tim J.S. Chesser, MD****;*
Pelvic and Acetabular Reconstruction Unit, Frenchay Hospital, North Bristol NHS Trust, Bristol, United Kingdom

Purpose: This study was conducted to evaluate the outcome and complications of anterior pubic symphysis plating in the stabilization of traumatic anterior pelvic ring injuries.

Methods: All patients who underwent anterior pelvic ring stabilization with a pubic symphysis plate in a tertiary referral pelvic and acetabular reconstruction unit were studied. Patients were followed up annually for 5 years with AP, inlet, and outlet radiographs at each visit. The mechanism of injury, fracture classification, type of fixation (including additional posterior fixation), complications of fixation, and incidence of metalwork failure were recorded.

Results: In a series of 178 consecutive patients, 159 (89%) were studied for a mean of 37.6 months (range, 3 months-13 years). There were 121 males and 38 females, with a mean age of 43 years (range, 9-80 years). Symphysis pubic fixation was performed in 100 AO-OTA type B and 59 AO-OTA type C injuries using a Matta symphyseal plate in 92, a reconstruction plate in 65, or a dynamic compression plate in 2 patients. Supplementary posterior pelvic fixation was performed in 102 patients. Five patients (3.1%) required revision for failure of fixation or symptomatic instability of the pubic symphysis. A further 7 patients (4.4%) had metalwork removed for other reasons. Metalwork breakage occurred in 63 patients (40%) (screws in 34, plate in 13, and both in 6 patients) at a mean of 20.1 months. 62 of these 63 patients were asymptomatic and metalwork was left in situ.

Conclusions: Plate fixation of the symphysis pubis is an effective method of stabilizing anterior pelvic ring injuries with a low rate of complications. There is a high rate of late metalwork breakage, but this is not clinically significant.

- 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 413.

Anatomic Description Is More Reliable for Pelvic Fractures When Orthopaedic Surgeons in the Community Communicate with Fellowship-Trained Orthopaedic Traumatologists

Utku Kandemir, MD; *Benjamin Busfield, MD; Todd Kim, MD; Akin Cil, MD; Murat Pekmezci, MD; Tigist Belaye, BS; Amir Matityahu, MD;*
Department of Orthopaedic Surgery, University of California San Francisco, San Francisco, California, USA

Background: Patients sustaining pelvic fractures are commonly seen by orthopaedic surgeons without fellowship trauma training who are on call at a remote hospital. These patients are often transferred to an institution with a fellowship-trained orthopaedic surgeon for final treatment. Therefore, communication regarding the type of fracture between orthopaedic surgeons is critical.

Purpose: The purpose of this study was to measure reliability of classification systems among orthopaedic surgeons with and without fellowship training in trauma and to determine if CT improves the reliability.

Methods: Three trauma fellowship–trained (TT) and three non-trauma fellowship–trained (NT) orthopaedic surgeons evaluated 50 patients with pelvic fractures for fracture stability and according to OTA, Young-Burgess, and anatomic classification based on plain radiographs (AP, inlet, outlet views) only and then with plain radiographs and CT scans. The interobserver agreements were calculated. The kappa statistic was used to describe inter- and intraobserver agreement.

Results: Assessing fracture stability by radiographs, kappa values were 0.37 for the NT and 0.47 for the TT orthopaedic surgeons. When plain radiographs and CT scans were utilized, the kappa values were 0.42 for the NT and 0.61 for the TT orthopaedic surgeons. Utilizing plain radiographs only, kappa values for OTA, Young-Burgess classifications, pubic rami fracture, acetabular fracture, symphysis injury, and sacral fracture were 0.19, 0.22, 0.54, 0.65, 0.65, and 0.26 for NT orthopaedic surgeons and 0.44, 0.28, 0.72, 0.81, 0.62, and 0.30 for TT orthopaedic surgeons, respectively. Using plain radiographs and CT scans, kappa values for OTA, Young-Burgess classifications, pubic rami fracture, acetabular fracture, symphysis injury, and sacral fracture were 0.25, 0.27, 0.64, 0.80, 0.71, and 0.51 for NT orthopaedic surgeons and 0.57, 0.37, 0.71, 0.52, 0.50, and 0.49 for TT orthopaedic surgeons, respectively. When utilizing radiographs only, categorizing the Young-Burgess and OTA classifications into main groups rather than subgroups markedly improves agreements between and within NT and TT orthopaedic surgeons.

Conclusions: Anatomic description of the site of pelvic injury using both plain radiographs and CT has a higher agreement and should be considered for communication between orthopaedic surgeons with and without fellowship training in trauma rather than OTA and Young-Burgess classifications. CT scans improve the reliability of classifications. For the OTA and Young-Burgess classifications, using main groups rather than subgroups is more reliable.

See pages 75 - 103 for financial disclosure information.

Is There a Relationship Between Pregnancy Hormones and Heterotopic Ossification Prevention?

***Waleed F. Mourad, MD, MSc*[1]**; *Satya Packianathan, MD, PhD[1]; Walid Waked, MD[1]; Rania Shourbaji, BS[2]; Zhen Zhang, MS[1]; Majid Khan, MD[1]; Matt L. Graves, MD[1]; George Russell, MD;*
[1]University of Mississippi Medical Center, Jackson, Mississippi, USA;
[2]Jackson State University, Jackson, Mississippi, USA

Purpose: Our objective was to assess the influence of hormones during pregnancy in the incidence of heterotopic ossification (HO) after traumatic pelvic and/or acetabular fractures followed by open reduction and internal fixation (ORIF). Patients who underwent ORIF for traumatic pelvic and/or acetabular fractures (TF) frequently undergo radiation therapy (RT) and/or indomethacin as preventive measures against HO. Due to the rarity of ORIF-requiring trauma in pregnant women, the influence of pregnancy in modulating the risk of HO, to our knowledge, has never been studied. We hypothesized that pregnancy decreases the risk of HO after TF and retrospectively investigated the risk of HO formation in pregnant women who were status post-ORIF of TF without any prophylactic measures and compared our findings to nonpregnant females who were status post-ORIF of TF followed by RT ± indomethacin.

Methods: This is a single-institution, retrospective study investigating the effect of pregnancy on HO formation after ORIF for TF. Between January 2000 and January 2008, we identified a total of 278 patients, of whom 262 nonpregnant females and 16 pregnant women all had ORIF for TF. All the nonpregnant women received RT ± indomethacin for prophylaxis of HO after ORIF. 700 cGy was delivered in a single fraction to the midplane using 6 to 18-MV photons (AP/PA portals), with fields that included the soft tissues around the proximal femur, without bone shielding. Indomethacin, 25 mg three times daily, was started on postoperative day 1 and continued for 6 weeks in patients who received it. Pregnant females received neither RT nor indomethacin after ORIF.

Results: The incidence of HO in the nonpregnant females was 28.2%, compared to the HO formation rate in pregnant females of 6.25%. The odds of HO formation was 0.4 in nonpregnant females, compared to the odds of HO formation (only 1 patient out of 16 developed HO-Brooker class I HO) in the pregnant female, 0.067). The odds ratio of HO formation between these two groups is sixfold higher in nonpregnant women despite prophylactic RT ± indomethacin.

