

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:

Welcome to San Antonio!

We are excited to be here for the OTA's 27th Annual Meeting. This year's Program Committee, under the leadership of Dr. Jim Goulet has organized what promises to be an outstanding educational event including symposia which highlight the role of the orthopaedic traumatologist in geriatric fracture management, address challenges and opportunities in treating pain, and



Andrew N. Pollak, MD

provide strategies for orthopaedic trauma practice management. The scientific sessions including over 91 podium presentations, 107 posters and 20 International posters selected from over 600 abstract submissions represents the world's most competitive and comprehensive forum for presentation of scholarly work in musculoskeletal injury.

The pre-meeting events including the Basic Science Forum, the International Orthopaedic Trauma Care Forum, the Masters Level Trauma Coding Course and the Young Practitioners Forum have all become popular introductions to the meeting that attract many attendees. This year, we have added an "Own the Bone" session to the menu to encourage secondary prevention of osteoporotic fractures and better bone health for older patients in general. Finally, we are truly honored to welcome Italy as our inaugural Guest Nation. We are delighted to have this opportunity for collaboration with our Italian colleagues and to recognize their contributions and achievements.

Dr. Animesh Agarwal, our local host, has helped our staff select and prepare the venues for what promises to be a wonderful social program. He has also provided some great local advice as to how to take advantage of the many attractions San Antonio has to offer.

Best wishes for a fabulous meeting,

6/lech

Andrew N. Pollak, MD President OTA



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

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

Orthopaedic Trauma Association

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

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SCIENTIFIC POSTERS

TECHNICAL EXHIBITS

Open: Thursday Friday Saturday Marriott Rivercenter, Grand Ballroom Foyer

11:00 am - 5:00 pm 6:30 am - 5:00 pm 6:30 am - 5:00 pm

> Marriott Rivercenter, Grand Ballroom (G - J)

6:30 am - 5:00 pm 6:30 am - 1:00 pm

SPEAKER READY ROOMS

Open: Friday

Saturday

Basic Science Focus Forum: Marriott Riverwalk, Alamo Ballroom Foyer Annual Meeting: Marriott Rivercenter, Conference Room 19

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, Found | ding President |
|-----------------------------|----------------|
| Michael W. Chapman, MD | 1985-87 |
| Charles C. Edwards, MD | 1987-88 |
| John A. Cardea, MD | 1988-89 |
| Bruce D. Browner, MD | 1989-90 |
| Joseph Schatzker, MD | 1990-91 |
| Richard F. Kyle, MD | 1991-92 |
| Robert A. Winquist, MD | 1992-93 |
| Peter G. Trafton, MD | 1993-94 |
| Kenneth D. Johnson, MD | 1994-95 |
| Alan M. Levine, MD | 1995-96 |
| Lawrence B. Bone, MD | 1996-97 |
| James F. Kellam, MD | 1997-98 |

| David L. Helfet, MD | 1998-99 |
|-----------------------------|---------|
| Andrew R. Burgess, MD | 1999-00 |
| M. Bradford Henley, MD, MBA | 2000-01 |
| Donald A. Wiss, MD | 2001-02 |
| Thomas A. Russell, MD | 2002-03 |
| Marc F. Swiontkowski, MD | 2003-04 |
| Roy Sanders, MD | 2004-05 |
| Paul Tornetta, III, MD | 2005-06 |
| Michael J. Bosse, MD | 2006-07 |
| Jeffrey O. Anglen, MD | 2007-08 |
| J. Tracy Watson, MD | 2008-09 |
| David C. Templeman, MD | 2009-10 |
| Timothy J. Bray, MD | 2010-11 |

ANNUAL MEETINGS

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

ORTHOPAEDIC TRAUMA ASSOCIATION ORGANIZATION

2011 BOARD OF DIRECTORS

President – Andrew N. Pollak, MD President Elect – Robert A. Probe, MD 2nd President Elect – Andrew H. Schmidt, MD CFO – David J. Hak, MD Secretary – James P. Stannard, MD Immediate Past President – Timothy J. Bray, MD 2nd Past President – David C. Templeman, MD Member-at-Large – Christopher T. Born, MD Member-at-Large – Lisa K. Cannada, MD Member-at-Large – David C. Teague, MD Annual Program – James A. Goulet, MD

NOMINATING (Elected Committee)

Timothy J. Bray (Chair) Pierre Guy M. Bradford Henley William T. Obremskey Thomas A. Russell

MEMBERSHIP (Elected Committee)

Nirmal C. Tejwani (Chair) Robert P. Dunbar, Jr. Susan A. Scherl Michael S. Sirkin Robert D. Zura

International Members Committee (Ad Hoc Committee)

Peter V. Giannoudis (Chair) Ney Amaral (Brazil) Guenter C. Lob (Germany) Akira Oizumi (Japan) Hans-Christoph Pape (Germany) Thomas A. (Toney) Russell (China focus)

ANNUAL MEETING ARRANGEMENTS

Animesh Agarwal (San Antonio, TX 2011 Local Host) David C. Templeman & Andrew H. Schmidt (Minneapolis, MN 2012 Local Hosts) Laura J. Prokuski (Phoenix, AZ 2013 Local Host) Roy Sanders & H. Claude Sagi (Tampa, FL 2014 Local Hosts) David J. Hak, CFO

ARCHIVES

Madhav A. Karunakar (Chair) Alan T. Kawaguchi Daniel J. Stinner

BY-LAWS & HEARINGS

Lawrence X. Webb (Chair) Mark J. Anders Alexandra Schwartz

CLASSIFICATION AND OUTCOMES

Craig S. Roberts (Chair) Thomas A. DeCoster Gregory L. DeSilva Douglas R. Dirschl Clifford B. Jones Douglas W. Lundy Andrew R. Evans Julie Agel (Presidential Consultant) James F. Kellam (Presidential Consultant) J. Lawrence Marsh (Presidential Consultant)

Open Fracture Work Group Milan K. Sen Debra L. Sietsema

EDUCATION

William M. Ricci (Chair) Paul J. Dougherty Matt L. Graves Kenneth J. Koval Marcus F. Sciadini Paul Tornetta, III Michael Beltran (Resident Member) David C. Teague (Presidential Consultant) **Education Sub Committee Advanced Trauma Techniques Course** - January 13 - 14, 2012 Christopher Finkemeier & Brett D. Crist 12th Annual AAOS/OTA Orthopaedic Trauma Update – April 12 - 14, 2012 Daniel S. Horwitz & Steven J. Morgan **Orthopaedic Trauma Fellows Course** - March 15 - 18, 2012 Paul Tornetta, III **Comprehensive Fracture Course for** Residents 2.0 - April 26 - 28, 2012 tentative Matt L. Graves & Gregory J. Della Rocca **Comprehensive Fracture Course for** Residents - October 3 - 6, 2012 Michael T. Archdeacon & Kyle J. Jeray JOT Editor: Roy Sanders

EVALUATION

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

FELLOWSHIP & CAREER CHOICES

Mark A. Lee (Chair) Cory A. Collinge George J. Haidukewych John M. Iaquinto Toni M. McLaurin Roy Sanders (Presidential Consultant) Augusta Whitney (Resident Member)

Fellowship MATCH Compliance

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

FINANCE AND AUDIT

David J. Hak, CFO (Chair) Alan L. Jones, Past CFO Brendan M. Patterson

FUND DEVELOPMENT

Steven J. Morgan (Chair) Peter L. Althausen Thomas J. Ellis Edward A. Perez Rena L. Stewart

Vendor Policy (Ad Hoc Committee of Fund Development) David J. Hak, CFO Andrew N. Pollak, President Timothy J. Bray, Immediate Past-President Robert A. Probe, President Elect James A. Goulet, Annual Meeting Program Chair

Laura J. Prokuski, RCFC Chair Alan L. Jones, Past CFO

Todd O. McKinley, 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 H. Richmond Heather A. Vallier Philip R. Wolinsky

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 Mark W. Richardson David C. Teague

MILITARY

LTC Romney C. Andersen (Chair) (Army) Robert J. Gaines (Navy) Christopher T. LeBrun (Air Force) LTC Joseph R. Hsu (Army) COL (Ret) Mark W. Richardson (Air Force)

PAST PRESIDENTS LIAISON

Timothy J. Bray, Immediate Past President (Chair) All past Presidents are committee members

PRACTICE MANAGEMENT

William R. Creevy (Chair) J. Scott Broderick David S. Brokaw Anthony F. Infante, Jr. James C. Krieg Michael S. Sirkin M. Bradford Henley (Presidential Consultant)

PROGRAM ANNUAL MEETING

James A. Goulet (Chair) Thomas F. Higgins (Co-Chair) Victor A. de Ridder Michael J. Gardner Pierre Guy Shepard R. Hurwitz Theodore Miclau, III Robert V. O'Toole John T. Ruth

Program Basic Science Sub Committee

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

Program Masters Level Coding Course William R. Creevy (Chair)

PUBLIC RELATIONS AND BRANDING

Jeffrey M. Smith (Chair) Joseph R. Cass Robert O. Crous, III Alex Jahangir Hasaan R. Mir Max Morandi Peter J. Nowotarski Craig S. Roberts (Presidential Consultant) Lisa K. Cannada (Newsletter)

Your Orthopaedic Connection (YOC)

Brett D. Crist and Steve A. Kottmeier, co-chair liaison with AAOS Charles M. Blitzer Christopher T. Born Joseph R. Cass Dan Coll Gregory J. Della Rocca Robert P. Dunbar, Jr. George M. Kontakis Max Morandi Lori K. Reed Lisa A. Taitsman

Social Media Project Team

Lisa A. Taitsman (Chair) Hassan R. Mir Robert P. Dunbar Erika J. Mitchell Edward K. Rodriguez Alexandra Schwartz

RESEARCH

Todd O. McKinley, (Chair) Brett D. Crist Gregory J. Della Rocca Kenneth A. Egol Bruce G. French Kyle J. Jeray Brian H. Mullis Steven A. Olson Hans-Christoph Pape George V. Russell Walter W. Virkus Robert D. Zura Edward J. Harvey (Presidential Consultant)

STRATEGIC PLANNING AND BOARD DEVELOPMENT

David C. Templeman, Chair - 2nd Past President Timothy J. Bray - Immediate Past President Andrew N. Pollak - President Robert A. Probe - President Elect Andrew H. Schmidt - 2nd President Elect David J. Hak - CFO

OTA PROJECT TEAMS

International Relationships William G. DeLong, Jr. (Chair) Jeffrey O. Anglen Peter V. Giannoudis Max Morandi Steven J. Morgan Saqib Rehman Andrew H. Schmidt Wade R. Smith David 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 Lisa K. Cannada - Communications
Michael Suk - Health Policy
William M. Ricci - Education
Todd O. McKinley – Research
Lisa K. Cannada – BOS Match Oversight Committee Chair
Mark A. Lee – BOS Match Oversight Committee OTA Rep
Kathleen Caswell - Executive Director
Jeffrey O. Anglen – BOS Chair
M. Bradford Henley – BOS Past Chair

ACS COT (American College of Surgeons

Committee on Trauma) Jeffrey O. Anglen (2013) Gregory J. Della Rocca (2014) William G. DeLong, Jr. (2013) Gregory Georgiadis (2013) Douglas W. Lundy (2014) Wade R. Smith (2014) David C. Teague (2012) Philip R. Wolinsky (2013)

OTA DISTINGUISHED VISITING SCHOLAR PROGRAM

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 in Afghanistan and Iraq prior to their return to the United 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 Dolfi Herscovici, Jr., MD Thomas F. Higgins, MD James J. Hutson, Jr., MD Kyle J. Jeray, MD Clifford B. Jones, MD Jonathan P. Keeve, MD James C. Krieg, MD L. Scott Levin, MD David W. Lhowe, MD David W. Lowenberg, MD Mark P. McAndrew, MD Michael D. McKee, MD Toni M. McLaurin, MD Michael A. Miranda, MD Steven J. Morgan, MD Brett C. Norris, MD Steven A. Olson, MD William T. Obremskey, MD 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: Ongoing Need for Volunteers!!

- Over 35 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

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

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.

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

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

- 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 <u>http://www.sign-post.org</u>.

Congratulations to the following OTA/SIGN Scholarship Winners:

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

- 2008 Duong Bunn, MD, Phnom Penh, Cambodia Oleg Gendin, MD, Krasnoyarsk, Russia
- 2009 Rizwan Akram, MD, Lahore, Punjab, Pakistan Patrick Sekimpi, MD, Kampala, Uganda
- 2010 Edmund Ndalama Eliezer, MD, Dar es Salaam, Tanzania
- 2011 Dr. Shahab ud Din, Hayatabad, Peshawar, KPK, Pakistan Dr. Tobias Otieno Ondiek, Kijabe, Kenya COL. Mohammad Ismail Wardak, MD, MS, Kabul, Afghanistan

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

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.

- 2010 "Travels with John 2.0" Sigvard T. Hansen, Jr., MD
- 2009 "Trauma Surgery Is Not Supposed To Be Easy" Lawrence B Bone, MD
- 2008 Orthopaedic Trauma Education: Industrial Strength? Peter G. Trafton, MD
- 2007 Once and Future Trauma Systems: Role of the Orthopaedic Surgeon A. Brent Eastman, MD, FACS
- 2006 Forty Years of Pelvic Trauma Looking Back, Looking Forward Marvin Tile, MD
- 2005 Delaying Emergency Fracture Care Fact or Fad Robert N. Meek, MD
- 2004 The Future of Education in Orthopaedic Surgery Michael W. Chapman, MD
- 2003 Tracking Patient Outcomes: Lessons Learned and Future Directions in Trauma Orthopaedics Ellen J. MacKenzie, PhD
- 2002 Thoughts on Our Future Progress in Acetabular and Pelvic Fracture Surgery Joel M. Matta, MD
- 2001 Cancelled
- 2000 The Metamorphosis of the Trauma Surgeon to the Reconstructionist *Jeffrey W. Mast, MD*
- 1999 The Changing Role of Internal Fixation A Lifetime Perspective Professor Martin Allgower, MD
- 1998 Travels with John: Blunt Multiple Trauma Sigvard T. Hansen, MD
- 1997 Trauma Care in Europe before and after John Border: The Evolution of Trauma Management at the University of Hannover *Professor Harald Tscherne, MD*

EDWIN G. BOVILL, Jr., MD AWARDS

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

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



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

EDWIN G. BOVILL, Jr., MD AWARDS, continued

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*

EDWIN G. BOVILL, Jr., MD AWARDS, continued

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

2011 CORPORATE DONORS - RESEARCH/EDUCATION (as of July 31, 2011)





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



ACKNOWLEDGMENTS

2011 CORPORATE DONORS - RESEARCH/EDUCATION, continued

Sponsors Award (\$5,000 - \$24,999) Ramon B. Gustilo, MD, OTA Founding President Orthopaedic Trauma Service (Florida Orthopaedic Institute, Tampa, Florida)*

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COTA Orthopaedic Trauma Fellowship Program Grants have been made available because of the generosity of three donor companies in supporting quality education to enhance future patient care. COTA is grateful for funding from *Smith & Nephew, Inc., Stryker Orthopaedics, and a pledge from Synthes, USA,* companies whose leadership has recognized the merit of the blinded selection process by non-conflicted orthopaedic trauma surgeons.



COTA is pleased to announce that the following twenty-one (21) Orthopaedic Trauma Fellowship Programs have received grants totaling \$1.3 Million:

Allegheny General Hospital, Drexel University School of Medicine, Pittsburgh, PA Daniel T. Altman, MD

> Brigham and Women's Hospital, Boston, MA Mark Vrahas, MD

Carolinas Medical Center Orthopaedic Trauma Fellowship, Charlotte, NC James F. Kellam, MD

Georgia Orthopaedic Trauma Institute, Macon, GA Lawrence X. Webb, MD

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> Reno Orthopaedic Trauma Fellowship, Reno NV *Timothy Bray, MD*

CENTER FOR ORTHOPAEDIC TRAUMA ADVANCEMENT ACKNOWLEDGMENTS, Continued

Saint Louis University Orthopaedic Trauma Fellowship, St. Louis, MO J. Tracy Watson, MD

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COTA is grateful to Smith & Nephew for additional funds which enabled COTA to award both research and resident education grants.



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COTA office address: 6300 N. River Road, Rosemont, IL 60018-4226 website: www.cotagrants.org • e-mail address: office@cotagrants.org

OTA 2011 RESEARCH GRANT AWARD RECIPIENTS

OTA DIRECTED TOPIC CLINICAL STUDY

Title: Qualification and Susceptibilities of Microbial Flora in Open Fractures Principal Investigator: Samir Mehta, MD Co-Principal Investigator: Paul Matuszewski, MD Grant Funded by: Zimmer/OTA

CLINICAL GRANT APPLICATIONS

Title: A Multicentre, Randomized Trial of Simple Decompression Versus Anterior Transposition of the Ulnar Nerve for Acute, Displaced Fractures of the Distal Humerus Treated With Plate Fixation Principal Investigator: Emil Schemitsch, MD, FRCSC Co-Principal Investigator: Michael McKee, MD, FRCSC Grant Funded by: Synthes/OTA

Title: A Multicentre, Randomized Trial of Conservative Treatment Versus Operative Plate Fixation for Acute, Displaced Fractures of the Distal Clavicle Principal Investigator: Jeremy Hall, MD, FRCSC Co-Principal Investigator: Michael McKee, MD, FRCSC Grant Funded by: COTA/Smith & Nephew

Title: Randomized Clinical Trial of Suprapatellar Versus Infrapatellar Tibial Nailing Principal Investigator: Roy Sanders, MD Grant Funded by: DePuy, A Johnson & Johnson Company/OTA

BASIC RESEARCH GRANTS

Title: The Use of Implantable Radio-Frequency Micromachined Capacitive Sensor Chips to Monitor Compartment Pressures in the Lower Limb Principal Investigator: Edward Harvey, MD, MSc Co-Principal Investigator: Vamsy Chodavarapu, PhD Grant Funded by: DePuy, A Johnson & Johnson Company/OTA

Title: Forceps Reduction of the Syndesmosis in Rotational Ankle Fractures: A Cadaveric Study and Prospective Case Series Principal Investigator: Phinit Phisitkul, MD Co-Principal Investigator: J. Lawrence Marsh, MD Grant Funded by: COTA/Smith & Nephew

Title: Effect of BMP-2 and MP-7 on Articular Cartilage Following Impact Load Principal Investigator: Paul Chin, MD, PhD Co-Principal Investigator: Joseph Borellli, Jr., MD Grant Funded by: Medtronic/OTA

Title: The Effect of Late Type Endothelial Progenitor Cells on Augmentation of Angiogenesis and Osteogenesis in a Segmental Bone Defect Model Principal Investigator: Ru Li, PhD Co-Principal Investigator: Emil Schemitsch, MD Grant Funded by: COTA/Smith & Nephew

OTA 2011 RESIDENT GRANT AWARD RECIPIENTS

(January 1 - December 31, 2011 Grant Cycle)

\$10,000 RESIDENT GRANT RECIPIENTS

Principal Investigator: **Brian Werner, MD**; Co-Investigator: **Frank Shen, MD** Grant Title: **Human Adipose-Derived Stem Cells In a PLGA Nanofiber Scaffold for Spine Fusion** Grant Funded by: **Foundation for Orthopaedic Trauma (FOT)/OTA**

Principal Investigator: Dennis Meredith, MD; Co-Investigator: Joseph Lane, MD Grant Title: The Effect of CT Scan Resolution on Fragility Fracture Risk Assessment Using the Heterogeneity of Bone Tissue Mineral Density Grant Funded by: Foundation for Orthopaedic Trauma (FOT)/OTA

Principal Investigator: **Scott Hadley, MD**; Co-Investigator: **Kenneth Egol, MD** Grant Title: **The Role of Ankylosis Protein In Bone Healing** Grant Funded by: **Foundation for Orthopaedic Trauma (FOT)/OTA**

Principal Investigator: Eric Swart, MD; Co-Investigator: Rosenwasser Melvin, MD Grant Title: A Complete Analysis of the Costs of Distal Radius Fractures Grant Funded by: Medtronic/OTA

Principal Investigator: Sasha Carsen, MD; Co-Investigator: Feibel John Robert, MD Grant Title: Post-Operative Radiographic Outcomes of Closed Diaphyseal Femur Fractures Treated with the SIGN Intra-Medullary Nail Grant Funded by: Medtronic/OTA

Principal Investigator: Marie Walcott, MD; Co-Investigator: John Wixted, MD Grant Title: Role of Htra1 in the Transition from Cartilage to Bone In Fracture Healing Grant Funded by: OTA

Principal Investigator: Josh Murphy, MD; Co-Investigator: Bruce Ziran, MD Grant Title: Mechanical Competence of Antibiotic-Laden, Bioabsorbable Bone Cement Grant Funded by: OTA

Principal Investigator: Britt Miller, MD; Co-Investigator: Bruce Ziran, MD Grant Title: The Utility of Reprocessed Drill Bits for Surgery; Performance Characterization of OEM, Used, and Reprocessed Grant Funded by: OTA

Principal Investigator: **Matthew Dietz, MD**; Co-Investigator: **David Hubbard, MD** Grant Title: **Vascularity of the Lateral Tibial Plafond After Ankle Fracture-Dislocation** Grant Funded by: **OTA**

Principal Investigator: **Benjamin Taylor, MD**; Co-Investigator: **Kevin Pugh, MD** Grant Title: **A Biomechanical Evaluation and Comparison of 6.5mm Cannulated Headless Compression Screws** Grant Funded by: **OTA**

OTA 2011 RESIDENT GRANT AWARD RECIPIENTS

(June 1, 2011 - May 30, 2012 Grant Cycle)

Following is the list of the Resident Grants awarded by the OTA Research Committee on February 16, 2011 at the AAOS Annual Meeting / Specialty Day.

\$10,000 RESIDENT GRANT RECIPIENTS

Principal Investigator: Jesse Emory Bible, MD, MHS Co-Investigator: William T. Obremskey, MD Grant Title: The Effect of Plasminogen Deficiency on Fracture Healing Grant Funded by: OTA

Principal Investigator: Gerard Slobagean, MD, MPH Co-Investigator: Peter J. O'Brien, MD Grant Title: Open Reduction and Plate Fixation of Flail Chest: A Randomized Controlled Feasibility Study Grant Funded by: OTA

Principal Investigator: Xudong Li, MD, PhD Co-Investigator: Quanjun Cui, MD Grant Title: Total Joint Tissue Engineering for the Young Trauma Patient Grant Funded by: OTA

Principal Investigator: Joel Williams, MD Co-Investigator: Mark A. Lee, MD Grant Title: The Role of Mechanical Environment in a Rodent Critical-Sized Defect Using a Novel Fixator Grant Funded by: OTA

Principal Investigator: Sanjit Konda, MD Co-Investigator: Kenneth A. Egol, MD Grant Title: CT Scan to Detect Intra-Articular Air in the Knee Joint: A Cadaver Model to Define Imaging Protocol Grant Funded by: OTA

Principal Investigator: Tameem Yehyawi, MD Co-Investigator: J. Lawrence Marsh, MD Grant Title: Articular Fracture Reduction Training for Orthopaedic Residents Through Pre-Operative Planning and Simulation Grant Funded by: OTA

Principal Investigator: Erin Prewitt, MD Co-Investigator: Eric Miller, MD Grant Title: Effects of Physical Therapy on Functional Outcomes in Operatively Treated Ankle Fractures: A Prospective Study Grant Funded by: OTA

OTA GRATEFULLY ACKNOWLEDGES THE FOLLOWING EXHIBITORS FOR THEIR SUPPORT OF THE 27TH ANNUAL MEETING:

| Booth # | Company Names | City, State |
|---------|---|------------------------|
| 412 | ACUMED | Hillsboro, OR |
| 423 | Advanced Orthopaedic Solutions (AOS) | Torrance, CA |
| 92 | AIP | Daytona Beach, FL |
| 214 | AO North America | Paoli, PA |
| 96 | Arthrex, Inc. | Naples, FL |
| 216 | Aspen Medical Products | Irvine, CA |
| 91 | Axogen, Inc. | Alachua, FL |
| 107 | Biomet | Warsaw, IN |
| 422 | BioMimetic Therapeutics | Franklin, TN |
| 324 | Bone Foam/Excel Medical Solutions, Inc. | Plymouth, MN |
| 94 | CFI Medical Solutions | Fenton, MI |
| 114 | DePuy Orthopaedics | Warsaw, IN |
| 416 | Exactech, Inc. | Gainesville, FL |
| 115 | Extra Ortho, Inc. | Memphis, TN |
| 93 | I.T.S. USA | Maitland, FL |
| 317 | Innovision, Inc. | Memphis, TN |
| 321 | The Journal of Bone & Joint Surgery | Needham, MA |
| 123 | Lilly USA, LLC. | Indianapolis, IN |
| 99 | Lippincott Williams & Wilkins - A Walters-Kluwer Company | Philadelphia, PA |
| 101 | Medtronic | Memphis, TN |
| 224 | Mizuho OSI | Union City, CA |
| 95 | ODI North America | Tampa, FL |
| 425 | Olympus Biotech Corporation | Hopkinton, MA |
| 220 | Orthofix SRL | Bussolengo (VR), Italy |
| 322 | Orthohelix Surgical Designs, Inc. | Medina, OH |
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| 421 | PFS Med, Inc. | Eugene, OR |
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| 320 | Sawbones | Vashon, WA |
| 125 | Shanghai Bojin Electric Instrument & Device Co., Ltd. | Shanghai, China |
| 315 | Skeletal Dynamics | Miami, FL |
| 106 | Smith & Nephew Inc. | Cordova, TN |

EXHIBITORS LISTING, continued

Booth # Company Names

- 119 Sonoma Orthopedic Products
- 127 Starr Frame LLC
- 300 Stryker
- 200 Synthes
- 319 Tornier
- 410 TriMed, Inc.
- 117 Twin Star ECS
- 121 Wound Care Technologies, Inc.
- 308 Zimmer

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contributions and achievements.



International Trauma Care Forum

Wednesday, October 12 - 7:45 am - 5:00 pm

Guest Nation Symposium

Wednesday, October 12 – 3:49 - 4:49 pm Treatment of Infected Non Union of Tibia; Italian and American Perspective

OTA International Reception

Wednesday, October 12 - 5:30 - 6:30 pm (Marriott Rivercenter Hotel - Sazos, Level 2) All International Attendees Invited

| INTERNATIONAL] Int'l Poster #1 (p. 387) | POSTER LISTING Intramedullary Nailing in Distal Tibial Fractures With an Anatomic Rod F. Biggi ¹ ; C. D'Antimo ¹ ; S. Di Fabio ¹ ; F. Isoni ² ; D. Salfi ¹ ; S. Trevisani ¹ ; ¹ Trauma Department at San Martino Hospital, Belluno, Italy; ² Resident at Cagliari University, Cagliari, Italy |
|--|---|
| Int'l Poster #2 (p. 388) | Percutaneus Trans-Ileo-Sacral Screw in Unstable Pelvic Injury: Comparison Between CT-Guided Technique and Image Intensifier Technique G. Lucidi; C. Ercolani; F. Lamponi; M. Trono; U.O. Ortopedia e Traumatologia Azienda Ospedaliera Rimini Ospedale Infermi, Rimini, Italy |
| Int'l Poster #3 (p. 389) | Reverse Total Shoulder Replacement Versus Hemiarthroplasty for Proximal Humeral Fractures R. Castricini¹; N. Panfoli¹; R. Nittoli¹; M. Di Benedetto²; F. Di Luggo³; N. Pace¹; ¹U.O. di Ortopedia e Traumatologia, ASUR Marche, Ospedale Civile, Jesi, Italy; ²U.O. di Ortopedia e Traumatologia, Maria Cecilia Hospital, GVM Care and Research, Cotignola, Ravenna, Italy; ³Clinica Ortopedica, Azienda Ospedaliero Universitaria, Ospedali Riuniti, Ancona, Italy |

Guest Nation: International Posters – WEDNESDAY, OCTOBER 12, 2011

| Int'l Poster #4 (p. 390) | The Effect of Reaming of Long Bone Fractures on Translocation of Mesenchymal Stem Cells <i>Tarek A.A.R.A.R. Roshdy, MD; Peter V. Giannoudis, MD;</i> <i>Elena Jones, PhD; Dennis McGonagle, PhD;</i> <i>Section of Musculoskeletal Disease, LIMM,</i> <i>The University of Leeds, Leeds, United Kingdom</i> |
|-------------------------------------|--|
| Int'l Poster #5 (p. 391) | Spinal Shock in Spinal Cord Injuries: Is Duration of Shock Related to Neurological Level? Rajeshwar Nath Srivastava, MD; Sanjeev Arya, MD; KG Medical College, CSM Medical University, Lucknow, India |
| Int'l Poster #6 (p. 392) | The Treatment of Ankle Fractures in Patients with Diabetes Mellitus <i>Talaat Al-Atassi, MD; Daud T.S. Chou, MD; Mohammad Ali, MD;</i> <i>Chris Boulton; Christopher G. Moran, MD;</i> <i>Nottingham University Hospital, Queens Medical Centre,</i> <i>Nottingham, United Kingdom</i> |
| Int'l Poster #7 (p. 393) | Patient Outcomes after Total Hip Replacement for Displaced Hip Fractures: A Matched Cohort Study Raymond E. Anakwe, MRCS, Ed; Scott D. Middleton, MB, ChB; Paul J. Jenkins, MRCS, Ed; Alison P. Butler, BMed, Sci; John F. Keating, FRCS, Ed (Tr&Orth); Matthew Moran FRCS, Ed(Tr&Orth); Orthopaedic Trauma Unit, Royal Infirmary, Edinburgh, Scotland, United Kingdom |
| Int'l Poster #8 (p. 395) | Outcomes after Pipkin Fractures of the Femoral Head Samuel Molyneux, MRCS, MSc.; Tim White, FRCS, MD; New Royal Infirmary of Edinburgh, Scotland, United Kingdom |
| Int'l Poster #9 (p. 397) | Predictors of Patient Mortality with Deep Infection after Hip Fracture Surgery <i>Andrew D. Duckworth, MSc, MRCSEd; Sally-Anne Phillips; Oliver Stone;</i> <i>Matthew Moran, FRCS, Ed(Tr&Orth); Leela C. Biant;</i> <i>Edinburgh Orthopaedic Trauma Unit, Royal Infirmary of Edinburgh,</i> <i>Edinburgh, Scotland, United Kingdom</i> |
| Int'l Poster #10 (p. 398) | Locked Percutaneous Compression Plating versus Third Generation Nailing for Unstable Intertrochanteric Femur Fractures Matthias Knobe, MD; Pia Antony, MD; Saskia Catharina Mooij, MD; Richard Martin Sellei, MD; Roman Pfeifer, MD; Wolf Drescher, MD, PhD; Hans-Christoph Pape, MD, FACS; Dept. of Orthopedic and Trauma Surgery, Medical Faculty, RWTH Aachen University, Aachen, Germany |
| Int'l Poster #11 (p. 399) | Subtrochanteric Fracture Non-unions with Implant Failure Managed with the Diamond Concept Mudussar A. Ahmad, MD; Oghor Opakponovwe, MD; Michael Mokawem, MD; Nikolaos K. Kanakaris, MD; Peter V. Giannoudis, MD; Leeds General Infirmary, Leeds, United Kingdom |

Guest Nation: International Posters – WEDNESDAY, OCTOBER 12, 2011

| Int'l Poster #12 (p. 400) | Prehospital Mortality of Trauma – An Analysis of Patients Declared "Dead on Arrival" Nikolaos K. Kanakaris, MD^{1,2}; Thomas Goff, MD¹, Robert M. West, MD¹; Christos Leukidis, MD³; Iordanis N. Papadopoulos, MD²; ¹Academic Department of Trauma and Orthopaedics, University of Leeds, Leeds, United Kingdom; ²Academic Department of General Surgery, University of Athens, Athens, Greece; ³Forensic Department of Athens, Athens, Greece |
|-------------------------------------|--|
| Int'l Poster #13 (p. 401) | Reduction of the SI Joint With Ilio-Sacral Screws: What is the Correlation With Long Term Outcome? <i>Andrew J.B. Tasker; Koye Odutola; Chris Morey; Rebecca Fox;</i> <i>Anthony J. Ward; Tim J.S. Chesser;</i> <i>Pelvic and Acetabular Reconstruction Unit, Frenchay Hospital,</i> <i>North Bristol NHS Trust, Bristol, United Kingdom</i> |
| Int'l Poster #14 (p. 403) | Pelvic Fracture Classification as a Key to Transfusion Requirements Nikolaos K. Kanakaris, MD; Oghor Opakponovwe, MD ; Vassilios S. Nikolaou, MD; Giles Moseley, MD; Peter V. Giannoudis, MD ; Academic Department of Trauma and Orthopaedics, Leeds Teaching Hospitals, School of Medicine, University of Leeds, Leeds, United Kingdom |
| Int'l Poster #15 (p. 404) | Analysis of Outcomes and Complications in Combined Pelvic and Abdominal Trauma – An Analysis of the Trauma Registry of DGU Roman Pfeifer, MD ¹ ; Philipp Kobbe, MD ¹ ; Philipp Lichte, MD ¹ ; Matthias Knobe, MD ¹ ; Robert L. Garrison, MD ² ; Rolf Lefering, MD ³ ; Hans-Christoph Pape, MD, FACS ¹ ; ¹ Department of Orthopedic Trauma Surgery, University of Aachen Medical Center, Aachen, Germany; ² University of Oklahoma-Tulsa, Orthopaedic Trauma Services of Oklahoma, Tulsa Oklahoma, USA; ³ Institute for Research in Operative Medicine, University of Witten/Herdecke, Cologne, Germany |
| Int'l Poster #16 (p. 405) | Reconstruction of Segmental Defects in Long Bones of the Lower Limbs Carlos F. Sancineto, MD; Jorge D. Barla, MD; Eliseo Firman, MD; Hospital Italiano de Buenos Aires, Buenos Aires, Argentina |
| Int'l Poster #17 (p. 406) | Lengthening Over a Plate in Post-Traumatic Limb Reconstruction Associated to Axial Deformity Carlos Sancineto, MD; Jorge Barla, MD; Gabriel Mecozzi, MD; Guido Carabelli, MD; Hospital Italiano de Buenos Aires, Buenos Aires, Argentina |
| Int'l Poster #18 (p. 407) | Minimally Invasive Tibial Naiing – Does it Avoid the Patella Tendon? Mr. Gunasekaran Kumar, MS Orth, FRCS Glasg (Tr&Orth); Mr. Badri Narayan, MS Orth, MCh Orth, FRCS (Tr&Orth); Royal Liverpool University Hospital, Liverpool, United Kingdom |
| Int'l Poster #19 (p. 408) | Reducing Fractures: Have You Thought of Using Ultrasound? <i>Manish Gaur, MCEM</i> ; York Hospital NHS Trust, York, United Kingdom |





2011 BASIC SCIENCE FOCUS FORUM WEDNESDAY, OCTOBER 12, 2011

| 6:30 am | Registration and Continental Breakfast (Marriott Riverwalk, Alamo Ballroom Foyer) |
|--|--|
| | Speaker Ready Room (Marriott Riverwalk, Alamo Ballroom Foyer) |
| 7:25 am | Introduction: Theodore Miclau, III, MD, Program Chair |
| 7:30 am – 8:50 am (Notes p. 117) | SYMPOSIUM 1: BIOMECHANICS: CHOOSING THE RIGHT MODEL Moderators: Steven A. Olson, MD Louis E. DeFrate, PhD |
| 7:30 am | Selecting the Right Specimens: Do Materials Matter? J. Lawrence Marsh, MD |
| 7:40 am | Sample Size: How Many is Enough? Louis E. DeFrate, PhD |
| 7:50 am | Critical Variables (Stiffness, Strain, Etc.) What Is Best? Donald D. Anderson, PhD |
| 8:05 am | Dynamic Versus Static Testing: What Is the Best? <i>Loren L. Latta, PhD</i> |
| 8:15 am | Avoiding Common Pitfalls in Study Design Steven A. Olson, MD |
| 8:30 am | Discussion |
| | Key: Δ = presentation was funded by an OTA administered grant |

Names in bold = Presenter

See pages 77 - 115 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 411.

| 8:50 am – | PAPER SESSION 1: |
|---------------------------------|---|
| 10:04 am | BIOMECHANICS |
| | Moderators: Steven A. Olson, MD |
| | Louis E. DeFrate, PhD |
| 8:50 am | Overview: Steven A. Olson, MD |
| 9:00 am (p. 118) Paper #1 | Δ Filling Empty Screw Holes Does Not Improve the Fatigue Life of the Fixation Construct in Comminuted Supracondylar Femoral Fractures <i>Reza Firoozabadi, MD; Erik McDonald, BS; Thuc-Quyen Nugyen, BS;</i> <i>Jenni M. Buckley, PhD; Utku Kandemir, MD;</i> <i>Dept. of Orthopaedic Surgery, University of California San Francisco,</i> <i>San Francisco, California, USA</i> |
| 9:06 am (p. 119) Paper #2 | Biomechanical Comparison of a Long Retrograde Intramedullary Supracondylar Femoral Nail Versus a Lateral Locked Plate in a Cadaveric Femur Fracture Model Matthew R. Craig, MD, MS ¹ ; Andrew L. Freeman, MSE ² ; Derek Goerke, BS ² ; Paul Lafferty, MD ³ ; Robert A. Morgan, MD ⁴ ; Richard F. Kyle, MD ⁵ ; ¹ Temple University, Dept. of Orthopaedics, Philadelphia, Pennsylvania, USA; ² Excelen, Minneapolis, Minnesota, USA; ³ Cooper University Hospital, Camden, New Jersey, USA; ⁴ Regions Hospital, St. Paul, Minnesota, USA; ⁵ Hennepin County Medical Center, Minneapolis, Minnesota, USA |
| 9:12 am (p. 120) Paper #3 | Use of Acute Shortening Versus Bridging Plate for Highly Comminuted OTA 21-B1.3(1) Unreconstructable Olecranon Fractures <i>Akira Yamamoto, MD</i> ; <i>Meir Marmor, MD</i> ; <i>David Friedberg, MD</i> ; <i>Erik McDonald, BS; Eric Meinberg, MD</i> ; <i>University of California, San Francisco, California, USA</i> |
| 9:18 am (p. 121) Paper #4 | The Effects of Locked and Unlocked Neutralization Plates on Load Bearing of Fractures Fixed With a Lag Screw <i>Richelle C. Takemoto, MD</i> ; Michelle T. Sugi, MD; Fredrick J. Kummer, PhD; Kenneth J. Koval, MD; Kenneth A. Egol, MD; NYU Hospital for Joint Diseases, New York, New York, USA |
| 9:24 am | Discussion |
| 9:32 am (p. 122) Paper #5 | Δ The Effect of Cannulated Lag Screw Placement and Tension Band Wiring on Patellar Fracture Fixation: A Cadaveric Biomechanical Study <i>Eric Henderson, MD</i> ¹ ; <i>Brandon Santoni, PhD</i> ² ; <i>Aniruddh Nayak, MS</i> ² ; <i>Andres Cabezas, BS</i> ² ; <i>Richard Cain, MD</i> ¹ ; <i>Riley Hale, MD</i> ¹ ; <i>H. Claude Sagi, MD</i> ¹ ¹ Dept. of Orthopaedic Surgery, University of South Florida, Tampa, Florida, USA; ² Phillip Spiegel Orthopaedic Research Laboratory, Foundation for Orthopaedic Research and Education, Tampa, Florida, USA |

 Δ OTA Grant See pages 77 - 115 for financial disclosure information.

| 9:38 am (p. 123) Paper #6 | Is Dynamic Locking the Answer in Some Complex Proximal Femoral Fractures? A Biomechanical Study Benjamin Ollivere, FRCS (Tr & Orth), MD; Markus Baker, MRCS; Simon T. Donell, FRCS(Orth), MD; Nish Chirodian, FRCS (Tr & Orth); James Wimhurst, FRCS (Tr & Orth); Norfolk & Norwich University Hospital NHS Trust, Norwich, United Kingdom |
|--|--|
| 9:44 am (p. 125) Paper #7 | A Biomechanical Comparison of Intramedullary and Volar Plate Fixation of Distal Radius Fractures R.J. van Kampen, MD¹; A.R. Thoreson, MS²; N.J. Knutson, MS³; J.E. Hale, PhD³; Steven L. Moran, MD¹; ¹Dept. of Plastic Surgery, Mayo Clinic, Rochester, Minnesota, USA; ²Orthopedic Biomechanics Laboratory, Dept. of Orthopedic Surgery, Mayo Clinic, Rochester, Minnesota, USA; ³Conventus Orthopaedics Inc., Maple Grove, Minnesota, USA |
| 9:50 am (p. 126) Paper #8 | Comparison of Two Techniques for Proximal Fixation of Periprosthetic Fractures: A Biomechanical Study Mark Lenz, MD ¹ ; Markus Windolf, MSc ¹ ; Thomas Mückley, MD ² ; Gunther O. Hofmann, MD, PhD ² ; Michael Wagner, MD ³ ; R. Geoff Richards, PhD ¹ ; Karsten Schwieger, PhD ¹ ; Boyko Gueorguiev, PhD ¹ ; ¹ AO Research Institute Davos, Davos, Switzerland; ² Clinic for Trauma, Hand and Reconstructive Surgery, Friedrich Schiller University, Jena, Germany; ³ Wilhelminenspital der Stadt Wien, Vienna, Austria |
| 9:56 am | Discussion |
| 10:04 am | Break |
| 10:20 am – 11:30 am (Notes p. 127) | SYMPOSIUM 2: HETEROTOPIC OSSIFICATION Moderators: Theodore Miclau, III, MD Michael J. Bosse, MD |
| 10:20 am | The Pathophysiology of Heterotopic Ossification <i>Aaron Nauth, MD</i> |
| 10:30 am | Heterotopic Ossification Prophylaxis in Orthopaedic Trauma Patients Michael J. Bosse, MD |
| 10:40 am | Treating Heterotopic Ossification in Fracture Patients Jeffrey O. Anglen, MD |
| 10:50 am | Blast Injuries and Heterotopic Ossification CPT Frederick P. O'Brien, MD |
| 11:00 am | CNS Injury and Heterotopic Ossification Samir Mehta, MD |
| 11:10 am | Discussion |