Conclusion: Our data show that pregnancy is associated with a reduced risk of HO after traumatic acetabular and/or pelvic 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 413.

The Effect of Time on the Incidence of Heterotopic Ossification

***Waleed F. Mourad, MD, MSc*[1]**; *Satya Packianathan, MD, PhD*[1]; *Walid Waked, MD*[1];
Rania Shourbaji, BS[2]; *Zhen Zhang, MS*[1]; *Majid Khan, MD*[1]; *Matt L. Graves, MD*[1];
George Russell, MD;
[1]*University of Mississippi Medical Center, Jackson, Mississippi, USA;*
[2]*Jackson State University, Jackson, Mississippi, USA*

Purpose: This study was undertaken to review the effect of time on the incidence of heterotopic ossification (HO) after operated acetabular fracture (OAF) from the date of initial injury of the fracture to radiation therapy (RT) ± indomethacin. Patients at risk for the development of HO frequently undergo RT postoperatively within 72 hours or preoperatively within 1 to 18 hours of surgery. To the best of our knowledge, the effect of time from injury to RT on the incidence and the risk of HO has never been studied. We therefore investigated the incidence and the risk of HO after RT ± indomethacin in relation to the time of RT relative to the initial injury of the OAF.

Methods: This is a single-institute retrospective study of 455 patients with OAF. All patients underwent open reduction and internal fixation (ORIF) followed by RT within 72 hours; 700 cGy was prescribed in a single fraction. RT fields included soft tissues around the proximal femur without bone shielding. Patients were classified into 6 groups according to the time interval from the injury to the delivery of RT ± indomethacin: group A, ≤ 3 days; group B, ≤7 days; group C, ≤10 days; group D, ≤14 days; group E, ≤21 days; and group F (>21 days). All charts were reviewed to determine HO occurrence, which was evaluated by standard radiographic images.

Results: Of the 455 patients with OAF treated with RT ± indomethacin, 142 (31%) had HO within the irradiated field and 313 (69%) had no HO. The median time from injury to RT was 15 days for patients who developed HO versus 6 days for those who did not develop HO. Generally, the longer the wait from the time of injury to RT ± indomethacin, the greater is the incidence and the risk of developing HO. Patients who received RT ± indomethacin within ≤3 days of injury representing group A (≤3 days) had 7% incidence of HO, group B (≤7 days) had 13% incidence of HO, group C (≤10 days) had 16% incidence of HO, group D (≤14 days) had 19% incidence of HO, group E (≤21 days) had 22% incidence of HO, and group F (>21 days) had 87.5% incidence of HO. Also, for patients who received RT ± indomethacin within ≤3 days of injury, the risk of HO was 28% lower than for those who received RT ± indomethacin after 3 days from injury (7% vs 35%; $p<0.0001$) and patients who received RT ± indomethacin >21 days after their injury, their risk of HO was 66% higher than that for patients who had received RT within 21 days of their OAF (88% vs 22%; $P < 0.0001$).

Conclusion: Our data show that as the time interval from date of injury to RT increases, there is an increase in the incidence and risk of HO. Patients who are going to have RT ± indomethacin after 3 weeks from the date of injury should be informed of their higher risk of HO formation. Radiation therapy should be administered as early as clinically possible after the trauma to minimize the risk of HO.

See pages 75 - 103 for financial disclosure information.

Pelvic Crescent Fracture: Radiographic Variation and its Implication in Treatment Options

Zhiqing Xing, MD; *Rick J. Gehlert, MD; Thomas A. DeCoster, MD;*
Department of Orthopaedics and Rehabilitation, University of New Mexico, Albuquerque, New Mexico, USA

Purpose: Pelvic crescent fracture, also known as sacroiliac joint fracture-dislocation, is traditionally classified as a lateral compression injury (LC-II in Young-Burgess classification) and considered to be rotationally unstable but vertically stable (Tile type B injury). However, we have found that this injury presents with a variety of radiographic patterns indicating different injury mechanisms and variable stability, thus complicating the treatments.

Methods: We reviewed 30 consecutive cases of pelvic crescent fracture treated at our institution from February 2005 to March 2009. We classified the injury mechanism to 3 types using radiographic criteria (plain radiographs and CT) as: lateral compression (LC, overlapped pubic rami fractures and internal rotation of the hemipelvis), AP compression (APC, pubic symphysis diastasis or separated pubic rami fractures and external rotation of the hemipelvis), and vertical shear (VS, >1 cm superior displacement of the hemipelvis). We analyzed the fracture patterns of each injury mechanism as well as treatment methods and outcomes.

Results: Patients' median age is 27 years (range, 10-82). The causes of injury are motor vehicle accident in 18 cases, falling from height in 5 cases, horse-related injury in 5 cases, and crush injury in 2 cases. Radiographic analysis revealed 19 cases of LC injury, 8 cases of APC injury, and 3 cases of VS injury. In cases of LC injury, the posterior iliac fracture is oblique at the sacroiliac joint level, with an anteriorly oblique direction of the fracture line from the anterior inferior iliac spine (AIIS) to the middle or anterior iliac crest. In cases of APC injury, the posterior iliac fracture is transverse at the sacroiliac joint level, with a posteriorly oblique direction of the fracture line from sciatic buttress (anterior to AIIS) to the middle or posterior iliac crest. In cases of VS injury, the posterior iliac fracture interface can be oblique or transverse depending on the combined LC (2 cases) or APC (1 case) injury. Four cases (all LC injury) with minimal displacement were treated nonoperatively with immediate mobilization and touch-down weight bearing for 6 weeks then weight bearing as tolerated. Six cases (4 APC, 2 LC) were treated nonoperatively due to multiple trauma and surgical contraindications. The other cases were treated with internal fixation after open or closed reduction. The options for posterior pelvic internal fixation include iliosacral screws, sciatic buttress screws, and/or iliac plates. The choice depends on the size of posterior fragment, obliquity of the fracture interface, and direction of the fracture line, which are fundamentally different between LC injury and APC injury. In 8 cases, posterior pelvic internal fixation was supplemented with anterior fixation of either pubic ramus/symphysis plating or pelvic external fixation. In cases without supplemental anterior fixation (9 LC, 2 APC, 1 VS), 2 cases of APC injury exhibited screw bending and delayed union.

Conclusion: Pelvic crescent fracture can be caused by different injury mechanisms that produce different radiographic fracture patterns and different pelvic stability that affects

- 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 413.

the choice of posterior pelvic internal fixation. In cases of LC injury, supplemental anterior fixation may not be necessary. However, in cases of APC or VS injury, supplemental anterior fixation with either a plate or an external fixator is recommended to maintain pelvic stability. Thus, we recommend individual analysis in cases of pelvic crescent fracture to guide treatment.

Current Approach to Cervical Spine Clearance in the United States: A National Survey

Murat Pekmezci, MD; *Thomas Philips, MD; Geoffrey Manley, MD; R. Trigg McClellan, MD;*
University of California San Francisco, San Francisco General Hospital,
San Francisco, California, USA

Background: Protocols for cervical spine clearance continue to evolve as advanced imaging modalities become more available. Multidetector CT scans are now recommended as the first-line imaging over cervical radiographs by the Eastern Association for Surgery of Trauma. Clearance of cervical spine in the obtunded patient remains controversial. The purpose of this study is document the current practice patterns in clearance of cervical spine in Level 1 trauma centers in the US.

Methods: A survey was designed to document the current protocols that are utilized to clear cervical spine in blunt trauma patients. 190 Level 1 trauma centers in the US were identified using the American College of Surgeons website and American Trauma Society website. Surveys were sent to orthopaedic spine surgeons, neurosurgeons, trauma surgeons, and emergency department chiefs.

Results: 85 responses were collected. The majority of the responses were collected from academic centers (67%). 72% of the institutions had an official cervical spine clearance protocol. All centers had multidetector CT scan and MRI. Miami-J and Aspen were the most commonly utilized hard collars (84%). The majority of the clinicians used NEXUS criteria to clear the cervical spine in alert, awake blunt trauma patients (53%). Multidetector cervical CT with coronal and sagittal reconstructions was the most commonly utilized first-line imaging in alert, awake patients with or without neck pain (87% and 63%). Following a negative multidetector CT scan in an obtunded blunt trauma patient, 50% utilize cervical MRI, 33% maintain the hard collar until a reliable examination can be obtained, and only 12% cleared the cervical spine based on the CT only.

Discussion: The results of this study showed that the majority of the trauma centers follow an institutional cervical spine clearance protocol. This study also demonstrated the change in the practice pattern in parallel to the literature, as multidetector cervical CT scan is now the first line of imaging in blunt trauma patients. Clinicians are reluctant to clear cervical spine in an obtunded patient based solely on a negative CT scan.

- 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 413.

Pelvic Fracture Experience from the Haitian Earthquake

Christiaan N. Mamczak, DO, LCDR, MC, USN[1]*; Lawrence B. Bone, MD*[2]*;*
Brendan M. Peterson, MD[3]*; Roman Hayda, MD, COL (Ret)*[4]*;*
[1]*Naval Medical Center Portsmouth, Portsmouth, Virginia, USA;*
[2]*SUNY-Buffalo Medical Center, Buffalo, New York, USA;*
[3]*Metro Health Medical Center, Cleveland, Ohio, USA;*
[4]*Brown University, Providence, Rhode Island, USA*

Purpose: This study is a descriptive analysis of pelvic and acetabular injuries treated aboard the United States Navy Ship (USNS) *Comfort* during the first 4 weeks after the disastrous 2010 Haitian earthquake, including the use of a novel pelvic injury triage treatment protocol.

Methods: A retrospective analysis was performed on medical records and imaging studies from the USNS *Comfort*, a 910-bed hospital ship that played a pivotal role as a Level 1 treatment facility during the acute phase of disaster relief. Fully equipped and equivalent to most tertiary care centers, victims were transferred aboard for treatment beginning 7 days after the quake. Pelvic ring and periacetabular injuries were initially triaged and evaluated by fellowship-trained trauma orthopaedic surgeons with examination and AP pelvic radiographs. CT imaging was used for operative planning. During the initial admission onslaught, a treatment protocol was created to optimize surgical resources. Operative priority was given to injuries that potentially lead to the greatest disability but had good potential for success. Fracture pattern, amount of fracture callus, polytrauma, and patient age were considered when deciding on surgery and fixation methods. Reduction was assessed intraoperatively with the assistance of fluoroscopy and could not be further graded.

Results: Between January 19, 2010 and February 23, 2010, 83 patients with pelvic injuries were admitted aboard the USNS *Comfort* (average age, 30 years [range, 6-79 years]; 61 female, 22 male). There were 61 pelvic ring injuries, 15 acetabular fractures, and 7 combined ring-acetabular injuries. Eight had associated hip fracture-dislocations (36%). Lateral compression ring injuries (81%) and transverse and/or posterior wall acetabular fractures (64%) were the most common. 32 patients (39%) were operatively treated (19 ring, 9 acetabular, and 4 combined injuries). The average numbers of days from injury to first surgery was 19.3 (range, 9-33). Open reduction was performed in 20 cases at an average of 22.2 days, versus 5 percutaneous fixations at 12 days and 7 combined techniques at 16.4 days. Overall, 24 of 83 patients had concurrent injuries requiring operative treatment and 2 patients expired due to sepsis before pelvic treatment. Complications included 4 deep venous thromboses, 1 intrapelvic small vessel ligation during open fixation, and 1 persistent hip subluxation after operative fixation. There were no iatrogenic nerve injuries, nor any postoperative infections or deaths.

Conclusions: Mass casualty earthquake disaster relief does not allow optimal treatment for all pelvic ring and acetabular injuries. A surgical triage protocol permits treatment of the most severe fracture patterns first. Crush patterns resulting in lateral compression ring injuries and transverse posterior wall acetabular fractures were more common. Delayed presentation and treatment (>14 days) is inevitable, but complex fracture patterns can still be optimally treated up to 4 weeks from injury, often necessitating longer open procedures with few short-term complications.

See page 396 for Disclaimer.

See pages 75 - 103 for financial disclosure information.

Immediate Medical Response to the Haiti Earthquake: The Experience of One Team to a Humanitarian Disaster

Neil MacIntyre, MD; ***Devon Jeffcoat, MD****; Dan Chan, MD; Florian Huber, MD; Dean G. Lorich, MD; David L. Helfet, MD;*
Hospital for Special Surgery, New York, New York, USA

Purpose: Our objective was to quantify the surgical experience of our team who arrived 4 days after the catastrophic magnitude 7.0-Mw Haiti earthquake on January 12, 2010.

Methods: An outreach plan was developed. A response team was assembled consisting of three attending surgeons, three orthopaedic trauma fellows, two anesthesiologists, two nurses, and two scrub technicians. A list of essential supplies was prepared and requests were made to both vendors and our institution for assistance with provision of equipment. Orthopaedic equipment and hospital supplies were donated by multiple sources including Synthes and the Hospital for Special Surgery. Supplies included 100 self-contained Synthes external fixator systems (large and small), four Synthes power drivers with saw-blade attachments and chargers, sterile gloves, gowns, drapes, instruments, sutures, antibiotics, and regional anesthesia supplies. The hospital was equipped with one x-ray machine, three makeshift operating rooms without anesthesia machines, and a postanesthesia care unit fitted with 8 beds. A nurse practitioner and the operating surgeons performed patient triage. A complement of general surgeons and nurses focused on postoperative care.

Results: The operating time period was 65 hours with only a 4-hour break time due to a power outage. Of the 81 operations performed, 20 (25%) were amputations (2 above-knee, 9 below-knee, 2 arm, 3 forearm, 4 feet), 49 (60%) external fixation/irrigation and débridement (3 humerus, 1 elbow,4 radius, 1 pelvis, 1 femoral neck, 13 femur, 22 tibia, and 4 pilon), 4 (5%) fasciotomies (1 forearm, 1 leg, and 2 feet), 5 (5%) massive soft-tissue débridements, 1 (1%) both-bone forearm open reduction and internal fixation, 1 (1%) hand pinning, and 1 (1%) assistance on a C-section.