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| 11:30 am – 12:12 pm | PAPER SESSION 2: HETEROTOPIC OSSIFICATION Moderators: Theodore Miclau, III, MD Michael J. Bosse, MD |
|-----------------------------------|---|
| 11:30 am | Overview: Leon J. Nesti, MD |
| 11:40 am (p. 128) Paper #9 | VEGF mRNA Expression in EPC Local Therapy for a Rat Segmental Bone Defect <i>Ru Li, MD, PhD; Erion Qamirani, MD, PhD; Aaron Nauth, MD; <i>Kivanc Atesok, MD; Emil H. Schemitsch, MD, FRCS(C);</i> <i>St. Michael's Hospital, University of Toronto, Toronto, Ontario, Canada</i></i> |
| 11:46 am (p. 129) Paper #10 | BMP Regulation of Mesenchymal Progenitor Cells in Regenerating Muscle Tissue Matthew W. Kluk, MD^{1,2}; Youngmi Ji, PhD²; Orna Amrani, MD²; Wesley M. Jackson, PhD²; Leon J. Nesti, MD^{1,2}; ¹Dept. of Orthopaedics and Rehabilitation, Walter Reed Army Medical Center, Washington, District of Columbia, USA; ²Clinical and Experimental Orthopaedics Laboratory, National Institute of Arthritis and Musculoskeletal and Skin Diseases, National Institutes of Health, Bethesda, Maryland, USA |
| 11:52 am (p. 131) Paper #11 | Gene Expression and Regulation in the Formation of Heterotopic Ossification Jared Vogler, DO ^{1,2} ; Emily Shin, MD ^{1,2} ; Amber B. Aragon, MD ² ; Matthew W. Kluk, MD ^{1,2} ; Youngmi Ji, PhD ² ; Wesley M. Jackson, PhD ² ; Leon J. Nesti, MD ^{1,2} ; ¹ Dept. of Orthopaedics and Rehabilitation, Walter Reed Army Medical Center, Washington, District of Columbia, USA; ² Clinical and Experimental Orthopaedics Laboratory, National Institute of Arthritis and Musculoskeletal and Skin Diseases, National Institutes of Health, Bethesda, Maryland, USA |
| 11:58 am (p. 133) Paper #12 | The Effect of Reaming of Long Bone Fractures on Translocation of Mesenchymal Stem Cells Tarek Roshdy, MD; Peter V. Giannoudis, MD ; Elena Jones, PhD; Dennis McGonagle, PhD; Section of Musculoskeletal Disease, LIMM, The University of Leeds, Leeds, United Kingdom |
| 12:04 pm | Discussion |
| 12:12 pm – 1:15 pm | Lunch |

See pages 77 - 115 for financial disclosure information.

| 1:15 pm -SYMPOSIUM 3:2:20 pmCOMPARTMENT SYNDROME: NEW TECHNOLOGIES(Notes p. 134)Moderators: Edward J. Harvey, MD Gregory K. Berry, MD | | | |
|--|--|--|--|
| 1:15 pm | m Non-Operative Management of Compartment Syndrome <i>David W. Sanders, MD</i> | | |
| 1:25 pm | Non-Invasive Compartment Monitoring Gregory K. Berry, MD | | |
| 1:35 pm | Invasive Compartment Monitoring Andrew H. Schmidt, MD | | |
| 1:45 pm | Compartment Syndrome: Emerging Concepts and Technologies <i>Edward J. Harvey, MD</i> | | |
| 2:00 pm Discussion | | | |
| 2:20 pm – 3:01 pm | PAPER SESSION 3: SOFT-TISSUE TREATMENT Moderators: Edward J. Harvey, MD Gregory K. Berry, MD | | |
| 2:20 pm | Overview: Edward J. Harvey, MD | | |
| 2:35 pm (p. 135) Paper #13 | Comparison of Chlorhexidine and Saline for Irrigating a Contaminated Open Fracture Model Jowan G. Penn-Barwell, MRCS^{1,2}; Clinton K. Murray, MD³; Joseph C. Wenke, PhD¹; ¹US Army Institute of Surgical Research, Fort Sam Houston, San Antonio, Texas, USA; ²Academic Dept. of Military Surgery and Trauma, Royal Centre for Defense Medicine, Birmingham, United Kingdom; ³Brooke Army Medical Center, Fort Sam Houston, Texas, USA | | |
| 2:41 pm Paper #14 | WITHDRAWN | | |

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| 2:41 pm (p. 138) Paper #15 | Retinoid Signaling by a Selective Retinoid Acid Receptor Agonist Hinders Angiogenesis, Formation of Granulation Tissue and Wound Closure in Cutaneous Models of Wound Healing Steven Grijalva, MD ^{1,2,3} ; Khairul Anam, PhD ¹ ; Yelena Lazdun, BS ¹ ; Mihret Amare, BS ¹ ; Jonathan A. Forsberg, MD ^{2,3} ; Benjamin K. Potter, MD ^{2,3,4} ; Eric A. Elster, MD ^{1,4} ; Thomas A. Davis, PhD ^{1,4} ; ¹ Regenerative Medicine Department, Naval Medical Research Center, Silver Spring, Maryland, USA; ² Dept. of Orthopedic Surgery, Walter Reed Army Medical Center, Washington, District of Columbia, USA; ³ Dept. of Orthopedic Surgery, National Naval Medical Center, Bethesda, Maryland, USA; ⁴ Dept. of Surgery, Uniformed Services University of the Health Sciences, Bethesda, Maryland, USA | | |
|--|--|--|--|
| 2:47 pm (p. 139) Paper #16 | Gentamicin for Open Fractures in Trauma Patients: Is it Safe? David Zamorano, MD; Jason H. Lee, MD ; Michael L. Nguyen, MD; Matthew Griffin, BS; University of California Irvine Medical Center, Orange, California, USA | | |
| 2:53 pm Discussion | | | |
| 3:01 pm | Break | | |
| 3:25 pm – 4:35 pm (Notes p. 140) | SYMPOSIUM 4: ADVANCES IN BIOMATERIALS AND SURFACE TECHNOLOGIES Moderators: Theodore Miclau, III, MD R. Geoff Richards, PhD | | |
| 3:25 pm | 3:25 pm Advances in Implant Surface Technologies David Grainger, PhD | | |
| 3:40 pm | Manipulating Osseointegration Through Material Surface Modification R. Geoff Richards, PhD | | |
| 3:55 pm | 3:55 pm Current Strategies in Anti-Infective Surfaces Fintan Moriarty, PhD | | |
| 4:05 pm | New Trauma Implant Technologies: Will Coatings Make a Difference <i>R. Trigg McClellan, MD</i> | | |
| 4:15 pm | Discussion | | |

See pages 77 - 115 for financial disclosure information.

| 4:35 p 5:17 p | om – om | PAPER SESSION 4: BIOMATERIALS AND SURFACE TECHNOLOGIES Moderators: Theodore Miclau, III, MD R. Geoff Richards, PhD | |
|------------------|----------------------------------|---|--|
| 4 | 4:35 pm | Overview: R. Geoff Richards, PhD | |
| 4 (F | 4:45 pm (p. 141) Paper #17 | Bone-Implant Interface Strength and Peri-Implant Bone Response to a Biodegradable Magnesium Alloy Implant and a Self-Reinforced PLGA Copolymer Control: Findings in a Transcortical Rat Model Richard A. Lindtner, MD ¹ ; Christoph Castellani, MD ² ; Peter Hausbrandt, MD ² ; Elmar K. Tschegg, PhD ³ ; Stefanie E. Stanzl-Tschegg, PhD ⁴ ; Annelie-Martina Weinberg, PhD ² ; ¹ Dept. of Trauma Surgery, Medical University Innsbruck, Innsbruck, Austria; ² Dept. of Pediatric and Adolescent Surgery, Medical University of Graz, Graz, Austria; ³ Institute for Building Construction and Technology, Vienna University of Technology, Vienna, Austria; ⁴ Institute of Physics and Materials Science, University of Natural Resources and Life Sciences, Vienna, Austria | |
| 4 (1 | 4:51 pm (p. 143) Paper #18 | Novel Antimicrobial Surface for Fracture Fixation Devices with Long-Term Stability Christopher R. Loose, PhD; Karen A. Schultz, PhD; Hao Wang, PhD; Koby J. Elias, BS; Semprus BioSciences, Cambridge, Massachusetts, USA | |
| 4 (F | 4:57 pm (p. 144) Paper #19 | Decreasing Complications in External Fixation Pins Via Time-Released Nitric Oxide Coatings William W. Kesler, III, AB ¹ ; Ken J. Addison ¹ ; Adriel M. Watts, BS ¹ ; Paul S. Weinhold, PhD ² ; Joshua B. Holt, BS ¹ ; Wesley L. Storm, BS ³ ; Mark H. Schoenfisch, PhD ³ ; Laurence E. Dahners, MD ² ; University of North Carolina School of Medicine, Chapel Hill, North Carolina, USA; ² Dept. of Orthopaedic Surgery, University of North Carolina, Chapel Hill, North Carolina, USA; ³ Dept. of Chemistry, University of North Carolina, Chapel Hill, North Carolina, USA | |
| 5 (I | 5:03 pm (p. 145) Paper #20 | Testing for Contrasting Infection Rates and Biofilm Formation Among Biomaterials in an In Vitro Biofilm Infection Model Brian Stover, BS ¹ ; Zalman Vaksman, MS ¹ ; Heidi B. Kaplan, PhD ¹ ; Catherine G. Ambrose, PhD ² ; Milan K. Sen, MD ² ¹ Dept. of Microbiology and Molecular Genetics, ² Department of Orthopaedic Surgery, UT Health, Houston, Texas, USA | |
| 5 | 5:09 pm | Discussion | |
| 5 | 5:17 pm | Adjourn Evening on your own | |

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2011 BASIC SCIENCE FOCUS FORUM THURSDAY, OCTOBER 13, 2011

| Registration and Continental Breakfast (Marriott Riverwalk, Alamo Ballroom Foyer) | |
|---|--|
| Speaker Ready Room | |
| | |

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

7:30 am– SYMPOSIUM 5:

 8:40 am
 PHYSIOLOGICAL CHALLENGES TO BONE REPAIR

 (Notes p. 146)
 Moderators: Joseph Borrelli, Jr., MD Hans-Christoph Pape, MD

- 7:30 am **Hypovitaminosis** Joseph M. Lane, MD
- 7:40 am Chronic Inflammation David J. Hak, MD, MBA
- 7:50 am **Diabetes** Sheldon S. Lin, MD
- 8:00 am Aging Peter V. Giannoudis, MD
- 8:10 am **Polytrauma** LTC Joseph R. Hsu, MD
- 8:20 am Discussion

| 8:40 am – | PAPER SES | PAPER SESSION 5: | | |
|-----------|-------------------------------------|--------------------------|--|--|
| 9:22 am | PHYSIOLOGICAL CHALLENGES TO HEALING | | | |
| | Moderators: | Joseph Borrelli, Jr., MD | | |
| | | Hans-Christoph Pape, MD | | |

- 8:40 am **Overview:** Joseph Borrelli, Jr., MD
- 8:50 am
(p. 147)Mesenchymal Stem Cells (MSCs) Facilitate Fracture Repair in an
Alcohol-Induced Impaired Healing ModelPaper #21Thomas S. Obermeyer, MD¹; Kristen Lauing¹; Stuart R. Stock, PhD²;
David Yonick, MD¹; Michael D. Stover, MD¹; John J. Callaci, PhD¹;
¹Loyola University, Maywood, Illinois, USA;
²Northwestern University, Chicago, Illinois, USA

See pages 77 - 115 for financial disclosure information.
Basic Science Focus Forum – THURSDAY, OCTOBER 13, 2011

| 8:56 am (p. 149) Paper #22 | Recombinant Human Parathyroid Hormone (PTH 1-34) Enhances Healing in a Mouse Fracture Nonunion Model Edward A. Lin, MD; Chuanju Liu, PhD; Kenneth A. Egol, MD; New York University School of Medicine, New York, New York, USA |
|---|---|
| 9:02 am (p. 150) Paper #23 | The Effect of Transdermal Nicotine on Fracture Healing in a Rabbit Model <i>Jonathan A. Donigan, MD</i> ; <i>Douglas Fredericks, BS; Joseph D. Smucker, MD;</i> <i>James V. Nepola, MD;</i> <i>University of Iowa Hospitals and Clinics, Iowa City, Iowa, USA</i> |
| 9:08 am (p. 151) Paper #24 | Incidence of Aseptic Femoral- and Tibial Shaft Nonunions: Is There a Genetic Predisposition? Frank Hildebrand, MD; Christian Zeckey, MD; Michael Frink, MD; Philipp Mommsen, MD; Christian Krettek, MD; Trauma Dept., Hannover Medical School, Hannover, Germany |
| 9:14 am | Discussion |
| 9:22 am | Break |
| 9:40 am – 10:50 am (Notes p. 152) | SYMPOSIUM 6: META-ANALYSIS IN ORTHOPAEDICS: STATISTICAL TRICKERY OR NOT? Moderators: Mohit Bhandari, MD, PhD Saam Morshed, MD, PhD |
| 9:40 am | What is a Meta-Analysis Saam Morshed, MD, PhD |
| 9:50 am | Meta-Analyses: Should they Guide Practice? <i>Peter V. Giannoudis, MD</i> |
| 10:00 am | Meta-Analyses are Dangerous – Be Forewarned! Mohit Bhandari, MD, PhD |
| 10:10 am | Case Study: Total Hip Arthroplasty Versus Hemi-Arthroplasty for Femoral Neck Fractures: A Critique of a Meta-Analysis <i>Dirk Stengel, PhD</i> |
| 10:20 am | If Not, Meta-Analyses, then What Do We Need? <i>Brad A. Petrisor, MD</i> |
| 10:30 am | Discussion |
| 10:50 am | Basic Science Focus Forum Adjourns |
| | Lunch (on your own) |
| | 27th ANNUAL MEETING BEGINS at 1:00 pm (<i>Marriott Rivercenter, Grand Ballroom, Level 3</i>) |

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2011 OTA ANNUAL MEETING THURSDAY, OCTOBER 13, 2011

| 6:30 am | Registration (Marriott Rivercenter Gran | d Ballroom Foyer) |
|-------------------|---|--|
| | Speaker Ready Room (Marriott Rivercenter Conf | erence Room 19) |
| 11:15 am – | INDUSTRY LUNCH SE | SSIONS |
| 12:30 pm | (San Antonio Convention C | Center) |
| 1:00 pm | WELCOME Andrew N. Pollak, MD – James A. Goulet, MD – <i>P.</i> Thomas F. Higgins, MD – Animesh Agarwal, MD – | (Marriott Rivercenter Grand Ballroom) OTA President rogram Chair - Program Co-Chair Local Host |
| 1:10 – 1:20 pm | RESEARCH and EDUC Andrew N. Pollak, MD, OTA President | ATION DONOR AWARD PRESENTATIONS |

SYMPOSIUM I: 1:20 – GERIATRIC FRACTURES: 2:45 pm THE ROLE FOR TRAUMA TRAINED SURGEONS

(

| 1:20 pm Landscape and Problems of Geriatric Fractures Nationally | oom) |
|--|------|
| Kyle J. Jeray, MD | |
| 1:35 pm Medical Work Up and Treatment for Geriatric Fractures Joseph M. Lane, MD | |
| 1:50 pm Pre- and Peri-Operative Hospital Care for Geriatric Patients Steven L. Kates, MD | |
| 2:05 pm Operative Technique and Options for Geriatric Fractures <i>Clifford B. Jones, MD</i> | |
| 2:20 pm Case Discussion and Questions Panel | |

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

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SCIENTIFIC SESSION I POLYTRAUMA

| 2:45 - | IOLIINAOMA |
|----------------------------------|--|
| 3:42 pm | Moderators - Victor A. de Ridder, MD, PhD & John T. Ruth, MD |
| 2:45 pm (p. 156) Paper #25 | Δ Timing of Orthopaedic Surgery in Multiple Trauma Patients: Development of a Protocol for Early Appropriate Care <i>Heather A. Vallier, MD</i> ; Xiaofeng Wang, PhD; Timothy A. Moore, MD; John H. Wilber, MD; MetroHealth Medical Center, Cleveland, Ohio, USA |
| 2:51 pm (p. 158) Paper #26 | Trends in Musculoskeletal Imaging for Trauma Patients: How Has our Practice Changed Over Time? <i>Frank A. Forde, BS¹; Kasra Ahmadinia, MD¹; Charles Ekstein, BS²;</i> <i>Paul Tornetta, III, MD²; Heather A. Vallier, MD¹;</i> ¹ MetroHealth Medical Center, Cleveland, Ohio, USA; ² Boston University Medical Center, Boston, Massachusetts, USA |
| 2:57 pm | Discussion |
| 3:02 pm (p. 160) Paper #27 | Delayed Wound Closure Increases Deep Infection Rate in Lower Grade Open Fractures: A Propensity-Matched Cohort Study Richard J. Jenkinson, MD, FRCS(C); Alexander Kiss, PhD; Samuel C. Johnson, MD; David J.G. Stephen, MD, FRCS(C); Hans J. Kreder, MD, MPH, FRCS(C); University of Toronto, Toronto, Ontario, Canada |
| 3:08 pm (p. 161) Paper #28 | Stress–Induced Hyperglycemia Is a Risk Factor for Surgical–Site Infection in Nondiabetic Orthopaedic Trauma Patients Justin E. Richards, MD ¹ ; Rondi M. Kauffmann, MD, MPH ² ; William T. Obremskey, MD, MPH ¹ ; Addison K. May, MD ² ; ¹ Div. of Orthopaedic Trauma, ² Div. of Emergency Surgery and Surgical Critical Care, Vanderbilt University Medical Center, Nashville, Tennessee, USA |
| 3:14 pm | Discussion |
| 3:19 pm (p. 162) Paper #29 | Is Patient Satisfaction After Fracture Predicted by Functional Outcome or Injury Severity? Eric J. Belin, MD ¹ ; Ebrahim Paryavi, MD ¹ ; Renan C. Castillo, PhD ² ; Robert V. O'Toole, MD ¹ ; ¹ R Adams Cowley Shock Trauma Center, Dept. of Orthopaedics, University of Maryland Medical School, Baltimore, Maryland, USA ² Center for Injury Research & Policy, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA |

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| 3:25 pm (p. 163) Paper #30 | Does Pain Correlate With Patient-Based Functional Outcome Scores After Commonly Operatively Treated Fractures? Clifford B. Jones, MD, FACS ¹ ; Debra L. Sietsema, PhD ¹ ; Gillian L. Sembler Soles, MD ² ; Paul Tornetta, III, MD ² ; ¹ Orthopaedic Associates of Michigan, Michigan State University, Grand Rapids, Michigan, USA; ² Boston University Medical Center, Boston, Massachusetts, USA |
|----------------------------------|--|
| 3:31 pm (p. 165) Paper #31 | Loss of Follow-Up in Orthopaedic Outcome Studies: Is 80% Follow-Up Still Acceptable? Boris A. Zelle, MD ¹ ; Mohit Bhandari, MD, MSc ² ; Alvaro I. Sanchez, MD, MS ¹ ; Christian Probst, MD ³ ; Hans-Christoph Pape, MD ⁴ ; ¹ University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA; ² McMaster University, Hamilton, Ontario, Canada; ³ University of Witten/Herdecke, Witten, Germany; ⁴ University of Aachen, Aachen, Germany |
| 3:37 pm | Discussion |
| 3:42 pm | Break Visit Scientific Posters (Marriott Rivercenter Grand Ballroom Foyer) & Technical Exhibits (Marriott Rivercenter Grand Ballroom G - J) |

SCIENTIFIC SESSION II BASIC SCIENCE

| 4:12 – 5:10 pm | Moderators - Theodore Miclau, III, MD & James A. Goulet, MD |
|-------------------|--|
| 4:12 pm | Early Initial Antibiotics and Debridement Independently Reduce |
| (p. 166) | Infection in an Open Fracture Model |
| Paper #32 | Jowan G. Penn-Barwell, MRCS ^{1,2} ; Clinton K. Murray, MD ³ ; |
| | Joseph C. Wenke, PhD ¹ ; |
| | ¹ US Army Institute of Surgical Research, Fort Sam Houston, Texas, USA; |
| | ² Academic Dept. of Military Surgery and Trauma, Royal Centre for Defense |
| | Medicine, Birmingham, United Kingdom; |
| | ³ Brooke Army Medical Center, Fort Sam Houston, Texas, USA |
| 4:18 pm | Effect of Negative-Pressure Wound Therapy on the Elution of |
| (p. 168) | Antibiotics from Polymethylmethacrylate Beads in a Porcine Simulated |
| Paper #33 | Open Femur Fracture Model |
| | Thomas M. Large, MD ¹ ; Geoffrey Douglas, MD ² ; Gregory Erickson, MD ¹ ; |
| | J. Kevin Grayson, DVM, PhD ² ; |
| | ¹ Dept. of Orthopaedic Surgery, |
| | ² Clinical Investigation Facility, David Grant Medical Center, Travis AFB, |
| | South Bend, Indiana, USA |

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| 4:24 pm (p. 169) Paper #34 | Δ Can We Trust Intraoperative Culture Results in Nonunions? <i>Daniel T. Altman, MD</i> ; Gregory T. Altman, MD; Jeffrey J. Sewecke, DO; Trenton M. Gause, II, BA; William J. Costerton, PhD; Allegheny General Hospital, Pittsburgh, Pennsylvania, USA |
|----------------------------------|--|
| 4:30 pm (p. 170) Paper #35 | Local Antibiotic Delivery by a Bioabsorbable Gel is Superior to PMMA Beads at Reducing Infection in an Open Fracture Model Jowan G. Penn-Barwell, MRCS^{1,2}; Clinton K. Murray, MD³; Joseph C. Wenke, PhD¹; ¹US Army Institute of Surgical Research, Fort Sam Houston, Texas, USA; ²Academic Dept. of Military Surgery and Trauma, Royal Centre for Defense Medicine, Birmingham, United Kingdom; ³Brooke Army Medical Center, Fort Sam Houston, Texas, USA |
| 4:36 pm | Discussion |
| 4:41 pm (p. 172) Paper #36 | A Biomechanical Analysis of Lag Screw Position in the Femoral Head for Cephalomedullary Nails Paul R.T. Kuzyk, MASc, MD, FRCS(C) ¹ ; Rad Zdero, PhD ^{2,3} ; Suraj Shah, MEng Cand. ^{2,3} ; Michael Olsen, PhD ² ; James P. Waddell, MD, FRCS(C) ¹ ; Emil H. Schemitsch, MD, FRCS(C) ^{1,2} ; ¹ Div. of Orthopaedics, Dept. of Surgery, University of Toronto, Toronto, Ontario, Canada; ² Martin Orthopaedic Biomechanics Lab., St. Michael's Hospital, Toronto, Ontario, Canada; ³ Dept. of Mechanical and Industrial Engineering, Ryerson University, Toronto, Ontario, Canada |
| 4:47 pm (p. 174) Paper #37 | When Does Anterior External Fixation Enhance Construct Stability in Zone II Sacral Fractures? A Biomechanical Evaluation Christian S. Bromfield, MD ¹ ; Erik McDonald, BS ² ; Michael P. Leslie, DO ³ ; Jenni M. Buckley, PhD ² ; Mark A. Lee, MD ¹ ; Tania A. Ferguson, MD ¹ ; ¹ University of California, Davis, Sacramento, California, USA; ² University of California, San Francisco, San Francisco, California, USA; ³ Yale School of Medicine Orthopaedics and Rehabilitation, New Haven, Connecticut, USA |
| 4:53 pm (p. 176) Paper #38 | Are Commercially Available Synthetic Osteoporotic Bone Models Valid? Edward H. Becker, MD ¹ ; Hyunchul Kim, MS ² ; Michael J. Shorofsky, BS ¹ ; Adam H. Hsieh, PhD ² ; Robert V. O'Toole, MD ¹ ; ¹ R Adams Cowley Shock Trauma Center, Baltimore, Maryland, USA; ² Department of Orthopaedics, University of Maryland School of Medicine, College Park, Maryland, USA |

 Δ OTA Grant See pages 77 - 115 for financial disclosure information.

| 4:59 pm (p. 177) Paper #39 | Do Locked Screws Work in Bent Plates? <i>Christina L. Boulton, MD</i> ¹ ; Hyunchul Kim, MS ² ; Swapnil B. Shah, MD ³ ; Scott P. Ryan, MD ¹ ; Thomas A. Metzger ² ; Adam H. Hsieh, PhD ² ; Robert V. O'Toole, MD ¹ ; ¹ R Adams Cowley Shock Trauma Center, Dept. of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA; ² Orthopaedics Mechanobiology Lab, Dept. of Bioengineering, University of Maryland, College Park, Maryland, USA; ³ Alameda County Medical Center, Oakland, California, USA |
|----------------------------------|--|
| 5:05 pm | Discussion |

Member Business Meeting (Marriott Rivercenter Grand Ballroom)

5:10 – 6:10 pm

6:30 – Welcome Reception

8:30 pm

Join the OTA for cocktails and a generous assortment of hors d'oeuvres at La Villita. La Villita is a historic arts village and plaza located on the River Walk, a short walk from the Marriott Riverwalk/ Rivercenter.



La Villita Photo courtesy of the San Antonio Convention & Visitor's Bureau / Richard Nowitz

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2011 OTA ANNUAL MEETING FRIDAY, OCTOBER 14, 2011

| 6:30 am | Attendee Registration (Marriott Rivercenter Grand Ballroom Foyer) |
|---------|--|
| | Scientific Posters (Marriott Rivercenter Grand Ballroom Foyer) |
| | Technical Exhibits (Marriott Rivercenter Grand Ballroom G - J) |
| | Speaker Ready Room (Marriott Rivercenter Conference Room 19) |
| 6:30 am | Continental Breakfast (Marriott Riverwalk Hotel and Marriott Rivercenter Grand Ballroom) |

6:45 - 7:45 am (Notes p. 178) Case Presentations-Tickets Required

6:45 – 7:45 am

CASE PRESENTATIONS

| Orthopaedic Trauma Coding Update (#F1) Moderator: William R. Creevy, MD Faculty: J. Scott Broderick, MD and Michael S. Sirkin, MD | (Marriott Riverwalk - Salon A) |
|---|---|
| Management of Pelvic & Acetabulum Fractures (#F2) Moderator: Paul Tornetta, III, MD Faculty: Clifford B. Jones, MD; Robert F. Ostrum, MD; Judith A. Siegel, MD and Adam J. Starr, MD | (Marriott Riverwalk - Salon C) |
| Challenging Hip Fractures-When the Fracture Table Doesn't Work (#F3) Moderator: Amer J. Mirza, MD Faculty: Daren Freiss, MD; James C. Krieg, MD and Samir Mehta, MD | (Marriott Riverwalk - Salon B) |
| New Approaches to Difficult Tibial Plateau Fractures (#F4) Moderator: David C. Templeman, MD Faculty: James A. Goulet, MD; J. Tracy Watson, MD and Robert A. Win | (Marriott Riverwalk - Salon D) quist, MD |
| Treatment of Clavicle Shaft Fractures: Straightforward, Right? (#F5) Moderator: Erik Kubiak, MD Faculty: Michael D. McKee, MD and Donald A. Wiss, MD | (Marriott Riverwalk - Salon E) |

| 8:00 – 9:30 am | SYMPOSIUM II: PAIN MANAGEMENT IN TRAUMA: RISK TO PATIENTS, BURDEN ON SURGEONS, OPPORTUNITY FOR IMPROVEMENT |
|-------------------|---|
| (Notes p. 179) | Moderator: Thomas F. Higgins, MD(Marriott Rivercenter Grand Ballroom)Faculty: Mark A. Lee, MD[Jeffrey D. Swenson, MDMark S. Vrahas, MD(Marriott Rivercenter Grand Ballroom) |
| 8:00 am | The Current State of Post-Operative Pain Management in the Trauma Patient <i>Thomas F. Higgins, MD</i> |
| 8:15 am | Physician Attitudes on the Use of Prescription Narcotics <i>Mark S. Vrahas, MD</i> |
| 8:30 am | Alternatives for Pain Management in the Hospitalized Patient <i>Jeffrey D. Swenson, MD</i> |
| 8:45 am | Legal / Ethical Issues in Surgical Pain Management Mark A. Lee, MD |
| 9:00 am | Discussion |
| 0.00 | |

9:30 am Break Visit Scientific Posters (Marriott Rivercenter Grand Ballroom Foyer) & Technical Exhibits

SCIENTIFIC SESSION III PELVIS and SPINE

Moderators - John T. Ruth, MD & Pierre Guy, MD, MBA

10:00 – 11:14 am

10:00 am (p. 180) Paper #40 **Cervical Spine Clearance Protocols in Level I, II and III Trauma Centers in the State of California** *Murat Pekmezci, MD*; Roberto Dinisio, BS; Geoffrey Manley, MD; Robert Mackersie, MD; R. Trigg McClellan, MD; University of California San Francisco, San Francisco General Hospital, San Francisco, California, USA

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| 10:06 am (p. 181) Paper #41 | Vertebral Artery Injury Associated With Blunt Cervical Spine Trauma: A Multicenter Study Darren R. Lebl, MD ¹ ; Kirkham B. Wood, MD ² ; George Velmahos, MD ² ; Umesh Metkar, MD ³ ; Christopher M. Bono, MD ⁴ ; Mitchel B. Harris, MD ⁴ ; ¹ Harvard Combined Orthopaedic Residency Program, Boston, Massachusetts, USA; ² Massachusetts General Hospital, Boston, Massachusetts, USA; ³ Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA; ⁴ Brigham and Women's Hospital, Boston, Massachusetts, USA |
|-----------------------------------|--|
| 10:12 am | Discussion |
| 10:17 am (p. 183) Paper #42 | The Clinical Efficacy of Compressive Transsacral Screw Fixation for Unstable Posterior Pelvic Ring Injuries <i>William Min, MD</i> ; Monique Chambers, BS; Michael P. Leslie, DO; Mark A. Lee, MD; Tania A. Ferguson, MD; University of California, Davis Medical Center, Sacramento, California, USA |
| 10:23 am (p. 184) Paper #43 | An Analysis of the Demographic and Technical Characteristics Associated With Iliac Cortical Perforation During Insertion of Iliosacral Screws J. Stuart Melvin, MD ¹ ; Nicholas Pulos, BA ² ; Keith Baldwin, MD, MPH, MSPT ² ; Amer J. Mirza, MD ³ ; Michael J. Gardner, MD ⁴ ; Samir Mehta, MD ² ; ¹ Carolinas Medical Center, Charlotte, North Carolina, USA; ² University of Pennsylvania, Philadelphia, Pennsylvania, USA; ³ Oregon Health & Science University, Portland, Oregon, USA; ⁴ Washington University, St. Louis, Missouri, USA |
| 10:29 am (p. 185) Paper #44 | Can a Single Screw Be Used for Bilateral Sacroiliac Fixation? <i>Jason A. Patterson, MD</i> ¹ ; Alex McLaren, MD ¹ ; Patrick Liu, MD ² ; Ryan McLemore, MD ¹ ; ¹ Banner Good Samaritan Medical Center, Phoenix, Arizona, USA; ² Mayo Clinic Phoenix, Phoenix, Arizona, USA |
| 10:35 am | Discussion |
| 10:40 am (p. 186) Paper #45 | Critical Analysis of Pelvic Angiography for Trauma and Development of a Scoring System <i>Maria Iannolo, MD</i> ; Jonathan M. Gross, MD; Catherine A. Humphrey, MD; Mark L. Prasarn, MD; John P. Ketz, MD; John T. Gorczyca, MD University of Rochester Medical Center, Rochester, New York, USA |
| 10:46 am (p. 189) Paper #46 | The Importance of Trauma Center Care on Mortality and Function Following Pelvic Ring and Acetabular Injuries <i>Saam Morshed, MD, PhD, MPH</i> ¹ ; Gregory J. Jurkovich, MD ² ; Jin Wang, PhD ² ; Simon Knops, MD ¹ ; Frederick P. Rivara, MD, MPH ² ; ¹ University of California San Francisco, San Francisco, California, USA; ² University of Washington School of Medicine, Seattle, Washington, USA |

| 10:52 am | Discussion |
|-----------------------------------|---|
| 10:57 am (p. 190) Paper #47 | Quality of Life and Sexual Function Following Traumatic Pelvic Fracture <i>Katherine F. Harvey-Kelly, MD¹; Nikolaos K. Kanakaris, MD²;</i> <i>Oghor Opakponovwe, MD²; Mudussar Ahmad, MD²; Robert M. West, MD³;</i> <i>Peter V. Giannoudis, MD¹;</i> ¹ <i>Academic Dept. of Trauma & Orthopaedics, School of Medicine,</i> <i>University of Leeds, Leeds, United Kingdom;</i> ² <i>Leeds Teaching Hospitals NHS Trust, Leeds, United Kingdom;</i> ³ <i>Dept. of Biostatics, University of Leeds, Leeds, United Kingdom</i> |
| 11:03 am (p. 191) Paper #48 | Quality of Life Following Acetabular Fracture Surgery, Importance of Reduction Tomas Borg, MD, PhD ; Sune Larsson, MD, PhD; Dept. of Orthopaedic Surgery, Uppsala University, Uppsala, Sweden |
| 11:09 am | Discussion |

| 11:14 am – 12:06 pm | SCIENTIFIC SESSION IV TIBIA Moderators - Thomas F. Higgins, MD & Robert V. O'Toole, MD |
|-----------------------------------|--|
| 11:14 am (p. 192) Paper #49 | ▲•Measurement of Tissue Oxygenation as a Novel Approach to Diagnosis of Compartment Syndrome Erik H. Hansen, MD¹; James M. Mok, MD²; Givenchy Manzano, BS¹; Utku Kandemir, MD¹; ¹Dept. of Orthopaedic Surgery, University of California San Francisco, San Francisco, California, USA; ²Orthopaedic Surgery Service, Dept. of Surgery, Madigan Army Medical Center, Tacoma, Washington, USA |
| 11:20 am (p. 193) Paper #50 | Fasciotomy for Acute Compartmental Syndrome Increases the Incidence of Infection, Nonunion and Delayed Union of Operatively Treated Tibial Fractures Dan Kemper, MD ¹ ; Alejandro Castellvi, BS ¹ ; Murat Erdogan, MD ² ; H. Claude Sagi, MD ¹ ; ¹ Florida Orthopaedic Institute, Tampa, Florida, USA; ² Ondokuz Mayis University, Samsun, Turkey |

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| 11:26 am (p. 194) Paper #51 | Do Intracompartmental Pressure Measurements Have a High False-Positive Rate in Diagnosing Compartment Syndrome? <i>Augusta Whitney, MD</i> ¹ ; Robert V. O'Toole, MD ¹ ; Emily Hui, MPH ¹ ; Marcus F. Sciadini, MD ¹ ; Andrew N. Pollak, MD ¹ ; Theodore T. Manson, MD ¹ ; W. Andrew Eglseder, MD ¹ ; Romney C. Andersen, MD ¹ ; Christopher T. LeBrun, MD ¹ ; Christopher Doro, MD ² ; Jason W. Nascone, MD ¹ ; ¹ R Adams Cowley Shock Trauma Center, Dept. of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA; ² Dept. of Orthopaedics, University of Wisconsin School of Medicine, Madison, Wisconsin, USA |
|-----------------------------------|--|
| 11:32 am | Discussion |
| 11:37 am (p. 195) Paper #52 | The Insertion of Intramedullary Nail Locking Screws Without Fluoroscopy: A Faster and Safer Technique Daniel S. Chan, MD ¹ ; Brandon Burris, MD ² ; Murat Erdogan, MD ³ ; H. Claude Sagi, MD ¹ ; Roy Sanders, MD ¹ ; ¹ Orthopaedic Trauma Service, Florida Orthopaedic Institute, Tampa, Florida, USA; ² University of South Florida, Tampa, Florida, USA; ³ Ondokuz Mayis University, Samsun, Turkey |
| 11:43 am (p. 196) Paper #53 | A Comparison of Efficacy and Resource Utilization Between Acute BMP-2 and Standard Treatment in Type III Tibia Fractures: A Multicenter Prospective, Randomized Controlled Trial OTA Study Group: Michael J. Bosse, MD ¹ ; Robert D. Zura, MD ² ; Andrew N. Pollak, MD ³ ; David A. Volgas, MD ⁴ ; William T. Obremskey, MD ⁵ ; David P. Barei, MD ⁶ ; Rachel Seymour, PhD ¹ ; ¹ Carolinas Medical Center is in Charlotte, North Carolina, USA; ² Duke University is in Durham, North Carolina, USA; ³ Shock Trauma/University of Maryland is in Baltimore, Maryland, USA; ⁴ University of Alabama at Birmingham is in Colombia, Missouri, USA; ⁶ Harborview Medical Center is in Seattle, Washington, USA |
| 11:49 am (p. 197) Paper #54 | Δ The Role of Antibiotics in Open Fractures Revisited: Characteristics of Staphylococcus aureus (SA) and Susceptibility Profile Carla C. Saveli, MD ; Steven J. Morgan, MD; Robert W. Belknap, MD; Erin Ross, BS; Philip F. Stahel, MD; David J. Hak, MD; Walter L. Biffl, MD; George W. Chaus, MD; Connie S. Price, MD; Denver Health Medical Center, University of Colorado School of Medicine, Denver, Colorado, USA |
| 11:55 am (p. 199) Paper #55 | Tibia Nonunion Prediction: Is It Possible? <i>Justin S. Yang, MD</i> ; Jesse Otero, MD; Christopher M. McAndrew, MD; William M. Ricci, MD; Michael J. Gardner, MD; Orthopaedic Trauma Service, Washington University School of Medicine, St. Louis, Missouri, USA |
| 12:01 pm | Discussion |

 Δ OTA Grant See pages 77 - 115 for financial disclosure information.

| 12:06 - | Lunch |
|---------|---|
| 1:00 pm | Visit Scientific Posters |
| - | (Marriott Rivercenter Grand Ballroom Foyer) |
| | & Technical Exhibits |
| | (Marriott Rivercenter Grand Ballroom G - J) |
| 12:06 - | Kathy Cramer, MD Memorial |
| 1:00 pm | Women in Orthopaedic Trauma |
| 1 | Luncheon/Meeting |
| | (Marriott Riverwalk - Salon EF) |
| | Co-Chairs: Jacqueline J. Krumrey, MD Laura S. Phieffer, MD |
| | Pre-Registration is required. |



1:00 -Concurrent Sessions2:30 pm(Mini Symposia and Skills Labs run concurrently.)(Notes pgs. 201 - 202)Tickets Required

1:00 – 2:30 pm

MINI SYMPOSIA

 The "Not So Simple" Ankle Fracture –
 (Marriott Riverwalk - Salon A)

 Avoiding Problems and Pitfalls to Improve Patient Outcome (#F6)

 Moderator:
 David J. Hak, MD

 Faculty:
 Kenneth A. Egol, MD; Michael J. Gardner, MD and Andrew Haskell, MD

Amputations in Trauma:

Getting the Most Out of Your Limb (#F7) Moderators: *Paul J. Dougherty, MD* and *Lisa K. Cannada, MD* Faculty: *Romney C. Andersen, MD* and *Rahul V. Vaidya, MD*

Preoperative Nightmares -

(Marriott Riverwalk - Salon C)

(Marriott Riverwalk - Salon D)

(Marriott Riverwalk - Salon B)

What is the Evidence? (#F8) Moderator: John T. Gorczyca, MD Faculty: Michael A. Miranda, MD; Kevin J. Pugh, MD and Jeffrey M. Smith, MD

Fundamentals in Trauma I (#F9)

Moderator: Robert F. Ostrum, MD Faculty: Frank A. Liporace, MD; Steven J. Morgan, MD; Thomas F. Varecka, MD and J. Tracy Watson, MD

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FRIDAY, OCTOBER 14, 2011

1:00 – 2:30 pm

SKILLS LABS

ORIF Distal Radius Fractures (#F10)(Convention CModerator:Erik Kubiak, MDFaculty:Gregory T. Altman, MD; Michael D. McKee, MD and Milan K. Sen, MD

ORIF Periprosthetic Fractures of the Femur (#F11)(Convention Center - Room 007 B)Moderator:George J. Haidukewych, MDFaculty:Cory A. Collinge, MD; Joshua Langford, MD and Bruce H. Ziran, MD

ORIF Distal Tibia and Fibula Fractures (#F12)

Moderator: Jason W. Nascone, MD Faculty: Brett J. Bauer, MD; Matt L. Graves, MD; Christopher T. LeBrun, MD; Robert V. O'Toole, MD and Marcus F. Sciadini, MD

SIGN Nailing (#F13)

(Convention Center - Room 007 C & D)

 Moderator: Lewis G. Zirkle, Jr., MD
 Faculty: Dipak Maharjan, MD; Tobias Otieno, MD; Prof. Dr. Shahab-uddin; Carla S. Smith, MD; John W. Staeheli, MD; David C. Templeman, MD; M. Ismail Wardak, MD and Frederick B. Wilson, Jr., MD

2:30 – 3:00 pm

Break Visit Scientific Posters (Marriott Rivercenter Grand Ballroom Foyer) & Technical Exhibits (Marriott Rivercenter Grand Ballroom G - J)

3:00 – 3:30 pm (Notes p. 203) PRESIDENT'S MESSAGE (Marriott Rivercenter Grand Ballroom)

Andrew N. Pollak, MD

"Overcoming Challenges to Fulfilling our Mission in Patient Care and Education"



(Convention Center - Room 008 B)

K C... MD

(Convention Center - Room 008 A)

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SCIENTIFIC SESSION V KNEE, FOOT and ANKLE

| 3:30 – 5:01 pm | Moderators - Michael J. Gardner, MD & Shepard R. Hurwitz, MD |
|----------------------------------|--|
| 3:30 pm (p. 204) Paper #56 | Definitive Plates Overlapping Provisional External Fixator Pin Sites: Is the Infection Risk Increased? <i>Chirag M. Shah, MD</i> ; Olubusola Brimmo, MD; William M. Ricci, MD; Michael J. Gardner, MD; Washington University School of Medicine, St. Louis, Missouri, USA |
| 3:36 pm (p. 205) Paper #57 | Computed Tomography (CT) Scan to Detect Traumatic Arthrotomies of the Knee Joint Sanjit R. Konda, MD ; Roy I. Davidovitch, MD; Kenneth A. Egol, MD; NYU Hospital for Joint Diseases, New York, New York, USA |
| 3:42 pm | Discussion |
| 3:47 pm (p. 206) Paper #58 | Immediate Primary Repair and Early Range of Motion of Acute Multiligamentous Knee Injuries: A Prospective Cohort Study <i>Philipp N. Streubel, MD</i> ; Justin E. Richards, MD; William T. Obremskey, MD; Vanderbilt Medical Center, Nashville, Tennessee, USA |
| 3:53 pm (p. 207) Paper #59 | Predictors of Knee Stiffness After Periarticular Fracture <i>Julius A. Bishop, MD</i> ¹ ; Julie Agel, MA, ATC ² ; Robert P. Dunbar, Jr., MD ² ; ¹ Dept. of Orthopaedic Surgery, Stanford University School of Medicine, Palo Alto, California, USA; ² Dept. of Orthopaedics and Sports Medicine, University of Washington, Seattle, Washington, USA |
| 3:59 pm | Discussion |
| 4:04 pm (p. 208) Paper #60 | Is Fixation of the Medial Malleolus Necessary? Paul Tornetta, III, MD; Virginia Mooney, MD ; Jason Pittman, MD, PhD; James Daley, MPH; William R. Creevy, MD; Boston University Medical Center, Boston, Massachusetts, USA |