Conclusion: The acute phase of a natural disaster is a critical time for surgical intervention. The vast majority of fracture care involved open fractures ranging from Gustilo and Anderson soft-tissue classification grade 1 to grade 3B. Many of the open fractures were contaminated and necrotic due to the lack of acute medical care. A successful medical and orthopaedic response mandates protocols for immediate disaster response that need to be coordinated with local and international government response agencies and associated humanitarian relief agencies including the Red Cross, United Nations, and the Department of State. Without such detailed planning and protocols, a larger incidence of morbidity and mortality can be expected, as evidenced in Haiti. A well-equipped and competent staff along with good logistical planning and personal safety plans are vital to any acute disaster medical relief plan.

- 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 413.

Haitian Earthquake Relief: Orthopaedic Care Aboard the USNS *Comfort*

Christiaan N. Mamczak, DO, LCDR, MC, USN;
Naval Medical Center Portsmouth, Portsmouth, Virginia, USA

Purpose: This study is an analysis of the triage and operative care of orthopaedic patients treated aboard the United States Navy Ship (USNS) *Comfort* during the initial surge of injuries after the catastrophic 2010 Haitian Earthquake.

Methods: The United States Navy Medical Corps was mobilized aboard the USNS *Comfort* shortly after the disaster and began receiving patients within 7 days of the initial quake. The *Comfort*, a 910-bed shipboard hospital equipped with a full staff and 10 operating rooms, was anchored off Port-au-Prince, Haiti and served as a critical staging Level 1 facility. Orthopaedic capabilities aboard were equivalent to most tertiary care centers. Earthquake casualties were initially triaged by civilian and military medical personnel in field clinics and hospitals before admission aboard the *Comfort*. Patients of all ages requiring emergent or urgent medical and/or surgical care were prioritized. A core group of military surgeons assisted in part by visiting orthopaedic trauma surgeons managed all orthopaedic-related injuries aboard. Surgical priority was given to limb-threatening or unstable axial skeleton injuries, followed by open fractures, long-bone fractures, and joint dislocations.

Results: In the first 3 weeks of care, there were 457 admissions (average age, 27 years [range, newborn-89 years]; 55% female, 45% male). Greater than 90% of admissions had one or more orthopaedic-related injuries. There were 630 operative cases performed in 3 weeks, treating 90 femur fractures, 52 below-knee/above-knee amputations, 47 tibia-fibular fractures, 30 facial fractures, 29 pelvic or acetabular fractures, 27 spine fractures, 16 foot and ankle fractures, 17 upper extremity fractures, and 14 cranial injuries. Greater than 75% of surgical patients required multiple procedures. No perioperative deaths were recorded.

Conclusions: The 2010 Haitian earthquake demonstrated an unprecedented level of orthopaedic trauma mass casualties. Complex crush injuries to the lower extremity, pelvis, and spine were the most commonly treated. Infected open fracture patterns required numerous surgical procedures, often ending in amputation. Delayed primary surgical care was complicated by infection, early fracture callus, and nonanatomic alignment or shortening. Initial triage with early and meticulous wound management, skeletal traction, joint relocation, and adequate fracture reduction with splinting is critical to mass casualty orthopaedic care. Complex fracture patterns can still be optimally treated up to 4 weeks from injury.

See pages 75 - 103 for financial disclosure information.

•Reduction of Shortened Malreduced Subacute Femur Fractures in Post-Earthquake Haiti

Coy Allen Wright, MD*; Mark Rahm, MD; William Hamilton, MD;*
Scott and White Healthcare/Texas A&M Health Science Center, Temple, Texas, USA

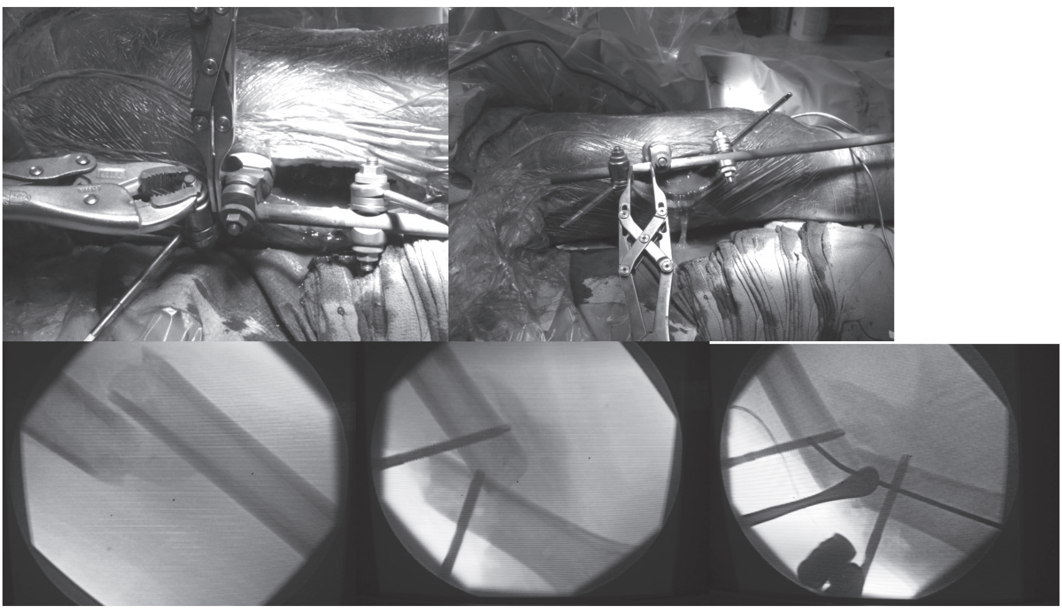
Background: Disaster response surgeons often have limited resources. Subacute fracture reduction and fixation issues were expected with team arrival 5 to 6 weeks after the earthquake in Haiti. Intraoperative fluoroscopy was available at our facility; however, lack of a femoral distractor and/or radiolucent fracture table required utilizing alternate techniques for successful intramedullary nailing.

Purpose: Our objective is to describe a method of achieving length and alignment and definitive fixation of a malreduced, shortened subacute 32-A3 femur fracture previously treated in external fixation for 6 weeks.

Methods: A radiolucent, wooden operating table was constructed. Sterile conditions were able to be maintained throughout the surgery. The patient underwent spinal anesthesia supplemented with ketamine. A sterile external fixator was placed utilizing a minimal lateral approach to the femur. To correct the rotation, the single 5.5-mm pins were placed adjacent to the fracture proximally and distally. The pins were then sequentially distracted with a spine instrumentation spreader to obtain length. The external fixator was removed after passage of the guidewire and acceptable length and alignment were achieved. The femur was then definitively stabilized with intramedullary fixation.

Results: Acceptable length, alignment, and rotation were restored.

Conclusion: We describe a method for achieving length, alignment, rotation, and definitive fixation in a subacute femur fracture when traditional resources are limited.



• 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 413.

Complications Associated with Nonoperative Management of Femur Fractures and Unstable Thoracolumbar Injuries in Post-Earthquake Haiti

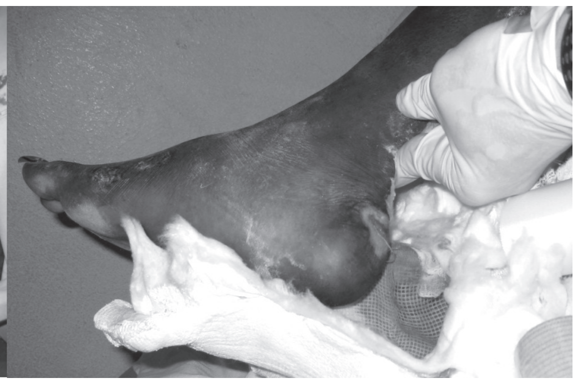
Coy Allen Wright, MD; *Bryce Allen, MD; Richard Barber, MD; Christopher Chaput, MD;*
Scott & White Memorial Hospital, Temple, Texas, USA

Purpose: Our objective was to document morbidity associated with nonoperative management of femur fractures and unstable thoracolumbar injuries in post-earthquake Haiti.

Methods: We treated complications associated with nonoperative treatment of thoracolumbar injuries and femur fractures. We observed 9 femur fractures and 4 thoracolumbar spine injuries. We found complications such as stage 4 sacral ulcers, full-thickness heel ulcers, and massive fecal and urine contamination of casts.

Results: 11 of 14 patients (73%) with thoracolumbar or femur fractures demonstrated significant complications when treated nonoperatively.

Conclusion: It should be emphasized that the injuries in this case series are typically managed surgically in the first world. We found a predictably high complication rate with nonoperative treatment of femur fractures and unstable thoracolumbar injuries in post-earthquake Haiti. Possible causes include problems with the following: lack of nursing/familial support/physical therapy, malnutrition, cultural barriers, climate, and lack of sanitation.



See pages 75 - 103 for financial disclosure information.

Rapid and Sustained Medical Relief to Haiti: Establishment of a University Field Hospital

(FDA=Non-U.S. research conducted within guidelines of my country)

Stephen M. Quinnan, MD; *Greg Gaski, MD; Chris Boullion, DO; Zakariah Mahmood, MD; Gregory Zych, DO; Fernando Vilella, MD; Eric Schiffman, MD; John Wang, MD;*
University of Miami/Jackson Memorial Hospital, Miami, Florida, USA

Purpose: On January 12, 2010 a 7.0-magnitude earthquake devastated Haiti, leaving over 230,000 to 300,000 dead and millions homeless. The University of Miami Global Institute Project Medishare (UMGIPM) established an effective and enduring field hospital within days of the earthquake. This study reports the types of injuries encountered, treatments administered, protocols adopted, and mechanisms of administration and cooperation with other relief organizations that were necessary to succeed in this undertaking.

Methods: Following IRB approval, patient records and operative logs were reviewed from January 16 to 24, 2010. The relief effort began on January 13 at a field hospital established in two tents at the United Nations compound (UMUN). Patients and supplies were transferred on January 21 to the University of Miami Hospital Haiti (UMHH), a field hospital consisting of four large tents with an inpatient capacity of over 250 people. Four operating rooms were built along with an intensive care unit, postanesthesia recovery room, neonatal intensive care unit, and a casting clinic. Anesthesia was administered by a team with expertise in regional anesthesia. All surgeries were performed with midazolam and/or ketamine for sedation and appropriate nerve blockade. Many patients with spine, pelvis, and femur fractures were transferred to the USNS Comfort or evacuated to Florida for definitive care.

Results: 203 surgical procedures were performed from January 16 to 24, including 34 primary amputations, 143 revision amputations and débridements, and 19 external fixator applications. No amputation closures were performed prior to three débridements, leading to only one infection requiring débridement. Surgical procedures grew in complexity in February and March as general anesthesia became available. There were a large number of compartment syndromes, 48 by January 24, presenting in a delayed fashion. These were treated nonoperatively with antibiotics and hydration with one limb developing an infection, ultimately leading to amputation. 98 fractures were reduced and casted from January 22 to 24.

Conclusion: The establishment of UMHH by the UMGIPM represents a new model for the implementation of disaster relief through the partnership of an academic medical institution and a nongovernmental relief organization. To our knowledge, this is the first report of a field hospital established and maintained by an academic medical institution. The vast majority of injuries we treated in the initial aftermath of the Haiti earthquake were orthopaedic in nature including open fractures, closed fractures, and compartment syndromes. Large-scale relief efforts require a pool of dedicated medically skilled volunteers, strong organizational support, and extensive cooperation with other relief efforts in order to be successful.

• 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 413.

Management of Earthquake Victims: 14 Days in Haiti

*Keith Antonangeli, ST[1]; Nathaly Arredondo, RN[2]; Heather Bedlion, RN[3]; Akshay Dalal, MD[1]; Grace M. Deveny, RN[1]; George S.M. Dyer, MD[3]; Mitchell B. Harris, MD[3]; Giliane Joseph, MD[4]; Denise Lauria, RN[1]; Sergeline Lucien, RN[3]; Sarah Marsh, RN[5]; Selwyn O. Rogers, Jr, MD, MPH[3]; Henry Salzarulo, MD[6]; Sachita M. Shah, MD[7]; **Raymond M. Smith, MD[1]**;*
R. James Toussaint, MD[1]; Judy Wagoner, RN[8];
[1]Massachusetts General Hospital, Boston, Massachusetts, USA;
[2]Lakeland Regional Medical Center, Lakeland, Florida;
[3]Brigham and Women's Hospital, Boston, Massachusetts, USA;
[4]Albert Einstein Hospital, Bronx, New York, USA;
[5]Partners in Health, Boston, Massachusetts, USA;
[6]Blue Ridge Surgery Center, Seneca, South Carolina, USA;
[7]Rhode Island Hospital, Providence, Rhode Island, USA;
[8]Beth Israel Deaconess Hospital, Boston, Massachusetts, USA

Background: On January 16, 2010, 13 medical staff were deployed to a small, intact, but barely functional hospital 100 km outside Port-au-Prince and found approximately 175 patients lying on the floor in essentially bare rooms mainly cared for by numerous relatives. The operating and recovery rooms were not functional but with local help we cleaned, repaired equipment and began work.

Methods: All of the patients had untreated major injuries, then in their fifth day, and were lying on dirty mattresses with unchanged dressings. The worst were obvious by the smell and the number of flies around a particular dressing. Several (including paraplegics) were lying on wooden doors and one on an ironing board; they had already developed pressure ulcers. Our final database held complete data on 142 patients. There were 150 major diagnoses, including 42 open fractures, 17 major open wounds, 11 neglected compartment syndromes, 22 closed femoral fractures (5 pediatric), 13 pelvic ring injuries of whom 10 were mechanically unstable, 4 paraplegics, 2 quadriplegics, 13 closed tibial fractures, 3 other lower limb fractures, and 6 closed upper limb fractures. There were also 2 patients with multiple rib fractures, 1 undiagnosed pneumothorax, 3 contusions/burns, 2 acetabular fractures, 4 head injuries (including 1 ruptured globe), 2 abdominal injuries, and many with significant closed soft tissue injuries. We established a triage system, focusing initially on the most critically ill patients in imminent danger of death with early, life-saving surgeries being wound débridement or amputations. In 14 days, we performed 216 earthquake-related procedures, 136 in the operating room and 80 complex dressing changes on the "wards" under anesthesia.