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| 4:10 pm (p. 210) Paper #61 | Posterolateral Antiglide Versus Lateral Plating for SE Pattern Ankle Fractures: A Multicenter Randomized Control Trial Paul Tornetta, III, MD¹; Laura S. Phieffer, MD²; Clifford B. Jones, MD³; Janos P. Ertl, MD⁴; Brian H. Mullis, MD⁴; Kenneth A. Egol, MD⁵; Michael J. Gardner, MD⁶; William M. Ricci, MD⁶; David C. Teague, MD⁷; William Ertl, MD⁷; Cory A. Collinge, MD⁸; Ross K. Leighton, MD⁹; Ojas Joshi, MS¹; ¹Boston University Medical Center, Boston, Massachusetts, USA; ²Ohio State University Medical Center, Columbus, Ohio, USA; ³Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA; ⁴Indiana University, Indianapolis, Indiana, USA; ⁶NYU Hospital for Joint Disease, New York, New York, USA; ⁶Washington University, St. Louis, Missouri, USA ⁷University of Oklahoma, Oklahoma City, Oklahoma, USA; ⁸Orthopaedic Associates – Fort Worth, Fort Worth, Texas, USA; ⁹Halifax Infirmary, Halifax, Nova Scotia, Canada |
|----------------------------------|--|
| 4:16 pm | Discussion |
| 4:21 pm (p. 212) Paper #62 | Δ Efficacy of Popliteal Block in Postoperative Pain Control After Ankle Fracture Fixation: A Prospective Randomized Study Rachel Y. Goldstein, MD, MPH; Nicole Montero, BA; Toni M. McLaurin, MD; Kenneth A. Egol, MD; Nirmal C. Tejwani, MD; NYU Hospital for Joint Diseases, New York, New York, USA |
| 4:27 pm (p. 213) Paper #63 | Twenty-Year Follow Up of Conservatively Treated "Isolated" Posterior Malleolar Ankle Fractures: A Case Series Christian Donken, MD ¹ ; A.J.F. Goorden ¹ ; Michael Verhofstad, PhD ² ; Michael J. Edwards, PhD ¹ ; Cees van Laarhoven, PhD ¹ ; ¹ Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands; ² St. Elisabeth Hospital, Tilburg, Netherlands |
| 4:33 pm | Discussion |
| 4:38 pm (p. 214) Paper #64 | TEFTOM – A Promising General Trauma Outcome Measure? Results of a Validation Study of Pan–American Ankle Trauma Patients <i>Michael Suk, MD, JD, MPH</i> ¹ ; Monica Daigl Cattaneo, MS ² ; Richard E. Buckley, MD ³ ; Cleber A.J. Paccola, MD ⁴ ; Dean G. Lorich, MD ⁵ ; David L. Helfet, MD ⁶ ; Beate Hanson, MD, MPH ² ; ¹ University of Florida, Jacksonville, Florida, USA; ² AO Foundation, Clinical Investigation and Documentation, Dübendorf, Switzerland; ³ Foothills Medical Centre, Calgary, Alberta, Canada; ⁴ Ribeirao Preto Medical School, Sao Paolo, Brazil; ⁵ New York Presbyterian Hospital, New York, New York, USA; ⁶ Hospital for Special Surgery, New York, New York, USA |

 Δ OTA Grant See pages 77 - 115 for financial disclosure information.

| 4:44 pm (p. 215) Paper #65 | Payer Status Negatively Influences Initial Treatment at Community Hospitals Compared to a Tertiary Care Center: A Prospective Study of 300 Operative Ankle Fractures Michael T. Archdeacon, MD, MSE; Sudhir R. Belagaje, MD; Theodore Toan Le, MD; John D. Wyrick, MD; University of Cincinnati Medical Center, Cincinnati, Ohio, USA |
|----------------------------------|--|
| 4:50 pm (p. 216) Paper #66 | Payer Status and Increased Distance Traveled for Fracture Care in a Rural State <i>William Lack, MD</i> ; Julian Carlo, MD; J. Lawrence Marsh, MD; University of Iowa Hospitals and Clinics, Iowa City, Iowa, USA |
| 4:56 pm | Discussion |
| 5:01 pm | Adjourn |
| 5:30 – 6:30 pm | OTA Military Reception (Marriott Rivercenter - Sazos, Level 2) Hosted by the OTA Board of Directors and the OTA Military Committee (All Active Duty Military and all Landstuhl Distinguished Visiting Scholar participants invited.) |

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2011 OTA ANNUAL MEETING SATURDAY, OCTOBER 15, 2011

| 6:30 am | Attendee Registration (Marriott Rivercenter Grand Ballroom Foyer) | |
|---------|--|--|
| | Scientific Posters (Marriott Rivercenter Grand Ballroom Foyer) | |
| | Technical Exhibits (Marriott Rivercenter Grand Ballroom G - J) | |
| | Speaker Ready Room (Marriott Rivercenter Conference Room 19) | |
| 6:30 am | Continental Breakfast (Marriott Riverwalk Hotel and Marriott Rivercenter Grand Ballroom) | |

6:45 - 7:45 am (Notes p. 218) **Case Presentations**–*Tickets Required*

6:45 – 7:45 am

CASE PRESENTATIONS

| Proximal Humerus Fractures – Current Concepts (#S1) (Marriott Riverwalk - Salon C) Moderator: Michael J. Gardner, MD | | |
|---|---|--|
| Faculty: Clifford B. Jones, MD; Utku Kandemir, MD; Samir Mehta, MD | and James R. Ringler, MD | |
| Practical Issues in Clinical Research (# <i>S2</i>) Moderator: <i>Theodore Miclau, III, MD</i> and <i>Mohit Bhandari, MD</i> Faculty: <i>Gerard P. Slobogean, MD, MPH</i> | (Marriott Riverwalk - Salon B) | |
| Evaluation and Management of Complex Pediatric (Marriott Riverwalk - Salon A) Elbow Fractures (#S3) Moderator: David A. Podeszwa, MD | | |
| Faculty: Christine A. Ho, MD; Anthony I. Riccio, MD and Robert L. Wi | imberly, MD | |
| Pelvic Ring Injuries: Surgical Treatment of Instability (#S4) Moderators: James C. Krieg, MD and M.L. Chip Routt, Jr., MD Faculty: Mark C. Reilly, MD | (Marriott Riverwalk - Salon D) | |
| Scapula Fracture Injuries and Treatment (#S5) Moderator: William T. Obremskey, MD Faculty: Peter A. Cole, MD; Clifford B. Jones, MD and Paul Tornetta, IL | (Marriott Riverwalk - Salon F) I, MD | |

| 8:00 – 9:30 am | SYMPOSIUM III: MANAGING AN ORTHOPAEDIC TRAUMA PRACTICE: STRATEGIES FOR TURBULENT TIMES | | |
|-------------------|---|---------------------------------------|--|
| lotes p. 219) | Moderator: William R. Creevy, MD Faculty: Lisa K. Cannada, MD Patricia Hofstra, JD John D. Martin, CEO OrthoIndy | (Marriott Rivercenter Grand Ballroom) | |
| 8:00 am | Introduction William R. Creevy, MD | | |
| 8:15 am | OTA Survey Data and MD Perspectives <i>Lisa K. Cannada, MD</i> | | |
| 8:30 am | Legal and Fair Market Issues Patricia Hofstra, JD | | |

- 8:45 am Hospital Administration Perspectives John D. Martin, CEO OrthoIndy
- 9:00 am Discussion

9:30 am Break Visit Scientific Posters (Marriott Rivercenter Grand Ballroom Foyer) & Technical Exhibits (Marriott Rivercenter Grand Ballroom G - J)

SCIENTIFIC SESSION VI PEDIATRICS, GERIATRICS, HIP, FEMUR and INJURY PREVENTION

10:00 am –12:00 pmModerators - James A. Goulet, MD & Victor A. de Ridder, MD, PhD10:00 amA Prospective Evaluation of Posttraumatic Stress Disorder and Parent

(p. 222) Paper #67

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A Prospective Evaluation of Posttraumatic Stress Disorder and Parent Stress in Children Exposed to Orthopaedic Trauma Meagan Wallace, MD; Aki Puryear, MD; Lisa K. Cannada, MD; Saint Louis University, Dept. of Orthopaedic Surgery, St. Louis, Missouri, USA

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| 10:06 am (p. 223) Paper #68 | Does Following the AAOS and AAP Guidelines for Trampoline Use Decrease the Severity of Pediatric Trampoline Injuries? A Prospective Study |
|-----------------------------------|--|
| | James R. Phelps, MD, MPT ¹ ; Christine A. Ho, MD ² ; Neil Evans, MD ³ ; Pam Okada. MD ² : |
| | ¹ University of Texas Southwestern Medical School, Dallas, Texas, USA; ² Children's Medical Center–Texas Scottish Rite Hospital, Dallas, Texas, USA; ³ Cook Children's Medical Center, Fort Worth, Texas, USA |
| 10:12 am | Discussion |
| 10:17 am (p. 224) Paper #69 | Pediatric Type 2 Supracondylar Humerus Fractures: Does Time to Surgery Matter? A. Noelle Larson, MD ¹ ; Sumeet Garg, MD ² ; Amanda L. Weller, MD ³ ; Nicholas D. Fletcher, MD ⁴ ; Jonathan R. Schiller, MD ⁵ ; Michael Kwon, MD ⁶ ; Lawson A.B. Copley, MD ⁷ ; Christine A. Ho, MD ⁷ ; ¹ University of Minnesota, Minneapolis, Minnesota, USA; ² Denver Children's Hospital, Denver, Colorado, USA; ³ University of Texas Southwestern, Dallas, Texas, USA; ⁴ Emory University, Atlanta, Georgia, USA; ⁵ Brown University, Providence, Rhode Island, USA; ⁶ Texas Scottish Rite Hospital for Children, ⁷ Children's Medical Center, Dallas, Texas, USA |
| 10:23 am (p. 225) Paper #70 | Management of the Pediatric Pulseless Supracondylar Humerus Fracture: Is Vascular Exploration Necessary? Amanda L. Weller, MD ¹ ; Sumeet Garg, MD ² ; A. Noelle Larson, MD ³ ; Nicholas D. Fletcher, MD ⁴ ; Jonathan R. Schiller, MD ⁵ ; Michael Kwon, MD ⁶ ; Lawson A.B. Copley, MD ⁷ ; Christine A. Ho, MD ⁷ ; ¹ University of Texas Southwestern Medical School, Dallas, Texas, USA; ² Denver Children's Hospital, Denver, Colorado, USA; ³ University of Minnesota, Minneapolis, Minnesota, USA; ⁴ Emory University, Atlanta, Georgia, USA; ⁵ Brown University, Providence, Rhode Island, USA; ⁶ Texas Scottish Rite Hospital for Children ⁷ Children's Medical Center, Dallas, Texas, USA |
| 10:29 am | Discussion |
| 10:34 am (p. 226) Paper #71 | Functional Outcomes of Nonoperative Treatment of Geriatric Acetabular Fractures Meeting Operative Criteria Scott P. Ryan, MD; Theodore T. Manson, MD; Christopher T. LeBrun, MD; Jason W. Nascone, MD; Marcus F. Sciadini, MD; Renan C. Castillo, PhD; Robert V. O'Toole, MD; R Adams Cowley Shock Trauma Center, Dept. of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland |

| 10:40 am (p. 227) Paper #72 | Functional Outcomes in Elderly Patients With Acetabular Fractures Treated With Minimally Invasive Reduction and Percutaneous Fixation <i>Joshua L. Gary, MD</i> ; <i>Michael VanHal, MD</i> ; <i>Steven D. Gibbons</i> ; <i>Charles M. Reinert, MD</i> ; <i>Adam J. Starr, MD</i> ; <i>University of Texas Southwestern Medical Center, Dallas, Texas, USA</i> |
|-----------------------------------|--|
| 10:46 am (p. 228) Paper #73 | Surgical Treatment Improves Clinical and Functional Outcomes for Patients Who Sustain Incomplete Bisphosphanate-Induced Femur Fractures Kenneth A. Egol, MD; Colin J. Prensky, BA; Ji Hae Park, BS; Zehava S. Rosenberg, MD; Nirmal C. Tejwani, MD; NYU Hospital for Joint Diseases, New York, New York, USA |
| 10:52 am | Discussion |
| 10:57 am (p. 229) Paper #74 | Patient Variables That May Predict Length of Stay and Incurred Hospital Costs in Elderly Patients With Low-Energy Hip Fracture Anna E. Garcia, BS; J. V. Bonnaig, BS; Zachary T. Yoneda, BS; Justin E. Richards, MD; Jesse M. Ehrenfeld, MD, MPH; Manish K. Sethi, MD; A. Alex Jahangir, MD; William T. Obremskey, MD, MPH; Vanderbilt University Medical Center, Nashville, Tennessee, USA |
| 11:03 am (p. 231) Paper #75 | DVT Prophylaxis and Mortality After Hip Fracture <i>Pierre Guy, MD</i> ¹ ; <i>Rik W. Nienhuis, MD</i> ² ; <i>Kelly A. Lefaivre, MD</i> ¹ ; <i>Lisa Kuramoto</i> ¹ ; <i>Boris Sobolev, PhD</i> ¹ ; ¹ University of British Columbia, Vancouver, British Columbia, Canada; ² University of Groningen, Groningen, The Netherlands |
| 11:09 am (p. 232) Paper #76 | Influence of Displacement and Treatment Method on Survivorship of the Index Procedure for Femoral Neck Fracture Donavan K. Murphy, MD, MSc, MBA; Timmothy Randell, MD; Kindyle L. Brennan, PhD, PT; Juhee Song, PhD; John M. Hamilton, BA; Michael Brennan, MD; Robert A. Probe, MD; Scott & White Memorial Hospital, Temple, Texas, USA |
| 11:15 am | Discussion |
| 11:20 am (p. 233) Paper #77 | Δ Pain and Satisfaction with Pain Management in Hospitalized Trauma Patients Kristin R. Archer, PhD¹; Renan C. Castillo, PhD²; Stephen T. Wegener, PhD³; Christine M. Abraham, MS¹; William T. Obremskey, MD¹; ¹Vanderbilt University Medical Center, Nashville, Tennessee, USA; ²Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA; ³Johns Hopkins Medicine, Baltimore, Maryland, USA |

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| 11:26 am (p. 235) Paper #78 | Clinical Outcomes of Locked Plating of Distal Femoral Fractures Martin F. Hoffmann, MD ¹ ; Clifford B. Jones, MD, FACS ^{2,3} ; Debra L. Sietsema, PhD ^{2,3} ; Paul Tornetta, III, MD ⁴ ; Scott J. Koenig, MD ⁴ ; Benjamin T. Maatman, BS ⁴ ; ¹ Grand Rapids Medical Education Partners, Grand Rapids, Michigan, USA; ² Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA; ³ Michigan State University, Grand Rapids, Michigan, USA; ⁴ Boston University Medical Center, Boston, Massachusetts, USA |
|---|---|
| 11:32 am (p. 236) Paper #79 | Locking Plate Fixation Versus Cephalomedullay Nailing of Unstable Proximal Femur Fractures: A Comparative Cohort Study Philipp N. Streubel, MD; Michael J. Moustoukas, MD; William T. Obremskey, MD; Vanderbilt Medical Center, Nashville, Tennessee, USA |
| 11:38 am | Discussion |
| 11:43 am (p. 237) Paper #80 | Postsplinting Radiographs of Minimally Displaced Fractures: Good Medicine or Medicolegal? <i>Sonia Chaudhry, MD</i> ; Edward M. DelSole, BS; Kenneth A. Egol, MD; NYU Hospital for Joint Diseases, New York, New York, USA |
| 11:49 am (p. 238) Paper #81 | Beyond the 5-Second Rule: What To Do With Drop-Contaminated Bone? <i>Chad A. Krueger, MD</i> ¹ ; <i>Daniel J. Stinner, MD</i> ¹ ; <i>Brendan D. Masini, MD</i> ¹ ; <i>Joseph C. Wenke, PhD</i> ² ; <i>LTC Joseph R. Hsu, MD</i> ² ; ¹ Brooke Army Medical Center, Fort Sam Houston, Texas, USA; ² United States Army Institute of Surgical Research, Fort Sam Houston, Texas, USA |
| 11:55 am | Discussion |
| 12:00 – 1:00 pm | Lunch Visit Scientific Posters (Marriott Rivercenter Grand Ballroom Foyer) |
| | LAST OPPORTUNITY TO VISIT Technical Exhibits (Marriott Rivercenter Grand Ballroom G - J) |
| 1:00 – 2:30 pm (Notes pgs. 239 - 240) | Concurrent Sessions (Mini Symposia and Skills Labs run concurrently.) Tickets Required |

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1:00 -2:30 pm

MINI SYMPOSIA

Complex Trauma from Combat - Reconstruction, **Rehab and Orthotics** (#S6) Moderators: COL Romney C. Andersen, MD and LTC Joseph R. Hsu, MD Faculty: Ryan Blanck, CPO; CDR Mark Fleming, MD; Lt COL Wade Gordon, MD; LTC Kevin Kirk, MD and Johnny C. Owens, MPT

Making Medicine's Voice Heard: Media Relations and Political Advocacy (#S7) Moderator: Jeffrey M. Smith, MD Faculty: Patricia Clark and Andrew N. Pollak, MD

2 Minutes/ 2 Slides: Upper Extremity

Technical Tips and Tricks (#S8) Moderator: Pierre Guy, MD, MBA Faculty: Edward J. Harvey, MD; Michael D. McKee, MD; David C. Ring, MD and Paul Tornetta, III, MD

Fundamentals in Trauma II (#S9)

Moderator: Robert F. Ostrum, MD Faculty: Jeffrey O. Anglen, MD; Frank A. Liporace, MD; Thomas F. Varecka, MD and J. Tracy Watson, MD

1:00 -2:30 pm

SKILLS LABS

IM Fixation of Proximal Tibial Fractures (#*S10*)

Moderator: Saam Morshed, MD Faculty: Christopher Finkemeier, MD; Jason W. Roberts, MD and Kenneth Wilkins, MD

IM Fixation of Proximal Femur Fractures (#S11) (Convention Center - Room 007 C & D)

Moderator: Kenneth J. Koval, MD Faculty: Michael Charlton, MD; Kenneth A. Egol, MD; Hassan R. Mir, MD; Mark Munro, MD; John Riehl, MD and Anjan Shah, MD

device is being discussed for an "off label" use). For full information, refer to page 411.

ORIF Distal Femur Fractures (#*S*12)

Moderator: Steven J. Morgan, MD Faculty: Michael S. Sirkin, MD and Bruce H. Ziran, MD

(Convention Center - Room 007 A & B)

(Convention Center - Room 008 A & B)

(Marriott Riverwalk - Salon D)

(Marriott Riverwalk - Salon A)

(Marriott Riverwalk - Salon E)

(Marriott Riverwalk - Salon C)

2:30 pm – Break 3:00 pm **Visit Scientific Posters** (Marriott Rivercenter Grand Ballroom Foyer)

3:00 – 3:30 pm (Notes p. 241) JOHN BORDER MEMORIAL LECTURE (Marriott Rivercenter Grand Ballroom)

Femoral Neck Fracture Management – WWJD (John)?

Marc F. Swiontkowski, MD CEO, TRIA Orthopaedic Center; Professor, Orthopaedic Surgery, University of Minnesota, Minneapolis, Minnesota, USA



Introduction: Andrew N. Pollak, MD, OTA President

| 3:30 – 4:50 pm | SCIENTIFIC SESSION VII RECONSTRUCTION, UPPER EXTREMITY, WRIST and HAND Moderators - Michael J. Gardner, MD & Robert V. O'Toole, MD |
|----------------------------------|---|
| 3:30 pm (p. 242) Paper #82 | The Fate of Patients After a Staged Nonunion Procedure for Known Infection Paul Tornetta, III, MD ¹ ; Kevin Dale, MD ¹ ; Clifford B. Jones, MD ² ; Brian H. Mullis, MD ³ ; Kenneth A. Egol, MD ⁴ ; Elliot Robinson, MD ⁵ ; Michael J. Bosse, MD ⁵ ; Andrew H. Schmidt, MD ⁶ ; Robert A. Hymes, MD ⁷ ; ¹ Boston University Medical Center, Boston, Massachusetts, USA ² Orthopaedic Associates of Michigan, Michigan State University, Grand Rapids, Michigan, USA ³ Indiana University, Indianapolis, Indiana, USA; ⁴ NYU Hospital for Joint Diseases, New York, New York, USA; ⁵ Carolinas Medical Center, Charlotte, North Carolina, USA; ⁶ Hennepin County Medical Center, Minneapolis, Minnesota, USA; ⁷ Inova Fairfax Hospital, Fairfax, Virginia, USA |

| 3:36 pm (p. 244) Paper #83 | •Does BMP-2 Increase the Incidence of Perioperative Wound Complications or Reoperation? Daniel Steven Chan, MD ¹ ; Joshua Garland, MD ² ; Anthony F. Infante, Jr., DO ¹ ; Roy Sanders, MD ¹ ; H. Claude Sagi, MD ¹ ; ¹ Orthopaedic Trauma Service, Florida Orthopaedic Institute, Tampa, Florida, USA; ² Naval Medical Center, Portsmouth, Virginia, USA |
|----------------------------------|--|
| 3:42 pm | Discussion |
| 3:47 pm (p. 245) Paper #84 | Δ Improved Outcome Following Primary Operative Fixation of Displaced Midshaft Fractures of the Clavicle Persists at 2 Years Post Injury: Implications for Clinical Treatment, Future Trials, and Economic Analysis <i>Laura A. Schemitsch; Emil H. Schemitsch, MD; Christian Veillette, MD;</i> <i>Olivia Y.Y. Cheng, Michael D. McKee, MD;</i> <i>St. Michael's Hospital, University of Toronto, Toronto, Ontario, Canada</i> |
| 3:53 pm (p. 246) Paper #85 | Acute Versus Late Intervention in Clavicle Fractures Benjamin Ollivere, MD, FRCS; Avishek Das, MRCS; Katie Rollins, MRCS; Kathleen Elliott, MBBS; Phillip Johnston, MD, FRCS; Lee van Rensburg, FRCS; Graham Tytherleigh-Strong, FRCS; Addenbrooke's Hospital, Cambridge University NHS Trust, Cambridge, United Kingdom |
| 3:59 pm (p. 247) Paper #86 | Clinical and Financial Comparison of Operative and Nonoperative Treatment of Displaced Clavicle Fractures Peter L. Althausen, MD, MBA ¹ ; Steven Shannon, BS ² ; Timothy J. O'Mara, MD ¹ ; Timothy J. Bray, MD ¹ ; ¹ Reno Orthopaedic Clinic, Reno, Nevada, USA; ² University of Nevada School of Medicine, Reno, Nevada, USA |
| 4:05 pm | Discussion |
| 4:10 pm (p. 248) Paper #87 | Determining the Efficacy of Screw and Washer Fixation as a Method for Securing an Olecranon Osteotomy Following the Treatment of Intra-Articular Distal Humerus Fractures Barrett I. Woods, MD; Andrew R. Evans, MD; Robert Hartman, MD; Peter Siska, MD; Gary S. Gruen, MD; Ivan S. Tarkin, MD; Dept. of Orthopaedic Surgery, Division of Traumatology, University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA |
| 4:16 pm (p. 250) Paper #88 | Simple Dislocation of the Elbow Is Associated With Good Long-Term Patient-Reported Outcomes but Persisting Pain and Stiffness are Common Raymond E. Anakwe, MD; Scott D. Middleton, MD; Paul J. Jenkins, MD; Margaret M. McQueen, MD; Charles M. Court-Brown, MD; Orthopaedic Trauma Unit, Royal Infirmary of Edinburgh, Edinburgh, Scotland, United Kingdom |

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| 4:22 pm (p. 251) Paper #89 | Predictors of Fracture Following Suspected Injury to the Scaphoid Andrew D. Duckworth, MSc, MRCSEd ¹ ; Geert A. Buijze, MD ² ; Stuart A. Aitken ¹ ; Matthew Moran ¹ ; Alasdair Gray, MD ³ ; Charles M. Court-Brown, MD ¹ ; David C. Ring, MD ² ; Margaret M. McQueen, MD ¹ ; ¹ Edinburgh Orthopaedic Trauma Unit, Royal Infirmary of Edinburgh, Edinburgh, Scotland, United Kingdom; ² Orthopaedic Hand and Upper Extremity Service, Massachusetts General Hospital, Boston, Massachusetts, USA; ³ Emergency Dept., Royal Infirmary of Edinburgh, Edinburgh, Scotland, United Kingdom |
|----------------------------------|--|
| 4:28 pm | Discussion |
| 4:33 pm (p. 252) Paper #90 | A Prospective Randomized Controlled Trial Comparing Occupational Therapy With Independent Exercises After Volar Plate Fixation of a Fracture of the Distal Radius J. Sebastiaan Souer, MD; Geert A. Buijze, MD; David C. Ring, MD, PhD; Orthopaedic Hand and Upper Extremity Service, Massachusetts General Hospital, Boston, Massachusetts, USA |
| 4:39 pm (p. 253) Paper #91 | A Randomized Prospective Clinical Trial Comparing Treatment of Distal Radius Fractures with Volar Locking Plate and Conventional Percutaneous Methods Alexia Karantana, MRCS ¹ ; Nicholas D. Downing, DM, FRCS(Orth) ¹ ; Daren P. Forward, MA, FRCS, DM ¹ ; Mark Hatton, FRCS(Orth) ¹ ; Professor Chris G. Moran, DM, FRCS(Ed) ¹ ; Andrew M. Taylor, DM, FRCS ¹ ; Professor Brigitte E. Scammell, DM, FRCS(Orth) ² ; Professor Tim R. Davis, FRCS, MCh ¹ ; ¹ Queens Medical Centre, Nottingham University Hospitals NHS Trust, Nottingham, United Kingdom; ² Division of Orthopaedic and Accident Surgery, University of Nottingham, Nottingham, United Kingdom |
| 4:45 pm | Discussion |
| 4:50 pm | Closing Remarks and Adjourn |

OTA 2011 ANNUAL MEETING SCIENTIFIC POSTERS

Marriott Rivercenter Grand Ballroom 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 Names in **bold** = **Presenter**

| POLYTRAUMA | |
|---------------------------|---|
| Poster #1 (p. 255) | Do Changes in the Economy Impact Orthopaedic Trauma Volume? Daniel S. Chan, MD ¹ ; Brandon Burris, MD ² ; Gerald Alexander, MD ; Roy Sanders, MD ¹ ; |
| | ¹ Orthopaedic Trauma Service, Florida Orthopaedic Institute, Tampa, Florida, USA; |
| | ² University of South Florida, Tampa, Florida, USA |
| Poster #2 (p. 257) | The Use of Routine Thoracoabdominal CT Scans in the Polytrauma Patient to Estimate Obesity |
| | <i>David F. Ferguson, MD</i> ¹ ; Bryce J. Busenlehner ² ; Mark D. Rahm, MD ¹ ; Sachin M. Mehta ² ; Juhee Song, PhD ¹ ; Matthew L. Davis, MD ¹ ; H. Wayne Sampson, PhD ² ; Christopher D. Chaput, MD ² ; |
| | ¹ Scott & White Hospital, Temple, Texas, USA; |
| | ² College of Medicine, Texas A&M Health Science Center, College Station, Texas, USA |
| Poster #3 | Bedside Fasciotomy Under Local Anesthesia for Acute |
| (p. 258) | Compartment Syndrome |
| | Nabil A. Ebraheim, MD ¹ ; Amr A. Abdelgawad, MD ² ; Molly A. Ebraheim ¹ ; Sreenivasa R. Alla, MD ¹ ; |
| | ¹ Dept. of Orthopedic Surgery, University of Toledo Medical Center, Toledo, Ohio, USA: |
| | ² Dept. of Orthopedic Surgery & Rehabilitation, Paul L. Foster School of |
| | Medicine, Texas Tech University Health Science Center at El Paso, El Paso, Texas, USA |
| Poster #4 | Can Patient Follow-Up After Orthopaedic Trauma Surgery |
| (p. 259) | be Improved? |
| | Guillaume Dumont, MD; Jeffery Padalecki, MD; Akas Siddiqui, MPH; William Robertson, MD; Rahul Banerjee, MD; |
| | University of Texas Southwestern Medical Center, Dallas, Texas, USA |

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| Poster #5 (p. 261) | Injury Severity But Not Head Injury Is Associated With Heterotopic Ossification in Patients Admitted to a Level 1 Trauma ICU Erika J. Mitchell, MD ¹ ; Patrick R. Norris, PhD ² ; Judith M. Jenkins, RN, MSN ² , John A. Morris, MD ² ; ¹ Loyola University Medical Center, Maywood, Illinois, USA; ² Vanderbilt University Medical Center, Nashville, Tennessee, USA |
|--|---|
| Poster #6 (p. 263) | Civilian Gunshot Wounds of the Humerus Anil Sethi, MD; Vic Gibson, DO; Robert Colen, DO; Daniel Hoard, MD; Robert Meehan, MD; Rahul V. Vaidya, MD ; Detroit Receiving Hospital, Detroit, Michigan, USA |
| Poster #7 (p. 264) | Does Anemia or Transfusion Increase the Risk of Complications in Orthopaedic Trauma Patients? Brian H. Mullis, MD; Erica Fisk, MD; DeWayne Weaver, MD; Qianqian Zhao, MS; Joanne Daggy, PhD; Indiana University School of Medicine Dept. of Orthopaedics, Indianapolis, Indiana, USA |
| SPINE Poster #8 (p. 265) | Early Stabilization of Thoracolumbar Injuries in Polytraumatized Patients <i>Timothy A. Moore, MD</i> ; <i>Heather A. Vallier, MD</i> ; <i>MetroHealth Medical Center, Cleveland, Ohio, USA</i> |
| Poster #9 (p. 266) | Minimally Invasive Surgery (MIS) Techniques and Outcomes for Stabilization/Correction of Single-Level Thoracolumbar Spinal Fractures Amit Kumar, MRCS; Christopher Lee, FRCS; Lincoln County Hospital, Lincoln, United Kingdom |
| PELVIS and ACETABU | LUM |
| Poster #10 (p. 267) | A Modified Ollier Approach for the Treatment of Acetabular Fractures Susan McDowell, MD ¹ ; Bradford S. Knight, MD ² ; Brian H. Mullis, MD ¹ ; Laurence E. Dahners, MD ² ; ¹ Indiana University School of Medicine, Dept. of Orthopaedics, Indianapolis, Indiana, USA; ² University of North Carolina School of Medicine, Dept. of Orthopaedics, Chapel Hill, North Carolina, USA |
| Poster #11 (p. 269) | What Outcomes Are Important for Patients Following Pelvic Trauma? Subjective Responses and Psychometric Analysis of 3 Published Pelvic Specific-Outcome Instruments Kelly A. Lefaivre, MD, MSc, FRCSC; Gerard P. Slobogean, MD; Jacqueline Ngai, BSc; Henry M. Broekhuyse, MD, FRCSC; Peter J. O'Brien, MD, FRCSCS; University of British Columbia, Vancouver, British Columbia, Canada |

| Poster #12 (p. 270) | Does Early Treatment of Acetabular Fractures Lead to Increased Blood Loss? <i>Caroline R. Gross. BS</i> ¹ : Robert V. O'Toole, MD ¹ : Renan C. Castillo, PhD ² : |
|----------------------------|--|
| | Theodore T. Manson, MD ¹ ; ¹ R Adams Cowley Shock Trauma Center, Dept. of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA; ² Center for Injury Research & Policy, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA |
| Poster #13 (p. 271) | Pelvic CT-Based Graphical Modeling for Safe Insertion of Anterior and Posterior Column Screws Soham Banerjee, BS; Cameron Sadeghi, MD; Adam J. Starr, MD; Rahul Banerjee, MD; University of Texas Southwestern Medical Center, Dallas, Texas, USA |
| Poster #14 (p. 273) | • Stability of an Anterior Internal Fixator for Vertically Unstable Pelvic Fractures Jonathan M. Vigdorchik, MD ¹ ; Amanda O. Esquivel, PhD ¹ ; Xin Jin, PhD ² ; King H. Yang, PhD ² ; David C. Markel, MD ¹ ; Rahul V. Vaidya, MD ¹ ; ¹ Detroit Medical Center/Providence Hospital Orthopaedic Residency Program, Detroit, Michigan, USA; ² Wayne State University, Detroit, Michigan, USA |
| Poster #15 (p. 275) | Percutaneous Retrograde Posterior Column Acetabular Fixation: Is the Sciatic Nerve Safe? A Cadaveric Study <i>Khalid Azzam, MD</i> ¹ ; Justin Siebler, MD ² ; Karl Bergmann, MD ² ; Miguel S. Daccarett, MD ¹ ; Matthew M. Mormino, MD ¹ ; ¹ University of Nebraska Medical Center, Omaha, Nebraska, USA; ² Creighton University Medical Center, Omaha, Nebraska, USA |
| Poster #16 (p. 276) | Can MRI Detect Ligamentous Injury in Pelvic Ring Disruptions? <i>Joshua L. Gary, MD</i> ¹ ; Michael Mulligan, MD ² ; Robert V. O'Toole, MD ¹ ; ¹ R A Cowley Shock Trauma Center, Dept. of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA; ² Dept. of Radiology, University of Maryland School of Medicine, Baltimore, Maryland, USA |
| Poster #17 (p. 277) | Biomechanical Analysis of Posterior Pelvic Ring Fixation in a Vertically Unstable Pelvic Fracture Model <i>Michael P. Leslie, DO</i> ¹ ; Christian S. Bromfield, MD ² ; Erik McDonald, BS ³ ; Jenni M. Buckley, PhD ³ ; Mark A. Lee, MD ³ ; Tania A. Ferguson, MD ² ; ¹ Yale University School of Medicine, New Haven, Connecticut, USA; ² University of California San Francisco, San Francisco, California, USA; ³ University of California, Davis, Sacramento, California, USA |
| Poster #18 (p. 279) | Can Experts in Acetabular Fracture Care Determine Hip Stability After Posterior Wall Fractures Using Plain Radiographs and Computed Tomography? Adrian T. Davis, MD; Berton R. Moed, MD; Saint Louis University School of Medicine, St. Louis, Missouri, USA |

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| Poster #19 (p. 280) | Long-Term Outcome After Displaced Sacral Fractures Treated With Internal Fixation Aron Adelved, MD ^{1,2} ; Anna Tötterman, MD, PhD ³ ; Thomas Glott, MD ⁴ ; Jan Erik Madsen, MD, PhD ² ; Olav Røise, MD, PhD ² ; ¹ Akershus University Hospital, Oslo, Norway; ² Oslo University Hospital, Oslo, Norway; ³ Karolinska University Hospital, Stockholm, Sweden; ⁴ Sunnaas Hospital, Nesodden, Norway |
|---|--|
| Poster #20 (p. 281) | Reexamination of Pelvic Inlet and Outlet Images Using Three-Dimensional Computed Tomography Reconstructions <i>Philip Rotter, MD; Paul Toogood, MD; Saam Morshed, MD;</i> <i>Utku Kandemir, MD; Murat Pekmezci, MD;</i> <i>Orthopaedic Trauma Institute, University of California San Francisco,</i> <i>San Francisco General Hospital, San Francisco, California, USA</i> |
| Poster #21 (p. 282) | The Incidence and Significance of L5 Transverse Process Fractures in Adult Blunt Trauma Patients Derek Ward, MD; Sina Akhavan, MS; Utku Kandemir, MD; Murat Pekmezci, MD ; Dept. of Orthopaedics, University of California, San Francisco, San Francisco, California, USA |
| Poster #22 (p. 283) | Condition-Specific Discomfort in Patients With Pelvic Ring Injuries Following Internal Fixation Tomas Borg, MD, PhD ¹ ; Marianne Carlsson, MD, PhD ² ; Sune Larsson, MD, PhD ¹ ; ¹ Dept. of Orthopaedic Surgery, Uppsala University, Uppsala, Sweden; ² Dept. of Public Health and Caring Sciences, Uppsala University, Uppsala, Sweden |
| TIBIA Poster #23 (p. 284) | Can Tibial Fracture Gap Volume Be Measured From Plain Radiographs? <i>Christen Vagts, BS</i> ; Theodore T. Manson, MD, MS; Robert V. O'Toole, MD, MS; R Adams Cowley Shock Trauma Center, Dept. of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA |
| Poster #24 (p. 285) | Intramedullary Fixation of Fibular Fractures Associated With Complicated Tibial Shaft and Pilon Fractures Christopher Stewart, MD; Dirk Kiner, MD; Peter J. Nowotarski, MD; Dept. of Orthopaedic Surgery, University of Tennessee-Chattanooga, Chattanooga, Tennessee, USA |

| Poster #25 | Injury Factors That Influence Outcome in Severe Open Tibia Fractures |
|---|---|
| (p. 200) | Travis C. Burns, MD ¹ ; Daniel J. Stinner, MD ¹ ; Andrew W. Mack, MD ² ; |
| | Benjamin K. Potter, MD ² , Kob Beer, MD ² ; Daniel K. Possley, DO ² ; |
| | Michael J. Beltran, MD ² ; Koman A. Hayaa, MD ² ; |
| | COL Komney C. Andersen, MD ⁴ ; John J. Keeling, MD ² ; |
| | Hurolu IVI. Frisch, NID'; Clinton K. Murruy, NID', Joseph C. Wenke, PhD'; |
| | Jumes K. Ficke, MD ² ; LIC Joseph K. HSU, MD ²⁰ ; |
| | ¹ Dent of Orthonaedics and Rehabilitation Brooke Army Medical Center |
| | Fort Sam Houston Texas 115 4: |
| | ² Dent of Orthonaedics and Rehabilitation Walter Reed National Military |
| | Medical Center Washinoton, District of Columbia 1154: |
| | ³ Dent of Orthongedics, Brozon University Warren Alnert School of Medicine |
| | Providence Rhode Island 11SA: |
| | ⁴ Mission Hospital Asheville North Carolina 11SA: |
| | ⁵ Dent of Medicine Brooke Army Medical Center Fort Sam Houston Texas USA: |
| | ⁶ US Army Institute of Surgical Research, Fort Sam Houston, Texas, USA |
| Poster #26 | A New External Fixation System for Tibial Shaft Fractures |
| (p. 288) | Peter B.M. Thomas. FRCS(Orth): Peter I. Ogrodnik. PhD: |
| (p. =00) | Christopher I. Moorcroft. PhD: Matthew Ockendon, MD: |
| | University Hospital of North Staffordshire. Staffordshire University. |
| | United Kingdom |
| Poster #27 | Results of Tibial Plateau Fractures Treated Through a Posteroloateral |
| (-200) | Trans Charles Assure to the |
| (p. 289) | Transfibular Approach |
| (p. 289) | Transfibular Approach Robert Baird, MD, BMBS, FRACS; Bogdan Solomon, MD; Agron MD; Authony Bohl, MD; Donald Hornia, MD; |
| (p. 289) | Transfibular Approach Robert Baird, MD, BMBS, FRACS ; Bogdan Solomon, MD; Aaron Stevenson, MD; Anthony Pohl, MD; Donald Howie, MD; Dent of Orthomagdics and Trauma, Bowal Addaida Hocnital |
| (p. 289) | Transfibular Approach Robert Baird, MD, BMBS, FRACS ; Bogdan Solomon, MD; Aaron Stevenson, MD; Anthony Pohl, MD; Donald Howie, MD; Dept. of Orthopaedics and Trauma, Royal Adelaide Hospital, University of Adelaide, Adelaide, South Australia, Australia |
| (p. 289) | Transfibular Approach Robert Baird, MD, BMBS, FRACS ; Bogdan Solomon, MD; Aaron Stevenson, MD; Anthony Pohl, MD; Donald Howie, MD; Dept. of Orthopaedics and Trauma, Royal Adelaide Hospital, University of Adelaide, Adelaide, South Australia, Australia |
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| Poster #29 (p. 292) | Locked Plating Versus Intramedullary Nailing: Management of Closed Distal Tibial Fractures—A Case-Matched Series Benjamin Ollivere, MD; David Cumming; Sue Deakin; West Suffolk Hospital, Suffolk, United Kingdom |
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| Poster #30 (p. 293) | Reamed Versus Unreamed Nailing of Tibial Shaft Fractures in Patients Requiring Two or More Re-Operations: A Subgroup Analysis of the SPRINT Trial SPRINT Investigators: Emil H. Schemitsch, MD ¹ ; Ashesh Kumar, MD, FRCSC ¹ ; Diane Heels-Ansdell, MSc ² ; Sheila Sprague, MSc ² ; Michael Saccone, BSc ² ; Gordon H. Guyatt, MD, MSc, FRCPC ² ; David W. Sanders, MD ³ ; Marc F. Swiontkowski, MD ⁴ ; Paul Tornetta, III, MD; Stephen D. Walter, PhD ² ; Mohit Bhandari, MD, PhD, FRCSC ⁶ ; ¹ Dept. of Surgery, Division of Orthopaedic Surgery, University of Toronto, Toronto, Ontario, Canada; ² Dept. of Clinical Epidemiology and Biostatistics, McMaster University, Hamilton, Ontario, Canada; ³ Dept. of Surgery, London Health Sciences Centre, London, Ontario, Canada; ⁴ Dept. of Orthopaedic Surgery, University of Minnesota, Minnesota, USA; ⁵ Dept. of Orthopaedic Surgery, Boston University Medical Center, Boston, Massachusetts, USA; ⁶ Dept. of Clinical Epidemiology and Biostatistics and Dept. of Surgery, Div. of Orthopaedic Surgery, McMaster University, Hamilton, Ontario, Canada |
| Poster #31 (p. 294) | The Effect of Two Distal Interlocking Screw Configuration and Orientation on Intramedullary Nail Stability: A Biomechanical Study S. Preston Jones, MD ¹ ; Alexander CM. Chong, MSAE, MSME ^{1,2} ; Bradley R. Dart, MD ¹ ; Vinh Pham, BSAE ² ; Adam J. Rogg ² ; Joel White, BSME ² ; Paul H. Wooley, PhD ^{1,2} ¹ Dept. of Surgery, Section of Orthopaedics, The University of Kansas School of Medicine-Wichita, Wichita, Kansas, USA; ² Via Christi Health, Orthopedic Research Institute, Wichita, Kansas, USA |
| KNEE and TIBIAL PLA Poster #32 (p. 295) | TEAU Biomechanical Comparison of Posterior Plates and Screw Fixation of Posteromedial Fragments in Tibial Plateau Fractures <i>John R. West, MD</i> ; Christopher E. Mutty, MD; T. Mark Ehrensberger, MD; State University of New York at Buffalo, Buffalo, New York, USA |
| Poster #33 (p. 297) | Reduction of Impacted Articular Fragments of the Tibial Plateau: A Cadaveric Evaluation of Inflatable Bone Tamps Andrew H. Schmidt, MD ¹ ; James P. Stannard, MD ² ; Jake P. Heiney, MD ³ ; ¹ Hennepin County Medical Center, Minneapolis, Minnesota, USA; ² University of Missouri, Columbia, Missouri, USA; ³ ProMedica Health System, Toledo, Ohio, USA |
| Poster #34 (p. 299) | Complication Rates Following Operative Fixation of Bicondylar Tibial Plateau Fractures Brent J. Morris, MD; R. Zackary Unger, BS; Aaron M. Perdue, MD; William T. Obremskey, MD; Vanderbilt University Medical Center, Nashville, Tennessee, USA |

| Poster #35 (p. 301) | Patellar Dislocation in the United States: Role of Sex, Age, Race, and Athletic ParticipationCPT Brian R. Waterman, MD, MC, USA1;LTC Philip J. Belmont Jr, MD, MC, USA1;CPT Matthew Laughlin, DO, MC, USA1;MAJ Brett D. Owens, MD, MC, USA2 ¹ William Beaumont Army Medical Center, El Paso, Texas, USA; ² Keller Army Hospital, US Military Academy, West Point, New York, USA |
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| Poster #36 | Clinical Outcome of Tibial Plateau Fractures Related to |
| (p. 302) | Meniscal Injuries <i>Martin F. Hoffmann, MD</i> ¹ ; Clifford B. Jones, MD, FACS ² ; Debra L. Sietsema, PhD ² : |
| | ¹ Grand Rapids Medical Education Partners, Grand Rapids, Michigan, USA; ² Orthopaedic Associates of Michigan, Michigan State University, Grand Rapids, Michigan, USA |
| Poster #37 | Clinical Outcome of Tibial Plateau Fractures Related to the |
| (p. 505) | Martin F. Hoffmann, MD ¹ ; Clifford B. Jones, MD, FACS ² ; Debra L. Sietsema, PhD ² : |
| | ¹ Grand Rapids Medical Education Partners, Grand Rapids, Michigan, USA; ² Orthopaedic Associates of Michigan, Michigan State University, Grand Rapids, Michigan, USA |
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| Poster #38 | Complications Following Open Reduction and Internal Fixation of |
| (p. 304) | Ankle Fractures in Patients With a Positive Urine Drug Screen Vilas Saldanha, MD; Nathan Tiedeken, MD; John Gaughan, PhD; Brett A. Sweitzer, MD; |