Results: There were 12 earthquake-associated deaths, due to tetanus (1), sepsis (2), massive pulmonary embolism (2), rhabdomyolysis (2), and respiratory failure (1) (C4 quadrant). There were 2 early postoperative deaths and 2 patients died soon after presenting to our "emergency department" in extremis. Of the 11 amputations, all but 1 (massive pulmonary embolism, 5 days after hip disarticulation) survived and did not become septic. The initial phase of amputation led to problems with several patients refusing surgery and leaving the hospital despite knowing that the alternative was probably death; their outcome is

See pages 75 - 103 for financial disclosure information.

unknown. Despite significant initial sepsis; after surgical débridement/amputation only one patient died of sepsis and after presenting in extremis. We noted that patients with large open wounds actually did better than those with small wounds. Wounds that had been closed while still contaminated were the worst and were often associated with severe sepsis. The closed compartment syndromes were hydrated and observed. Two, both with compartment syndrome affecting the buttock, thigh, and leg, died of rhabdomyolysis, but all the others survived with preserved limbs.

Conclusion: We concluded that in a crisis situation, medical professionals must work as a team, be resourceful and creative with the tools at hand, and listen to the local population. We continue to provide local care and strongly suggest coordination of subsequent efforts with established charities that have links in the community and an understanding of the local culture.

- 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 413.

The American Orthopaedic Response to the 2010 Haiti Earthquake: The First 30 Days

Thomas M. Penoyar, MD; ***Amber M. Caldwell, BA****; Ralph R. Coughlin, MD;*
Richard Gosselin, MD;
Institute for Global Orthopaedics and Traumatology, San Francisco, California, USA

Purpose: A magnitude 7.0 Mw earthquake struck Haiti on January 12, 2010, killing nearly 200,000 and causing an estimated 700,000 orthopaedic injuries. An overwhelming and unprecedented orthopaedic effort was made in Haiti between January 12 and February 11, 2010. This study was designed to evaluate, both qualitatively and quantitatively, the acute response by the orthopaedic community in the United States to the 2010 earthquake in Haiti. The hypothesis was that the orthopaedic relief effort in the first 30 days was conducted as effectively as possible within the confines of a developing country ravaged by natural disaster.

Methods: Actions involving orthopaedics and Haiti in the 30 days following the earthquake were reviewed. Information was gathered from relief worker interviews and online surveys. The survey was distributed to all American Academy of Orthopaedic Surgeons (AAOS) members following IRB approval. Organizations of particular interest were AAOS, OTA, SIGN, and International Medical Surgical Response Team (IMSuRT). Interviews and surveys were conducted using a standardized questionnaire developed by several members of the United States orthopaedic community who have served overseas and/or in previous relief missions. At the time of submission, 11 interviews and 109 surveys have been completed.

Results: Over 30 medical nongovernmental organizations (NGOs) deployed representatives, many within 72 hours of the earthquake. Temporary hospitals and operating rooms were organized with the first operations performed on January 15. The USNS Comfort arrived and began seeing patients on January 19. The majority of procedures done in the first week were external fixation, débridement, and amputations. Later in the first week, infections, including gangrene, tetanus, and Pseudomonas, were common due to the lack of sterile conditions in the hospitals and operating rooms. American orthopaedic NGOs present included CURE International, SIGN, and Operation Rainbow. Academic orthopaedic groups included the Hospital for Special Surgery, Dartmouth University, University of Miami, and Shock Trauma, among others. The AAOS and OTA advocated immediately for interested volunteers to affiliate with NGOs and began a communication network to connect volunteers with relief groups. In the weeks following, orthopaedic volunteers based in the Dominican Republic near the Haitian border received a large number of patients with complications from inappropriate initial surgery. Interview and survey results are pending.

Conclusion: The massive response to this disaster resulted in countless lives and limbs saved. Organizing efforts and distribution of supplies were the most obvious challenges, though other challenges will be elaborated upon following results analysis. To handle future orthopaedic care of these patients, it will be necessary to coordinate a volunteer database and standardized training prior to deployment. In contrast to our hypothesis, we propose that personnel who flew to Haiti unaffiliated with an NGO or governmental organization were in fact hindering the relief effort by consuming valuable water, shelter, and transportation.

See pages 75 - 103 for financial disclosure information.

Coordinated Trauma Care for the Haitian Earthquake Victims by the Georgia Orthopaedic Society

Douglas W. Lundy, MD[1]*; Steve McCollam, MD*[2]*; Danny Guy, MD*[3]*;*
Obinwanne Ugwonali, MD[2]*; Douglas H. Murray, MD*[2]*;*
[1]*Resurgens Orthopaedics, Marietta, Georgia, USA;*
[2]*Peachtree Orthopaedic Clinic, Atlanta, Georgia, USA;*
[3]*Southern Center for Orthopedics, Lagrange, Georgia, USA*

Purpose: This study reports the methodology used by the Georgia Orthopaedic Society (GOS) to participate in the emergent care of trauma patients after the earthquake in Haiti. Synchronized efforts through the GOS ensured that the appropriate personnel and equipment were stationed at the correct times to ensure a coordinated response and continuity of care.

Methods: After the earthquake on January 12, 2010, the hospital administrators at Hôpital Albert Schweitzer in Deschapelles Haïti contacted Dr McCollam and requested orthopaedic surgeons to care for the multiple patients with fractures they had received from Port-au-Prince. Dr McCollam and the Peachtree Orthopaedic Clinic coordinated personnel and equipment to maximally care for these injured patients and utilized previous relationships with the hospital ensure maximal efforts.

Results: Three coordinated orthopaedic teams from GOS were dispatched to Haiti to provide orthopaedic care. Long-standing relationships and communication with the hospital administrators enabled rapid integration of the surgical teams into action and understanding of the need. The first team comprised of three orthopaedic surgeons (trauma, upper extremity, and spine) and an operating room team arrived 8 days after the earthquake. This team operated on many patients, performing operative fixation of upper and lower extremity fractures with the large volume of equipment they brought with them. The second team, consisting of three orthopaedic surgeons and an operating room team, arrived in Haiti 3 weeks later prepared to continue the efforts of the first team. They operated on 38 patients and performed many soft-tissue coverage procedures and fracture surgery coordinated with the first team. The third team consisting of four orthopaedic surgeons arrived weeks later prepared to continue the care of these injured patients by addressing wound and fracture issues resulting from the significant effort provided earlier.