Dept. of Orthopaedic Surgery, Albert Einstein Medical Center, Philadelphia, Pennsylvania, USA

| Poster #39 (p. 305) | Syndesmotic ART: The Anatomic Repair Technique <i>Joseph Assini, MD</i> ; Ryan Paul, BSc; Abdel Lawendy, MD; Ajay Manjoo, MD; David W. Sanders, MD; London Health Sciences Centre, University of Western Ontario, London, Ontario, Canada |
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| Poster #40 (p. 306) | Optimal Fixation for Horizontal Medial Malleolus Fractures <i>Derek F. Amanatullah, MD, PhD</i> ¹ ; Erik McDonald, BS ² ; Adam D. Shellito ¹ ; Shain R.S. Lafazan ¹ ; Alejandro Cortes ¹ ; Shane Curtiss, AS ¹ ; Philip R. Wolinsky, MD ¹ ; ¹ Dept. of Orthopaedic Surgery, University of California, Davis, Sacramento, California, USA; ² University of California, San Francisco/San Francisco General Hospital Orthopaedic Trauma Institute, San Francisco, California, USA |

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| Poster #41 (p. 308) | Quantification of Posterior Ankle Exposure Through an Achilles Tendon-Splitting Versus Posterolateral Approach Jeanne C. Patzkowski, MD ^{1,2} ; Kevin L. Kirk, DO ² ; Justin D. Orr, MD ³ ; CPT Brian R. Waterman, MD ³ ; Jess M. Kirby, MD; LTC Joseph R. Hsu, MD ^{1,2} ; Skeletal Trauma Research Consortium (STReC); ¹ United States Army Institute of Surgical Research, Fort Sam Houston, Texas, USA; ² Brooke Army Medical Center Dept. of Orthopaedics and Rehabilitation, Fort Sam Houston, Texas, USA; ³ William Beaumont Army Medical Center, El Paso, Texas, USA |
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| Poster #42 (p. 309) | Calcaneal Fixation: Extensile Lateral Versus Sinus Tarsi Approach – Early Outcome Evaluation Gerard J. Cush, MD; Kaan Irgit, MD ; Patrick J. Maloney, MD; Blake E. Moore, MD; Zhiyong Hou, MD; Steven Lillmars, DO; James C. Widmaier, MD; Wade R. Smith, MD; Geisinger Health System, Danville, Pennsylvania, USA |
| Poster #43 (p. 310) | The Impact of Clamp Position on Accuracy of Syndesmotic Reduction <i>Timothy Judkins, MD; David J. Hak, MD;</i> <i>Denver Health/University of Colorado, Denver, Colorado, USA</i> |
| Poster #44 (p. 312) | Comparison of Functional Outcome Between Bony and Ligamentous Injuries in Supination External Rotation Type IV (SER IV) Ankle Fractures Marschall B. Berkes, MD; Milton T.M. Little, MD; Lionel E. Lazaro, MD; Peter K. Sculco, MD; Rachel M. Cymerman, BA; David L. Helfet, MD; Dean G. Lorich, MD; Hospital for Special Surgery, New York, New York, USA |
| Poster #45 (p. 313) | Outcomes of Calcaneal Lateral Wall Exostectomy as a Treatment for Peroneal Tendon Impingement in Patients With Prior Calcaneal Fractures Paul Tornetta, III, MD; Joey LaMartina, II, MD; Boston University Medical Center, Boston, Massachusetts, USA |
| Poster #46 (p. 314) | Long-Term Results in Acute Achilles Tendon Rupture: Fibrin Glue Versus Percutaneous Repair Matthias Knobe, MD; Johannes Corsten; Saskia Catharina Mooij, MD; Richard Martin Sellei, MD; Roman Pfeifer, MD; Hans-Christoph Pape, MD, FACS; Dept. of Orthopedic and Trauma Surgery, RWTH Aachen University, Aachen, Germany |
| Poster #47 (p. 315) | The Anterior Distal Tibial Angle: Published Values Are Misleading <i>Matt L. Graves, MD</i> ¹ ; Patrick Powell, MD ¹ ; Sean Nork, MD ² ; George V. Russell, MD ¹ ; ¹ University of Mississippi Medical Center, Jackson, Mississippi, USA; ² Harborview Medical Center, Seattle, Washington, USA |

| Poster #48 (p. 316) | PACS (Picture Archiving and Communication System) and Plain Radiography Fracture Classification Agreement of the Tibial Plafond Justin R. Kauk, MD; Douglas R. Dirschl, MD; University of North Carolina–Chapel Hill, Dept. of Orthopaedic Surgery, Chapel Hill, North Carolina, USA |
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| Poster #49 (p. 317) | Evaluation of Clinical Outcomes Following Mini-Fragment Dual-Plate Fixation of Talar Neck Fractures Mary A. Herzog, 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 Partners, Grand Rapids, Michigan, USA; ² Michigan State University, Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA |
| Poster #50 (p. 318) | The Effect of Clamp and Screw Placement on Syndesmotic Reduction <i>Anna N. Miller, MD</i> ; Bruce J. Sangeorzan, MD; David P. Barei, MD; Daphne M. Beingessner, MD; Harborview Medical Center, Seattle, Washington, USA |
| Poster #51 (p. 319) | Assessing the Utility of Knee and Foot Radiographs for the Evaluation of Ankle Fractures Valentin Antoci, MD, PhD ¹ ; Michael J. Weaver, MD ² ; J. Kent Ellington, MD ³ ; John Y. Kwon, MD ⁴ ; ¹ Harvard Combined Orthopaedic Residency Program, Boston, Massachusetts, USA; ² Brigham and Women's Hospital, Boston, Massachusetts, USA; ³ Ortho Carolina, Charlotte, North Carolina, USA; ⁴ Massachusetts General Hospital, Boston, Massachusetts, USA |
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| Poster #52 (p. 320) | Increased Severity of Type III Supracondylar Humerus Fractures in the Pre-Teen Population Nicholas D. Fletcher, MD ¹ ; Jonathan R. Schiller, MD ² ; Sumeet Garg, MD ³ ; Amanda L. Weller, MD ⁴ ; A. Noelle Larson, MD ⁵ ; Michael Kwon, MD ⁶ ; Lawson A.B. Copley, MD ⁷ ; Christine A. Ho, MD ⁷ ; ¹ Emory University, Atlanta, Georgia, USA; ² Brown University, Providence, Rhode Island, USA; ³ Denver Children's Hospital, Denver, Colorado, USA; ⁴ University of Texas Southwestern, Dallas, Texas, USA; ⁵ University of Minnesota Minneapolis, Minnesota, USA; ⁶ Texas Scottish Rite Hospital for Children, Dallas, Texas, USA; ⁷ Children's Medical Center, Dallas, Texas, USA |
| Poster #53 (p. 321) | Acute Complications Associated With Removal of Flexible Intramedullary Rods Placed for Pediatric Femoral Shaft Fractures Jeffrey Levy, MD; David A. Podeszwa, MD; Christine A. Ho, MD; Geof LeBus, BS; Lane Wimberly, MD; Dept. of Orthopaedic Surgery, University of Texas Southwestern, Children's Medical Center Dallas, and Texas Scottish Rite Hospital, Dallas, Texas, USA |

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| Poster #54 (p. 322) | Supracondylar Humeral Fractures in Children: Experience of Performing Surgeon and Delay of Treatment Have No Influence on the Incidence of Open Reduction and Complications <i>Timo Schmid, MD</i> ¹ ; Kai Ziebarth, MD ² ; Alexander Joeris, MD ³ ; Theddy Slongo, MD ⁴ ; ¹ Inselspital Bern, Dept. of Orthopedic Surgery, Bern, Switzerland; ² Inspital Bern, Dept. of Orthopedic Surgery, Bern, Switzerland; ³ Inspital Bern, Dept. of Pediatric Surgery, Bern, Switzerland; ⁴ Inselspital Bern, Dept. of Pediatric Surgery, Bern, Switzerland |
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| Poster #55 (p. 323) | Tibial Shaft Fractures in Adolescents: Analysis of Cast Treatment Successes and Failures <i>Greg Dammann, MD¹; Christine A. Ho, MD²; David A. Podeszwa, MD²;</i> <i>Jeffrey Levy, MD¹; Robert L. Wimberly, MD²;</i> ¹ <i>Tripler Medical Center, Honolulu, Hawaii, USA;</i> ² <i>Texas Scottish Rite Hospital – Children's Medical Center Dallas,</i> <i>Dallas, Texas, USA</i> |
| GERIATRIC FRACTUR | RES |
| Poster #56 (p. 324) | Is Bisphosphonate Usage Associated With Atypical Humeral Diaphyseal Fractures? Matthew A. Popa, MD ¹ ; Clifford B. Jones, MD, FACS ^{2,3} ; Debra L. Sietsema, PhD ^{2,3} ; Shaun Kink, BS ³ ; Matthew S. Nies, BS ³ ; ¹ Grand Rapids Orthopaedic Residency Program, Grand Rapids, Michigan, USA; ² Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA; ³ Michigan State University, Grand Rapids, Michigan, USA |
| Poster #57 (p. 325) | Functional Outcome, Complications, and Radiographic Comparison of Supination–External Rotation Type IV Ankle Fractures in Geriatric Versus Nongeriatric Populations Milton T.M. Little, MD; Marschall B. Berkes, MD; Lionel E. Lazaro, MD; Peter K. Sculco, MD; Rachel M. Cymerman, BA; David L. Helfet, MD; Dean G. Lorich, MD; Hospital for Special Surgery, New York, New York, USA |
| Poster #58 (p. 326) | Open Reduction and Internal Fixation of Proximal Humerus Fractures in Patients Older Than 70 Years Using a Locked Plate: Minimum 1 Year Follow-up Jonathan C. Levy, MD; Holy Cross Orthopaedic Institute, Ft. Lauderdale, Florida, USA |
| Poster #59 (p. 327) | Can We Prevent Renal Failure by Using Ciprofloxacin Instead of Gentamicin for the Treatment of Open Fractures in Older Patients? <i>Maria Iannolo, MD</i> ; Nathan D. Mah, PharmD; Nicole M. Acquisto, PharmD; Jonathan M. Gross, MD; John P. Ketz, MD; Mark L. Prasarn, MD; Catherine A. Humphrey, MD; John T. Gorczyca, MD; University of Rochester Medical Center, Rochester, New York, USA |
| Poster #60 (p. 328) | Cemented Hemiarthroplasty Is Associated With a Higher Early Mortality Rate Than Uncemented Hemiarthroplasty—Fact or Fiction? <i>Talaat Al-Atassi, MD</i> ; D.T.S. Chou, MD; Chris Boulton; Christopher G. Moran, MD; Queens Medical Centre, Nottingham University Hospitals NHS Trust, Nottingham, United Kingdom |
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| Poster #61 (p. 329) | Cortical Width Can Predict Bone Mineral Density and Screw Pullout Strength in the Distal Radius <i>Meir Marmor, MD</i> ; Kate Liddle, MD; Jenni M. Buckley, PhD; Amir Matityahu, MD; Dept. of Orthopaedic Surgery, University of California San Francisco, San Francisco, California, USA |
| Poster #62 (p. 330) | Is the Use of Cement Safe When Performing Arthroplasty for Hip Fractures? Tim J.S. Chesser ¹ ; Robert Handley ² ; Carlos Sharpin ³ ; on behalf of the Hip Fracture Guideline Development Group ³ ; ¹ Dept. of Orthopaedics, Frenchay Hospital, Bristol, United Kingdom; ² John Radcliffe Hospital, Oxford, United Kingdom; ³ National Institute of Clinical Excellence, London, United Kingdom |
| Poster #63 (p. 331) | Postoperative Outcomes of Femoral Subtrochanteric Fractures in Patients on Bisphosphonate Therapy: A Prospective Study Bryon J.X. Teo ¹ ; Joyce S.B. Koh, FRCS(Orth) ² ; Seo Kiat Goh, FRCS(Orth) ² ; Meng Ai Png, FRCR ³ ; David T.C. Chua, FRCS(Orth) ⁴ ; Howe Tet Sen, FRCS(Orth) ² ; ¹ Yong Loo Lin School of Medicine, National University of Singapore, Singapore; ² Dept. of Orthopaedic Surgery, Singapore General Hospital, Singapore; ³ Dept. of Diagnostic Radiology, Singapore General Hospital, Singapore; ⁴ Dept. of Orthopaedic Surgery, Changi General Hospital, Singapore |
| Poster #64 (p. 332) | A Retrospective Analysis of Patients Who Sustain a Hip Fracture While Taking Warfarin Frederick Tonnos, DO ; Paul Gregory, MD; Mercy San Juan Medical Center, Carmichael, California, USA |
| Poster #65 (p. 333) | Can Plain Radiographs Differentiate Bisphosphonate Femur Fractures From Nonbisphosphonate Femur Fractures? Nirmal C. Tejwani, MD; Ji Hae Park, BA; Renata La Rocca Vieira, MD; Zehava Sadka Rosenberg, MD; Leon D. Rybak, MD; Sandra Moore, MD; Jenny Bencardino, MD; Kenneth A. Egol, MD ; NYU Hospital for Joint Diseases, New York, New York, USA |
| Poster #66 (p. 334) | Combination Nail-Plate Fixation of Osteoporotic Distal Metaphyseal Femoral Fractures <i>Kevin D. Grant, MD</i> ; Safet Hatic, DO; Hassan R. Mir, MD; Anthony F. Infante, Jr., DO; Orthopaedic Trauma Service, Florida Orthopedic Institute, Tampa, Florida, USA |

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| Poster # 67 (p. 335) | Hip Fractures: Be Careful This Weekend <i>Adam G. Miller, MD</i> ¹ ; <i>Kathryn Kasmire, BA</i> ² ; <i>Fabio Orozco, MD</i> ³ ; <i>Alvin Ong, MD</i> ³ ; ¹ Thomas Jefferson University Hospital, Philadelphia, Pennsylvania, USA; ² Thomas Jefferson University, Philadelphia, Pennsylvania, USA; ³ Rothman Institute; Philadelphia, Pennsylvania, USA |
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| Poster #68 (p. 336) | Time Between First and Second Hip Fractures in Elderly Patients: Defining the Prevention Target <i>Pierre Guy, MD</i> ; Kelly A. Lefaivre, MD, Lisa Kuramoto; Boris Sobolev, PhD; University of British Columbia, Vancouver, British Columbia, Canada |
| HIP and FEMUR Poster #69 (p. 337) | Accurate Measurement of Distal Femoral Sagittal Alignment Martin F. Hoffmann, MD ¹ ; Clifford B. Jones, MD, FACS ² ; Debra L. Sietsema, PhD ² ; ¹ Grand Rapids Medical Education Partners, Grand Rapids, Michigan, USA; ² Orthopaedic Associates of Michigan, Michigan State University, Grand Rapids, Michigan, USA |
| Poster #70 (p. 339) | Are Routine Postoperative Radiographs Necessary Following Hip Hemiarthroplasty? Paul Appleton, MD; Aron Chacko, BS; Greta Thomsen, BA; Edward K. Rodriguez, MD, PhD; Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA |
| Poster #71 (p. 340) | Complications and Injuries Associated with Traumatic Hip Dislocations: What Predicts Outcome? <i>Paul C. Chin, MD, PhD</i> ¹ ; <i>Rahul Banerjee, MD</i> ¹ ; <i>John McDonald, MD</i> ¹ ; <i>Robert Lewis, BS</i> ¹ ; <i>Akas Siddiqui, MPH</i> ¹ ; <i>Lisa K. Cannada, MD</i> ² ; <i>Maureen Finnegan, MD</i> ¹ ; ¹ University of Texas Southwestern Medical Center, Dallas, Texas, USA; ² Saint Louis University, St. Louis, Missouri, USA |
| Poster #72 (p. 341) | Skeletal Versus Cutaneous Femoral Traction for Diaphyseal Femur Fractures: Prospective Randomized Controlled Trial Jesse L. Even, MD; Justin E. Richards, MD; Colin G. Crosby, MD; Philip J. Kregor, MD; Erika J. Mitchell, MD; A. Alex Jahangir, MD; Marc A. Tressler, MD; William T. Obremskey, MD; Vanderbilt University Medical Center in Nashville, Tennessee, USA |
| Poster #73 (p. 342) | Factors Leading to Nonunion After Locked Plating of Distal Femoral Fractures Christina L. Boulton, MD ¹ ; Aron Chacko ² ; Edward K. Rodriguez, MD² ; ¹ R Adams Cowley Shock Trauma Center, University of Maryland School of Medicine, Dept. of Orthopaedic Surgery, Baltimore, Maryland, USA; ² Beth Israel Deaconess Medical Center, Dept. of Orthopaedics, Boston, Massachusetts, USA |

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| Poster #74 (p. 344) | Accuracy and Precision of the Piriformis and Trochanteric Entry Point for Intramedullary Nailing in Femoral Shaft Fractures Using Image-Guided Navigation and Conventional Fluoroscopy Meghan Crookshank ^{1,2} ; Max Edwards, MD ³ ; Michael Sellan ⁴ ; Cari Whyne, MD ² ; Emil H. Schemitsch, MD ¹ ; ¹ St. Michael's Hospital, Toronto, Ontario, Canada; ² Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada; ³ Princess Royal University Hospital, London, United Kingdom; ⁴ Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada |
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| Poster # 75 (p. 345) | Risk to the Superior Gluteal Nerve With a Proximal Percutaneous "On-Axis" Insertion Portal for Antegrade Piriformis Femoral Nailing Jason A. Lowe, MD ¹ ; Mark A. Lee, MD ² ; William Min, MD ¹ ; Philip R. Wolinsky, MD ² ; ¹ University of Alabama at Birmingham, Birmingham, Alabama, USA; ² University of California, Davis, Sacramento, California, USA |
| Poster #76 (p. 346) | Predictors for Mechanical Failure of Proximal Femoral Locking Plates <i>Philipp N. Streubel, MD</i> ; <i>Aaron M. Perdue, MD</i> ; <i>William T. Obremskey, MD, MPH;</i> <i>Vanderbilt Medical Center, Nashville, Tennessee, USA</i> |
| Poster #77 (p. 347) | Effect of Varus and Valgus Alignment on Implant Loading After Proximal Femur Fracture Fixation Meir Marmor, MD; Kate Liddle, MD; Jenni M. Buckley, PhD; Amir Matityahu, MD; Dept. of Orthopaedic Surgery, University of California San Francisco, San Francisco, California, USA |
| Poster #78 (p. 349) | The Effect of Fracture Pattern and Implant Type on Stability of OTA Type 31-A2 Proximal Femur Fractures <i>Meir Marmor, MD</i> ; <i>Kate Liddle, MD</i> ; <i>Jenni M. Buckley, PhD</i> ; <i>Murat Pekmezci, MD</i> ; <i>Amir Matityahu, MD</i> ; <i>Dept. of Orthopaedic Surgery, University of California San Francisco,</i> <i>San Francisco, California, USA</i> |
| Poster #79 (p. 350) | Surgical Preferences of Patients at Risk of Hip Fractures Noor Alolabi, MD ¹ ; Bashar Alolabi, MD ² ; Raman Mundi, MD ¹ ; Paul J. Karanicolas, MD ³ ; Jonathan D. Adachi, MD ⁴ ; Mohit Bhandari, MD ¹ ; ¹ Division of Orthopaedic Surgery, McMaster University, Hamilton, Ontario, Canada; ² Dept. of Surgery, University of Western Ontario, London, Ontario, Canada; ³ Memorial Sloan-Kettering Cancer Center, New York, New York, USA; ⁴ Dept. of Medicine, McMaster University, Hamilton, Ontario, Canada |

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| Poster #80 (p. 351) | Systematic Review of the Treatment of Periprosthetic Distal Femur Fractures Bill Ristevski, MD, MSc, FRCS(C) ¹ ; Aaron Nauth, MD, FRCS(C) ¹ ; Mohit Bhandari, MD, PhD, FRCS(C) ² ; Emil H. Schemitsch, MD, FRCS(C) ¹ ; ¹ Dept. of Surgery, Division of Orthopaedics, St. Michael's Hospital, University of Toronto, Toronto, Ontario, Canada; ² Dept. of Surgery, Division of Orthopaedics, Hamilton General Hospital, McMaster University, Hamilton, Ontario, Canada |
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| Poster #81 (p. 353) | Δ The Impact of Nerve Blocks on Opioid Use, Hospital Length of Stay, and Pain in Patients With Traumatic Lower Extremity Injury <i>Stephen M. Tourjee, BA</i> ¹ ; William T. Obremskey, MD, MPH ¹ ; Renan C. Castillo, PhD ² ; Christine M. Abraham, MS ¹ ; Jesse M. Ehrenfeld, MD ¹ ; Kevin D. Phelps, BA ¹ ; Rishi D. Naik, BA ¹ ; Kristin R. Archer, PhD ¹ ; ¹ Vanderbilt University Medical Center, Nashville, Tennessee, USA; ² Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA |
| Poster #82 (p. 355) | Catastrophic Failure Following Open Reduction and Internal Fixation of Femoral Neck Fractures With a Novel Locking Plate Implant Marschall B. Berkes, MD; Milton T.M. Little, MD; Lionel E. Lazaro, MD; Rachel M. Cymerman, BA; David L. Helfet, MD; Dean G. Lorich, MD; Hospital for Special Surgery, New York, New York, USA |
| Poster #83 (p. 356) | Radiographic Incidence of Cam-Type Impingement in Femoral Neck Fractures Treated With Reduction and Internal Fixation <i>Matthew Wendt, MD</i> ; Joseph R. Cass, MD; Robert Trousdale, MD; Mayo Clinic, Dept. of Orthopedics, Rochester, Minnesota, USA |
| Poster # 84 (p. 357) | Δ Larger Diameter Interlocking Screws Improve the Fatigue Life of Femoral Nail Fixation Utku Kandemir, MD ; Erik McDonald, BS; Michael Kelly, MD; Kate Liddle, BS; Jenni M. Buckley, PhD; Dept. of Orthopaedic Surgery, University of California San Francisco, San Francisco, California, USA |
| Poster #85 (p. 359) | Retrograde Nailing of Supraisthmal Femur Fractures: How High Can You Go? <i>Kevin M. Kuhn, MD</i> ; Ashley N. Haegele, BS; John A. Boudreau, MD; Lisa K. Cannada, MD; J. Tracy Watson, MD; Saint Louis University Hospital, St. Louis, Missouri, USA |
| Poster #86 (p. 360) | Proximal Femoral Locking Plates: Clinical Outcomes at a Level 1 Trauma Center CPT Kelly G. Kilcoyne, MD ¹ ; CPT Jonathan F. Dickens, MD ¹ ; Robert A. Hymes, MD ² ; ¹ Walter Reed Army Medical Center, Washington, District of Columbia, USA; ² Inova Fairfax Hospital, Falls Church, Virginia, USA |

 Δ OTA Grant See pages 77 - 115 for financial disclosure information.

| Poster #87 (p. 361) | Getting the Right Curve: Factors Associated with Femoral Bow <i>Joseph D. Maratt, MD</i> ; Peter Schilling, MD; Sven Holcombe, BEng; Ryan Dougherty; Ryan Murphy; Stewart Wang, MD, PhD; James A. Goulet, MD; University of Michigan Health System, Ann Arbor, Michigan, USA |
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| INJURY PREVENTIC Poster #88 (p. 362) | DN Reliability of the Open Fracture Classification System Julie Agel, MA, ATC ¹ for the OTA Classification Committee; ¹ Harborview Medical Center, Seattle, Washington, USA |
| Poster #89 (p. 363) | The Link Between Texting and Motor Vehicle Collision Frequency in the Orthopaedic Trauma Population <i>Neil M. Issar, BS; Rishin J. Kadakia, BS; James M. Tsahakis, BA;</i> <i>Zachary T. Yoneda, BS; William T. Obremskey, MD, MPH;</i> <i>Manish K. Sethi, MD;</i> A. Alex Jahangir, MD ; <i>Vanderbilt University Medical Center, Nashville, Tennessee, USA</i> |
| Poster #90 (p. 364) | Is It Possible to Train Patients to Bear Limited Weight on a Lower Extremity? <i>Joshua W. Hustedt, BA</i> ; Daniel J. Blizzard, BS; Michael R. Baumgaertner, MD; Michael P. Leslie, DO; Jonathan N. Grauer, MD; Yale University School of Medicine, New Haven, Connecticut, USA |
| Poster #91 (p. 365) | Incidence, Risk Factors, and Diagnostic Evaluation of Postoperative Fever in an Orthopaedic Trauma Population Robert Petretta, MD; Mark McConkey, MD, FRCSC; Gerard P. Slobogean, MD, MPH; Henry M. Broekhuyse, MD, FRCSC; University of British Columbia, Vancouver, British Columbia, Canada |
| POST TRAUMATIC Poster #92 (p. 366) | RECONSTRUCTION Comparative Effect of Orthosis Design on Functional Performance Jeanne Cameron Patzkowski, MD ^{1,2} ; Ryan V. Blanck, CPO ³ ; Johnny G. Owens, MPT ³ ; Jason M. Wilken, PhD, MPT ³ ; Kevin L. Kirk, DO ² ; Joseph C. Wenke, PhD ¹ ; LTC Joseph R. Hsu, MD ¹ ; ¹ United States Army Institute of Surgical Research, Fort Sam Houston, Texas, USA; ² Brooke Army Medical Center, Fort Sam Houston, Texas, USA; ³ Center for the Intrepid, Fort Sam Houston, Texas, USA |
| Poster #93 (p. 367) | Long-Term Results and Costs of Free Flap Coverage and Ilizarov Bone Transport in Lower Limb Salvage David Lowenberg, MD ¹ ; Rudolf F. Buntic, MD ² ; Gregory M. Buncke, MD ² ; Brian M. Parrett, MD ² ; ¹ Stanford University, Palo Alto, California, USA; ² The Buncke Clinic, San Francisco, California, USA |

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| Poster #94 (p. 368) | Heterotopic Ossification Following Total Hip Arthroplasty for Acetabular Fractures: Acute Versus Delayed Oliver Chémaly, MD ^{1,2} ; George-Yves Laflamme, MD ¹ ; |
|----------------------------|---|
| | Dominique Rouleau, MD ¹ ; |
| | ¹ Sacré-Coeur Hospital, Montreal, Quebec, Canada; |
| | ² University of Montreal, Montreal, Quebec, Canada |
| Poster #95 (p. 369) | Single-Stage and Multiple-Stage Coverage of Complex Orthopaedic Wounds Including Exposed Bone and Tendon With a Bioartificial Dermal Substitute and Split-Thickness Skin Graft Daniel R. Schlatterer, DO; Stephen Becher, MD; Atlanta Medical Center, Atlanta, Georgia, USA |
| Poster #96 | Tobacco Use May Delay Recovery of Nerve Function after |
| (p. 370) | <i>Colin M. Dunderdale, PA-C</i> ; Daniel J. Stinner, MD; Jessica D. Cross, MD; Benjamin K. Potter, MD; Travis C. Burns, MD; Michael J. Beltran, MD; LTC Joseph R. Hsu, MD; |
| | Brooke Army Medical Center, Fort Sam Houston, Texas, USA |
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| UPPER EXTREM | ITY EXCLUDING WRIST AND HAND |
| Poster #97 | Hardware-Associated Complications in Simple Olecranon Fracture |
| (p. 371) | and Osteotomy Fixation Anand Panchal DO^1 : Daniel S. Chan MD^2 : H. Claude Saoi MD^2 : |
| | Roy Sanders, MD ² : David Watson, MD ² : |
| | ¹ Grandview Medical Center, Dayton, Ohio, USA; |
| | ²Orthopaedic Trauma Service, Florida Orthopaedic Institute, Tampa, Florida, USA |
| Poster #98 (p. 372) | Surgical Repair of Humerus Nonunions: Factors Affecting Functional Outcome and Pain Scores |
| (<u>F. c. </u>) | Sanjit R. Konda, MD; Roy I. Davidovitch, MD; Kenneth A. Egol, MD; NYU Hospital for Joint Diseases, New York, New York, USA |
| Poster #99 (p. 373) | Medial Elbow Exposure: Over-the-Top Versus FCU Split <i>Jeannie Huh, MD</i> ¹ ; Chad A. Krueger, MD ¹ ; Michael J. Medvecky, MD ² ; Jess M. Kirby, MD ³ ; LTC Joseph R. Hsu, MD ³ ; Skeletal Trauma Research Consortium (STReC) ³ ; |
| | ¹ Brooke Army Medical Center, Fort Sam Houston, Texas, USA; ² Yale University School of Medicine, New Haven, Connecticut, USA; ³ United States Army Institute of Surgical Research, Fort Sam Houston, Texas, USA |
| Poster #100 | Relevant Anatomy in Antegrade Humeral Nailing |
| (p. 374) | Kyle Chun, MD; James C. Krieg, MD ; |
| | University of Washington, Seattle, Washington, USA |

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| Poster #101 (p. 375) | Operative Treatment of Extra-Articular Distal Humerus Fractures Utilizing Single-Column Plating <i>Gustavo X. Cordero, MD¹; Miguel S. Daccarett, MD²; <i>Edward V. Fehringer, MD</i>²; <i>Peter Siska, MD</i>¹; <i>Andrew R. Evans, MD</i>¹; <i>Steven Sands, DO</i>¹; <i>Matthew M. Mormino, MD</i>²; <i>Ivan S. Tarkin, MD</i>¹; ¹University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA;</i> ² University of Nebraska Medical Center, Omaha, Nebraska, USA |
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| Poster #102 (p. 376) | Reoperation Following Open Reduction and Plate Fixation of Displaced Midshaft Clavicle Fractures <i>Brad Ashman, BSc; Gerard P. Slobogean, MD, MPH;</i> <i>Trevor Stone, MD, FRCSC; Darius Viskontas, MD, FRCSC;</i> <i>Farhad Moola, MD, FRCSC; Bertrand Perey, MD, FRCSC;</i> <i>Dory S. Boyer, MD, FRCSC; Robert G. McCormack, MD, FRCSC;</i> <i>Royal Columbian Hospital, University of British Columbia,</i> <i>Vancouver, British Columbia, Canada</i> |
| Poster #103 (p. 377) | Results of Proximal Ulna Fractures Treated With a Multiplanar, Locked Intramedullary Nail: First Experience With 28 Cases Scott G. Edwards, MD ¹ ; Mark S. Cohen, MD ² ; W. Andrew Eglseder, MD ³ ; ¹ Georgetown University Hospital, Washington, District of Columbia, USA; ² Rush University Medical Center, Chicago, Illinois, USA; ³ University of Maryland, R Adams Cowley Shock Trauma, Baltimore, Maryland, USA |
| WRIST and HAND Poster #104 (p. 378) | National Health Care Disparities Among the Treatment of Traumatic Thumb Amputations Paul E. Matuszewski, MD ¹ ; Taruna J. Madhav, MD ² ; Keith Baldwin, MPH, MD ³ ; Samir Mehta, MD ³ ; ¹ University of Maryland School of Medicine, Dept. of Orthopaedics, Baltimore, Maryland, USA; ² Hand & Orthopaedic Surgery Centers, Oakbrook Terrace, Illinois, USA; ³ Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania, USA |
| Poster #105 (p. 379) | • A Novel, Multiplanar, and Less Invasive Approach to Distal Radius Fracture Fixation: Early Clinical Experience Michael K. Strassmair, MD ¹ ; Daniel A. Rikli, MD ² ; Andrew H. Schmidt, MD ³ ; Thomas M. Walsh, MD ⁴ ; Steven L. Moran, MD ⁵ ; ¹ Klinikum Starnberg, Starnberg Germany; ² Universitatsspital Basel, Basel Switzerland; ³ Hennepin County Medical Center, Minneapolis, Minnesota, USA; ⁴ Park Nicollet Health Services, Minneapolis, Minnesota, USA; ⁵ Mayo Clinic, Rochester, Minnesota, USA |

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| Poster #106 (p. 380) | Safety of Pain Exposure: Physical Therapy in Patients with Complex Regional Pain Syndrome Type 1 Jan Paul M. Frölke, MD; Margreet H.M. Oerlemans, PhD; Almar M.A. Bruggeman, MD; Frank P.A.J. Klomp; Robert T.M. van Dongen, MD; Rob A.B. Oostendorp, PhD; Henk van de Meent, MD; Radboud University Nijmegen Medical Center, Nijmegen, The Netherlands |
|-----------------------------|---|
| Poster #107 (p. 381) | Acute Complications of Open Distal Radius Fractures: Retrospective Cohort Study of 240 Fractures Jaehon M. Kim, MD ¹ ; Mitchel B. Harris, MD ² ; David Zurakowski, PhD ³ ; Wanjun Liu, MD ⁴ ; Jesse B. Jupiter, MD ⁴ ; Frank M. McCormick, MD ¹ ; Mark S. Vrahas, MD ⁴ ; ¹ Harvard Combined Orthopaedic Surgery Residency, Boston, Massachusetts, USA; ² Brigham and Women's Hospital, Boston, Massachusetts, USA; ³ Children's Hospital Boston, Boston, Massachusetts, USA; ⁴ Massachusetts General Hospital, Boston, Massachusetts, USA |
| (p. 383) | BEST TRAUMA RELATED POSTER-2011 ORS MEETING: RSA Evaluation of an Implant System for Above the Knee |



Amputee Patients

Charles Bragdon, PhD¹; Anne Antonellis, BA¹; Rickard Branemark, MD; Johan Kärrholm, MD, PhD; Orjan Berlin, MD; Henrik Malchau, MD, PhD¹; ¹Harris Orthopaedic Laboratory, Massachusetts General Hospital, Boston, Massachusetts, USA; ²Salgrenska University Hospital, Gotborg, Sweden

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| | Posters #28, 30, 79, 80 |
| Biant, Leela C | (5-JRI UK) Int'l Poster #9 |
| Biffl, Walter L. | (<i>n</i>) |
| Biggi, F | (3B-Zimmer) Int'l Poster #1 |
| Bishop, Julius A. | (2- <i>Synthes</i>) |
| Blanck, Ryan | (<i>n</i>) Mini Symposium Faculty |
| Blitzer, Charles M | (9-Past President New Hampshire Medical Society, |
| | Member Marketing Committee Medical |
| | Mutual of Maine, AAOS, BOC) OTA Committee |
| Blizzard, Daniel J. | (<i>n</i>) |
| Bonnaig, J. V. | (<i>n</i>) |
| Bono, Christopher M. | (6-Barricaid, Intrinsic Therapeutics; |
| | 7-Informa, Wolters Kluwer Health - Lippincott |
| | Williams & Wilkins; 8-Journal of the American |
| | Academy of Orthopaedic Surgeons, The Spine Journal; |
| | 9-AAOS, North American Spine Society) Paper #41 |
| Borg, Tomas | (9-AO Trauma Sweden) Paper #48; |
| | |

Disclosure:

| Born, Christopher T. | (3B-Stryker, Illuminoss; 3C,4-Biointraface; |
|-------------------------|---|
| | 4-Illuminoss; 5-Stryker; 8-Journal of the American |
| | Academy of Orthopaedic Surgeons, |
| | Clinical Orthopaedics and Related Research, |
| | Iournal of Orthopaedic Trauma. Journal of |
| | Trauma: 9-American College of Surgeons |
| | Orthonaedic Trauma Association AAOS OTA Board: |
| | Foundation for Orthonaedic Trauma) OTA Committee |
| Pornalli Josoph In | 7 Electricate Initiative (Iournal): Carringore) OTA Committee |
| borrein, Joseph Jr. | (7-Eiseoler - Injury (Journul); Springer) OIA Committee; |
| | BSFF Moderator |
| Bosse, Michael J. | (<i>n</i>) |
| | BSFF Moderator; BSFF Faculty; |
| | Papers #53, 82 |
| Boudreau, John A. | (<i>n</i>) Poster #85 |
| Boulton, Chris | (<i>n</i>)Poster #60; |
| | Int'l Poster #6 |
| Boulton, Christina L. | (6-Synthes Resident Program.) Paper #39; Poster #73 |
| Boyer, Dory S. | (<i>n</i>) Poster #102 |
| Bray, Timothy J. | (6-Synthes, Smith & Nephew, Renown |
| 5, 5, 5 | Regional Medical Center Institutional OTA Board: |
| | Trauma Fellowshin Sunnort: OTA Committee: |
| | 8-Orthonaedic Trauma Association) Paper #86 |
| Brennan Kindyle I | $\binom{n}{2}$ |
| Bronnan Michael | $\binom{n}{2}$ |
| Brimmo Olubusolo | $(n) \qquad \qquad \text{Paper #56}$ |
| Drillino, Olubusola | (11) |
| brouerick, J. Scott | (2-AOINA, 5D-Zimmer, 9-Orinopaeuic |
| | Trauma Association, South CarolinaOTA Committee; |
| | Orthopaeaic Association) Case Presentation Faculty |
| Broekhuyse, Henry M. | (6-Synthes, Stryker, Zimmer) Posters #11, 91 |
| Brokaw, David S | (5-Medtronic provides dedicated financial |
| | support to our corporate research department |
| | for IRB supported projects. No \$ goes to |
| | investigators or their family. It is all for |
| | research dept. support; |
| | 9-Orthopaedic Trauma Association |
| | Practice Management Committee) OTA Committee |
| Bromfield, Christian S. | (<i>n</i>) Paper #37; Poster #17 |
| Bruggeman, Almar M.A. | (<i>n</i>) |
| Brumback, Robert I. | (3B-Biomet, Zimmer) OTA Committee |
| Buckley, Jenni M. | (5-Stryker, Biomet, Smith&Nephew BSFF Papers #1. 37: |
| | Depuy, Osteomed) Posters #17. 61. 77. 78. 84 |
| | |

Disclosure:

| Buckley, Richard E | . (5-Stryker, Smith & Nephew, DePuy, |
|-----------------------|---|
| - | Osteomed, Biomet)Paper #64 |
| Buijze, Geert A. | . (<i>n</i>) |
| Buncke, Gregory M. | .* |
| Buntic, Rudolf F. | .* |
| Burns, Travis C | . (<i>n</i>) |
| Burris, Brandon | . (<i>n</i>) |
| Busenlehner, Bryce J. | . (<i>n</i>) |
| Busse, Jason W. | . (5-Smith & Nephew) Poster #28 |
| Butler, Alison P. | . (<i>n</i>) |
| Cabezas, Andres | . (<i>n</i>) |
| Cain, Richard | . (<i>n</i>) |
| Callaci, John J. | . (<i>n</i>) |
| Cannada, Lisa K | . (2-Smith & Nephew; 5-Zimmer, Synthes, Dept. |
| | of Defense; 8-Journal of Orthopaedics and |
| | Traumatology, Orthopedics Today, |
| | Journal of Bone and Joint Surgery OTA Board; |
| | American, Clinical OrthopaedicsOTA Committee; |
| | and Related Research;Mini Symposium Moderator; |
| | 9-AAOS, Orthopaedic Trauma Association, Paper #67; |
| | Ruth Jackson Orthopaedic Society) Posters #71, 88 |
| Carabelli, Guido | . (<i>n</i>) |
| Carlo, Julian | . (7-Father: Publisher for two books on |
| | neonatology; 8-Father: Neonatology; |
| | 9-Father: Director for Mednax, |
| | Committee on the Fetus and Newborn of the |
| | American Academy of Pediatrics, Steering |
| | committee for NIH neonatal research network, |
| | steering committee for NIH Global Network)Paper #66 |
| Carlsson, Marianne | . (<i>n</i>) |
| Carmack, David B | . (2-AO (Teach at AO courses, but they are |
| | not an equipment company); |
| | 8-Journal of Trauma-Reviewer; |
| | 9-Orthopaedic Trauma Association- |
| | Public Policy Committee) OTA Committee |
| Cass, Joseph R | . (2-Synthes; 4-Johnson & Johnson;OTA Committee; |
| | 9-Orthopaedic Trauma Association, AAOS) Poster #83 |
| Castellani, Christoph | . (<i>n</i>) |
| Castellvi, Alejandro | . (<i>n</i>) |
| Castillo, Renan C | . (<i>n</i>) |
| Castricini, R | .* |
| Caswell, Kathleen | . (<i>n</i>) |

Disclosure:

| Chacko, Aron | (<i>n</i>) Posters #70, 73 |
|------------------------|--|
| Chambers, Monique | (<i>n</i>) |
| Chan, Daniel S. | (<i>n</i>) Papers #52, 83; |
| | Posters #1, 97 |
| Chaput, Christopher D | (3B-Pioneer; 3C-Link Orthopaedics; |
| 1 / 1 | 5-DePuy, A Johnson & Johnson Company: |
| | Struker: Nuvasive) |
| Charlton, Michael | (2.5-Synthes: 5-Struker) Lab Faculty |
| Chaudhry, Sonia | (n) |
| Chaus, George W | $(n) \qquad \qquad \text{Paper #54}$ |
| Chémaly Oliver | $(n) \qquad \qquad \text{Poster #94}$ |
| Cheng Olivia YY | $(n) \qquad \qquad \text{Paper #84}$ |
| Chossor Tim IS | (3B-Struker) Poster #62: |
| Chesser, 1111 J.S | (<i>JD-5119</i> , <i>Cl</i>) |
| Chin Paul C | $(n) \qquad \qquad \text{Postor #71}$ |
| Chirodian Nich | $(n) \qquad \qquad \text{BSEE Paper #6}$ |
| Chong Alexander CM | $(n) \qquad \qquad \text{Postor #21}$ |
| Chou David TS | $(n) \qquad \qquad \text{Poster #60}$ |
| Chou, Daud 1.5 | (n) I USLET #00, |
| Chura David T.C. | (4) Dester #62 |
| Chura, David I.C. | (<i>n</i>) |
| Churk Detricie | (n) |
| | (n) Mini Symposium Faculty |
| Cohen, Mark 5 | (1,5-Integra; 2,3B-Mylad) Poster #103 |
| Cole, Peter A. | (<i>3B-Synthes</i>) Case Presentation Faculty |
| Colen, Robert | (<i>n</i>) Poster #6 |
| Coll, Dan | (4-Merck) |
| Collinge, Cory A | (1,3B-Biomet, Smith & Nephew, |
| | Advanced Orthopedic Systems;OTA Committee; |
| | 8-Journal of Orthopaedics and Traumatology; Lab Faculty; |
| | 9-Foundation for Orthopedic Trauma) Paper #61 |
| Copley, Lawson A.B. | (<i>n</i>) Papers #69, 70; Poster #52 |
| Cordero, Gustavo X | (<i>n</i>) Poster #101 |
| Corsten, Johannes | (<i>n</i>) Poster #46 |
| Cortes, Alejandro | (<i>n</i>) Poster #40 |
| Costerton, William J. | (5-Synthes) |
| Court-Brown, Charles M | (7-Wolters Kluwer Health - Lippincott |
| | Williams & Wilkins; 8-Journal of Bone |
| | and Joint Surgery - British) Papers #88, 89 |
| Craig, Matthew R | (3A-Exelen)BSFF Paper #2 |
| Creevy, William R | (<i>n</i>) OTA Committee; Moderator; |
| - | Case Presentation Moderator; |
| | |

Disclosure:

| Crist, Brett D | . (4-Amedica Corporation; 5-Medtronic, |
|------------------------|--|
| | Novalign, Synthes, Wound Care Technologies; |
| | 8-Journal of Orthopaedic Trauma, Journal of |
| | the American Academy of Orthopaedic Surgeons, |
| | Your Orthopaedic Connection; |
| | 9-Orthopaedic Trauma Association) OTA Committee |
| Crookshank, Meghan | . (<i>n</i>) |
| Crosby, Colin G. | .(<i>n</i>) |
| Cross, Jessica D. | (<i>n</i>) |
| Crous, Robert | (<i>n</i>) |
| Cumming, David | (<i>n</i>) |
| Curtiss, Shane | (<i>n</i>) |
| Cush, Gerard J. | . (2-Trimed) |
| Cymerman, Rachel M. | (<i>n</i>) |
| D'Antimo, C. | (<i>n</i>) |
| Daccarett, Miguel S. | (<i>n</i>) |
| Daggy, Joanne | (<i>n</i>) |
| Dahners, Laurence E. | . (1-Tornier) BSFF Paper #19; Poster #10 |
| Daigl Cattaneo, Monica | . (<i>n</i>) |
| Dale, Kevin | . (<i>n</i>) |
| Daley, James | . (<i>n</i>) |
| Dammann, Greg | . (<i>n</i>) |
| Dart, Bradley R. | . (<i>n</i>) |
| Das, Avishek | . (<i>n</i>) |
| Davidovitch, Roy I. | . (3B-Stryker; 4-Surgix LTD.) Paper #57; Poster #98 |
| Davis, Adrian T. | . (<i>n</i>) |
| Davis, Matthew L. | . (<i>n</i>) |
| Davis, Thomas A. | . (<i>n</i>) |
| Davis, Tim R. | . (6-Hand Research Fund - |
| | Nottingham University Hospitals Trust Charity) Paper #91 |
| de Ridder, Victor A | . (<i>n</i>) |
| Deakin, Sue | . (<i>n</i>) |
| DeCoster, Thomas A. | . (4-Merck, Pfizer, US Orthopedics; 8-OKO; |
| | 9-Orthopaedic Trauma Association) OTA Committee |
| DeFrate, Louis E | . (<i>n</i>) BSFF Moderator; BSFF Faculty |
| Della Rocca, Gregory J | . (4-Amedica; 5-Synthes, Smith & Nephew, Stryker, |
| | Wound Care Technologies, Kinetic Concepts, Inc.; |
| | 8-Journal of Bone and Joint Surgery - American, |
| | Journal of Orthopaedic Trauma, Journal of the |
| | American Academy of Orthopaedic Surgeons; |
| | 9-AAOS, Orthopaedic Trauma Association). OTA Committee |

Disclosure:

| DeLong, William G. Jr. | (9-AAOS, American College of Surgeons, |
|-------------------------|---|
| | Orthopaedic Trauma Association) OTA Committee |
| DelSole, Edward M. | (<i>n</i>) |
| DeSilva, Gregory L. | (4-Pfizer)OTA Committee |
| Di Benedetto, M. | (<i>n</i>) |
| Di Fabio, S | (<i>n</i>) Int'l Poster #1 |
| Di Luggo, F | (<i>n</i>) Int'l Poster #3 |
| Dickens, CPT Jonathan F | (<i>n</i>) Poster #86 |
| Dinisio, Roberto | (<i>n</i>) |
| Dirschl, Douglas R | (1-Biomet; 9-AmericanOTA Committee; |
| - | Orthopaedic Association) Poster #48 |
| Donell, Simon T. | (<i>n</i>)BSFF Paper #6 |
| Donigan, Jonathan A. | (<i>n</i>)BSFF Paper #23 |
| Donken, Christian | (5-AO research grant for a cadaver study |
| | about ankle fractures) |
| Doro, Christopher | (<i>n</i>)Paper #51 |
| Dougherty, Paul J. | (8-Clinical Orthopaedics andOTA Committee; |
| | Related Research) Mini Symposium Moderator |
| Dougherty, Ryan | (<i>n</i>) Poster #87 |
| Douglas, Geoffrey | *Paper #33 |
| Downing, Nicholas D | (6-Hand Research Fund - Nottingham |
| - | University Hospitals Trust Charity)Paper #91 |
| Drescher, Wolf | (<i>n</i>) Int'l Poster #10 |
| Duckworth, Andrew D | (<i>n</i>) Paper #89; |
| | Int'l Poster #9 |
| Dumont, Guillaume | (<i>n</i>) Poster #4 |
| Dunbar, Robert P. Jr. | (9-Orthopaedic Trauma Association) OTA Committee; |
| | |
| Dunderdale, Colin M | (<i>n</i>) Poster #96 |
| Duwelius, Paul J | (1,2,3B,5-Zimmer; 7-Journal of Arthroplasty; |
| | <i>8-AAOS Now; 9-AAOS)</i> OTA Committee |
| Ebraheim, Molly A | (<i>n</i>) |
| Ebraheim, Nabil A | (<i>n</i>) |
| Edwards, Max | (<i>n</i>) |
| Edwards, Michael J. | (5-AO research grant for a cadaver study |
| | about ankle fractures)Paper #63 |
| Edwards, Scott G. | (3B-Medartis; 4,5-Mylad; 5-Synthes, Zimmer, |
| | Acumed, ITS, Stryker; 7-Elsevier; |
| | 8-Elsevier Lippincott; 9-American Society |
| | for Surgery of the Hand Washington |
| | DC Society for Surgery of the Hand) Poster #103 |

Disclosure:

| Eglseder, W. Andrew | (3C-Mylad Orthopaedic Solutions LLC) Paper #51; Poster #103 |
|----------------------|--|
| Fool Kenneth A | (1-Fractech Inc · 4-Johnson & Johnson |
| | Surgix Inc. 5-Struker Sunthes OREF: OTA Committee: |
| | 7-SI ACK Incornorated Wolters Mini Symposium Faculty: |
| | Kluzver Health - Linnincott Williams |
| | & Wilkins: 8-Journal of Orthonaedics BSEE Papors #4, 22: |
| | & Traumatologue 9-Orthonaedic Papers #57 61 62 73 80 82: |
| | Trauma Association- Research Committee) Postors #65.98 |
| Ebropfold Josso M | (7-Springer Lippingett Paper #74: |
| | Ovford University Press) Postor #81 |
| Ebronsborger T Mark | $(n) \qquad \qquad \text{Postor #32}$ |
| Finhorn Thomas A | (1) |
| | 3R-Anika: I&I Pharma, Kuros, Lilly Novartis: |
| | A-Biomineral Holdings HealthnointCanital |
| | Implant Protection NeoStem: 7-Fleevier |
| | Journal of Bone and Joint Surgery _ American |
| | I innincott-Williams and Wilkins: |
| | 8-BONE Journal of Bone and Joint Surgery |
| | – American Journal of Bone and Mineral |
| | Research Journal of Orthonaedic Research) Poster #28 |
| Ekstein Charles | $(n) \qquad \qquad \text{Paper #26}$ |
| Elias Koby I | (3A 4-Semnrus BioSciences) BSFF Paper #18 |
| Ellington I Kent | (n) Poster #51 |
| Elliott. Kathleen | (<i>n</i>) |
| Ellis, Thomas I. | (1-Acute Innovations: 3B-Smith & Nephew: |
| ,,,,,,, | 3B.5-Stryker: |
| | 9-Foundation Orthopaedic Trauma) OTA Committee |
| Elster, Eric A. | (<i>n</i>)BSFF Paper #15 |
| Endres, Terrence J. | (<i>n</i>) |
| Ercolani, C | (<i>n</i>) Int'l Poster #2 |
| Erdogan, Murat | (<i>n</i>) |
| Erickson, Gregory | (<i>n</i>) |
| Ertl, Janos P. | (2-Stryker; 5-Amgen Co, Synthes)Paper #61 |
| Ertl, William | (<i>n</i>)Paper #61 |
| Esquivel, Amanda O | (6-Arthrex, Inc) Poster #14 |
| Evans, Andrew R. | (<i>n</i>) OTA Committee; Paper #87; Poster #101 |
| Evans, Neil | (<i>n</i>) |
| Even, Jesse L | (<i>n</i>) Poster #72 |
| Fehringer, Edward V. | (1,4,5-Tornier) Poster #101 |
| Ferguson, David F. | (<i>n</i>) Poster #2 |

Disclosure:

| Ferguson, Tania A | . (2-AONA, DePuy; 2,5-Stryker; Papers #37, 42; |
|-------------------------|--|
| | <i>5-Synthes</i>) Poster #17 |
| Ficke, James R. | . (9-American Orthopaedic Foot and Ankle Society, |
| | AAOS, Society of Military Orthopaedic Surgeons, |
| | Airlift Research Foundation) Poster #25 |
| Finkemeier, Christopher | . (2-Synthes) OTA Committee; Lab Faculty |
| Finnegan, Maureen | . (8-Clinical Orthopaedics and Related Research; |
| - | 9-AAOS Texas Orthopedic Association) Poster #71 |
| Firman, Eliseo | . (<i>n</i>) |
| Firoozabadi, Reza | . (<i>n</i>) |
| Fisk, Erica | . (<i>n</i>) |
| Fleming, CDR Mark | . (<i>n</i>) Mini Symposium Faculty |
| Fletcher, Nicholas D | . (<i>n</i>) Papers #69, 70; Poster #52 |
| Forde, Frank A. | .(<i>n</i>) |
| Forsberg, Jonathan A. | (n)BSFF Paper #15 |
| Forward, Daren P. | . (6-Hand Research Fund - Nottingham |
| , | University Hospitals Trust Charity) |
| Fox. Rebecca | (<i>n</i>) |
| Fredericks, Douglas | (5-Biomet, EBL Medtronic Sofamor Danek), BSFF Paper #23 |
| Freeman, Andrew L | (5-Smith & Nenhew Medtronic |
| | IDR Snine) BSFF Paper #2 |
| Freiss Daren | (3B-Acumed LLC) Case Presentation Faculty |
| French Bruce G | (3B-Riomet: Riomet: 8-Journal of |
| | Orthonedic Trama) OTA Committee |
| Friedberg David | $(n) \qquad \qquad \text{BSFE Paper #3}$ |
| Frink Michael | * BSEE Paper #24 |
| Frisch Harold M | (n) Poster #25 |
| Frölko Jan Paul M | $(n) \qquad \qquad \text{Postor #106}$ |
| Coince, Jail 1 auf Mi | $(n) \qquad \qquad$ |
| Carcia Appa E | (n) Paper #74 |
| Cardner Michael I | (11) aper #74 (2P Sumthas: DCIMad: Amagn Co: OTA Committee: |
| Garunei, Michael J. | 5 Sunthas: Amagen Co: 7 Walters Moderator: |
| | <i>S-Synthes, Amgen Co., 7-Wollers</i> |
| | Nilliano S. William S. |
| | <i>vvillums & vvilkins;</i> |
| Come Come of | 9-Orthopaedic Irauma Association)Papers #43, 55, 56, 61 |
| Garg, Sumeet | (n) Papers #69, 70; Poster #52 |
| Garland, Joshua | . (<i>n</i>) |
| Garrison, Robert L. | .^ |
| Gary, Joshua L. | (n) Paper #72; Poster #16 |
| Gaughan, John | (<i>n</i>) |
| Gaur, Manish | .^ Int'l Poster #19 |
| Gause, Trenton M. II | . (<i>n</i>) |

Disclosure:

| Georgiadis, Gregory | . (3B-Smith & Nephew; 8-Journal of |
|----------------------|--|
| | Orthopaedic Trauma; 9-American College |
| | of Surgeons, Committee on Trauma) OTA Committee |
| Giannoudis, Peter V. | (2-Eli Lilly; 2,3B,5-DePuy, A Johnson & |
| · | Johnson Company, Stryker, Synthes; |
| | 3C-Pfizer: 8-BMC Musculoskeletal Disorders. |
| | Iniury, Journal Orthonaedic Trauma. |
| | European Journal of Trauma Open Journal |
| | of Orthonaedics Expert Oninion on |
| | Drug Safetu: 9-Orthonaedic Trauma |
| | Association British Trauma Society OTA Committee: |
| | British Orthongedic Association BSEE Eaculty: |
| | European Education of National BSEE Dopor #12: |
| | According of Orthomodics and Paper #17: |
| | Associations of Orthopeaics and |
| Cibbana Chavan D | 17000000000000000000000000000000000000 |
| Gibbons, Steven D | (<i>n</i>) |
| Glbson, vic \dots | |
| | (n) Poster #19 |
| Goerke, Derek | (<i>(3A-Exelen)</i> |
| Goff, Thomas | (n) Int I Poster #12 |
| Goldstein, Rachel Y. | (n) |
| Goorden, A.J.F. | (<i>n</i>) |
| Gorczyca, John T. | (8-The Journal of Orthopaedic Trauma, Mini Symposium |
| | <i>The Journal of Trauma, Injury,</i> Moderator; |
| | Infection and Critical Care; Paper #45; |
| | 9-AAOS CME Committee Poster #59 |
| Gordon, Lt COL Wade | (n) Mini Symposium Faculty |
| Goulet, James A. | . (1-Zimmer; 2-Smith & Nephew; OTA Board; |
| | 9-American Orthopaedic Association,OTA Committee; |
| | Orthopaedic Trauma Association) Moderator; |
| | Case Presentation Faculty; |
| | |
| Graham, Brent | . (7-Journal of Bone and Joint Surgery - American; |
| | 8-Journal of Bone and Joint Surgery -American; |
| | 9-American Society for Surgery of the Hand) BSFF Faculty |
| Grainger, David | (3C-Elute, Inc, (USA)BSFF Faculty |
| Grant, Kevin D. | (<i>n</i>) Poster #66 |
| Grauer, Jonathan N. | (<i>n</i>) Poster #90 |
| Graves, Matt L. | (2,3B,5-Synthes; 5-Stryker; |
| | 8-Journal of Orthopaedic Trauma;OTA Committee; |
| | 9-Orthopaedic Trauma AssociationLab Faculty; |
| | Education Committee) Poster #47 |

Disclosure:

| Gray, Alasdair | (<i>n</i>) |
|-----------------------|---|
| Grayson, J. Kevin | (<i>n</i>) |
| Gregory, Paul | (<i>n</i>) |
| Griffin, Matthew | *BSFF Paper #16 |
| Grijalva, Steven | (<i>n</i>)BSFF Paper #15 |
| Gross, Caroline R. | (<i>n</i>) |
| Gross, Jonathan M. | (<i>n</i>) |
| Gruen, Gary S. | (3B-Smith & Nephew)Paper #87 |
| Gueorguiev, Boyko | (6-Synthes, Switzerland)BSFF Paper #8 |
| Guy, Pierre | (3B-Stryker; 5-Synthes; Stryker; DePuy, OTA Committee; |
| 2 | A Johnson & Johnson Company) Moderator; |
| | |
| | Paper #75; Poster #68 |
| Guyatt, Gordon | (<i>n</i>) Posters #28, 30 |
| Haegele, Ashley N. | (<i>n</i>) |
| Haidukewych, George J | (1-DePuy, A Johnson & Johnson Company; |
| | 3B-Smith & Nephew, Synthes; |
| | 4-Surmodics, Orthopediatrics; |
| | 8-Journal of Orthopedic Trauma;OTA Committee; |
| | 9-AAOS) Lab Moderator |
| Hak, David J. | (3B-Amgen; 4-Emerge; 5-Synthes; OTA Board; |
| | Stryker; 8-Orthopedics, Journal ofOTA Committee; |
| | Orthopaedic Trauma; 9-Orthopaedic BSFF Faculty; |
| | Trauma Association,Mini Symposium Moderator; |
| | International Society for Paper #54; |
| | Fracture Repair) Poster #43 |
| Hale, Joseph E | . (3B-Conventus Orthopedics, Inc.)BSFF Paper #7 |
| Hale, Riley | <i>(n)</i> BSFF Paper #5 |
| Hamilton, John M. | <i>(n)</i> |
| Handley, Robert | .* |
| Hansen, Erik H. | (<i>n</i>) |
| Hanson, Beate | (<i>n</i>) |
| Harris, Mitchel B. | (3B-LRS Ortho; 4-LRS Ortho - 161 shares; OTA Committee; |
| | 9-AAOS, North American Spine Society, Paper #41; |
| | Orthopaedic Trauma Association) Poster #107 |
| Hartman, Robert | .* |

Disclosure:

| Harvey, Edward J. | . (5-Synthes, Stryker, Smith & Nephew, |
|----------------------------|--|
| - | Zimmer; 7-Canadian Journal of Surgery; |
| | 8-Canadian Journal of Surgery, Journal of |
| | <i>Orthopaedic Trauma)</i> ; 9-OrthopaedicOTA Committee; |
| | Trauma Association, Canadian BSFF Moderator; |
| | <i>Orthopaedic Association,</i> BSFF Faculty; |
| | Orthopaedic Research Society) Mini Symposium Faculty |
| Harvey-Kelly, Katherine F. | (3B-Struker Europe) Paper #47 |
| Haskell, Andrew | (n) |
| Hatic. Safet | (<i>n</i>) |
| Hatton Mark | (6-Hand Research Fund - Nottinoham |
| | University Hospitals Trust Charity) Paper #91 |
| Hausbrandt Peter | (5-Sunthes) BSFF Paper #17 |
| Havda Roman A | (2-AONA: 3C-BioIntraface: 9-AAOS |
| | Orthonaedic Trauma Association) Poster #25 |
| Heckman, James D | (7 8-Journal of Bone and Joint Surgery – American |
| Treekinari, junico D. | Wolters Kluzver Health - Linnincott Williams |
| | & Wilkins: 9-Orthonaedic Research and |
| | Education Foundation) Poster #28 |
| Heels-Ansdell Diane | $(n) \qquad \qquad \text{Poster #30}$ |
| Heinev Jake P | (7-KCI Pfizer (Kino Pharmaceuticals) |
| Theme y, juke T | OsteoMed: Medtronic: 3B-Medtronic |
| | OsteoMed Pfizer Sunthes Orthonedic |
| | Designs Inc: 5-Medtronic Pfizer Whieth: |
| | 9-Orthonaedic Trauma Association) Poster #33 |
| Holfet David I | (3B 5-Sunthes) Paper #64: |
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| Henley M Bradford | (1 2 3B-7immer: 2-Smith & Nonhorn Struker: |
| Treffic y, Wi. Diadiora | 3B-Cerson Lehrman Crown Guidenoint Clohal |
| | Milliman Care Guidelines, Oregon Health |
| | Sciences University Premera Blue Cross |
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| | Karen Zunko and Acete Sunergen Surgical |
| | (Renovis) Sunthes: 4-Renovis (formerly |
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| | Williams & Wilkins shock (Journal)) BSFF Paper #24 |
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| Ho, Christine A. | $(n) \dots n$ Case resentation faculty, |
| | Papers #68, 69, 70; |
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| Hoard, Daniel | . (<i>n</i>) |
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| | Posters #36, 37, 69 |
| Hofmann, Gunther O. | . (<i>n</i>) |
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| Howie, Donald | (3B-Stryker; 5-Zimmer; 8-Orthopeaics Poster #2/ |
| Hsieh, Adam H. | (5-Synthes) Papers #38, 39 |
| Hsu, LTC Joseph R. | . (5-The Geneva Foundation;OTA Committee; |
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| | Posters #25, 41, 92, 96, 99 |
| Huh, Jeannie | .(<i>n</i>) |
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| Humphrey Catherine A | $(n) \qquad \qquad \text{Paper #45: Poster #59}$ |
| Hurwitz Shepard R | (7-Saunders/Moshu-Flsezier |
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| TT , 1 , T 1 T 1 | Orthopaedic Irauma Association) Moderator |
| Hustedt, Joshua W. | . (a-Grant from Foundation for Greater |
| | New Haven) Poster #90 |
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| Iannolo, Maria | . (<i>n</i>) |
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| Jahangir, A. Alex | (9-Orthopaedic Trauma Association) OTA Committee: |
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| Ienkins, Iudith M. | (<i>n</i>) Poster #5 |
| Ienkins, Paul I. | (<i>n</i>) |
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| Ienkinson, Richard I. | (<i>n</i>)Paper #27 |
| Jerav. Kyle I. | (2-AONA: 3B-Zimmer: 5-Sunthes: |
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| Jones, Chinord D. | (2-AOINA, 0-JDJ5, JDJ5 IIUUIIIU Norvelatter Journal of Orthomadia |
| | Trauma Journal of Trauma COPP |
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| | Michigan Orthopaedic Papers #30, 61, 78, 82; |
| T 10 | Society Legislative Chair) Posters #36, 37, 49, 56, 69 |
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| Kaplan, Heidi B. | . (<i>n</i>) |
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| Kiss, Alexander | . (<i>n</i>) |
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| | Int'l Posters #10, 15 |
| Knops, Simon | . (<i>n</i>) |
| Knutson, Nathan J. | . (3A,4-Conventus Orthopedics, Inc.)BSFF Paper #7 |
| Kobbe, Philipp | .* Int'l Poster #15 |
| Koenig, Scott J. | . (<i>n</i>) |
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| | 2,5,6-Synthes; 6-Servier; 8-Journal |
| | of Shoulder and Elbow Surgery; |
| | 9-Singapore Orthopaedic Association) Poster #63 |
| Konda, Sanjit R | . (<i>n</i>) |
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| Krettek, Christian | . (1,2-Synthes; 6-Stryker; |
| | 8-Saunders/Mosby-Elsevier Springer)BSFF Paper #24 |
| Krieg, James C. | . (1-SAM Medical Synthes CMF;OTA Committee; |
| | <i>3B-Synthes; 9-AAOS</i> Case Presentation Moderator; |
| | Annual Medical Committee) Case Presentation Faculty; |
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| Krueger, Chad A | . (9-AAUS: Kesident Member Communications |
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Disclosure:

⁽n) = Respondent answered 'No' to all items indicating no conflicts; 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society. *= Not available at time of printing. Refer to pages 412 - 414.

| Krumrey, Jacqueline J. | (<i>n</i>) |
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| | Zimmer; 6-Biomet, Synthes, |
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| Kuhn, Kevin M. | (<i>n</i>) |
| Kumar, Amit | (<i>n</i>) |
| Kumar, Ashesh | (<i>n</i>) Poster #30 |
| Kumar, Gunasekaran | (<i>n</i>) |
| Kummer, Fredrick J. | (4-Johnson & Johnson) BSFF Paper #4 |
| Kuramoto, Lisa | (<i>n</i>) Paper #75; Poster #68 |
| Kuzvk. Paul R.T. | (5-Implants donated by Struker)Paper #36 |
| Kwon, John Y. | (<i>n</i>) Poster #51 |
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| Kyle, Richard F | (1, 3B-Smith & Nephew, Zimmer; |
| 5 | 9-Orthopaedic Research and |
| | Education Foundation)BSFF Paper #2 |
| Lack, William | (<i>n</i>) |
| Lafazan, Shain R.S. | (<i>n</i>) |
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| LaMartina, Joey II | (<i>n</i>) |
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| Lane, Joseph M. | (2-Eli Lilly, Harvest Technologies, Inc., |
| Ĩ | Novartis, Weber Chilcott; 3B-Amgen, |
| | CollPlant, Inc., Bone Therapeutics, SA, |
| | BioMimetics, DFine, Graftys, Zimmer; |
| | 5-Amgen, Inc.; 9-Orthopaedic Research |
| | Society, Musculoskeletal Tumor Society, |
| | AAOS, Association of Bone BSFF Faculty; |
| | and Joint Surgeons)Symposium Faculty |
| Langford, Joshua | (3B-Stryker, Internal Fixation Systems; |
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| Large, Thomas M | (<i>n</i>) |
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| Larsson, Sune | (2, 3B, 5-Stryker; 3B-Pfizer; |
| | 5-Wyeth, Pfizer, Biomimetic; Paper #48; |
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| | Advisory Boards of Ortho Sense, Exos, |
| | Miami Device Solutions, Sky Medical; |
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| | 7-Springer Verlag Saunders AOPA) BSEE Eaculty |
| Laughlin CPT Matthew | $\begin{array}{c} 7-5pringer vering, summers, AOTA \end{pmatrix} \dots \dots Dorr racuny \\ (u) \qquad \qquad$ |
| Laughini, Cr i Matulew | $(n) \qquad \qquad$ |
| Lauing, Kristen | (n) |
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| Lazdun, Yelena | $(n) \dots BSFF Paper #15$ |
| Le, Theodore Toan | $(n) \dots \dots$ |
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| | 6-Synthes Fellowship Support) Posters #17, 75 |
| Lefaivre, Kelly A. | . (6-Synthes, Stryker, Zimmer) Paper #75; |
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| Leone, michael | Posters #17 90 |
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| Leukidis, Christos | .* |
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| Levy, Jeffrey | . (<i>n</i>) |
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| | 5-Stryker Orthopaedics) Poster #58 |
| Lewis, Robert | . (<i>n</i>) |
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| Lichte, Philipp | (<i>n</i>) |
| Liddle, Kate | . (<i>n</i>) |
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| | nrowided by the Sunthes GmbH in |
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| Little Milton TM | (n) Posters #44 57 82 |
| Liu Chuaniu | (<i>n</i>) $BSFF Paper #22$ |
| Liu Patrick | $\binom{n}{2}$ |
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| | 8-Furonean Journal of Orthonaedic |
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| Lundy, Douglas W | (2-AO; 2,3C-Synthes; 4-Livengood Engineering; 8-Clinical Orthopaedics and Related Research, Journal of Orthopaedic Trauma, Orthopedics; 9-AAOS, American College of Surgeons, Georgia Orthopaedic Society, Orthopaedic Trauma Association) |
|-----------------------------------|--|
| Maatman, Benjamin T. | (<i>n</i>) |
| Mack, Andrew W | (<i>n</i>) Poster #25 |
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| Madhav, Taruna J. | (<i>n</i>) Poster #104 |
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| Maratt, Joseph | (3A,4-Merck, Genzyme; 6-Stryker) Poster #87 |
| Markel, David C. | (2,55,4,5-Stryker; 4-Nool Bone und Joint Center, Pfizer, Biogen; 8-Clinical Orthopaedics and Related Research, Journal of Arthroplasty, Journal of Bone and Joint Surgery - American, Osteoarthritis and Cartilage; 9-American Association of Hip and Knee Surgeons, Mid-America Orthopaedic Association, Michigan Orthopaedic Society, American Academy of Orthopaedic Surgeons) Poster #14 |
| Marmor, Meir | (<i>n</i>) BSFF Paper #3; |
| Marsh, J. Lawrence | (1-Biomet; 7-Oxford Press; 9-American Board of Orthopaedic Surgery, Inc., American Orthopaedic OTA Committee; Association, Orthopaedic Trauma BSFF Faculty; Association) |
| Martin, John Masini, Brendan D | (<i>n</i>) |
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| Matuszewski, Paul E | (<i>n</i>) Poster #104 |

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| | 9-Surgical Infection Society)Paper #28 |
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| | Western Orthopaedic Association) Paper #40 |
| McConkey, Mark | . (<i>n</i>) |
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| McCormick, Frank M. | . (<i>n</i>) Poster #107 |
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| | Posters #17, 40, 84 |
| McDonald, John | . (<i>n</i>) |
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| | <i>Elbow Surgeons, Orthopaedic</i> Case Presentation Faculty; |
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| McLaurin, Toni M | . (3B-Smith & Nephew) OTA Committee; Paper #62 |
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| | - Lippincott Williams & Wilkins) Papers #88, 89 |
| Mecozzi, Gabriel | .* |
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| Meehan, Robert | . (<i>n</i>) |
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| | Care Foundation) Case Presentation Moderator |
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| Miller, Adam G. | . (<i>n</i>) |
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| Min, William | . (<i>n</i>) |
| Mir, Hassan R. | . (8-AAOS Resident Newsletter Co-Editor, |
| | Journal of Orthopaedic Trauma Consultant |
| | Editor, Journal of the American Academy |
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| | Orthopaedic Trauma AssociationLab Faculty; |
| | Public Relations Committee) Poster #66 |
| Miranda, Michael A. | . (2-Synthes; 4-Johnson & Johnson; |
| | <i>Pfizer</i>) Mini Symposium Faculty |
| Mirza, Amer J | . (2-Accuray; |
| | 2,3B,3C-Acumed, LLC; Case Presentation Moderator; |
| | 3C-Seattle Information Systems) Paper #43 |
| Mitchell, Erika J. | .(<i>n</i>) |
| Moed, Berton R | .(<i>n</i>) |
| Mok, James M. | .(5-Nuvasive)Paper #49 |
| Mokawem, Michael | (n) Int'l Poster #11 |
| Molyneux, Samuel | (n) Int'l Poster #8 |
| Mommsen, Philipp | (n)BSFF Paper #24 |
| Montero, Nicole | (n) |
| Mooij, Saskia Catharina | .(<i>n</i>) |
| Maala Farbad | Int'l Poster #10 |
| Nioola, Farnad | (n) Poster #102 |
| Niconey, Virginia | $(n) \dots Paper \#60$ |
| Moorcroft, Christopher I. | (4-Inteurgent Orthopaeaics, UK) Poster #26 |
| NIOORE, BIAKE E | .(<i>n</i>) Poster #42 |

Disclosure:

| Moore, Sandra | . (1-Amersys Books, Inc.) Poster #65 |
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| Moore, Sharon | .(<i>n</i>)OTA Staff |
| Moore, Timothy A. | .(<i>n</i>) |
| Moran, Christopher G. | . (6-Hand Research Fund - Nottingham |
| | University Hospitals Trust Charity) |
| | Int'l Poster #6 |
| Moran Matthew | (5-IRI) Paper #89: |
| | Int'l Posters #7.9 |
| Moran Steven I | (3B-Conventus Accension) BSEE Paper #7: Poster #105 |
| Morandi May | (8-Orthonedics) OTA Committee |
| Morgan Pohert A | (u) BSEE Dapor #2 |
| Morgan Stavan I | $(n) \dots \dots$ |
| Worgan, Steven J. | Outhersondies Associate A Isterson S |
| | Linear Emers Medical & Lement of |
| | Johnson, Emerge Meaical; 8-Journal of |
| | Orthopaedic Irauma; 9-AAOS,OIA Committee; |
| | Orthopaedic Irauma Association,Lab Moderator; |
| | Western OrthopaedicMini Symposium Faculty; |
| | <i>Trauma Association</i>)Paper #54 |
| Moriarty, Fintan. | . (<i>n</i>) |
| Mormino, Matthew M. | . (2-Zimmer) |
| Morrey, Chris | .* Int'l Poster #13 |
| Morris, Brent J. | . (<i>n</i>) |
| Morris, John A. | . (<i>n</i>) |
| Morshed, Saam | . (<i>n</i>) |
| | Lab Moderator |
| | |
| Moseley, Giles | .* Int'l Poster #14 |
| Moustoukas, Michael J. | . (<i>n</i>) |
| Mückley, Thomas | . (5-Stryker, Synthes; 9-AIOD Germany)BSFF Paper #8 |
| Mulligan, Michael | . (7-Informa) Poster #16 |
| Mullis, Brian H. | . (2-Medtronic; Smith & Nephew; Synthes; |
| | 5-Amgen Co, Synthes; 8-Journal ofOTA Committee; |
| | Orthopaedic Trauma: 9-Orthopaedic Papers #61, 82: |
| | <i>Trauma Association</i>) Posters #7, 10 |
| Mundi, Raman | (<i>n</i>) |
| Munro, Mark | (3B-Smith & Nenhern) Lab Faculty |
| Murphy Donavan K | $\binom{n}{2}$ |
| Murphy Ryan | $\binom{n}{2}$ |
| Murray Clinton K | $(n) \qquad \qquad \text{BSFE Paper #13}$ |
| | Papers #32 35. Postor #25 |
| Mutty Christopher F | (11) $Doctor #21$ |
| Naile Dichi D | (11) Destar #01 |
| $INAIK, INISIII D. \dots$ | . (<i>n</i>) |

Disclosure:

| Narayan, Badri | (2-Smith & Nephew) Int'l Poster #18 |
|--------------------------|--|
| Nascone, Jason W. | (<i>3B-Synthes</i>)Lab Moderator; |
| | Papers #51, 71 |
| Nauth, Aaron | (<i>n</i>)BSFF Faculty; BSFF Paper #9; |
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| Navak, Aniruddh | (<i>n</i>)BSFF Paper #5 |
| Nepola, James V. | (1.3C.4-Biomet:4-Intuitive Surgical. |
| | Medtronic, Orthofix, Inc., Wright |
| | Medical Technology Inc. 9-AAOS) BSFF Paper #23 |
| Nesti Leon I | (9-Orthonaedic Research Society American |
| | Society for Surgery of the Hand) BSEE Papare #10, 11 |
| Nazi Jacqueline | $\frac{1}{2} \int \frac{1}{2} \int \frac{1}$ |
| Nguyan Michael I | (<i>n</i>) PCEE Depent #16 |
| Nguyen, Michael L. | (<i>n</i>) |
| | (<i>n</i>) |
| Nies, Matthew S. | (<i>n</i>) Poster #56 |
| Nikolaou, Vassilios S | (<i>n</i>) Int'l Poster #14 |
| Nittoli, R | (<i>n</i>) Int'l Poster #3 |
| Nork, Sean | (2-Stryker; 2,3B,5-AONA, Synthes; |
| | <i>3B,5-Amgen; 5-OTA</i>) Poster #47 |
| Norris, Patrick R. | (<i>n</i>) Poster #5 |
| Nowotarski, Peter J. | (<i>n</i>) OTA Committee; Poster #24 |
| Nugyen, Thuc-Quyen | (<i>n</i>)BSFF Paper #1 |
| O'Brien, Frederick P | (<i>n</i>) BSFF Faculty |
| O'Brien, Peter J. | (6-Synthes, Stryker, Zimmer) Poster #11 |
| O'Mara, Timothy J | (4-Orthopaedic Implant Company)Paper #86 |
| O'Toole, Robert V. | (<i>3B</i> ,5- <i>Synthes</i> ; |
| | 5-Stryker, OREF) Moderator; Lab Faculty; |
| | |
| | Posters #12, 16, 23 |
| Obermeyer, Thomas S | $(n) \qquad \qquad \text{BSFF Paper #21}$ |
| Obremskey William T | (3B-Biomimetic: 8-Iournal of the American |
| | Academy of Orthonaedic Surgeons |
| | Journal of Bone and Joint Surgery |
| | American Journal of Orthonaedics OTA Committee: |
| | and Traumatology Cose Presentation Moderatory |
| | <i>Clinical Orthogodica and</i> Departs #28, 58, 74, 77, 70. |
| | Cunical Orinopaeulos ana Papers #26, 56, 74, 77, 79, |
| | Keutteu Keseurch) Poster #34, 72, 76, 81, 89 |
| Ockendon, Matthew | (6-Intelligent Orthopaeaics) Poster #26 |
| Odutola, Koye | " Int'i Poster #13 |
| Oerlemans, Margreet H.M. | * |
| Ogrodnik, Peter J. | (4-Intelligent Orthopaedics, UK) Poster #26 |
| Oizumi, Akira | (<i>n</i>) OTA Committee |

Disclosure:

| Okada, Pam | . (<i>n</i>) |
|---------------------------|--|
| Ollivere, Benjamin | .(<i>n</i>) BSFF Paper #6; |
| , , | |
| Olsen, Michael | (n) |
| Olson, Steven A. | (5-Smith & Nenhew: |
| | 5.6-Sunthes) BSFF Moderator: BSFF Faculty |
| Ong Alvin | (3B-Struker: Smith & Nenherov |
| | 5-Zimmer: 8-Journal of Arthronlastu) Poster #67 |
| Oostandarp Rob A B | * Postor #106 |
| Opakpopouwa Oghor | $(u) \qquad \qquad \text{Paper } \#17:$ |
| | Int'l Dectors #11 14 |
| Orozza Eshia | (2D Churchan 5 Zimman 6 Dfram |
| | $\begin{array}{c} (3D-Stryker; 3-Ztminer; 6-PjiZer; \\ 0 \ \text{Leture} = 1 \circ (Authenside (u)) \\ \end{array}$ |
| | <i>δ-journul of Arthroplusty</i>) Posler #67 |
| Orr, Justin D. | (n) Poster #41 |
| Ostrum, Robert F. | . (5-AONA, Synthes;Mini Symposium Moderator; |
| | 8-Journal of Orthopaedic Irauma). Case Presentation Faculty |
| Otero, Jesse | . (<i>n</i>) |
| Otieno, Tobias | . (<i>n</i>) |
| Owens, Johnny C. | . (<i>3C-Twin Star Medical</i>) Mini Symposium Faculty |
| Owens, MAJ Brett D. | . (8-American Journal of Sports Medicine, |
| | Journal of Surgical Orthopaedic Advances, |
| | Orthopedics, Orthopedics Today; |
| | 9-American Orthopaedic Society for |
| | Sports Medicine, Society of Military |
| | Orthopaedic Surgeons) Poster #35 |
| Paccola, Cleber A.J. | . (<i>n</i>) |
| Pace, N. | . (<i>n</i>) |
| Padalecki, Jeffery | .(<i>n</i>) |
| Panchal, Anand | (<i>n</i>) Poster #97 |
| Panfoli, N | (<i>n</i>) |
| Papadopoulos, Iordanis N. | (<i>n</i>) |
| Pape, Hans-Christoph | (2-Sunthes: 3B-Stryker: 3C-Canadian OTA Committee: |
| | Orthonaedic Foundation: 7-Journal BSFF Moderator: |
| | of Orthonaedic Research Wolters Kluzver Paper #31: |
| | Health–Linnincott Williams & Wilkins: Poster #46: |
| | 8-Journal of Orthonaedic Trauma) Int'l Posters #10, 15 |
| Park li Hao | $(n) \qquad \qquad$ |
| Parrott Brian M | (n) Postor #03 |
| Parwawi Ebrahim | $(n) \qquad \qquad \text{Paper #20}$ |
| Pattorson Brondon M | (0 Orthonadic Trauma Association) OTA Committee |
| Patterson Jacon A | $(u) \qquad \qquad$ |
| Patrikowski Joanna C | (n) |
| ratzkowski, jeanne C. | . (<i>n</i>) |

Disclosure:

| Paul, Ryan | . (<i>n</i>) |
|-----------------------|--|
| Pekmezci, Murat | . (5-Biomet, Stryker, Nuvasive) Paper #40; |
| | Posters #20, 21, 78 |
| Penn-Barwell, Jowan G | . (<i>n</i>) |
| Perdue, Aaron M. | (<i>n</i>) Posters #34, 76 |
| Perev. Bertrand | (5-Synthes Canada) Poster #102 |
| Perez. Edward | . (2.5-Smith & Nephew: 3B-Novalign. |
| | Medtronic: 4-Bristol-Myers Sauibb. |
| | Pfizer. Struker: 5-Sunthes. Wyeth: |
| | <i>7-Saunders/Mosbu-Elsevier</i>)OTA Committee |
| Petretta, Robert | (<i>n</i>) |
| Petrisor, Brad A. | (2.3B.5-Struker: 5.6-Sunthes)BSFF Faculty |
| Pfeifer Roman | $(n) \qquad \qquad \text{Poster #46:}$ |
| | Int'l Posters #10, 15 |
| Pham Vinh | (<i>n</i>) Poster #31 |
| Phelps James R | $\binom{n}{2}$ |
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| Phieffer I aura S | (9-AAOS) Eaculty: Paper #61 |
| Phillips Sally-Anne | $(n) \qquad \qquad \text{Int'l Poster #9}$ |
| Pittman Jason | $\binom{n}{2}$ |
| Podeszwa David A | (n) Case Presentation Moderator: |
| | Posters #53 55 |
| Pohl Anthony | (2-11nnaid local sneaker at meeting organised |
| | hu Conidien Hunaid interstate sneaker at |
| | meetings groanised by Surgical Supergies |
| | - included airfare and accommodation): |
| | 5-PL in an international study of a biomaterial) Poster #27 |
| Pollak Andrew N | (1-FrtraOrtho: 2-KCI: |
| | 3A 3B 5-Smith & Nenhern: |
| | 5-Struker: 7-AAOS: OTA President: |
| | 8-SI ACK Incornorated: OTA Committee: |
| | 9-National Trauma Institute Mini Symposium Faculty: |
| | Orthonaedic Trauma Association) Paper #51 |
| Popa Matthew A | $(n) \qquad \qquad \text{Poster #56}$ |
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| Potter Benjamin K | (5-Nanotheraneutics) BSFE Paper #15: |
| | Posters #25.96 |
| Powell Patrick | $(n) \qquad \qquad \text{Postor } \#27$ |
| Prasarn Mark L | $(n) \qquad \qquad \text{Paper #45: Poster #59}$ |
| Prensky Colin I | (n) Paner $\#73$ |
| Price Connie S | $(n) \qquad \qquad$ |
| | . (<i>n</i>) |