Conclusion: By capitalizing on established relationships with Hôpital Albert Schweitzer in Deschapelles Haïti, the GOS was able to deliver effective orthopaedic teams to those injured in the earthquake. The coordination of these teams enabled the proper equipment and skill sets to be sent to Haiti at appropriate time intervals. By previously establishing a presence in this area of the developing world, the ramp-up time for these teams was minimized. State orthopaedic societies are uniquely positioned to coordinate surgeons from different practices to effectively respond to an international disaster.

- 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 413.

Haiti 2010: An Orthopedic Resident's Perspective on a Successful Medical Mission
Leroy Rise, MD; *Jaymes Granata, MD;*
The Ohio State University Medical Center, Columbus, Ohio, USA

Purpose: This presentation will outline an orthopaedic resident's successful experience during disaster relief efforts after the 2010 Haiti earthquake.

Methods: A review of the chain of events that lead to the successful outcome of this endeavor was informally compared to other stories of the 2010 Haiti disaster relief effort and conclusions were drawn. A "successful" outcome was defined as action being taken that led to expected results of orthopaedic trauma care being administered to earthquake victims within a reasonable amount of time, with expected therapeutic results, and without undue detriment to the surgical team or the Haitian people.

Results: Three main points made this mission to Haiti a success. First, the organization you are with makes all the difference. The Sacred Heart Hospital in Milot, Haiti, and the Crudem Foundation that runs it have been coordinating volunteer efforts for over 25 years. Their infrastructure and knowledge were already well established. Other relief organizations that did not already have a presence in Haiti were less able to coordinate in a timely fashion the personnel, transportation, or supplies needed, despite being well funded. Second, be prepared to be flexible and use all your talents. I was able to repair and/or install radiographic and other equipment that allowed our efforts to move forward unimpeded. Finally, understand orthopaedic injuries and treatments in the context of your environment and surgical capabilities. We changed our treatment paradigms to limit the pervasive threat of infection and to prioritize surgical options for those injuries thought to cause the most dysfunction. For example, traction was used for hip fractures, both-bone forearm fractures were surgically fixed, and ankle fractures were casted.

Conclusion: For those who might be interested in doing a medical mission, we believe that attention to three important points will help you achieve the desired result. Number one, choose your organization carefully; they can make all the difference in the world. Two, be prepared to use all your talents and be creative. And three, understand your limitations and use traditional treatments when called for because sometimes less is more.

See pages 75 - 103 for financial disclosure information.

Prognosticating Acetabular Fractures Using CT Analysis

Michael Kreder[1]; David Wright[1]; Cari M. Whyne, PhD[1,2]; Hans Kreder[2];
Alex Kiss; Omri Lubovsky, PhD[2];
[1]Orthopaedic Biomechanics Laboratory,
[2]Division of Orthopaedics,
Sunnybrook Health Science Centre, Toronto, Ontario, Canada

Introduction: Displaced acetabular fractures occur in young adults as the result of high-energy trauma. In a many cases, surgical reconstruction leads to excellent patient outcome [1]; however, it is recognized that some fracture patterns have worse prognoses than others. Current methods of analysis and classification of fractures are limited in their ability to predict functional outcome in acetabular fractures [2].

Previous CT based study of healthy acetabuli showed that measured bone density distributions corresponded with areas considered to be under the highest load (in agreement with Wolff's Law, the concept that bone grows in response to mechanical loading). It is hypothesized that measurement of damage to the regions of highest mechanical load will give a better prediction of patient outcome than is currently available, allowing clinicians to improve treatment planning for patients with poor prognoses.

This study aims: 1) to quantify initial damage to acetabular subchondral bone through measurement of bone density and the location and extent of fracture lines in relation to twelve previously defined regions of the acetabulum and 2) to evaluate these values as predictors of patient specific functional outcome.

Materials and Methods: Preoperative CT scans were analyzed from 25 patients who received surgery for unilateral acetabular fractures. Using AmiraDev4.1 (Visage Imaging, Carlsbad, USA) and custom image-analysis code, an intensity map was generated from the CT scans for the broken acetabuli and the contralateral healthy acetabuli. Each broken acetabulum was manually reconstructed prior to the generation of the intensity maps.

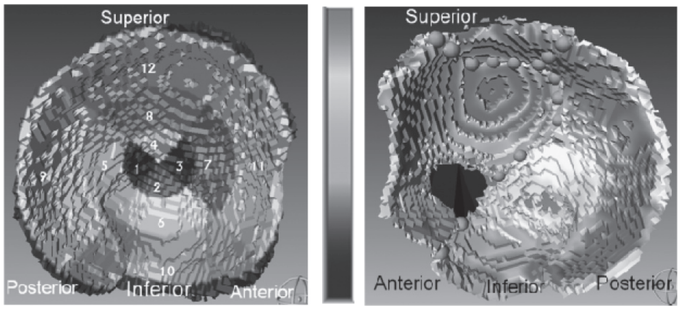
Intensity maps were split into twelve regions corresponding to those previously studied in healthy acetabuli: four quadrants (superior, inferior, posterior and anterior) that were each split into radial thirds. The average intensity of the CT scan was measured for each of these twelve regions (Figure 1). If the bone was too badly damaged to allow full reconstruction (without gaps), areas without bone in the acetabulum were defined to have a minimal intensity value. The number of fracture lines and their lengths were also recorded for each region.

All patients completed a quality of life survey package at least two years post-operatively. Scores to quantify functional outcome were generated from the MFA lower extremity domain (Move), SF-36 "Physical Functioning" (PF) and SF-36 "Bodily Pain" (BP).

For each acetabulum (intact and fractured), regional densities were normalized to the average density of all regions in that acetabulum. The average length of a fracture line in a region was examined over multiple and individual regions.

- 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 413.

Figure 1:
Left: average acetabulum densities shown in twelve regions of a right unfractured acetabulum. Right: density map of a fractured left acetabulum. Yellow landmarks follow fracture lines and unrecoverable bone is identified by the dark blue (low density) surface.



Results: The 25 patients in the study had an average age of 39 years (range 19 to 74, median 40). There were 19 males and 6 females.

The normalized density of regions 8 and 12 of the fractured acetabulum was statistically significantly correlated with the average functional outcome score (R2 = 0.230, 0.267 respectively, p<0.05). Adjusting for normalized regional density on the intact side resulted in an even stronger association of injured regional bone density with function in regions 3, 8, 9, and 12. The strongest correlation was observed between the average adjusted density in regions 8, 9 and 12, and the average functional outcome score (R2 = 0.404, p<0.001). Decreased density in regions 8, 9, and 12 correlated with negative outcomes. When regions 8, 9, and 12 were injured, region 3 tended to remain intact resulting in a negative correlation between adjusted density in region 3 and functional outcome. Similar associations were observed in regions 8 and 12 when fractured acetabuli were normalized directly to their contralateral healthy acetabuli.

The average length of a fracture line in all regions excluding the inner 4 regions (1-4) was weakly and negatively correlated with functional outcome (R2 = 0.211, p<0.05). Unlike the regional dependency for the density / outcome relationship (regions 8, 9, and 12), the average fracture length in individual regions showed no association with functional outcome.