Disclosure:

| Probe, Robert A. | (2-Synthes; 2,3B-Stryker; |
|------------------------|--|
| | 8-Journal of Bone and Joint Surgery - |
| | American, Journal of the American |
| | Academy of Orthopaedic Surgeons. |
| | Journal of Orthomaedic Trauma Journal |
| | of Trauma: 9-Orthonaedic Trauma OTA Board: |
| | Association Scott & White Health OTA Committee: |
| | Care Scott S White Memorial Hamital) |
| Duck at Chainting | Cure Scott & vvnite Memorial Hospital) |
| Probst, Christian | (n) Paper #31 |
| Prof. Dr. Shahab-uddin | (6-Acumed) Lab Faculty |
| Prokuski, Laura J. | (8-Journal of the American Academy |
| | of Orthopaedic Surgeons) OTA Committee |
| Pugh, Kevin J. | (2,3B,5-Medtronic, Smith & Nephew; |
| | 2,3C-Synthes, 3C-AO North America; |
| | 8-Journal of Orthopaedic Trauma; |
| | 9-AAOS) Mini Symposium Faculty |
| Pulos, Nicholas | (<i>n</i>) |
| Purvear, Aki | (3B-Globus Medical Medicrea: |
| <i>y</i> | 3C-K2M)Paper #67 |
| Oamirani, Erion | (n) BSFF Paper #9 |
| Rahm Mark D | (2 3B 5-DePuy A Johnson & Johnson Company: |
| | 3B 5-K2M: 3C-Sninesmith: |
| | A Johnson & Johnson) Doctor #2 |
| Pandall Timmathy | $\frac{4}{3} Johnson O Johnson) \dots 1 Oster #2$ |
| Randen, Infinitoury | (11) |
| Reed, LOTI K | (<i>SD-Weutronic</i> , <i>9-Orthopueuic</i> |
| | Irauma Association) |
| Rehman, Saqıb | (n) OIA Committee |
| Reid, J. Spence | (2,3B-Smith & Nephew; 3B-Synthes; |
| | 8-Journal of Orthopaedics |
| | and Traumatology) OTA Committee |
| Reilly, Mark C. | (2-Synthes; Smith & Nephew; Stryker; |
| | 9-AO Foundation)Case Presentation Faculty |
| Reinert, Charles M. | (<i>n</i>) |
| Ricci, William M. | (1,2,3B,3C,5-Smith & Nephew; |
| | 1,2,3B,3C,5-Wright Medical Technology, Inc.; |
| | 3B-Biomet; Stryker; 5-AONA; |
| | 7.8-Wolters Kluwer Health - |
| | Linnincott Williams & Wilkins: |
| | 8-Journal of Orthonaedic Trauma: OTA Committee |
| | 9-Orthonaedic Trauma Association) Papers #55 56 61 |
| Piccio Anthony I | (2 Similar) Case Descentation Eastly |
| NICCIO, AITUIOITY I | (2-synules) Case r resentation Faculty |

Disclosure:
| Richards, Justin E | (<i>n</i>) Papers #28, 58, 74; |
|-------------------------------|---|
| | Poster #72 |
| Richards, R. Geoff | (6-Synthes, Switzerland) BSFF Moderator; |
| | BSFF Faculty; BSFF Paper #8 |
| Richardson, COL (Ret) Mark W. | (<i>n</i>) OTA Committee |
| Richmond, Jeffrey H. | <i>(n)</i> OTA Committee |
| Riehl, John | (<i>n</i>) |
| Rikli, Daniel A. | (<i>3B-Synthes</i>) Poster #105 |
| Ring, David C. | (1-Wright Medical Technology, Inc.; |
| 0 | 3B-Biomet, Skeletal Dynamics, |
| | Wright Medical Technology, Inc.; |
| | 4-Illuminos; 8-Journal of Hand Surgery - American, |
| | Journal of Orthopaedic Trauma; |
| | 9-American Shoulder and Elbow |
| | <i>Surgeons, American Society</i> , Mini Symposium Faculty: |
| | for Surgery of the Hand)Papers #89, 90 |
| Ringler, James R. | (<i>n</i>) |
| 8 , , | |
| Ristevski, Bill | (<i>n</i>) Poster #80 |
| Rivara, Frederick P. | (<i>n</i>) |
| Roberts, Craig S. | (5-Sunthes: 7-Skeletal Trauma royalties: |
| , 0 | 8-Injury (Deputy Editor). Journal of |
| | Orthopaedic Trauma (Editorial Board): |
| | 9-American Academy of Orthopaedic |
| | Surgeons-Evaluation Committee. |
| | Mid-America Orthopaedic Association |
| | (Treasurer). Orthopaedic Trauma |
| | Association-Public Relations Committee. |
| | Kentucky Orthopaedic Society |
| | (<i>Vice-President</i>))OTA Committee |
| Roberts, Jason W. | (9-AAOS-Trauma Evaluation |
| | Subcommittee member. Milwaukee |
| | Orthopaedic Society-President) Lab Faculty |
| Robertson, William | (3B-CONMED Linvatec) Poster #4 |
| Robinson, Elliot | (<i>n</i>) |
| Rodriguez, Edward K. | (3B-XO: 3B.4-MXO: 5-AO, Synthes) Posters #70, 73 |
| Rogg, Adam I. | (<i>n</i>) Poster #31 |
| Røise, Olav | (<i>n</i>) Poster #19 |
| Rollins, Katie | (<i>n</i>) |
| Rosenberg, Zehava S. | (<i>n</i>) |
| Roshdy, Tarek | (<i>n</i>) BSFF Paper #12: |
| <i>J</i> , | |

Disclosure:

| Ross, Erin | (<i>n</i>) |
|----------------------------|--|
| Rotter, Philip | (<i>n</i>) |
| Rouleau, Dominique | . (5-DePuy, A Johnson & Johnson Company, |
| * | KCI, Smith & Nephew, Stryker, Synthes) Poster #94 |
| Routt, M.L. Chip Jr. | (<i>n</i>) Case Presentation Moderator |
| Russell, George V. | (2-AONA, Honorarium for two courses |
| | per year; 4-Zimmer, Stock Options; |
| | 5-Synthes, Research Support, Salary OTA Committee; |
| | support for research manager) Poster #47 |
| Russell, Thomas A. (Toney) | (1,2,4-Smith & Nephew; |
| | 3B-Smith & Nevhew Knee Creations: |
| | 3C.4-Etex: 4-Struker. Pfizer. Medtronic. |
| | Innovision: 7-Wolters Kluwer Health - |
| | Linnincott Williams & Wilkins)OTA Committee |
| Ruth, John T | (<i>n</i>) OTA Committee: Moderator |
| Rvan Scott P | (n) Papers #39 71 |
| Rybak Leon D | $(n) \qquad \qquad \text{Poster #65}$ |
| Saccone Michael | $\binom{n}{2}$ |
| Sadeghi Cameron | $\binom{n}{2}$ |
| Sagi H Claude | (2 3R-Struker Smith & Nenhern OTA Committee: |
| | Advanced Orthonedics) BSEF Paper #5: |
| | Papers #50 52 83: |
| | Poster #97 |
| Saldanha Vilas | $\begin{array}{c} (n) \\ Postor #38 \end{array}$ |
| Salfi D | $(n) \qquad \qquad \text{Int'l Postor #1}$ |
| Sampon H Wayno | $(n) \qquad \qquad \text{Postor #2}$ |
| Sanchoz Alvaro I | (n) Papar #21 |
| Sancinez, Alvaro I | * Int'l Poetore #16_17 |
| Sandors David W | (3B 5 Smith & Nonhous 5 Sunthace |
| Sanders, David W. | 8 Journal of Orthonaedics and BSEE Esculture |
| | Traumatology) Postors #30.30 |
| Sandara Day | (1 CONMED Linguates DeDun |
| Sanders, Roy | A Johnson St Johnson Commany |
| | A johnson & johnson Compuny, |
| | 1,2,3B,3-Smith & Nephew; |
| | 2,5B,5-Wiedtronic; 1,5-Stryker; |
| | D-Meulin unu Mumun Services, |
| | |
| | $(NIANIS \sigma NICHD), \dots OIA Committee;$ |
| | NIETKC (DOD); 7,8-journal of |
| | Orthopaeaic Irauma) Posters #1,97 |
| Sanas, Steven | .(<i>n</i>) |

Disclosure:

| Sangeorzan, Bruce J. | . (8-Foot and Ankle International; |
|------------------------|--|
| - | 9-American Orthopaedic Foot and |
| | Ankle Society) |
| Santoni, Brandon | . (5-Musculoskeletal Transplant |
| | Foundation, Medtronic, Synthes)BSFF Paper #5 |
| Saveli, Carla C. | .(<i>n</i>) |
| Scammell, Brigitte E | . (6-Hand Research Fund - Nottingham |
| , 8 | University Hospitals Trust Charity) |
| Schemitsch, Emil H. | . (1,3B,6-Stryker; 3B-Amgen Co, Synthes, |
| , | Baxter Wright Medical Technology, Inc., Kuros: |
| | 3B.5.6-Smith & Nevhew: 6-Canadian Institutes |
| | of Health Research (CIHR). Brainlab. |
| | OMEGA. Zimmer: 7-Saunders/Mosby-Elsevier): |
| | 8-Iournal of Orthopaedic Trauma: |
| | 9-Orthopaedic Trauma AssociationOTA Committee: |
| | Canadian Orthonaedic Association |
| | Osteosunthesis and Trauma |
| | <i>Care</i> Foundation) |
| Schemitsch, Laura A. | (3B-Struker) Paper #84 |
| Scherl, Susan A. | . (7-UnToDate: Wolters Kluwer Health |
| | - Linnincott Williams & Wilkins): |
| | 8-POSNA Resident Review: |
| | 9-AAOS. Orthopaedic Trauma Association. |
| | Pediatric Orthonaedic Society |
| | of North America) |
| Schiller, Ionathan R. | (n) |
| | Poster #52 |
| Schilling, Peter | (<i>n</i>) |
| Schlatterer, Daniel R. | (2-Integra Life Sciences, Healthpoint Ltd.) |
| Schmeling, Gregory I | (8-Iournal of Orthonaedic Trauma. |
| | American Journal of Orthonedics. |
| | <i>Journal of Bone and Joint Surgery</i> - |
| | American, Clinical Orthopaedics |
| | and Related Research. Journal of Trauma: |
| | Iniury. Infection. and Critical Care. |
| | <i>Journal of Surgical Education:</i> |
| | <i>9-AAOS, ACGME</i>) OTA Committee |
| Schmid, Timo | .(<i>n</i>) |
| · | |

Disclosure:

| Schmidt, Andrew H | . (1-Smith & Nephew; 2-Synthes; |
|-------------------------|--|
| | 3B-Medtronic, DGIMed Orthopedics, AGA; |
| | 3C,4,5-Twin Star Medical; |
| | 4-Anthem Orthopedics, Conventus OTA Board; |
| | <i>Orthopaedics;</i> 7- <i>Thieme, Inc.;</i> OTA Committee; |
| | <i>8-Journal of Orthopaedic Trauma,</i> BSFF Faculty; |
| | <i>Journal of Knee Surgery:</i> Paper #82: |
| | 9-Orthonaedic Trauma Association) Posters #33, 105 |
| Schoenfisch, Mark H. | (3B. 4-Novan, Inc.) |
| Schultz, Karen A. | (3A.4-Semnrus BioSciences: |
| | 4-Johnson & Johnson) BSFF Paper #18 |
| Schwartz, Alexandra K | (2-Sunthes) OTA Committee |
| Schwieger Karsten | (6-Sunthes Switzerland) BSFF Paper #8 |
| Sciadini Marcus F | (2 3B 4-Struker: Smith & Nenhezu) OTA Committee: |
| | I ab Faculty: |
| | Papers #51 71 |
| Sculco Poter K | $(n) \qquad \qquad \text{Postars #44.57}$ |
| Sollan Michael | (n) Postor #74 |
| Solloi Richard Martin | $\begin{array}{c} (n) \end{array} \qquad \qquad \text{Postor } \#/4 \\ \end{array}$ |
| Seller, Richard Warth | Int'l Postor #10 |
| Somblar Solas Cillian I | $(n) \qquad \qquad \text{Paper #30}$ |
| Son Howo Tot | $\binom{n}{2}$ |
| Son Milon K | (2 3 R Smith & Nanhazo Struker: OTA Committee: |
| | 2 3 B 5 Stuathes) BSEE Paper #20 |
| Sothi Anil | (n) |
| Setti Manish V | $\begin{array}{c} (n) \\ (n) \\$ |
| Settil, Mallisti K | (<i>n</i>) |
| Sewecke, Jenney J | $(1) \qquad \qquad$ |
| Seymour, Racher | $(n) \qquad \qquad \text{Paper #56}$ |
| Shah, Chirag M | $(n) \qquad \qquad \text{Paper #26}$ |
| Shah, Suraj | $(n) \dots \dots$ |
| Shannon Stoven | (1) (12-5ynunes) |
| Shamin Carles | $(n) \qquad \qquad$ |
| Sharpin, Carlos | (n) Poster #40 |
| Shellito, Adam D | (n) Poster #40 |
| Shin, Emily | (n) |
| Shorofsky, Michael J. | $(n) \dots Paper #38$ |
| Siddiqui, Akas | (4-GlaxoSmithKline, Boston Scientific, |
| | Northfield Labs, Anglotech Pharmaceuticals, |
| | Baxter, Biopure, Perrigo, Geron, Pfizer, |
| | Procter & Gamble, Johnson & Johnson) Posters #4, /1 |
| Siebler, Justin | .(<i>n</i>) |

Disclosure:

| Siegel, Judith A. | (3B-Smith & Nephew; 7-Wolters Kluwer Health |
|---------------------------|---|
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| Sletsenia, Debra L. | .(2,5D-Ell Lilly) |
| | |
| C: 1 · M: 1 1 C | Posters #36, 37, 49, 56, 69 |
| Sirkin, Michael S. | . (1,2,3B-Biomet; /-Saunaers/Niosby-Elsevier; |
| | 8-Journal of the American Academy |
| | of Orthopaedic Surgeons,OTA Committee; |
| | <i>Journal of Irauma, Journal of</i> Case Presentation Faculty; |
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| | Hamilton Health Sciences Research Grant. |
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| Staeheli John W | (4-Abhott: DePuy, A Johnson & |
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| Stanzl-Tschegg, Stefanie E | . (5-Synthes)BSFF Paper #17 |
| Starr, Adam J. | . (1-StarrFrame, LLC) Paper #72; Poster #13 |
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| Strassmair, Michael K. | . (2- <i>Stryker Europe</i>) Poster #105 |
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| van de Meent, Henk | (<i>n</i>) Poster #106 |
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| van Laarhoven. Cees | (5-AO research grant for a cadaver study |
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| Velmahos, George | (<i>n</i>) |
| Verhofstad, Michael | (2-Synthes, Bettlach, Swiss: 6-AO Foundation, |
| ·, | Restricted research grant)Paper #63 |
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| | 8-American Journal of Orthopedics, |
| | Journal of Bone and Joint Surgery - American, |
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| | Palated Pacagreb: 0 AO Equidation) Postor #107 |
| Waddall Jamas D | (1 2D 6 Smith & Nonhorm 6 Stankow |
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| Wagner, Michael | .^BSFF Paper #8 |
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| Walter, Stephen | (<i>n</i>) Posters #28, 30 |
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| Wang, Jin | (<i>n</i>) |
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| Ward, Derek | (<i>n</i>) Poster #21 |
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| , | |
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| | Papers #32, 35, 81: |
| | Posters #25. 92 |
| West, John R | (1-Linvatec Inc.) Poster #32: |
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| | Association, AAOS, AOA) Posters #40, 75 |
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| | OREF, Synthes; 8-Spine)Paper #41 |
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| Zdero, Rad | . (<i>n</i>) |
| Zeckey, Christian | . (<i>n</i>)BSFF Paper #24 |
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Disclosure:

| | BSFF SYMPOSIUM 1: Biomechanics: Choosing the Right Model |
|-------------|---|
| Moderators: | Steven A. Olson, MD Louis E. DeFrate, PhD |
| 7:30 am | Selecting the Right Specimens: Do Materials Matter? J. Lawrence Marsh, MD |
| 7:40 am | Sample Size: How Many is Enough? Louis E. DeFrate, PhD |
| 7:50 am | Critical Variables (Stiffness, Strain, Etc.) What Is Best? <i>Donald D. Anderson, PhD</i> |
| 8:05 am | Dynamic Versus Static Testing: What Is the Best? <i>Loren L. Latta, PhD</i> |
| 8:15 am | Avoiding Common Pitfalls in Study Design Steven A. Olson, MD |
| 8:30 am | Discussion |

NOTES

[•] The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 411.

Δ Filling Empty Screw Holes Does Not Improve the Fatigue Life of the Fixation Construct in Comminuted Supracondylar Femoral Fractures

Reza Firoozabadi, MD; Erik McDonald, BS; Thuc-Quyen Nugyen, BS; Jenni M. Buckley, PhD; **Utku Kandemir, MD**; Dept. of Orthopaedic Surgery, University of California San Francisco, San Francisco, California, USA

Purpose: It has been suggested that filling the empty holes in periarticular locking plates may improve the fatigue strength of fixation. The purpose of this study was to investigate how the fatigue life of periarticular distal femoral plates with combination locking/compression holes under multiaxial loading would be affected by plugging the holes in a comminuted supracondylar fracture model.

Methods: 33 synthetic femurs were instrumented with a locking / compression plate and a 6-cm metaphyseal defect was created (OTA Type 33-A3). The specimens were then divided into 3 groups: unplugged, plugging with locking screw only, and fully plugged holes. For the fully plugged group, a stainless steel plug was manufactured for the compression hole. Using a servo-hydraulic testing machine with pivots allowing for offset loading and unconstrained rotation in the sagittal plane, 6 specimens per group



Figure 1. The unplugged, locking screw only, and plugged specimens.

underwent a stepwise fatigue loading of 100 to 660 N of compression and 0 to 13 Nm of external rotation, which was increased by 110 N and 2 Nm every 25,000 cycles. Another 5 specimens per group underwent run-out loading at a constant load level of 110 to 660 N of axial and 0 to 13 Nm torsional loading. The mode of failure was recorded.

Results: *Stepwise Loading:* All specimens in the stepwise group failed at the 770-N load level. The mean number of cycles to failure for the stepwise specimen was $25,500 \pm 1500$ cycles, $28,800 \pm 6300$ cycles, and $26,400 \pm 2300$ cycles for the unplugged, screw only, and fully plugged configurations, respectively (P > 0.05). *Run-out Loading:* The mean number of cycles to failure for the run-out specimens was $42,800 \pm 10,700$ cycles, $36,000 \pm 7200$ cycles, and $36,600 \pm 10,000$ cycles for the unplugged, screw only, and fully plugged configurations, respectively (P > 0.05). There were also no differences in axial or torsional stiffness between the constructs. The failure was through the screw holes at the level of comminution, which is consistent with clinical observation.

Conclusions: Filling the empty combi-holes in the plate at the level of supracondylar comminution does not increase the fatigue life of fixation construct in a comminuted supracondylar femur fracture model (OTA 33.A3) with 6 cm of gap.

Funding: This study is funded by an OTA grant. Hardware was provided through an inkind donation by Synthes. Δ OTA Grant See pages 77 - 115 for financial disclosure information. Biomechanical Comparison of a Long Retrograde Intramedullary Supracondylar Femoral Nail Versus a Lateral Locked Plate in a Cadaveric Femur Fracture Model Matthew R. Craig, MD, MS¹; Andrew L. Freeman, MSE²; Derek Goerke, BS²; Paul Lafferty, MD³; Robert A. Morgan, MD⁴; Richard F. Kyle, MD⁵; ¹Temple University, Dept. of Orthopaedics, Philadelphia, Pennsylvania, USA; ²Excelen, Minneapolis, Minnesota, USA; ³Cooper University Hospital, Camden, New Jersey, USA; ⁴Regions Hospital, St. Paul, Minnesota, USA; ⁵Hennepin County Medical Center, Minneapolis, Minnesota, USA

Purpose: The objective of this study was to compare the primary stability and fatigue failure properties of a retrograde intramedullary (IM) femoral nail with blocking screws versus a lateral locking plate in a cadaveric supracondylar femur fracture model. To date, no biomechanical study in the literature specifically evaluates the stability of these commonly used implants.

Methods: Ten matched pairs of fresh-frozen osteoporotic cadaveric human femora were acquired and scanned to evaluate bone mineral density (BMD). For each matched pair, 1 femur received a long retrograde 13-mm femoral nail with 3 distal interlocking screws, 2 distal targeted stability blocking screws, and 2 proximal interlocking screws. The contralateral femur received a locked 9-hole supracondylar femur plate. Following device implantation, a 10-mm transverse gap osteotomy was created 8 cm above the intracondylar notch (AO/OTA33-A3). Specimens were potted and subjected to nondestructive initial stiffness tests in axial compression (100-600 N) and torsion (±12 Nm with 100-N compressive load) followed by cyclic loading to failure. Cyclic tests were conducted by applying 500 cycles at 1 Hz from 100 to 400 N with a 200-N load increase every 500 cycles until failure or 10,000 cycles. The 3-dimensional motion of the proximal and distal fracture fragments was recorded using a 4-camera noncontact motion measurement system. Failure was defined as 5 mm of collapse of the proximal segment.

Results: The nail group had less motion in all degrees of freedom than the plate group during initial axial stiffness tests (P < 0.05). In torsion, the internal/external rotation of the nail and plate were similar between the proximal and distal fragments at $10.9^{\circ} \pm 1.4^{\circ}$ and $11.9^{\circ} \pm 3.7^{\circ}$, respectively (Figure). The mean load to failure for the nail group of 2978 ± 961 N was greater than the plate group, which failed at an average of 1622 ± 307 N (P < 0.005). Specimen BMD was shown to be a significant predictor of failure load in the nail group (P < 0.001), where large BMD values correlated with high failure loads. In the plate group, the primary failure mode was plate bending, and was not dependent on BMD.

Conclusions: In this study, a contemporary, long retrograde IM femoral nail with stability blocking screws was biomechanically superior to a laterally locked plate in a cadaveric supracondylar femur fracture model.



The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 411.

Use of Acute Shortening Versus Bridging Plate for Highly Comminuted OTA 21-B1.3(1) Unreconstructable Olecranon Fractures Akira Yamamoto, MD; Meir Marmor, MD; David Friedberg, MD; Erik McDonald, BS;

Eric Meinberg, MD; University of California, San Francisco, California, USA

Purpose: Highly comminuted unreconstructable olecranon fractures can be treated by excision of the comminuted fragments and acute shortening (AS) of the olecranon or by bridging the comminution with a bridging plate (BP) construct. Biomechanical studies have shown that a significant portion of the olecranon can be excised without compromising elbow joint stability; however, with loss of elbow flexion (EF). Use of a BP may avoid loss of EF; however, there is a paucity of data studying the critical fracture gap at which BP may create an unstable elbow joint. Our hypothesis was that there is a critical fracture gap at which BP the elbow joint.

Methods: Eight cadaveric elbow specimens were used for testing. A standard posterior approach to the olecranon was performed preserving the medial and lateral collateral ligaments and the extensor mechanism. A transverse osteotomy to generate a 2-mm joint gap (JG) in the center of the sigmoid notch, simulating a highly comminuted segment, was created using an oscillating saw. The JG was increased by 2-mm increments up to the point where the olecranon was not amenable to BP. After each osteotomy, the olecranon was fixed using a BP construct (4-hole nonlocking olecranon plate) and then by performing AS and lag screw fixation (3.5-mm screw and washer). Gross stability (joint opening) and range of motion were assessed using C-arm imaging after performing BP and AS at each JG.

Results: The elbows remained stable after both BP and AS at all JGs with the maximum 88% comminution of the articular surface. Average initial extension was 0° with no change after simulated fracture in both BP and AS. Average initial EF was 146° ± 8°. Maximal JG (comminution) obtained before BP was unfeasible due to inadequate bony fixation (83% ± 5%). At all JGs for BP, EF was 145° ± 9°. For AS, at 20-40% JG, EF was 137° ± 14°; at 40-60% JG, EF was 117° ± 12°; and at >60% JG, EF was 83° ± 16° (Figure 1).

Conclusion: In highly comminuted unreconstructable olecranon fractures (up to 88% of joint), use of a BP as opposed to AS of the olecranon can maintain full elbow range of motion without compromising joint stability or creating subluxation of the joint. Increasing fracture gap in AS results in a linear decrease in elbow flexion.



Figure 1. Scatterplot graph showing decreasing maximum EF with increasing olecranon comminution in the AS group.

The Effects of Locked and Unlocked Neutralization Plates on Load Bearing of Fractures Fixed With a Lag Screw

Richelle C. Takemoto, MD; Michelle T. Sugi, MD; Fredrick J. Kummer, PhD; Kenneth J. Koval, MD; Kenneth A. Egol, MD; NYU Hospital for Joint Diseases, New York, New York, USA

Purpose: The use of a locked plate as a neutralization device for lag screw fracture fixation has been reported. Because these plates have different fixation biomechanics than unlocked plates, we investigated how this would affect loading of the lag screw at the fracture site. The purpose of this study was to assess load seen at a fracture site compressed with a lag screw when both locked and unlocked plates are used as neutralization devices.

Methods: Nine cadaver femurs had a midshaft, oblique fracture created and were fixed with a lag screw incorporating load transducers at the fracture site and lag screw. Three different neutralization plate constructs, a standard plate, a locked plate applied to bone, and an offset locked plate were sequentially applied and loaded. The fracture site and at the lag screw were measured following the various applied axial loads to the constructs.

Results: Application of plates to the lag screw fixations did not significantly change the load at the fracture site or on the lag screw. The unlocked, locked, and offset locked plates all behaved similarly. The addition of a load to the specimens did not appreciably change the lag screw loads but increased the average fracture loads by approximately 20% of the applied load.

Conclusion: Our study showed that unlocked and locked neutralization plates do not affect the initial compressive load across a fracture fixed by a lag screw and that both behaved similarly in transferring load when the fracture was loaded. For a well-fixed, stable fracture fixed with a lag screw, use of a locked plate and screw neutralization plate is not detrimental to fracture biomechanics, but there is no advantage to the use of this expensive implant over a standard plate if adequate screw purchase can be achieved.

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 Δ The Effect of Cannulated Lag Screw Placement and Tension Band Wiring on Patellar Fracture Fixation: A Cadaveric Biomechanical Study

*Eric Henderson, MD*¹; Brandon Santoni, PhD²; Aniruddh Nayak, MS²; Andres Cabezas, BS²; Richard Cain, MD¹; Riley Hale, MD¹; H. Claude Sagi, MD¹ ¹Dept. of Orthopaedic Surgery, University of South Florida, Tampa, Florida, USA; ²Phillip Spiegel Orthopaedic Research Laboratory, Foundation for Orthopaedic Research and Education, Tampa, Florida, USA

Purpose: This study was designed to determine whether cannulated screw proximity to the articular surface in a tension band construct for simple, transverse patellar fractures significantly affects compression and gapping at the articular surface. Our hypothesis was that fracture gapping will be lowest and fragment compression will be highest for both ventral and dorsal fracture gaps when the cannulated screws are placed close to the articular surface of the patella.

Methods: Nine matched-pair human cadaveric knees were dissected of soft tissues leaving the joint capsule, ligaments, and the extensor mechanism attached. The femur was transected 12 cm proximal and the tibia 15 cm distal to the tibiofemoral joint surface. Patellar fracture was simulated via a transverse cut using an oscillating bone saw and the fragments were reduced and instrumented with 4.0-mm-diameter cannulated lag screws placed in either the articular or nonarticular halves of the patellae across the fracture line. A 1.25-mm cerclage wire was then passed through the screws and placed in a figureof-8 pattern through the ligamentous structures and close to the bone. To simulate the weight of the lower leg and foot, a 3.1-kg weight was coupled to the tibia 25 cm from the tibiofemoral joint. The quadriceps tendon was sutured to high-strength webbing and coupled to the actuator of a biaxial load frame via a pulley mechanism. The femur was potted in polyvinylchloride pipe and affixed to the loading frame such that the femur was in a horizontal position. Flexion-extension range of motion (90°) was accomplished by cycling the construct between 10 N and 270 N at 0.2 Hz for 1000 cycles. The relative displacement of the patellar fragments was continuously recorded with a 3-dimensional motion capture system (0.01-mm resolution) in the unloaded condition (full flexion) and in full extension at 270 N.

Results: During the first cycle, fracture site displacement in flexion on the ventral patellar surface was not significantly different (P = 0.820) for articular (0.237 ± 0.572 mm) versus nonarticular (0.063 ± 0.112 mm) lag screw placement. Fracture site displacement in flexion on the dorsal patellar surface followed a similar trend (P = 0.690) during the first cycle (articular: 0.002 ± 0.414 mm; nonarticular: -0.047 ± 0.186 mm). At 1000 cycles, total fracture site displacement at the ventral (articular: 0.730 ± 0.619 mm; nonarticular: 0.751 ± 0.615 mm) and dorsal (articular: -0.104 ± 0.322 mm; nonarticular: 0.217 ± 0.611 mm) aspects of the patella was not dependent on lag screw proximity to the articular surface (P = 0.920 and P = 0.167, respectively).

Conclusion: Contrary to our initial hypothesis, the results of this cadaveric biomechanical study indicate that, when combined with the tension band wiring technique, fracture gapping in simple, transverse patellar fractures is not dependent on cannulated lag screw proximity to the articular surface of the patella.

Δ OTA Grant

Is Dynamic Locking the Answer in Some Complex Proximal Femoral Fractures? A Biomechanical Study

Benjamin Ollivere, FRCS (Tr & Orth), MD; Markus Baker, MRCS; Simon T. Donell, FRCS(Orth), MD; Nish Chirodian, FRCS (Tr & Orth); James Wimhurst, FRCS (Tr & Orth); Norfolk & Norwich University Hospital NHS Trust, Norwich, United Kingdom

Background: The advent of cephalomedullary nails has improved outcomes of complex basicervical and intertrochanteric femoral neck fractures. However, the literature provides little evidence of an advantage over traditional plate and sliding lag screw fixation in reverse oblique and 3- or 4-part fractures. Nonunion rates in some series are reported as approaching 30% and implant failure rates up to 20%.

Methods: We present a biomechanical dry bones study using standard osteotomized Synbone femurs and the proximal femoral nail α [PFN α]). All AO fracture classification configurations of proximal femoral fractures were tested. A custom-built jig and standardized digital imaging was used to measure the migration of fragments during cyclical loading of fixed proximal femoral fractures. The effect of the static and dynamic locking options of the PFN α was observed on each fracture type. All fractures were loaded with 40-N force for up to 100 cycles, or implant failure (defined as screw cut-out or periprosthetic fracture). In addition, a validation exercise for the model's reproducibility was performed.

Results: Static locking was significantly (P < 0.05) more stable with failure after 5 times the loading in fractures with a preserved medial cortex when compared to dynamically locked nails (Figures 1 and 2). The situation is reversed in fractures without a medial cortex or reverse oblique fractures where static locking results in early failure (Figure 3). Inter- and intraobserver reliability for the model was excellent with κ values of 0.91 and 0.97 respectively.



Discussion: Cephalomedullary nails are designed as load-sharing devices, and are not designed to provide absolute stability or to "bridge" a fracture. Dynamic locking in fractures without a medial cortex allows for controlled fracture collapse and load sharing, which improves the stability of fixation in these fractures.

Although an in vitro model, the characteristics of Synbone are similar to that of real bone, and such a

marked difference would suggest these results can be translated into clinical practice. Application of this biomechanical principle may improve the outcomes in fractures without a medial buttress.

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Conclusion: In fractures with no stable medial cortical apposition, dynamic locking results in a more stable biomechanical construct, and may result in a better outcome for these difficult fractures.





• A Biomechanical Comparison of Intramedullary and Volar Plate Fixation of Distal Radius Fractures

R.J. van Kampen, MD¹; A.R. Thoreson, MS²; N.J. Knutson, MS³; J.E. Hale, PhD³; **Steven L. Moran, MD¹**; ¹Dept. of Plastic Surgery, Mayo Clinic, Rochester, Minnesota, USA; ²Orthopedic Biomechanics Laboratory, Dept. of Orthopedic Surgery, Mayo Clinic, Rochester, Minnesota, USA; ³Conventus Orthopaedics Inc., Maple Grove, Minnesota, USA

Purpose: Volar plating is commonly used for dorsally comminuted extra-articular distal radius fractures. However, such internal fixation can be associated with periosteal stripping, scarring, and tendon irritation, which can necessitate hardware removal. Intramedullary (IM) fixation preserves soft tissue and reduces the risk of tendon irritation. Recent advancements now allow for the placement of a nitinol IM scaffold into the distal metaphysis through the intramedullary canal using percutaneous techniques. This study compares the biomechanical properties of this new IM scaffold construct to volar plates.

Methods: A novel IM scaffold designed for fixation of distal radius fractures was compared to a commercially available titanium volar locking plate and a stainless steel T-plate (SST). Three different devices were implanted in 18 radius bone surrogates (Sawbones model 1005). To simulate a dorsally comminuted extra-articular distal radius fracture, a 10-mm dorsal wedge osteotomy was performed before implantation. The devices were implanted according to respective instructions for use. For the IM scaffold, the IM canal of the distal metaphysis was prepared and the scaffold was inserted through a 5-mm-diameter drill hole on the lateral aspect of the radius, approximately 7 cm proximal to the fracture site. Cannulated screws were inserted over Kirschner wires placed through the fragments and IM scaffold, providing secure fixation and interfragmentary compression. 10,000 cycles of dynamic axial loading between 10 N and 100 N were applied at 2 Hz. Axial and dorsal bending stiffness was assessed before and after cyclic loading.

Results: Testing revealed no significant (P = 0.956) difference in axial stiffness between the titanium volar locking plate ($392 \pm 67 \text{ N/mm}$) and the IM scaffold ($405 \pm 108 \text{ N/mm}$) after 10,000 loading cycles. The SST plate showed significantly (P < 0.001) less axial stiffness (187 $\pm 53 \text{ N/mm}$) compared to the other 2 devices. Bending stiffness was also not significantly (P = 0.931) different between the IM scaffold ($67 \pm 140 \text{ N/mm}$) and titanium volar locking plate ($63 \pm 5 \text{ N/mm}$). SST plate bending stiffness was significantly (P < 0.001) less ($25 \pm 4 \text{ N/mm}$) than the other 2 devices.

Conclusion: Fixation stability was equivalent when comparing a novel IM scaffold to a titanium volar locking plate in a dorsal wedge model of distal radius fractures. Biomechanical testing revealed no statistically significant difference in stiffness compared to a commonly utilized volar locking plate. Both the IM scaffold and the volar locking plate were stiffer than the nonlocking stainless steel T-plate.

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Comparison of Two Techniques for Proximal Fixation of Periprosthetic Fractures: A Biomechanical Study

Mark Lenz, MD¹; Markus Windolf, MSc¹; Thomas Mückley, MD²; Gunther O. Hofmann, MD, PhD²; Michael Wagner, MD³; R. Geoff Richards, PhD¹; Karsten Schwieger, PhD¹; **Boyko Gueorguiev, PhD**¹; ¹AO Research Institute Davos, Davos, Switzerland; ²Clinic for Trauma, Hand and Reconstructive Surgery, Friedrich Schiller University, Jena, Germany; ³Wilhelminenspital der Stadt Wien, Vienna, Austria

Purpose: Safe bicortical screw placement for plate fixation of periprosthetic femoral fractures is difficult due to the intramedullary prosthesis stem. Additionally, proximal failure of the osteosynthesis is common. Mechanical properties of a locking attachment plate construct (LAP–locking compression plate [LCP]), allowing bicortical screw placement laterally to the stem, are evaluated and compared to a cerclage-LCP construct.

Methods: Eight right adult synthetic femora with implanted uncemented total hip endoprostheses were cut distally to the tip of the prosthesis and fixed with LCPs with angular stable monocortical screws and either additional LAP (n = 4) or cerclage (n = 4). The distal plate ending was cut, embedded into polymethylmethacrylate (PMMA) and attached to the testing machine. Cyclic testing was performed with monotonically increasing sinusoidal loading until failure. Construct stiffness was determined at the test beginning and after 5000 cycles. Relative movements at the LCP-bone interface were registered with motion tracking. Statistical differences were detected with unpaired *t* test and general linear model repeated measures.

Results: Stiffness of the LAP-LCP construct was significantly higher at the beginning of the test (875.4 N/mm ± 29.8) as well as after 5000 cycles (1213.0 N/mm ± 101.1) compared to the cerclage-LCP (644.96 N/mm ± 50.1 and 851.9 N/mm ± 81.9) (P = 0.013). Relative movements for bending in anterior-posterior direction (B) and translation in axial direction (T) of the LAP-LCP at the beginning ($0.07^{\circ} \pm 0.02$, $0.20 \text{ mm} \pm 0.08$), after 500 cycles ($0.16^{\circ} \pm 0.10$, $0.26 \text{ mm} \pm 0.07$), and after 5000 cycles ($0.26^{\circ} \pm 0.11$, $0.31 \text{ mm} \pm 0.07$) differ significantly from the cerclage-LCP (beginning: $0.26^{\circ} \pm 0.04$, $0.28 \text{ mm} \pm 0.05$; 500 cycles: $0.47^{\circ} \pm 0.03$, $0.53 \text{ mm} \pm 0.07$; 5000 cycles: $0.63^{\circ} \pm 0.18$, $0.79 \text{ mm} \pm 0.13$) (B: P = 0.02, T: P = 0.04). Relative movements for medial bending are not significantly different between the 2 constructs. Cycles to failure (criterion 1-mm axial translation) differ significantly between the LAP-LCP (19,519 ± 1758) and the cerclage-LCP ($11,265 \pm 2472$) (P = 0.035).

Conclusion: Biomechanically, proximal fixation of periprosthetic fractures using a locking attachment plate in combination with LCP is superior to the cerclage-LCP construct.

BSFF SYMPOSIUM 2: Heterotopic Ossification

| Moderators: | Theodore Miclau, III, MD Michael J. Bosse, MD |
|-------------|---|
| 10:20 am | The Pathophysiology of Heterotopic Ossification <i>Leon J. Nesti, MD</i> |
| 10:30 am | Heterotopic Ossification Prophylaxis in Orthopaedic Trauma Patients Aaron Nauth, MD |
| 10:40 am | Treating Heterotopic Ossification in Fracture Patients <i>Jeffrey O. Anglen, MD</i> |
| 10:50 am | Blast Injuries and Heterotopic Ossification CPT Frederick P. O'Brien, MD |
| 11:00 am | CNS Injury and Heterotopic Ossification <i>Samir Mehta, MD</i> |
| 11:10 am | Discussion |

NOTES

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Wed., 10/12/11 BSFF: Heterotopic Ossification, Paper #9, 11:40 am OTA-2011

VEGF mRNA Expression in EPC Local Therapy for a Rat Segmental Bone Defect

Ru Li, MD, PhD; Erion Qamirani, MD, PhD; Aaron Nauth, MD; Kivanc Atesok, MD; Emil H. Schemitsch, MD, FRCS(C); St. Michael's Hospital, University of Toronto, Toronto, Ontario, Canada

Purpose: Angiogenesis and osteogenesis are essential for bone growth, fracture repair, and bone remodeling. Vascular endothelial growth factor (VEGF) has an important role in bone repair by promoting angiogenesis and osteogenesis. In our previous study, endothelial progenitor cells (EPCs) promoted bone healing in a rat segmental bone defect. In addition, cell-based VEGF gene transfer has been effective in the treatment of segmental bone defects in a rabbit model. This study was conducted to evaluate VEGF gene expression after EPC local therapy for a rat segmental bone defect.

Methods: Rat bone marrow–derived EPCs were isolated from the rat bone marrow by the Ficoll-Paque gradient centrifuge technique. The EPCs were cultured for 7 to 10 days in endothelial cell growth medium with supplements (EGM-2-MV-SingleQuots). EPCs were identified by immunocytochemistry staining with primary antibodies for CD34, CD133, FLK-1, and vWf. A total of 56 rats were studied. A 5-mm segmental bone defect was created in the middle one-third of each femur followed by mini-plate fixation. The treatment group received 1×10^6 EPCs locally at the bone defect and control animals received saline only. Seven control and seven EPC-treated rats were included in each group at 1, 2, 3, and 10 weeks. Animals were sacrificed at the end of the treatment period, and specimens from the fracture gap area were collected. Rat VEGF mRNA was measured by reverse transcriptase-polymerase chain reaction (RT-PCR) and quantified by VisionWorksLS.

Results: Cultured EPCs at 1 week showed positive staining for CD34, CD133, Flk-1 and vWf markers. The EPC group had a greater VEGF expression than the control group at week 1, 2, and 3 but not at week 10. Three VEGF isoforms were detected in this rat model: $VEGF_{120}$, $VEGF_{164}$, and $VEGF_{188}$. $VEGF_{120}$ and $VEGF_{164}$ levels peaked at 2 weeks, while $VEGF_{188}$ levels peaked at 3 weeks. All 3 VEGF isoform levels were low at 10 weeks.

Conclusion: EPC-based therapy for a segmental bone defect results in increased VEGF expression during the early period of fracture repair. These findings demonstrate that EPCs promote fracture healing by increasing VEGF levels and thus stimulating angiogenesis, a process that is essential for early callus formation and bone regeneration.

Wed., 10/12/11 BSFF: Heterotopic Ossification, Paper #10, 11:46 am OTA-2011

BMP Regulation of Mesenchymal Progenitor Cells in Regenerating Muscle Tissue *Matthew W. Kluk, MD*^{1,2}; Youngmi Ji, PhD²; Orna Amrani, MD²; Wesley M. Jackson, PhD²; Leon J. Nesti, MD^{1,2}; ¹Dept. of Orthopaedics and Rehabilitation, Walter Reed Army Medical Center, Washington, District of Columbia, USA; ²Clinical and Experimental Orthopaedics Laboratory, National Institute of Arthritis and Musculoskeletal and Skin Diseases, National Institutes of Health, Bethesda, Maryland, USA

Purpose: Posttraumatic heterotopic ossification (HO) is a condition characterized by ectopic bone formation; more than 60% of the patients who sustained blast-related trauma during Operation Enduring Freedom and Operation Iraqi Freedom were diagnosed with HO within 1 year of their injury. Our laboratory has previously identified a population of multipotent mesenchymal progenitor cells (MPCs) that are present in regenerating muscle tissue. Our overall hypothesis was that the bone morphogenetic proteins (BMPs) dysregulate the proregeneration functions of the MPCs to promote pathologic wound healing over muscle regeneration.

Methods: Muscle samples were obtained from the zone of injury following blast trauma according to an IRB-approved protocol. Control muscle tissue was obtained from patients undergoing elective orthopaedic reconstruction. One specimen was homogenized to determine the BMP gene expression with qRT-PCR (quantitative real-time polymerase chain reaction). Protein-level measurements of BMP were determined by placing specimens in growth medium. The growth medium concentration of BMP-2, -4, and -6 was measured with enzyme-linked immunosorbent assay (ELISA). MPCs were seeded in 12-well plates to adhere overnight, and then treated with either BMP-4 over the range of concentrations that was observed during the BMP release kinetics experiment. The effect of the BMPs on fibrogenesis was assayed by measuring the concentration of matrix metalloproteinase (MMP)–1 in the cell supernatants with ELISA. qRT-PCR was also performed on cells exposed to BMP-4 using an RT² Profiler PCR array for the Human Osteogenesis pathway.

Results: We measured substantial gene-level expression of *BMP2*, *BMP4*, *BMP5*, and *BMP6* in control muscle, although the gene expression of *BMP4* and *BMP5* was significantly lower in the traumatized muscle tissue (P < 0.015, Student *t* tests). There was a significant increase in the amount of MMP-1 expressed by the MPCs that were cultured with BMP-4 (P < 0.05, repeated-measures analysis of variance with n = 3). Cartilage oligomeric matrix protein (COMP) was significantly upregulated in cells exposed to 200 ng of BMP-4 for 7 days when compared with controls (P < 0.05). Conversely, tumor necrosis factor (TNF) was significantly downregulated in cells exposed to 200 ng of BMP-4 for controls (P < 0.05) as measured by PCR.