A multiple regression of average fracture line length and the difference in density distribution for regions 8, 9, and 12 yielded the strongest correlation with functional outcome (Adjusted R2 = 0.519, p<0.0005, Figure 2).

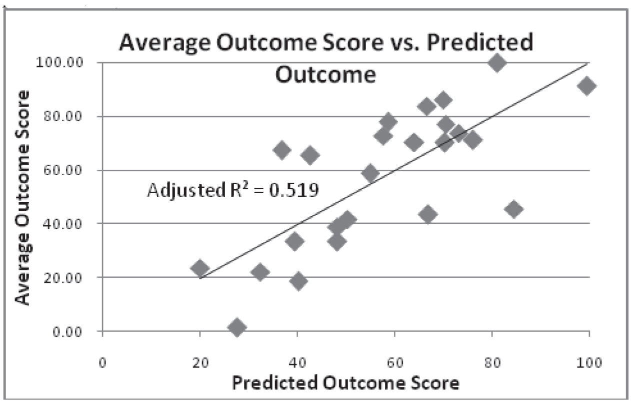


Figure 2:
Predicted outcome based on multiple regression of the average difference in normalized density distribution for regions 8, 9, and 12 and the average length per fracture line recorded in regions 5-12 to predict the averaged outcome score. The two variables were uncorrelated, allowing them to be included in the same model.

See pages 75 - 103 for financial disclosure information.

Discussion: Damage to the posterior wall (region 9) and dome (region 8 and 12) of the acetabulum may result in more severe functional compromise due to the high mechanical loads experienced by those regions. Referencing the intact acetabulum for the density distribution data minimizes the effect of inter-patient variability, improving the predictive ability of the analysis. It was found that smaller average fracture lengths over regions 5-12 corresponded with worse functional outcome. This indicates a comminuted fracture with many small components may affect functional outcome more negatively than long simple fracture lines.

The ability to prognosticate functional outcome based on CT analysis at the time of injury can be used to guide the development of new surgical techniques designed specifically around cases with poor outcomes and can facilitate accurate comparisons of current surgical techniques by providing an expected outcome for reference. While patients with acetabular trauma frequently suffer from multiple traumatic injuries, making it difficult to isolate the acetabulum's effect on the patient's well-being, we have shown that damage to the subchondral bone in key regions of a fractured acetabulum can be successfully quantified and used in the prognosis of functional outcomes. Further research is needed to refine and fully automate this CT analysis based method before these measurements can translate into a clinical prognostic tool.

References:

1) Matta, J. M., & Merritt, P. O. (1988). Displaced acetabular fractures. *Clinical Orthopaedics and Related Research*, (230)(230), 83-97.
2) Swiontkowski, M. F., Agel J., McAndrew M. P., Burgess A. R., MacKenzie E. J. (2000). Outcome validation of the AO/OTA fracture classification system. *Journal of Orthopaedic Trauma*, 14(8), 534-541.

- 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 413.

Address or Name Correction / Request for Information

Name ____

Address ____

Telephone Number ________________________________

FAX Number ___________________________________

e-mail address __________________________________

Please return this form to the registration desk
or submit to the Association's Administrative Office:

OTA
6300 N. River Road, Suite 727 • Rosemont, IL 60018-4226 USA
PHONE: (847) 698-1631 FAX: (847) 823-0536
e-mail: ota@aaos.org

Please send me the following information:

- ❑ Membership Application *(deadline November 1, 2010)* www.ota.org
- ❑ Advanced Trauma Techniques Course
  January 14 - 15, 2011 — Phoenix, Arizona, USA
- ❑ Resident Research Grant Application
  (deadlines December 6, 2010 & June 21, 2011)
- ❑ Specialty Day Meeting: February 19, 2011 — San Diego, CA, USA
- ❑ Research Grant Pre-Proposal *(deadline February 7, 2011)*
- ❑ 11th Annual AAOS/OTA Trauma Update Course:
  March 31 - April 2, 2011 — Lake Buena Vista, Florida, USA
- ❑ Orthopaedic Trauma Fellows Course
  April 15 - 17, 2011 — Boston, Massachusetts, USA
- ❑ OTA Comprehensive Fracture Course for Residents
  April 28 - 30, 2011 — Chicago Area, Illinois, USA
- ❑ Comprehensive Fracture Course for Residents
  October 12 - 15, 2011 – San Antonio, Texas, USA
- ❑ 27th Annual Meeting and Pre-Meeting Events
  October 12 - 15, 2011 – San Antonio Marriott Rivercenter Hotel, San Antonio, Texas, USA

ABSTRACT APPLICATION *(deadline February 1, 2011)*
Apply on-line at www.ota.org

Address/Name Correction

ORTHOPAEDIC TRAUMA ASSOCIATION
RESEARCH FUND - 2010

The OTA Research Fund is used to help fund peer reviewed orthopaedic trauma research, including multi-center studies, and to support OTA educational programs.

Make check payable to:
OREF or *Orthopaedic Trauma Association - Research*

❑ OTA Approved Research Grants
❑ OTA Approved Educational Courses/Meetings
❑ Either OTA Approved Research or Education Grants

RESEARCH AWARD LEVELS
Contributions received by December 31, 2010.

Diamond Award	$150,000 and above
Platinum Award	$125,000 - $149,999
Gold Award	$100,000 - $124,999
Silver Award	$75,000 - $99,999
Bronze Award	$50,000 - $74,999
Copper Award	$25,000 - $49,999
Sponsors Award	$5,000 - $24,999
Members Award	$1,000 - $4,999
Friends Award	$250 - $999

Name ______________________________

Address ______________________________

____

____

Telephone Number ______________________________

FAX Number ______________________________

e-mail address ______________________________

Amount Enclosed: $ ____________

Please send your tax-deductible contributions to:

OTA, Trauma Research
6300 N. River Road, Suite 727
Rosemont, IL 60018-4226 USA

This form is available on-line at:
www.ota.org/donation/donorform.html

Links are available on-line from OTA to OREF and you may designate OTA as a partial recipient.

ACCREDITATION – CME INFORMATION

This 26th 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 educational activity for a maximum of **20** ***AMA PRA Category 1 Credits***™. Physicians should only claim credit commensurate with the extent of their participation in the activity.

FDA STATEMENT

Some drugs or medical devices demonstrated at this 26th 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 26th 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 26th 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 while submitting their abstracts online have identified the options to disclose as follows:

- A. Royalties from a company or supplier;
- B. Speakers bureau/paid presentations;
- Ci. Paid employee for a company or supplier;
- Cii. Paid consultant for a company or supplier;
- Ciii. Unpaid consultant for a company or supplier;
- D. Other financial or material support from a company or supplier;
- E. Stock or stock options in a company or supplier;
- F. Self/family research support from a company or supplier;
- G. Departmental research support from a company or supplier;
- H. Other financial/material support from publishers;
- I. Self/family research support from publishers;
- J. Departmental research support from publishers.

Authors who completed their financial disclosures through the Academy 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.

An indication of the participant's disclosure appears after his/her name in the alphabetical listing and/or on the abstract page 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.