Conclusions: BMP-4 gene expression is downregulated in response to injury. We detected an increase in BMP-4 accumulation in the explant. BMP-4 could be released from the extracellular matrix during the early remodeling stages of wound healing. We found that increased BMP concentration resulted in a corresponding increase in MMP-1 concentration, which has been associated with decreased fibrosis. BMP-4 exposures lead to an upregulation of

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COMP. COMP is an extracellular matrix calcium-binding protein found in cartilage. There was also a significant decrease in TNF- α . BMP-4 has previously been shown to have an antiapoptotic effect on mesenchymal pluripotent cells via a suppression of TNF-mediated apoptosis leading to a protective effect on MPCs. In cases where the injury is severe, the process of muscle regeneration may be extended beyond the normal interval via the antiapoptotic effect of BMP-4. This in turn generates an osteoinductive environment with the upregulation of COMP that is susceptible to HO formation.

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Wed., 10/12/11 BSFF: Heterotopic Ossification, Paper #11, 11:52 am OTA-2011

Gene Expression and Regulation in the Formation of Heterotopic Ossification Jared Vogler, DO^{1,2}; **Emily Shin, MD**^{1,2}; Amber B. Aragon, MD²; Matthew W. Kluk, MD^{1,2}; Youngmi Ji, PhD²; Wesley M. Jackson, PhD²; Leon J. Nesti, MD^{1,2}; ¹Dept. of Orthopaedics and Rehabilitation, Walter Reed Army Medical Center, Washington, District of Columbia, USA; ²Clinical and Experimental Orthopaedics Laboratory, National Institute of Arthritis and Musculoskeletal and Skin Diseases, National Institutes of Health, Bethesda, Maryland, USA

Purpose: Heterotopic ossification (HO), a condition that is rarely encountered in civilian trauma, occurs frequently in patients with severe combat-related extremity wounds. This disease, which occurs in at least 60% of patients following blast injury, severely limits timely recovery and return to duty. Our laboratory has recently identified a gene expression profile that is associated with traumatized muscle, which included a number of cytokines with no known association with HO. Therefore, the objective of this study was to correlate the gene expression of these cytokines in traumatized muscle tissue with the incidence and severity of HO formation. We also measured the expression of microRNA (miRNA) sequences in the traumatized muscle tissue to evaluate their role in the regulation of gene expression following muscle trauma. MicroRNAs are small noncoding RNAs that are endogenously expressed, and by binding to the 3' UTR (untranslated region) of target mRNAs, miRNAs can act as negative regulators of gene expression by inhibiting the translation or promoting degradation of the target mRNAs. Consequently, these molecules have been shown to play keys roles in a wide range of biologic processes, including development, self-renewal of stem cells, differentiation, disease, and cancer.

Methods: *Tissue Collection:* Traumatized muscle tissue samples were obtained with IRB approval during serial washouts of extremity wounds sustained during Operation Iraqi Freedom and Operation Enduring Freedom. The patients were followed for 18 months to determine whether they had developed symptoms of HO. *Real-Time miRNA PCR Array:* Total RNA, including small RNA, were prepared using the miRNeasy Kit. Gene expression was determined using real-time polymerase chain reaction (RT-PCR) arrays to simultaneously assay for over 120 gene sequences. The miRNA expression was analyzed using Cell Differentiation and Development RT² PCR miRNA using an ABI7900HT RT-PCR system. These arrays contain 88 different miRNA sequences, including 20 miRNAs that are muscle-specific. Gene expression analysis was performed using the RT² Profiler PCR Array Data Analysis software. *Immunohistochemistry:* Fixed tissues samples were paraffin-embedded and sectioned into serial cross-sections, which were stained with hematoxylin and eosin, Mallory's trichrome, and with immunohistochemistry.

Results: A differential cytokine expression profile was observed between traumatized muscle tissue samples from patients that went on to form HO compared to those who did not. The samples from tissues at early stages of HO formation expressed higher levels of genes associated with osteogenesis (eg, *BMP2*, *BMP6*, and *MSX*). We localized these proteins relative to fibroproliferative lesions in serial sections of the tissue using immunohistochemistry. We also identified a unique miRNA profile of traumatized muscle tissue at the initial stages of HO formation.

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Conclusions: Our results have identified a set of genes that are upregulated in traumatized muscle and may play a role in producing ectopic bone after traumatic injury. We have previously demonstrated that *BMP2* and *BMP6* were not upregulated by trauma, but the present study suggests that there is differential expression of these genes between traumatized tissues that form HO and those that do not. Our microarray data also identified 2 additional miRNAs that may have a potential role in HO etiology. The miR-146b expression in the HO tissue suggests that the cells in a stress-response state due to a chronic inflammation and exposure to NF (nuclear factor)– κ B. miR-205 has been implicated in epithelial to mesenchymal transition (EMT), and EMT is assumed to occur during HO development as cells of vascular origin participate in the formation of ectopic bone. It is currently unknown whether these miRNAs contribute directly to the initiation of HO, or if their expression leading to HO may be regulated by miRNAs, which offer new targets for developing strategies to prevent this disease.

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The Effect of Reaming of Long Bone Fractures on Translocation of Mesenchymal Stem Cells

Tarek Roshdy, MD; **Peter V. Giannoudis, MD**; Elena Jones, PhD; Dennis McGonagle, PhD; Section of Musculoskeletal Disease, LIMM, The University of Leeds, Leeds, United Kingdom

Purpose: The hypothesis that mesenchymal stem cells (MSCs) circulate extensively and home to sites of tissue damage in normal physiologic situations is extremely contentious. Whether MSCs circulate following trauma remains also obscure. The purpose of this study was to investigate whether reamed intramedullary nailing of fractured tibias and reaming of intact femurs with the RIA (reamer-irrigator-aspirator) reamers for bone-graft harvesting is associated with mechanical translocation of MSCs into the vascular system.

Methods: 10 mL of femoral venous blood from the ipsilateral fractured limb and matched peripheral venous blood from the contralateral median cubital vein was collected from 12 patients immediately following closed reaming for intramedullary nailing of tibia fractures. Similarly, 10 mL of femoral venous blood from the ipsilateral limb after RIA reaming and matched peripheral venous blood from the contralateral median cubital vein was collected from 12 patients immediately following closed RIA reaming for bone-graft harvesting. Following density centrifugation, colony-forming-unit–fibroblast assay (CFU-F) was performed in 10-mm round dishes using 5 and 10×10^6 mononuclear cells/dish. Individual colonies were then expanded in standard conditions for 14 days and osteogenic assays and multiparameter flow cytometry were undertaken and compared with the "gold standard" iliac crest–derived MSCs.

Results: From fracture tibia cases, 4 out of 12 (33.33%) of femoral vein aspirates contained classical CFU-F colonies comprised of typical fibroblast-like cells. From the RIA cases, 8 out of 12 (66.67%) of femoral vein aspirates were positive for CFU-F colonies and 2 out of 12 (16.67%) contained CFU-F colonies in the peripheral blood. Colonies with a macrophage morphology were also present in those samples. It was possible to culture-expand CFU-Fs from femoral veins only, with these exhibiting osteogenesis as determined by alkaline-phosphatase activity. The immunophenotype of CFU-F culture expanded from femoral blood was identical to iliac crest bone marrow aspirate MSCs: positive for CD73, CD90, and CD105; and negative for CD45, CD271, CD34, CD31, CD19, and CD14.

Conclusions: MSCs were identified within the circulation at sites immediately adjacent to intramedullary reaming (both conventional and RIA) and at a lower frequency in peripheral venous blood, presumably being secondary to capillary filtering by pulmonary and systemic beds. This suggests that their presence in the blood is more likely the consequence of biomechanical trauma rather than a specific molecular cascade involving cell migration and homing. We believe that confusion in the literature may relate to the mischaracterisation of adherent myeloid or endothelial colonies as CFU-Fs.

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| | BSFF SYMPOSIUM 3: Compartment Syndrome: New Technologies |
|-------------|--|
| Moderators: | Edward J. Harvey, MD Gregory K. Berry, MD |
| 1:15 pm | Non-Operative Management of Compartment Syndrome <i>David W. Sanders, MD</i> |
| 1:25 pm | Non-Invasive Compartment Monitoring <i>Gregory K. Berry, MD</i> |
| 1:35 pm | Invasive Compartment Monitoring Andrew H. Schmidt, MD |
| 1:45 pm | Compartment Syndrome: Emerging Concepts and Technologies <i>Edward J. Harvey, MD</i> |
| 2:00 pm | Discussion |
| | NOTES |

• Comparison of Chlorhexidine and Saline for Irrigating a Contaminated Open Fracture Model

Jowan G. Penn-Barwell, MRCS^{1,2}; Clinton K. Murray, MD³; Joseph C. Wenke, PhD¹; ¹US Army Institute of Surgical Research, Fort Sam Houston, San Antonio, Texas, USA; ²Academic Dept. of Military Surgery and Trauma, Royal Centre for Defense Medicine, Birmingham, United Kingdom; ³Brooke Army Medical Center, Fort Sam Houston, Texas, USA

Purpose: Chlorhexidine gluconate (CHG) is an antiseptic that potentially combines the mechanical action of an inert fluid in physically removing bacteria with an active chemical antimicrobial effect without damaging host tissue. Interestingly, despite its reputation as a rapidly active, broad-spectrum antiseptic with low toxicity and its extensive use in most modern hospitals, CHG has not been thoroughly evaluated in either an animal model of open fracture or a clinical trial. Despite this lack of evidence, a small number of orthopaedic surgeons do irrigate open fracture wounds with 0.05% CHG solution in preference to the commonly accepted clinical standard of saline. This study compares irrigation with CHG to the clinical standard of saline in an animal model.

Methods: This study used a segmental defect rat femur model contaminated with *Staphylococcus aureus* and treated 6 hours after injury with débridement and irrigation with 60 mL of fluid delivered at low pressure via a hand-held syringe. In study groups of 10 animals each, 3 concentrations of CHG (0.5, 0.05, and 0.005%) were used as well as a group irrigated with 0.05% CHG then saline and a control group treated with saline only. After irrigation, animals' wounds were closed and the rats were recovered. 14 days later, bone and hardware was harvested for separate microbiologic analysis. The primary outcome measure was detectible bacteria on bone or hardware. Quantitative cultures were also performed.

Results: Irrigation with aqueous CHG at a range of concentrations has a similar effect on infection rate to irrigation with saline alone. Initial irrigation with 0.05% CHG, followed by a saline rinse to remove CHG residue, was more effective than saline alone at reducing the infection rate but this effect did not reach statistical significance (*P*=0.2). This group similarly had the lowest quantity of bacteria in the wound. The most dilute concentration of



CHG tested resulted in the greatest quantity of bacteria in the wound; however, this was not significant.

Conclusion: This study demonstrates that 0.05% CHG may be an appropriate solution for irrigating open fractures provided it is rinsed from the wound prior to closure or dressing. These results appear to support the concept of a balance between antibacterial effect and

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tissue damage determining the overall effect of antiseptics on infection. The most dilute CHG irrigation group has the greatest amount of bacteria, consistent with this concentration being too weak to exert an antibacterial effect but still sufficient to damage tissues. Conversely, the group with the lowest infection rate and bacterial quantification was exposed to the antimicrobial effect of CHG, then had the residual CHG removed with a saline rinse. This may have possibly reduced the potential for subsequent tissue damage, which is thought to allow bacteria to thrive.

Disclaimer: The opinions and assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of the Army or Department of Defense.

WITHDRAWN

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Retinoid Signaling by a Selective Retinoid Acid Receptor Agonist Hinders Angiogenesis, Formation of Granulation Tissue and Wound Closure in Cutaneous Models of Wound Healing

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Purpose: Heterotopic ossification (HO) is a common late complication of modern wartime extremity injuries. Recently, the prophylactic administration of retinoid acid receptor agonists (RARAs) was found to inhibit the formation of HO, thought in part to inhibition of vascular development. The effects of RARAs on tissue revascularization and cutaneous wound closure are unclear. The aim of our study is to determine the effects of RARA treatment in murine models of wound healing on skin isograft revascularization and acute excisional wounds.

Methods: A circular 2-cm² full-thickness excisional wound was produced on the dorsum of BALB/C mice. Wounds were either left open or covered immediately with a full-thickness syngeneic skin graft. - Mice were treated daily with RARA γ (5-15 mg/kg) or vehicle control for 7 days. Grafted skin was assessed at different time points for gross revascularization, angiogenic mRNA transcript expression, CD31⁺ vessel density, and histology. Open wound areas were quantified using digital planimetry.

Results: In comparison to vehicle-treated mice, a significant loss in skin isograft integrity and graft revascularization was observed at the macroscopic level in grafts from RARAγtreated mice at day 7. RT-PCR (real-time polymerase chain reaction) gene expression of grafts and wound margin tissue revealed marked suppression in key proangiogenic gene transcripts including angiopoietin, the ELR-CXC chemokines, proinflammatory cytokines, MMP (matrix metalloproteinase)–9, and leptin. Moreover, histologic analysis indicated decreased graft re-epithelialization as well as a 32% reduction in wound-bed granulation tissue containing 73% fewer CD31⁺ vessels. RARAγ treatment delayed open excisional wound closure (30.1% vs 52%) as a result of reduced granulation tissue formation and impaired wound contraction.

Conclusion: Although RARAs have shown effectiveness against HO formation, our results reveal a suppressive regulatory role of retinoid signaling on key wound healing processes and may dampen enthusiasm for HO treatment in the setting of open fractures.

Gentamicin for Open Fractures in Trauma Patients: Is it Safe?

David Zamorano, MD; **Jason H. Lee, MD**; Michael L. Nguyen, MD; Matthew Griffin, BS; University of California Irvine Medical Center, Orange, California, USA

Purpose: This study was designed to evaluate the incidence of acute renal insufficiency (ARI) in trauma patients with open fractures who received gentamicin for infection prophylaxis in comparison to those who did not receive gentamicin. The hypothesis was that gentamicin use in open fractures would significantly increase the incidence of ARI.

Methods: Data were collected on 351 consecutive trauma patients with open fractures that were reported during the period of July 2001 through June 2008 by accessing the Trauma Surgery Database and electronic medical records. Patients were dichotomized into those who received gentamicin within the first 7 days of hospitalization (group 1) and those who did not receive gentamicin (group 2). All patients had open fractures of the upper or lower extremity. The initial 7 days of serum creatinine values and clinical data following their injury were collected and further evaluated through a retrospective chart review.

Results: The demographics and comorbidities known to increase the risk of ARI were similar between the comparison groups. Based on an elevation of creatinine values, the overall prevalence of ARI in our population of 351 trauma patients with open fractures was 6.8%. The prevalence of ARI was significantly higher in group 1 (9.3%) than in group 2 (3.8%) (2-sided P = 0.044). Patients who developed ARI received total amounts of gentamicin that were only slightly higher on average than the total amounts administered to the patients who did not develop ARI (713.5 mg to 707.0 mg, respectively), and the difference between these means (6.5) was not statistically significant (2-sided P = 0.97). Males who received gentamicin exhibited a significantly higher rate of ARI (10.3%) than males who did not receive gentamicin (3.3%) (2-sided P = 0.027).

Conclusion: The use of gentamicin in patients with open fractures significantly increased the incidence of acute renal insufficiency in this retrospective study.

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| | BSFF SYMPOSIUM 4: Advances in Biomaterials and Surface Technologies |
|-------------|--|
| Moderators: | Theodore Miclau, III, MD R. Geoff Richards, PhD |
| 3:25 pm | Advances in Implant Surface Technologies David Grainger, PhD |
| 3:40 pm | Manipulating Osseointegration Through Material Surface Modification R. Geoff Richards, PhD |
| 3:55 pm | Current Strategies in Anti-Infective Surfaces <i>Fintan Moriarty, PhD</i> |
| 4:05 pm | New Trauma Implant Technologies: Will Coatings Make a Difference <i>R. Trigg McClellan, MD</i> |
| 4:15 pm | Discussion |

NOTES
Bone-Implant Interface Strength and Peri-Implant Bone Response to a Biodegradable Magnesium Alloy Implant and a Self-Reinforced PLGA Copolymer Control: Findings in a Transcortical Rat Model

Richard A. Lindtner, MD¹; Christoph Castellani, MD²; Peter Hausbrandt, MD²; Elmar K. Tschegg, PhD³; Stefanie E. Stanzl-Tschegg, PhD⁴; Annelie-Martina Weinberg, PhD²; ¹Dept. of Trauma Surgery, Medical University Innsbruck, Innsbruck, Austria; ²Dept. of Pediatric and Adolescent Surgery, Medical University of Graz, Graz, Austria; ³Institute for Building Construction and Technology, Vienna University of Technology, Vienna, Austria; ⁴Institute of Physics and Materials Science, University of Natural Resources and Life Sciences

⁴Institute of Physics and Materials Science, University of Natural Resources and Life Sciences, Vienna, Austria

Purpose: Currently available bioabsorbable (co)polymeric implants lack sufficient mechanical strength for fracture fixation and may cause adverse tissue reactions. In contrast, biodegradable magnesium alloys combine biodegradability, improved biocompatibility, and are more suitable for load-bearing applications due to their excellent mechanical properties. Although the mechanical quality of the bone-implant interface of these novel alloys can have a dramatic effect on the success or failure of the implanted degradable device, this issue has not yet been addressed. In the present study, we therefore aimed to investigate whether bone-implant interface strength and peri-implant bone response to a novel biodegradable magnesium alloy is comparable to that of a polymeric bioabsorbable self-reinforced poly(lactic-co-glycolic acid) (PLGA) control in a rat transcortical model.

Methods: 68 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 bioabsorbable selfreinforced PLGA (85:15) control for 4, 12, and 24 weeks, respectively. Each rat received 1 rod randomly implanted either into the left or into the right femoral bone. After sacrifice, harvested femurs were subjected to microfocus CT to quantify peri-implant bone formation. Biomechanical push-out testing was used to determine maximum push-out force and ultimate shear strength 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 as well as ultimate shear strength in the investigated magnesium alloy implant than in the PLGA control after each implantation period ($P \le 0.001$ for all comparisons). Microfocus CT showed significantly higher bone-implant contact (P = 0.001) and trabecular bone volume per tissue volume (P = 0.043) in magnesium alloy implants 4 weeks after implantation, n whereas there were no significant differences at 12 and 24 weeks. Moreover, in vivo degradation of the magnesium-based alloy did not induce local or relevant systemic inflammatory reactions.

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Conclusions: These results suggest that the investigated magnesium alloy achieves an enhanced bone response at 4 weeks and a greater interfacial strength at all 3 time points than the polymeric PLGA control in a rat transcortical model. Thus, it seems to be a promising candidate for future bone implant application under load-bearing conditions in pediatric trauma surgery.

Wed., 10/12/11 BSFF: Biomaterials & Surface Tech, Paper #18, 4:51 pm OTA-2011

Novel Antimicrobial Surface for Fracture Fixation Devices with Long-Term Stability *Christopher R. Loose, PhD*; Karen A. Schultz, PhD; Hao Wang, PhD; Koby J. Elias, BS; Semprus BioSciences, Cambridge, Massachusetts, USA

Purpose: Polybetaine surface modifications give constant reduction in biofilm formation after 90 days of exposure to human serum for a range of medical devices. This modification has been adapted to titanium substrates for orthopaedic trauma with the optional controlled release of chlorhexidine to enhance antibiofilm efficacy during the initial stage after implantation.

Methods: Titanium substrates were modified using proprietary polybetaine grafting technology. Characterization of the surfaces included: ATR-IR (attenuated total reflectance–infrared) spectroscopy to verify the chemical composition of the modification, SEM (scanning electron microscopy) of the sample cross-section to determine thickness and conformality, and a fibrinogen assay to quantify resistance to protein adsorption. A subset of samples was formulated with a reservoir of chlorhexidine. The in vitro chlorhexidine release profiles were measured using UV-vis (ultraviolet and visible) spectroscopy. A modified CDC biofilm reactor system was utilized for growing biofilms (ASTM E2562-07). Samples were also subjected to shear testing to measure mechanical integrity and adherence of the polymeric modification to the titanium substrate.

Results: Polybetaine-modified samples exhibited >90% reduction in protein adsorption relative to unmodified titanium substrates. The nonfouling properties were retained after several weeks of chlorhexidine release. Polybetaine-modified materials yielded >2-log reductions in bacterial colonization following serum exposure. Through formulation optimization, controlled release of chlorhexidine from polybetaine-modified samples was achieved for 8 weeks, as well as consistent adhesion to the titanium substrate throughout chlorhexidine release at 37 °C.

Conclusion: The nonfouling polybetaine surface modification that has shown long-term efficacy against biofilm formation can be applied to titanium substrates for orthopaedic trauma devices, and optionally coupled with the controlled release of chlorhexidine, which may be especially beneficial during the initial weeks after implantation. These materials are highly resistant to protein fouling and have shown stability under physiologic conditions. Formulations will be assessed in animal models, targeting the reduction in device-related orthopaedic infections. A superior solution compared to current technology of biofilm control, this approach innovatively addresses the initial bacterial challenge and the longer-term biofilm formation on orthopaedic trauma devices by coupling the potential for drug release with a highly nonfouling polymer that reduces bacterial adhesion during and after implantation to avoid biofilm formation.

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Decreasing Complications in External Fixation Pins Via Time-Released Nitric Oxide Coatings

*William W. Kesler, III, AB*¹; Ken J. Addison¹; Adriel M. Watts, BS¹; Paul S. Weinhold, PhD²; Joshua B. Holt, BS¹; Wesley L. Storm, BS³; Mark H. Schoenfisch, PhD³; Laurence E. Dahners, MD²; University of North Carolina School of Medicine, Chapel Hill, North Carolina, USA;

²Dept. of Orthopaedic Surgery, University of North Carolina, Chapel Hill, North Carolina, USA; ³Dept. of Chemistry, University of North Carolina, Chapel Hill, North Carolina, USA

Purpose: This study was designed to quantitatively evaluate the effectiveness of a nitric oxide (NO)–releasing diazeniumdiolate xerogel and multiple treatments of a polysiloxanebased topical gel containing NO-releasing nanoparticles on infection rates and the bone-pin interface strength of external fixation pins in a rat model.

Methods: Three 2-mm-diameter acid-etched titanium pins belonging to either the xerogelcoated group, the group to which the topical gel was applied, or the control group were aseptically implanted into the dorsal aspects of the third, fourth, and fifth tail vertebrae of Sprague Dawley rats. The group receiving the topical gel was treated twice weekly. Implant sites were qualitatively graded every 2 weeks by blinded observers, and the rats were sacrificed after 42 days. The pins were then subjected to torsional testing, and the pin tract sites were cultured.

Results: The pin tract sites on which the topical gel was applied had significantly fewer bacterial colony forming units (CFUs) (700 ± 1482 CFUs) than the control group (7225 ± 15,851 CFUs) (P = 0.044). The torques required to initiate loosening were not significantly different between the experimental groups (25.26 ± 17.54 N mm for the xerogel-coated group and 35.72 ± 23.46 N mm for the topical gel group) and the controls (41.15 ± 30.26 N mm).

Conclusion: Because the NO-releasing topical gel significantly reduced bacteria counts without compromising the fixation of the pins, we believe such treatments could potentially be optimized to reduce infection rates in external fixators and other transcutaneous implants in humans.

Testing for Contrasting Infection Rates and Biofilm Formation Among Biomaterials in an In Vitro Biofilm Infection Model

Brian Stover, BS¹; Zalman Vaksman, MS¹; Heidi B. Kaplan, PhD¹; **Catherine G. Ambrose, PhD²**; Milan K. Sen, MD² ¹Dept. of Microbiology and Molecular Genetics, ²Department of Orthopaedic Surgery, UT Health, Houston, Texas, USA

Purpose: This study presents an in vitro model for biofilm formation on orthopaedic biomaterials. Several materials have been evaluated to determine if *Staphylococcus aureus* biofilm growth rates vary among the materials.

Methods: An in vitro S. aureus biofilm model adapted from one previously developed in our laboratory was used to study biofilm formation on different biomaterials. Materials tested in this study included stainless steel, TMZF alloy, and grades 2 and 5 titanium treated with type II and III anodization, which were in the form of 10-mm disks that were sterilized and then coated with serum proteins prior to use. A clinical isolate of S. aureus obtained from a human osteomyelitis infection was used to evaluate the rate of biofilm growth on the different materials. Disks of each material were incubated statically for 24 hours at 37°C, with 1×10^6 S. aureus cells in a synthetic interstitial fluid (SIF) consisting of physiologic concentrations of salt, glucose, hyaluronic acid, and fetal bovine serum. On each subsequent day the SIF was carefully removed and replaced with fresh, sterile SIF. For analysis on days 1 through 7 the biofilms on each disk to be examined were stained using a LIVE/DEAD BacLight Bacterial Viability Kit (Invitrogen) and imaged with a Zeiss LSM 510 Meta confocal laser scanning microscope. The data were then analyzed to compare the biofilm growth on the different materials by using the nPHLIP 2.0 software previously developed in our lab. Polymethylmethacrylate (PMMA) disks were tested along with the metals and used as controls. For each time point and material tested, a total of 4 disks were examined in 2 separate experiments.

Results: All results were normalized by dividing the total biovolume on each disk by the total biovolume on the control disks on the day of maximum growth (day 6). On days 2 through 6, there were statistically significant differences between the biovolumes on the disks. For each of these days, the biofilm biovolumes on the stainless steel and TMZF alloy disks were significantly greater than those on the grade 2 and grade 5 titanium and PMMA disks. At no time point was there a significant difference between biofilm growth on the grade 2 and grade 5 titanium disks.

Conclusion: *S. aureus* biofilms were detected on all materials tested. The biovolume of live cells within the biofilms was significantly greater on the stainless steel and TMZF alloy materials, indicating that the grade 2 and grade 5 titanium materials might be more resistant to implant-associated infections. The type of anodization was not found in this study to result in significantly different biofilm growth rates.

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BSFF SYMPOSIUM 5: Physiological Challenges to Bone Repair

| Moderators: | Joseph Borrelli, Jr., MD Hans-Christoph Pape, MD |
|-------------|---|
| 7:30 am | Hypovitaminosis Joseph M. Lane, MD |
| 7:40 am | Chronic Inflammation <i>David J. Hak, MD, MBA</i> |
| 7:50 am | Diabetes Sheldon S. Lin, MD |
| 8:00 am | Aging Peter V. Giannoudis, MD |
| 8:10 am | Polytrauma LTC Joseph R. Hsu, MD |
| 8:20 am | Discussion |

NOTES

Thurs., 10/13/11 BSFF: Physiological Challenges, Paper #21, 8:50 am OTA-2011

Mesenchymal Stem Cells (MSCs) Facilitate Fracture Repair in an Alcohol-Induced Impaired Healing Model

Thomas S. Obermeyer, MD¹; Kristen Lauing¹; Stuart R. Stock, PhD²; David Yonick, MD¹; Michael D. Stover, MD¹; John J. Callaci, PhD¹; ¹Loyola University, Maywood, Illinois, USA; ²Northwestern University, Chicago, Illinois, USA

Purpose: Clinical studies have shown alcohol to be a risk factor not only for sustaining traumatic orthopaedic injuries, but also in delayed fracture healing and nonunion. Data from animal studies suggest that alcohol exposure has an inhibitory effect on fracture repair. Our laboratory sought to develop a rodent model of impaired fracture healing based on repeated alcohol exposure, which could more accurately mimic clinical nonunion when compared with nonunion models employing a critical-sized defect. Using this model, we sought to examine the regenerative effects of an intravenously administered population of isolated and expanded MSCs. Understanding MSC recruitment patterns and functional contributions to fracture repair may lead to their use in patients with impaired fracture healing and nonunion.

Methods: Institutional Animal Care and Use Committee approval was obtained prior to the initiation of experiments. Adult 10-week-old C57BL/6 mice were exposed to a 2-week alcohol binge via intraperitoneal alcohol injection and subjected to a surgically created, stabilized midshaft tibia fracture. Autologous MSCs were isolated by bone marrow immunodepletion from transgenic green fluorescent protein (GFP)–expressing adolescent mice and cultured in highly specific media. Cells were tested for multi-lineage differentiation potential and MSC surface marker expression. Cultured MSCs were then administered via tail vein to injured animals on postinjury day 1. In vivo assessment of MSC localization was performed at daily intervals with a Xenogen fluorescence imaging system. Animals were sacrificed at 2 weeks following injury, and fractured tibiae were collected and formalin-fixed prior to microCT, biomechanical, and immunohistochemical analysis. Biomechanical analysis was performed via 4-point bending with an Instron materials testing machine.

Results: Alcohol exposure had significant detrimental effects on callus volume and biomechanical strength (P < 0.05 for both) of fractured specimens compared with controls. Isolated MSCs possessed multi-lineage differentiation potential and expressed MSC surface markers in high concentration. In vivo imaging demonstrated a time-dependent migration of tagged MSCs to the fracture site. MSC transplants restored both fracture callus volume (P < 0.05) and biomechanical strength (P < 0.05) in animals with alcohol-impaired healing. Statistical analyses were performed with one-way analysis of variance with Tukey's post hoc test. Immunohistochemical analysis of GFP-expressing cells showed transplanted MSCs incorporated into the fracture callus.

Conclusion: We have developed a reproducible metabolic model of impaired fracture healing in the mouse using a binge alcohol exposure regimen prior to infliction of fracture injury. Intravenously administered autologous MSCs were recruited to the site of fracture injury and were capable of mitigating the detrimental effects of repeated preinjury alcohol exposure on fracture repair parameters such as callus strength and volume. This study pro-

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vides the groundwork for additional studies evaluating the role of MSC therapy in patients with delayed or nonhealing fractures, particularly those patients intoxicated at admission or with a history of alcohol abuse prior to injury.

Funding: This study was funded by the National Institute of Alcohol Abuse and Alcoholism AA016138 and by the AO Foundation and AO North America.

Thurs., 10/13/11 BSFF: Physiological Challenges, Paper #22, 8:56 am OTA-2011

Recombinant Human Parathyroid Hormone (PTH 1-34) Enhances Healing in a Mouse Fracture Nonunion Model

Edward A. Lin, MD; *Chuanju Liu, PhD; Kenneth A. Egol, MD; New York University School of Medicine, New York, New York, USA*

Purpose: Recombinant human parathyroid hormone (PTH 1-34), which has been used clinically for the treatment of osteoporosis, has been previously shown to enhance fracture healing in animal models. The purpose of this study was to evaluate the therapeutic use of PTH 1-34 in the treatment of an atrophic fracture nonunion.

Methods: We developed a reproducible long-bone murine fracture nonunion model by generating a midshaft femur fracture, followed by fixation and fracture distraction using an intramedullary pin and custom metallic clip to maintain a fracture gap of 1.7 mm. Mice were randomized to receive either daily intraperitoneal injections of 30 μ g/kg PTH 1-34 for 14 days, or saline injections. At 6 weeks following the surgical procedure, the animals were sacrificed and radiographic and histologic assessment of fracture healing was performed.

Results: At 6 weeks following surgery, the group treated with PTH (N = 8) showed a higher rate of bony union (50% vs 17%) as assessed by radiographic analysis of the fracture site. Mean gap size was significantly lower in the PTH group (1.43 mm vs 0.48 mm in the control group; P < 0.05). Histologic analysis of atrophic nonunions in the control group (N = 8) revealed a significant persistent fracture gap with intervening fibrous tissue. In contrast, healed subjects in the PTH-treated group had cortical bridging with mature bone and a complete lack of callus, which is consistent with primary intramembranous ossification.

Conclusion: Daily systemic administration of PTH 1-34 increased the rate of union in a mouse atrophic nonunion model. This may have important implications for the potential clinical role of PTH 1-34 in the treatment of atrophic fracture nonunions.

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Thurs., 10/13/11 BSFF: Physiological Challenges, Paper #23, 9:02 am OTA-2011

The Effect of Transdermal Nicotine on Fracture Healing in a Rabbit Model *Jonathan A. Donigan, MD*; *Douglas Fredericks, BS; Joseph D. Smucker, MD; James V. Nepola, MD; University of Iowa Hospitals and Clinics, Iowa City, Iowa, USA*

Background: Clinical studies have shown that cigarette smoking inhibits fracture healing and places the patient at higher risk of delayed union and nonunion. Nicotine has been implicated as the primary ingredient responsible for these effects. However, an analysis of current published investigations reveals conflicting data, with some evidence that nicotine alone does not significantly affect healing. Clinicians struggle to understand whether nicotine replacement would benefit smokers with fractures by decreasing the risk of delayed union and nonunion in comparison to cigarette smoking. An animal study of the effects of transdermal nicotine on fracture healing is an appropriate initial step in determining whether a change in clinical practice is justified.

Methods: 26 adult male New Zealand White rabbits were randomly assigned to the nicotine group or the control group. A midshaft tibial osteotomy, stabilized with an external fixator, was performed on all 26 rabbits' left tibiae. The nicotine rabbits were exposed using a 10.5-mg transdermal patch applied daily to the ear. Serum cotinine levels (a nicotine metabolite and marker of nicotine exposure) were checked to confirm nicotine levels comparable to those in human subjects using the nicotine patch for nicotine replacement therapy (NRT). Radiographs were obtained prior to sacrifice and the area of fracture callus was assessed. Rabbits were euthanized at 21 days. In 11 rabbits from each group, the left and right tibiae (right tibiae for an internal control) underwent destructive biomechanical testing. Fractures were stressed to failure and load / deformation curves recorded for statistical evaluations. Two animals in each group did not undergo mechanical testing to allow histologic evaluation.

Results: Serum cotinine levels were checked in the nicotine rabbits at 14 and 21 days and averaged 177 ppb or ng/mL, well approximating human NRT levels. The average area of callus formation was greater in the control group (control: 0.158 cm^2 ; nicotine: 0.124 cm^2), but the difference was not statistically significant (P = 0.30). There was a significant difference between the 2 groups for mean normalized torque to failure (nicotine: 36% of nonfractured side; control: 69% of nonfractured side; P = 0.028). The control group mean normalized stiffness was significantly greater than that for the nicotine rabbits (control: 87%; nicotine: 43%; P = 0.036). There were 3 nonunions in the nicotine group (27%) compared to none in the control group (P = 0.062).

Conclusion: In a rabbit model of fracture healing, transdermal nicotine exposure resulted in decreased mechanical strength of healing fractures at 21 days and a higher rate of nonunion at 21 days compared to controls.

Thurs., 10/13/11 BSFF: Physiological Challenges, Paper #24, 9:08 am OTA-2011

Incidence of Aseptic Femoral- and Tibial Shaft Nonunions: Is There a Genetic Predisposition?

Frank Hildebrand, MD; Christian Zeckey, MD; Michael Frink, MD; Philipp Mommsen, MD; Christian Krettek, MD; Trauma Dept., Hannover Medical School, Hannover, Germany

Purpose: Long bone fractures, such as of the femoral or tibial shaft, are common in trauma patients. Nonunions following trauma and surgical treatment remain a great challenge for the surgeon and the patient. Fracture healing is a well-organized process between several molecules and mediators. As known from other diseases, genetic polymorphisms may exhibit different expression patterns in these mediators. Concerning fracture healing, this may lead to an extended healing process or nonunion. We therefore investigated the incidence of polymorphisms in patients with aseptic nonunions after femoral and tibial shaft fractures, as compared to patients with uneventful healing.

Methods: Patients sustaining nonunions of the femoral or tibial shaft following fracture were enrolled. The control group consisted of patients with uneventful healing. Exclusion criteria were smoking, diabetes, bilateral fractures, systemic corticoid therapy and septic nonunions. Analysis of allele frequencies and genotype distribution of various mediators were carried out following polymerase chain reaction. Clinical parameters such as injury severity and in-hospital were analyzed. Significance level was set at *P* ≤0.05.

Results: 51 patients following nonunion were enrolled; the control group consisted of 52 patients. A significant association of a platelet-derived growth factor (PDGF) haplotype and nonunions following fracture could be observed (P = 0.02). In contrast, we were able to demonstrate a tendency (P = 0.055) to an association of increased fracture healing and the matrix metalloproteinase (MMP)–13 A>G polymorphism. Injury severity was comparable in both groups. There was a significantly increased in-hospital time and amount of surgical procedures in the nonunion group.

Conclusion: Polymorphisms within the PDGF gene seem to be crucial to develop nonunions of the lower extremity following fracture. The early identification of high-risk patients could result in an adapted therapeutic strategy. Identified polymorphisms associated with nonunions can therefore be a therapeutic target in the future and might contribute to a significant decrease of posttraumatic nonunions.

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BSFF SYMPOSIUM 6: Meta-Analysis in Orthopaedics: Statistical Trickery or Not? Moderators: Mohit Bhandari, MD, PhD Saam Morshed, MD, PhD 9:40 am What is a Meta-Analysis Saam Morshed, MD, PhD 9:50 am Meta-Analyses: Should they Guide Practice? Peter V. Giannoudis, MD 10:00 am Meta-Analyses are Dangerous – Be Forewarned! Mohit Bhandari, MD, PhD 10:10 am Case Study: Total Hip Arthroplasty Versus Hemi-Arthroplasty for Femoral Neck Fractures: A Critique of a Meta-Analysis Dirk Stengel, PhD 10:20 am If Not, Meta-Analyses, then What Do We Need? Brad A. Petrisor, MD 10:30 am Discussion

NOTES

ORTHOPAEDIC — TRAUMA — ASSOCIATION 27th Annual Meeting

October 12 - 15, 2011 ANNUAL MEETING BEGINS

Marriott Rivercenter Hotel San Antonio, Texas

Andrew N. Pollak, MD, *President* James A. Goulet, MD, *Program Chair* Thomas F. Higgins, MD, *Program Co-Chair*

Animesh Agarwal, MD, Local Host

ERS



SYMPOSIUM I: GERIATRIC FRACTURES: THE ROLE FOR TRAUMA TRAINED SURGEONS

Moderator: Clifford B. Jones, MD

- Faculty: Kyle J. Jeray, MD Steven L. Kates, MD Joseph M. Lane, MD
 - 1:20 pm Landscape and Problems of Geriatric Fractures Nationally Kyle J. Jeray, MD
 - 1:35 pm Medical Work Up and Treatment for Geriatric Fractures Joseph M. Lane, MD
 - 1:50 pm **Pre- and Peri-Operative Hospital Care for Geriatric Patients** Steven L. Kates, MD
 - 2:05 pm **Operative Technique and Options for Geriatric Fractures** *Clifford B. Jones, MD*
 - 2:20 pm **Case Discussion and Questions** *Panel*

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Δ Timing of Orthopaedic Surgery in Multiple Trauma Patients: Development of a Protocol for Early Appropriate Care

Heather A. Vallier, MD; Xiaofeng Wang, PhD; Timothy A. Moore, MD; John H. Wilber, MD; MetroHealth Medical Center, Cleveland, Ohio, USA

Purpose: Early fixation of unstable fractures of the femur, pelvis, acetabulum, and spine reduces some complication rates. However, the practice of "early total care" has been criticized, because hemorrhage from surgery can be associated with a deleterious systemic inflammatory response in an under-resuscitated patient. The alternative of "damage control orthopaedics" could diminish the risk for systemic compromise, but additional complications and costs associated with this strategy are controversial. The purposes of this project were to define which injuries or clinical parameters warrant delay of definitive orthopaedic care, and to determine what time interval for fracture fixation promotes optimal patient outcome. A model was developed to predict complications and to reduce complications and costs.

Methods: A database of 1443 adult patients treated surgically for fractures of the pelvis (n = 291), acetabulum (n = 399), spine (n = 102), and/or proximal or diaphyseal femur (n = 953) was developed. Mean age was 37.8 and mean ISS was 24.7. Low-energy fractures, such as from a fall from standing height, were excluded. Data included fracture characteristics, associated injuries, timing and technique of surgery and any provisional treatment (for spine, pelvis, acetabulum, and femur only), transfusions, length of ventilator assistance, length of ICU and hospital stay, and complications. Vital signs and laboratory parameters including pH, base excess, lactate, and hematocrit were recorded at 8-hour intervals for the first 72 hours. Univariate and multivariate analyses of variance were used to assess associations of parameters over time with the occurrence of complications. Logistic predictive models were developed with the incorporation of multiple fixed and time-dependent covariates. Odds ratios, *F* tests, and receiver operating characteristic curves were calculated based on the models.

Results: Pulmonary complications were identified in 12.7% of patients, with 8.2% of all patients developing pneumonia. pH and base excess values were significantly lower at all time points (all P < 0.0001), and the rate of improvement of these values over time was also significantly slower (all P < 0.007), in patients who developed pneumonia or any pulmonary complication. Similarly, lactate values were significantly greater at all time points in patients with pulmonary complications (all P < 0.02). Hematocrit and blood pressure values were not associated with complications. Multivariate analysis of variance suggested lactate to be the most specific predictor of complications. Presence of chest injury-mild (abbreviated injury scale [AIS] \leq 2) or severe (AIS \geq 3)—was the strongest independent predictor of pulmonary complication. Chest injury coupled with initial pH, and the number of fractures treated, generated a predictive model with area under the curve of 0.765 for pneumonia and 0.820 for acute respiratory distress syndrome (ARDS). Initial lactate value was a stronger predictor of pneumonia (P = 0.0006) than initial pH (0=0.04) or the rate of improvement of pH over the first 8 hours (P = 0.0007). When initial pH was >7.25, pulmonary complications occurred in <25% of patients. Other factors predictive of an uncomplicated course included absence of chest injury (P < 0.0001), and definitive fixation of fractures within the first 24 hours (P =

Δ OTA Grant

0.007) or 48 hours (P = 0.005). Additional models are being developed to predict probability of complications in patients with various injury combinations when specific laboratory parameters measuring residual acidosis have been achieved.

Conclusion: Early recognition and control of hemorrhage and aggressive resuscitation to improve acidosis are critical in reducing morbidity and mortality. Acidosis on presentation, as measured by pH, base excess, or lactate is predictive of complications. Correction of pH within the first 8 hours to >7.25 reduces risk of pulmonary complications. Presence and severity of chest injury, number of fractures to be treated, and timing of fixation are other significant variables to include in a predictive model and algorithm development for early appropriate care. The goal is to minimize complications by definitive management of major skeletal injury once the patient has been adequately resuscitated.

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Trends in Musculoskeletal Imaging for Trauma Patients: How Has our Practice Changed Over Time?

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Purpose: Utilization of advanced diagnostic imaging has escalated over time. Emergent CT scans account for much of the increased usage in trauma patients. Previous work showed substantial increases in usage of CT scans within the 24 hours of admission in trauma patients over time, with no change in patient acuity. The purpose of the study was to review the experience of 2 major Level 1 trauma centers and determine the amount of musculosk-eletal imaging versus other studies throughout the hospital course. We hypothesized that the frequency of musculoskeletal imaging has increased over time, but at a lesser rate than other radiography. With enhanced understanding of the indications and ordering patterns for various tests, there may be opportunities for more judicious utilization.

Methods: 300 consecutive trauma patients per year from 2 urban Level 1 trauma centers were retrospectively reviewed for 2002, 2005, and 2008. Radiographic tests included plain radiographs (XR), CT scans, and MRI. Tests were characterized as to body location, day of hospitalization, department of the ordering physician, and radiation dosages (mSv). Total charges for radiography were calculated, including professional and technical charges, standardized to 2008 charges for Center 1. Length of stay and ISS were determined for each patient.

Results: The majority of diagnostic imaging was done within 24 hours of injury: 76% in 2002, 70% in 2005, and 69% in 2008; thus, the majority of radiation was also received in the first 24 hours. The mean number of all studies per patient (XR + CT + MRI) performed at Center 1 was 9.6, 10.3, 13.0 in 2002, 2005, and 2008, respectively, during the entire hospital course. The mean number of studies per patient at Center 2 was 18.3, 21.9, and 19.3 in 2002, 2005, and 2008. Usage of CT scans was higher in Center 1 at all time points, while usage of plain XR was higher in Center 2, resulting in a larger number of total studies in Center 2. Center 2 had a trend toward more usage of musculoskeletal CT scans on subsequent days of hospitalization, but the percentage of studies that were musculoskeletal was stable at both centers at 25% over the period of study. In 2002, 20% of all radiographic studies were CT scans, while in 2008, 35% were CT scans (P < 0.0001), the majority of which were not musculoskeletal. During this time no change in patient acuity as measured by ISS or length of stay was seen. CT scans accounted for the majority of all radiation in trauma patients. Significant increases in radiation were seen over time at both centers, with mean radiation per patient of 16.6 mSv in 2002, 28.5 mSv in 2005, and 37.4 mSv in 2008 (P <0.0001). The percentage of total radiation attributable to musculoskeletal studies increased from 25% in 2002, to 29% in 2005, and 31% in 2008 (P < 0.001). Mean total charges per patient for radiographic tests significantly increased between 2002 and 2008: \$4,345 in 2002, \$5,539 in 2005, and \$8,222 in 2008 (*P* < 0.001).

Conclusion: The number of diagnostic imaging tests, radiation, and charges in trauma patients increased over time at both trauma centers, with CT scans the majority of the radiation and costs. Most of the imaging was completed within 24 hours. Radiation per patient more than doubled over the course of study. Approximately 25% of radiographic tests were for musculoskeletal purposes, and the increasing usage of musculoskeletal CT scans resulted in a significantly larger percent of radiation attributable to these tests over time. Previous studies have suggested an increased risk of cancer with exposures of 20 to 40 mSv, making the mean total radiation dosages of 28.5 mSv in 2005 and 37.4 mSv in 2008 of great concern. Variability in ordering patterns between the 2 centers with similar patient acuity and length of stay suggests opportunity for discussion about indications for utilization, which could result in lower radiation and expenses.

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Delayed Wound Closure Increases Deep Infection Rate in Lower Grade Open Fractures: A Propensity-Matched Cohort Study

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Purpose: Traumatic wounds after open fractures have traditionally been left open in hopes of minimizing rates of infection. Our study aims to compare the rate of subsequent deep infection among open fracture patients treated with either immediate primary closure after débridement or delayed primary closure while minimizing bias using a matched-pairs design.

Methods: A review of open fractures of the 4 years from 2003 to 2006, inclusive, at our Level 1 trauma center identified 360 fractures with Gustilo-Anderson grading of 1, 2, or 3A. 92 fractures were treated with delayed primary closure while 268 were treated with immediate closure after surgical débridement. A deep infection was defined as the need for an unplanned return to the operating room for an additional irrigation and débridement or treatment of an infected nonunion. To provide similar groups, a propensity score was created using a logistic regression equation predicting the likelihood of treatment with delayed primary closure. The propensity score algorithm incorporated terms for age, sex, time to débridement, ASA (American Society of Anesthesiologists) score, ISS, gunshot versus blunt mechanism, fracture grade, presence of gross contamination, and tibial versus other anatomic site. A one-to-one matching algorithm based on this propensity score was used to generate 75 matched pairs of fractures in individual patients.

Results: Among the original groupings, the 92 fractures treated with delayed primary closure had a higher infection rate (17% vs 3%; P = 0.0009); however, these fractures tended to be more severe injuries with a higher proportion of grade 3 fractures (P = 0.0003), tibia fractures (P = 0.018), and gross contamination (P = 0.0001). After applying the propensity-matching algorithm, the 2 treatment groups showed similar characteristics among all of the elements of the propensity score including fracture grade (P = 1.0), gross contamination (P = 0.86), and tibial fractures (P = 0.87). Deep infection developed among 4 of the 75 open fractures treated with immediate closure (5.3%) compared to 15 of the 75 fractures treated with delayed primary closure (20%). This was statistically significant with standard statistics (Fisher exact test P = 0.0124) and when accounting for the paired data using conditional logistic regression (odds ratio = 3.75; 95% confidence interval, 1.245-11.29).

Conclusion: Immediate closure of wounds in grade 1, 2, and 3A open fractures is safe and is associated with a lower infection rate compared with delayed primary closure.

See pages 77 - 115 for financial disclosure information.

Stress–Induced Hyperglycemia Is a Risk Factor for Surgical–Site Infection in Nondiabetic Orthopaedic Trauma Patients

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Purpose: The purpose of this investigation was to evaluate the effect of stress-induced hyperglycemia on infectious complications in a population of orthopaedic trauma patients.

Methods: This is a retrospective study of isolated orthopaedic trauma patients admitted to an academic Level 1 trauma center from January 2004 to October 2009. Inclusion criteria were age \geq 18 years, ICU stay \geq 1 day, orthopaedic injury requiring operative intervention, and more than 1 documented blood glucose (BG) value. Patients with a history of diabetes mellitus, corticosteroid use, immunologic disease, or Abbreviated Injury Scale scores other than extremity were excluded. Demographics, injury severity, units of red blood cell transfusion, BG, and infectious complication data were obtained. Infections considered were pneumonia, urinary tract infection (UTI), surgical-site infection (SSI), and bacteremia. The Hyperglycemic Index (HGI) was calculated for each patient and reflects the mean BG level above 108 mg/dL. HGI was determined from BG values obtained prior to the diagnosis of infection. HGI was considered separately as a continuous variable and a dichotomous variable >1.72 (equivalent to BG of 139 mg/dL).

Results: 187 patients were identified. All were managed with a tight glycemic protocol (target BG: 80-110 mg/dL). Mean age was 47.7 ± 23.2 years and 121 of 187 patients (64.7%) were male. Mean ICU and hospital length of stay was 4.0 ± 4.9 and 10.0 ± 8.1 days, respectively. ISS was higher in patients with an infection (10.6 \pm 3.7 vs 9.5 \pm 2.8; *P* = 0.03), but not clinically significant. Infections were recorded in 43 of 187 patients (23.0%) and SSIs specifically documented in 16 patients (8.6%). Open fractures were not associated with SSI (8 of 83 [9.6%] vs 8 of 104 [7.7%]; P = 0.64). By univariate analysis there was no difference in admission BG or HGI and infection. However, there was a significant difference in HGI when considering SSI alone $(2.1 \pm 1.7 \text{ vs } 1.2 \pm 1.1; P = 0.003)$. HGI >1.72 was associated with SSIs (8 of 16 [50.0%] vs 33 of 171 [19.3%]; P = 0.005). Patients with an SSI received a greater amount of blood transfusions (14.9 \pm 12.1 vs 4.9 \pm 7.6; P <0.001). No patient was diagnosed with a separate infection (ie, pneumonia, UTI, bacteremia) prior to SSI. There was no difference in ISS among patients with an SSI ($11.1 \pm 4.0 \text{ vs } 9.6 \pm 3.0$; P = 0.06). Multivariable regression testing HGI as a continuous variable demonstrated a significant relationship (odds ratio [OR], 1.8; 95% confidence interval [CI], 1.2-2.6) with SSI after adjusting for blood transfusions (OR, 1.1; 95% CI, 1.1-1.2).

Conclusions: Stress-induced hyperglycemia may represent a significant risk factor for SSIs in nondiabetic trauma patients with isolated orthopaedic injuries.

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Is Patient Satisfaction After Fracture Predicted by Functional Outcome or Injury Severity?

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Purpose: Patient satisfaction (PS) is becoming a critical metric used by consumers, insurance providers, and healthcare decision makers. However, the actual meaning of PS is still controversial and almost nothing is known about PS in the orthopaedic trauma setting. In particular, it is unknown to what extent PS contributes additional information or is merely a proxy for either the severity of the injury or functional recovery. Our hypothesis was that PS is driven by both functional outcome and injury severity.

Methods: Our study group was 104 patients with at least 1 fracture treated at orthopaedic trauma clinics at one Level 1 trauma center who were ≥ 6 months from injury. Outcome measures were the Short Musculoskeletal Function Assessment (SMFA) and Patient Satisfaction Questionnaire (PSQ), which investigates multiple domains of patient satisfaction. We evaluated the relationship between domains of PS, injury severity determined by upper and lower extremity AIS (abbreviated injury scale) and ISS, and functional outcome (as measured by the SMFA) following orthopaedic injuries. Analysis of variance was used to determine differences in mean satisfaction by patient and injury characteristics. Pearson correlation coefficients with 95% confidence intervals were used to assess the correlation between PSQ domains and SMFA.

Results: PS was moderate to high in general (greater than 4.0 on a 5-item scale) (mean, 4.08; 95% confidence interval [CI] 3.97, 4.19), and in particular for the domains communication, manner, technical quality, and general satisfaction (scores range, 4.24-4.42). PS was lower for the satisfaction with time spent with physician, accessibility and convenience, and orthopaedic recovery (mean scores 3.84, 3.77, and 3.81 respectively). Patients experienced particularly low satisfaction with the financial aspects of their care (mean, 3.6; 95% CI 3.36, 3.76). The SMFA did not predict PS, as overall, observed correlations between domains of patient satisfaction and the SMFA function and bothersome indices were generally nonsignificant (95% CI includes 0) and weak (r < 0.3). PS also did not correlate substantially with injury severity, as there was no statistically significant relationship between any domain of satisfaction and ISS, AIS, or injury type (P > 0.3).

Conclusion: In contrast to our hypothesis, our data indicate that patient satisfaction measures a distinct aspect of care that does not appear to be substantially driven by either injury severity or functional outcome. Overall, satisfaction was high in this population; however, many experienced low satisfaction with certain satisfaction domains, particularly financial aspects of their care, and satisfaction with orthopaedic recovery. These data demonstrate the importance of obtaining independent satisfaction data and highlight potential areas for improvement in care.

Does Pain Correlate With Patient-Based Functional Outcome Scores After Commonly Operatively Treated Fractures?

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Purpose: The purpose of this study was to evaluate the correlation of a validated visual analog scale (VAS) for pain with the Short Musculoskeletal Function Assessment (SMFA) indices in patients treated operatively for common fracture patterns: proximal humerus, distal radius, pelvic ring, acetabulum, and tibial plateau.

Methods: A consecutive cohort of 140 patients with proximal humeral fractures, 32 patients with unstable distal radius fractures, 205 patients with pelvic ring injuries, 67 patients with acetabular fractures, and 92 patients with tibial plateau fractures who were treated operatively and followed for >6 months comprise the study group. SMFA and VAS pain scores (10-point scale) were prospectively collected. The SMFA indices were correlated with the VAS, age, gender, and the SMFA question 46 ("How much are you bothered by problems with stiffness and pain?").

Results: The dysfunction and bother indices were recorded for the fractures respectively as follows: proximal humeral, 24.0 and 23.6; distal radius, 23.1 and 28.3; pelvic ring, 27.2 and 30.8; acetabular, 27.8 and 28.3; and tibial plateau, 28.0 and 28.0. Age did not relate to pain for proximal humeral, distal radius, or acetabular fractures (P > 0.05). However, pain inversely related to age in patients who had pelvic ring and tibial plateau fractures (P < 0.001). No difference was present between males and females regarding pain for any of the studied fractures. Significant correlations were found between pain and all SMFA indices and the SMFA question 46 for all studied fractures (P < 0.01).

| Fractures | Dysfunction index | Bother index | Daily function | Emotional status | Arm & hand | Mobility | SMFA question 46 | VAS |
|---------------------|----------------------|-----------------|-------------------|---------------------|---------------|----------|---------------------|---------------|
| Proximal humeral | 0.626 | 0.688 | 0.534 | 0.722 | 0.478 | 0.554 | 0.735 | 3.3 ± 2.9 |
| Distal radius | 0.563 | 0.647 | 0.571 | 0.638 | 0.434 | 0.430 | 0.759 | 3.9 ± 2.9 |
| Pelvic ring | 0.754 | 0.769 | 0.666 | 0.798 | 0.354 | 0.709 | 0.782 | 4.4 ± 3.1 |
| Acetabular | 0.629 | 0.685 | 0.572 | 0.589 | 0.381 | 0.594 | 0.685 | 4.3 ± 2.8 |
| Tibial plateau | 0.775 | 0.730 | 0.704 | 0.797 | 0.393 | 0.785 | 0.750 | 4.4 ± 3.3 |

Correlation of SMFA With VAS, Pearson Correlation Coefficient (r): P < 0.01 for All

Conclusions: Our findings suggest that pain, measured by a validated VAS scale, is an important factor in the explanation of SMFA results for patients with common operatively

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treated traumatic fractures. Knowing whether pain relates to musculoskeletal outcome can affect interventions related to pain management, rehabilitation, and return to previous activities. Pain should be investigated further concerning clinical outcomes and function measurements.

Loss of Follow-Up in Orthopaedic Outcome Studies: Is 80% Follow-Up Still Acceptable?

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Purpose: Loss of follow-up is a potential source of bias in orthopaedic outcome studies. Previously suggested guidelines propose 20% loss of follow-up as acceptable. However, these guidelines for acceptable loss of follow-up were arbitrarily derived and have not been established through scientific investigations. The goal of this study was to evaluate how loss of follow-up influences the statistical significance in an orthopaedic database.

Methods: In this simulation study, we used a database of 637 polytrauma patients who had been reexamined at an average follow-up of 17.5 years (range, 10-28 years) after their injury. The functional outcome as measured by the Hannover Score for Polytrauma Outcome (HASPOC) of workers' compensation patients versus non–workers' compensation patients was compared using a logistic regression model with adjustments for age, gender, ISS, and head injuries. As documented in a previous publication, a significant difference between the 2 groups was found (P < 0.05). In the current simulation study, we simulated a gradually increasing loss of follow-up by randomly deleting an increasing number of patients from 2%, 5%, 10%, and then increasing in increments of 5% until the significance changed. This process of simulating an increasing loss of follow-up was repeated 50 times. A different electronic random generator was used in each of these 50 simulation series. In each simulation series, we documented the simulated loss of follow-up at which the results turned from statistically significant to nonsignificant at the level of P = 0.05.

Results: Among the 50 simulation series, the turning point from significant to nonsignificant varied between 15% loss of follow-up and 75% loss of follow-up. The average turning point from significant to nonsignificant was at 40% \pm 18.3% simulated loss of follow-up. In 14 of the 50 simulation series (28%), the results changed from significant to nonsignificant with a simulated loss of follow-up of 20% or less.

Conclusions: A loss of follow-up of 20% or less may frequently change the study results. In the planning phase of clinical studies, researchers should carefully establish protocols to minimize the loss of follow-up. The actual loss of follow-up should be clearly stated in manuscript publications.

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Early Initial Antibiotics and Debridement Independently Reduce Infection in an Open Fracture Model

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Purpose: Open fractures are common, and infection frequently complicates these injuries. Despite this, there is still controversy and uncertainty regarding the urgency of initial treatment. The majority of animal studies indicate that early irrigation and débridement reduces infection; unfortunately, these studies often do not involve antibiotics. Clinical studies indicate that early antibiotic administration may be beneficial but suggests that the timing of initial débridement does not affect the infection rate. These studies are all observational or retrospective and are fraught with confounding variables. The purpose of this study was to control for these variables using an animal model incorporating both systemic antibiotics and surgical treatment.

Methods: This study used a segmental defect rat model contaminated with *Staphylococcus aureus* and treated with a - day course of systemic cefazolin (5 mg/kg 12 hourly) and surgical treatments, both of which were initiated independently at 2, 6, and 24-hour time points. After 14 days, bone and hardware was harvested for separate microbiologic analysis. The outcome measure was whether bacteria was detectible on bone or hardware at this point.

Results: These results show that the earlier systemic antibiotic treatment or surgery is initiated, the more infection is reduced, and their effect is independent of each other and are synergistic. When antibiotics are started at 2 hours, delaying surgical treatment from 2 to 6 hours significantly increases infection (P = 0.047). However, delaying surgery to 24 hours increases infection, but not significantly



(P = 0.054). In order to determine which had a more temporally significant effect on bacteria, antibiotics or surgery, two pairs of "mirrored" study groups were compared, first a pair of groups in which the timing of surgery and antibiotics was reversed around the 2 and 6-hour time points, and second in which treatments occurred at 2 and 24 hours. In both comparisons, the timing of antibiotics had a more significant effect on the proportion of

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positive samples than earlier surgery. At the 2 and 6-hour treatments, the *P* value was 0.004 and for the 6 and 24 timings, it was 0.003.

Conclusion: Surgery and antibiotics at 2 hours completely eradicates the bacteria, but surgical delay for 6 hours appears to allow the bacteria to form nonsusceptible colonies. Further delaying surgery until 24 hours does not appear to affect the infection rate. Delaying antibiotics to 6 or 24 hours had a profound detrimental effect on the infection rate regardless of timing of surgery. These findings are consistent with the concept that bacteria progress from a vulnerable planktonic form to a treatment-resistant biofilm.

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Effect of Negative-Pressure Wound Therapy on the Elution of Antibiotics from Polymethylmethacrylate Beads in a Porcine Simulated Open Femur Fracture Model *Thomas M. Large, MD*¹; *Geoffrey Douglas, MD*²; *Gregory Erickson, MD*¹; J. Kevin Grayson, DVM, PhD²; ¹Dept. of Orthopaedic Surgery, ²Clinical Investigation Facility, David Grant Medical Center, Travis AFB, South Bend, Indiana, USA

Purpose: There are few data on the simultaneous use of antibiotic-impregnated polymethylmethacrylate (PMMA) beads and negative-pressure wound therapy (NPWT). Our objective was to determine whether NPWT affects antibiotic concentrations in simulated femur fractures treated with antibiotic-impregnated PMMA beads and whether fascial closure between beads and sponge affects the outcome.

Methods: PMMA beads containing vancomycin and tobramycin were placed adjacent to bilateral corticotomies created in 20 anesthetized pigs. In one leg, NPWT was applied with the sponge either in direct contact with the beads, or superficial to reapproximated fascia lata. The contralateral wound was conventionally closed. Vancomycin and tobramycin concentrations in wound drainage were measured every 12 hours for 72 hours, and tobramycin levels were measured in periosteal tissue obtained at 72 hours.

Results: Drainage vancomycin and tobramycin concentrations were highest at 12 hours and fell rapidly by 24 hours, but remained steady thereafter. At each 12-hour interval, there were no significant differences in the vancomycin and tobramycin concentrations between NPWT and control wound drainage, although whether the fascia was closed or left open had an influence on vancomycin levels. The total vancomycin and tobramycin eluted into the drains was significantly less in the NPWT group with open fascia. The antibiotic levels measured in wound drainage remained above the minimum inhibitory concentration for common wound organisms throughout the study period. Neither NPWT nor fascial closure had a significant effect on tobramycin periosteal tissue concentrations.

Conclusions: Concurrent application of NPWT along with antibiotic-impregnated PMMA beads to simulated open femur fractures in pigs did not decrease local antibiotic concentrations in the wounds but did decrease the total amount of eluted vancomycin and tobramycin locally available when the fascia was left open.



Δ Can We Trust Intraoperative Culture Results in Nonunions?

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Purpose: Orthopaedic infections can become chronic when bacteria adopt a biofilm mode of growth, which is resistant to both host defense mechanisms and antibiotics. Direct microscopy has shown that biofilms can inhabit the surface of internal fixation devices. As they grow poorly on agar media, the bacteria in biofilms are difficult to identify using standard culture techniques. The purpose of this study was to determine the validity of routine intraoperative cultures in detecting the true presence of biofilm bacteria in delayed osseous healing.

Methods: 34 patients with nonunions were scheduled for surgery and enrolled in this ongoing, double-blinded, prospective study funded by the OTA. Intraoperative samples of tissue and membrane were collected from removed biomaterials. The nonunion sites and hardware were tested for bacterial contamination and biofilms utilizing standard cultures, DNA-based technology (Ibis, Abbott), and RNA-based fluorescent in situ hybridization (FISH). Samples were visualized using confocal microscopy to visualize FISH probes specific to bacteria found during culture and Ibis analysis.

Results: The mean age of the patients was 48.41 years (range, 17-71 years). The anatomic sites of nonunions were: 7 femoral shafts, 2 distal femur, 2 proximal femur, 1 femoral neck, 1 femoral neck and shaft, 2 supracondylar humerus, 1 humeral shaft, 14 tibial shaft, 3 tibial pilon, and 1 tibial plateau. 13 patients had open fractures. Of the 34 patients with nonunions, 23 (67%) had negative cultures and positive Ibis results for bacterial presence. Six of the 23-culture negative, Ibis-positive patients required additional surgery to achieve union. Cultures taken from the 6 patients during subsequent surgeries were positive in 50% of the cases (3 of 6). Of the 34 nonunions, 9 (27%) had positive cultures, all of which yielded positive Ibis results. Three of the culture-positive, Ibis-positive patients required additional procedures for infections or continued nonunions. Cultures taken from the culture-positive, Ibis-positive patients (2 of 3). Two patients (6%) had negative culture and Ibis results, none of which required surgical revision, and both healed with the index procedure to repair nonunion. FISH analysis confirmed the culture and Ibis data.

Conclusions: Our preliminary data indicate that culture results taken at the site of nonunion should be read with a degree of skepticism since negative cultures often do not detect bacteria in biofilms. The failure to identify the bacterial presence may result in continued nonunion and need for additional surgery.

Δ OTA Grant

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•Local Antibiotic Delivery by a Bioabsorbable Gel is Superior to PMMA Beads at Reducing Infection in an Open Fracture Model

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Purpose: Infection remains a common complication of open fracture despite the use of systemic antibiotics. Local delivery potentially allows a high concentration of antibiotics to be achieved in the wound, thus avoiding the side effects and cost associated with systemic administration. Beads molded from polymethylmethacrylate (PMMA) arthroplasty cement are currently the clinical standard for local antibiotic delivery. However, PMMA beads are not the ideal local antibiotic vehicle; they are bulky and not bioabsorbable, therefore complicating closure and requiring surgical removal. Moreover, they are merely a depot and do not cover the entire surface of the wound. The purpose of this study was to evaluate whether a phospholipid gel might be a superior local antibiotic vehicle to PMMA beads.

Methods: This study used a segmental defect rat model contaminated with *Staphylococcus aureus* and treated with similar amounts of local antibiotics delivered by gel or PMMA beads. The gel, called DFA-02, was a phospholipid vehicle containing 1.7% vancomycin and 1.9% gentamicin by weight. These antibiotics are eluted to a peak tissue concentration between 1 and 8 hours and sustained above the *S. aureus* mean inhibitory concentration for 5 days. PMMA beads were manufactured using a standard technique with commercial PMMA cement and 3.3% vancomycin and 4% tobramycin by weight. Tobramycin was used instead of gentamicin as this is the aminoglycoside used in PMMA beads in the US. In the gel group, 1 mL of DFA-02 was spread throughout the wound, a total of approximately 36 mg of antibiotics. In the bead group, four 3-mm beads were placed in the wound, 2 in the defect and 2 in the adjacent tissue envelope—a total of 60 mg of antibiotics. A combined beads/gel group received half of both treatments in each wound and a control group received no antibiotics. After 14 days, bone and hardware was harvested for separate microbiologic analysis. The outcome measure was the presence and quantification of bacteria on bone or hardware at this point.

Results: These results show that there was a significantly lower infection rate in groups treated with antibiotics delivered by gel compared with those treated with either antibiotic beads or no antibiotics at all. Quantitative cultures also demonstrate significantly less bacteria in the wounds that were treated with the gel (P = 0.001).



Conclusion: These results indicate that local antibiotics are superior at reducing infection when delivered in a gel rather than by beads. It is believed that the ability to apply the gel to all areas of the wound caused high levels of antibiotics throughout the wound. The beads are a local depot that has a concentration gradient within the wound. In animals treated with antibiotic beads, only some areas of the wound may be exposed to enough antibiotics to kill the bacteria, particularly those that are within a biofilm. This study demonstrates that local antibiotic delivery vehicles that cover the entire wound bed may be more effective at reducing infection.

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A Biomechanical Analysis of Lag Screw Position in the Femoral Head for Cephalomedullary Nails

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Purpose: The purpose of this study was to determine if lag screw position affects the biomechanical properties of a cephalomedullary nail used to fix an unstable peritrochanteric fracture.

Methods: Unstable peritrochanteric fractures were created in 30 synthetic femurs and repaired with long Gamma3 nails using one of 5 lag screw positions: superior, inferior, anterior, posterior, central. Radiographic measurements including tip-apex distance (TAD) and a calcar-referenced TAD (CalTAD) were calculated from AP and lateral radiographs (Figure 1). Specimens

weretested for axial, lateral, and torsional stiffness, and then loaded to failure in the axial position. Analysis of variance and linear regression were used for statistical analysis.



Figure 1. Five radiographic measurements used for linear correlation: A, tipapex distance calculated on AP radiograph (TAD_{AP}); B, TAD as referenced to the calcar calculated on the AP radiograph (CalTAD_{AP}); C, TAD calculated on the lateral radiograph (TAD_{Lat}); D, TAD; and E, calcar-referenced TAD (CalTAD). D_{True} is the known diameter of the lag screw (ie, 10.5 mm).

Results: The inferior lag screw position had significantly greater mean axial stiffness than superior (P < 0.01), anterior (P = 0.02), and posterior (P = 0.04) positions. Analysis revealed significantly less mean torsional stiffness for the superior lag screw position compared to other lag screw positions (P < 0.01 all 4 pairings). No statistically significant differences were noted for lateral stiffness. Superior and central lag screw positions had significantly greater mean load to failure than anterior (P < 0.01 and P = 0.02) and posterior (P < 0.01 and P = 0.05) positions. There were significant negative linear correlations between stiffness with distance from the calcar on AP radiographs, and load to failure with distance from the center of femoral neck on the lateral radiographs.

Conclusions: The inferior lag screw position produced the highest axial and torsional stiffness. Anterior and posterior lag screw positions produced the lowest stiffness and load to failure. For a cephalomedullary nail, in contrast to a sliding hip screw, we therefore suggest inferior placement of the lag screw, just above the calcar, on the AP radiograph and central placement in the femoral neck on the lateral radiograph, such that CalTAD is minimized.

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When Does Anterior External Fixation Enhance Construct Stability in Zone II Sacral Fractures? A Biomechanical Evaluation

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Purpose: This study was designed to evaluate the biomechanical contribution of anterior external fixation (AEF) to various posterior fixation constructs in both a "reduced" and a "comminuted" (gap) zone II sacral fracture model. Our null hypothesis was that AEF does not increase load to failure over that observed with the posterior fixation alone.

Methods: We simulated a transforaminal sacral fracture with ipsilateral rami fractures (AO/OTA 61-C1.3) in fourth-generation composite epoxy–coated full pelvic models (N = 6). We tested 8 posterior fixation constructs: (1) tension band plate (TBP), (2) single iliosacral (IS) screw at S1, (3) 2 IS screws at S1, (4) IS screws at S1 and S2, (5) IS screw at S1 + TBP, (6) transsacral (TS) screw at S1, (7) TS screw at S1 + TBP, and (8) TS screws at S1 and S2. Each construct was tested with and without AEF (at anterior inferior iliac spine [AIIS]), and with and without posterior fracture gap (simulating a situation in which there is no posterior cortical contact). Load to failure was tested in a single-leg stance model, and displacement was measured by tracking relative motion of the involved hemipelvis with a 3-dimensional motion tracking camera.

Results: The TBP construct was unable to withstand load without an AEF with or without posterior gap. In the setting of posterior cortical contact, addition of AEF contributed to ultimate load to failure only in the setting of single-level IS fixation (S1 IS, S1 IS \times 2). The contribution of AEF in the presence of a posterior gap varied by construct. Failures prior to achieving 1000-N load occurred in all constructs except transsacral fixation (S1 TS). AEF enhanced the stability of single-level (S1 only) fixation constructs. When 2-level (S1 and S2) fixation was achieved via IS, TS, or TBP, AEF did not significantly increase the sustainable load.

Conclusions: When used as supplemental fixation, AEF displayed a biomechanical advantage in load to failure when posterior fixation was limited to single-level sacral fixation. The contribution was greatest in the setting of a posterior gap. Transsacral fixation at S1 alone decreased the



importance of AEF. With 2 levels of posterior fixation (S1 and S2), AEF made no significant contribution to construct stability. Clinically, this indicates that AEF should be added when safe posterior fixation is limited to S1 IS screws or a TBP alone, but does not improve stability when fixation at both S1 and S2 can be achieved.

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Are Commercially Available Synthetic Osteoporotic Bone Models Valid?

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Purpose: Many biomechanical studies focusing on osteoporotic bone have opted to use commercially available synthetic models rather than cadaveric samples due to their decreased variability, increased availability, and overall ease of use. To the best of our knowledge, the companies' claims that these models reasonably approximate osteoporotic bone for use in fracture fixation studies has not been tested. Our hypothesis was that these models would mimic actual osteoporotic cadaveric bone properties.

Methods: We compared the performance of 6 commercially available synthetic bone analogs (n = 6 each) to 12 osteoporotic cadaveric humeri (DEXA [dual-energy x-ray absorptiom-etry]–validated). We utilized a previously described 5-mm fracture gap model and posterior plating technique using a 4.5-mm narrow 10-hole locking compression plate. Torque was applied to a peak of ± 10 Nm for 1000 cycles at 0.3 Hz using a servohydraulic biaxial testing machine.

Results: Unlike actual osteoporotic bone, 3 groups of synthetic bone analogs did not survive sufficient numbers of cycles during the loading procedure to even be analyzed. The remaining 3 types of osteoporotic bone analogs were found to have more subtle differences in biomechanical properties from osteoporotic cadaveric specimens. For example, relative to initial stiffness (cycle 1), cadaveric humeri exhibited a slight decrease in stiffness that became statistically significant at cycle 7 (P < 0.05). In contrast, by approximately cycles 30 through 70, all synthetic humeri had statistically significant increases in torsional stiffness (strain hardening) relative to initial stiffness (P < 0.05).

Conclusions: We found differences between osteoporotic bone analogs and actual osteoporotic cadaveric bone that ranged from profound (complete failure at initial failure) to more subtle differences (strain hardening that is not present in actual bone). These findings may invalidate conclusions from prior work depending on the bone analog that was used in the fracture model. Future work should strive to validate bone analogs before using them to draw clinical conclusions.
Do Locked Screws Work in Bent Plates?

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Purpose: Locking plates often require bending to contour the plate to bony anatomy; however, little is known about the subsequent effects on locked screw function. The purpose of our study was to determine whether plate bending significantly changes the biomechanical properties of a locked screw-hole unit.

Methods: Small fragment 3.5-mm locking compression plates were used and a single coronal plane bend was placed in each test plate with the bend apex at a locking hole. Contoured test samples were created with bends at 5°, 15°, or 45° and a 45° test group was created in which a locking screw-hole insert was placed prior to bending. Ten plates were tested for each group and compared to non-bent controls in a step-wise cyclic loading protocol for a total of 10,000 cycles or until failure.

Results: Outcome variables included screw failure and number of cycles survived before failure. The Fisher exact test was used to compare survival between groups. There was a statistically significant difference between control and both the 15° (P = 0.006) and the 45° (P = 0.0007) groups. The 5° group showed a trend towards poorer survival but this did not reach statistical significance (P = 0.17). The average cyclic load (# cycles) survived was also poorer for all bent plate groups. The difference between controls (mean, 9004.5) and the 15° (mean, 5691.4; P = 0.027) and 45° (mean, 3827.6; P = 0.0002) groups was statistically significant. The mean cycles to failure in the 5° group was 16% lower than controls (mean, 7537.5 vs 9004.5); however, this did not reach statistical significance (P = 0.37). Analysis of variance comparing groups showed a statistically significant effect (P = 0.0002). The additional test group bent to 45° after placement of a locking screw-hole insert showed no significant difference from the regular 45° group in mean number of cycles survived or in protocol survival.

Conclusion: Plate bending at a locking hole of over 5° results in a statistically significant decrease in survival of the corresponding locked screw during a cyclic loading protocol. This effect cannot be prevented by the placement of a locking screw-hole insert prior to bending.

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CASE PRESENTATIONS

Orthopaedic Trauma Coding Update (#F1) Moderator: William R. Creevy, MD Faculty: J. Scott Broderick, MD and Michael S. Sirkin, MD

Management of Pelvic & Acetabulum Fractures (#F2)

Moderator: Paul Tornetta, III, MD Faculty: Clifford B. Jones, MD; Robert F. Ostrum, MD; Judith A. Siegel, MD and Adam J. Starr, MD

Challenging Hip Fractures-When the Fracture Table Doesn't Work (#F3)

Moderator: Amer J. Mirza, MD Faculty: Daren Freiss, MD; James C. Krieg, MD and Samir Mehta, MD

New Approaches to Difficult Tibial Plateau Fractures (#F4)

Moderator: David C. Templeman, MD Faculty: James A. Goulet, MD; J. Tracy Watson, MD and Robert A. Winquist, MD

Treatment of Clavicle Shaft Fractures: Straightforward, Right? (#F5)

Moderator: Erik Kubiak, MD Faculty: Michael D. McKee, MD and Donald A. Wiss, MD

NOTES

SYMPOSIUM II: PAIN MANAGEMENT IN TRAUMA: RISK TO PATIENTS, BURDEN ON SURGEONS, OPPORTUNITY FOR IMPROVEMENT

Moderator: Thomas F. Higgins, MD

- Faculty: Mark A. Lee, MD Jeffrey D. Swenson, MD Mark S. Vrahas, MD
 - 8:00 am The Current State of Post-Operative Pain Management in the Trauma Patient Thomas F. Higgins, MD
 - 8:15 am **Physician Attitudes on the Use of Prescription Narcotics** *Mark S. Vrahas, MD*
 - 8:30 am Alternatives for Pain Management in the Hospitalized Patient *Jeffrey D. Swenson, MD*
 - 8:45 am Legal / Ethical Issues in Surgical Pain Management Mark A. Lee, MD
 - 9:00 am Discussion

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Cervical Spine Clearance Protocols in Level I, II and III Trauma Centers in the State of California

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Purpose: Cervical spine clearance protocols have been developed to standardize the clearance of C-spine following high-energy blunt trauma and prevent neurologic deficits secondary to missed unstable spine injuries. The guidelines on cervical spine clearance are evolving as new imaging techniques become more available. Ideally each trauma center should develop and update their cervical spine clearance protocols; however, this is not mandatory. The purpose of this study is to evaluate the cervical spine clearance practice in trauma centers in the State of California.

Methods: Level 1 (n = 15), 2 (n = 30), and 3 (n = 11) trauma centers in the State of California were identified through the Trauma Managers Association of California website. The trauma managers in these centers are contacted via e-mail and phone calls. If the center has an official cervical spine clearance protocol, these protocols were evaluated to understand their current practice.

Results: Overall, only 50% of all trauma centers in California had a cervical spine clearance protocol. Specifically, 80% of Level 1, 47% of Level 2, and only 18% of Level 3 trauma centers had an official cervical spine clearance protocol. Of the centers that have an official C-spine clearance protocol, 67% of Level 1 and 57% of Level 2 centers use Nexus criteria with/without painless range of motion to clear asymptomatic patients. 67% of Level 1 and 64% of Level 2 centers use multi-detector CT scans as the first line of imaging in symptomatic patients. 58% of Level 1 and 28% of Level 2 centers prefer MRI in addition to CT scans, whereas 25% of Level 1 and 21% of Level 2 centers prefer CT scan only to clear cervical spine of obtunded patients. Only 2 Level 3 centers had protocols; however, they were not clear with regard to the algorithm that should be followed.

Conclusions: This study showed that only 50% of the trauma centers in California have an official cervical spine clearance protocol and only 30% of the centers have protocols that follow current recommendations. Policies should be made to improve the quality and use of official cervical spine protocols in all trauma centers.

Vertebral Artery Injury Associated With Blunt Cervical Spine Trauma: A Multicenter Study

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Background: Vertebral artery injury (VAI) in the blunt trauma patient may be clinically silent or have catastrophic neurologic sequelae. The optimal screening process for VAI associated with cervical spine injury has yet to be clearly defined.

Purpose: We sought to define the incidence, patient characteristics, and the independent predictors for VAI from blunt cervical spine trauma.

Methods: We conducted a retrospective review of prospectively collected patient data from the American College of Surgeons (ACS) institutional trauma registries at 3 Level 1 trauma centers over a 3-year period. Patients screened for VAI by CTA were identified, studied, and logistic regression analysis was performed.

Results: 1204 patients sustained a cervical spine injury during the study period; 253 patients (21.0%) underwent screening for VAI by CT angiography. VAI was diagnosed in 42 patients (3.5% incidence), 38 with unilateral VAI (3.2%) and 4 with bilateral (0.3%). Fracture displacement into the transverse foramen >1 mm (odds ratio [OR] = 3.66; 95% confidence interval [CI], 1.32-10.18; P <0.01), basilar skull fracture (OR = 5.18; 95% CI, 2.07-12.98; P <0.001), occipital-cervical dissociation (P < 0.001), and ankylosing spondylitis (AS)/diffuse iodiopathic skeletal hyperostosis (DISH) (OR = 8.05; 95% CI, 1.30-49.69; P < 0.01) were found to be independent predictors for VAI. Patients with VAI had a significantly lower GCS (P <0.001), higher ISS (P < 0.01), and higher mortality rate (P < 0.001). There was no significant difference in age, gender, hospital length of stay or ICU length of stay between patients with VAI and those without. The stroke rate for VAI was 6 out of 42 patients (14%) and the stroke-related mortality rate was 2 of 42 patients (4.8%). Any injury from the occiput to C2 (P = 0.89), multiple transverse process fractures (P = 0.43), fractures entering the transverse foramen (P = 0.46), atlas fractures (P = 0.84), C2 fractures (hangman's [P = 0.99] or dens [P = 0.96] (0.12), and facet subluxations/dislocations (P = 0.28) were not associated with an increased likelihood of VAI. Fractures undergoing operative stabilization (P = 0.40) and patients with a high-energy mechanism of injury (P = 0.19) were not independently predictive of VAI. A minimum of 1 contraindication to antiplatelet or anticoagulation treatment for VAI was present in 100 (39.5%) of the screened patients. 30 of 42 patients (71%) diagnosed with VAI did not receive any new medication or treatment subsequent to the diagnosis of VAI during their hospitalization.

Conclusions: In the more severely injured patient population with VAI, anticoagulation or antiplatelet therapy is often not feasible. Routine, obligatory CT angiography screening

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for VAI in the asymptomatic cervical spine trauma patient should be avoided. Patients with a basilar skull fracture, occipital-cervical dissociation, AS/DISH, or transverse process fracture displaced into the transverse foramen >1 mm should be strongly considered for VAI screening.

The Clinical Efficacy of Compressive Transsacral Screw Fixation for Unstable Posterior Pelvic Ring Injuries

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Purpose: This study was undertaken to evaluate the use of compression via transsacral (TS) intramedullary screw fixation in the management of unstable posterior pelvic ring injuries. We hypothesized that our fixation protocol of anatomic reduction, compression, and TS screw fixation would improve stability of fixation, and that TS screw fixation would not cause detectable neurovascular injuries.

Methods: We reviewed a prospectively maintained, IRB-approved database of all patients treated with our fixation protocol between January 2006 and April 2010. Patients with less than 6 months of follow-up were excluded. Postoperative pelvic radiographs were assessed for radiographic healing, fixation failure, and loss of reduction at the immediate, 6-week, 3-month, and 6-month postoperative intervals. Medical records were reviewed for changes in the neurologic examination before and after surgical management of the pelvic ring injury.

Results: 50 patients treated with 55 TS screws met inclusion criteria. 35 (70.0%) of these patients had zone II sacral fractures, 19 (38.0%) had sacroiliac fracture/dislocations, and 4 (8.0%) had spinopelvic dissociation. 37 screws were placed through the S1 body, and 18 were placed through S2. Nine patients were documented to have preoperative nerve injuries, but none had new neurologic deficits after reduction and fixation. Two patients suffered post-operative displacements. One patient had a combined injury pattern demonstrating cranial displacement, flexion, and internal rotation through a zone II sacral fracture. Although the cranial reduction was maintained, flexion and internal rotation of 5° over a retrograde ramus screw was observed at the 6-week radiograph and the patient healed in this position. The second patient had spinopelvic dissociation with gluteal necrosis and massive soft-tissue injury. She was stabilized with anterior symphyseal plating, spinopelvic fixation, and TS fixation at S1. A severe infection developed requiring removal of spinopelvic fixation. The TS screw subsequently failed by pull-out, resulting in complete hemipelvic displacement and an infected sacral nonunion.

Conclusions: Anatomic compression and transsacral screw fixation provided excellent stability and maintenance of reduction in patients with unstable posterior pelvic ring injuries. Although the placement of an intramedullary screw traversing the sacrum inherently increases the risk of neurologic encroachment, we did not observe any iatrogenic neurologic deficits with TS screw placement. Furthermore, the compression of zone II sacral fractures was not associated with neurologic injury.

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An Analysis of the Demographic and Technical Characteristics Associated With Iliac Cortical Perforation During Insertion of Iliosacral Screws

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Purpose: Iliosacral screws are a common fixation method for posterior pelvic ring injuries, and are associated with minimal blood loss and low rates of infection and nonunion. Reports of complications for iliosacral screws have focused on nerve and vessel injury. Perforation of the outer cortex of the ilium during tightening of iliosacral screws has been observed, but seldom reported. This complication may compromise fixation stability. This investigation sought to identify risk factors associated with breach of the outer iliac cortex during iliosacral screw insertion.

Methods: 142 consecutive patients who had undergone iliosacral screw fixation of the posterior pelvic ring were retrospectively identified from 3 Level 1 trauma centers. The demographic and technical characteristics of each case were reviewed. Postoperative CT scans were scrutinized for any evidence of washer penetration through the outer table of the ilium.

Results: 236 iliosacral screws with washers were inserted for an average of 1.66 screws per patient. 28 screws (11.9%) in 26 patients (18.3%) perforated the outer cortex of the ilium. Patients with screw perforation were older (52.61 years vs 38.6 years; P = 0.0002) and more likely to be diabetic (P = 0.0071). Additionally, perforated screws were more often fully threaded (P = 0.0315) and patients with a perforated cortex had significantly more screws inserted (1.92 vs 1.60; P = 0.037). Sex, time to surgical fixation, laterality, smoking status, OTA fracture classification, and surgeon did not affect the rate of cortical breach.

Conclusion: Perforation of the outer iliac cortex is common during insertion of iliosacral screws and may lead to an increased number of screws being inserted. Factors increasing rates of cortical perforation are linked to poor bone quality, such as age and diabetes, and also fully threaded screws. These factors should be kept in mind during final iliosacral screw tightening. Additionally, the 20° "roll-over" view tangential to the outer table can help visualize complete washer seating and may avoid perforation. Further research is warranted to evaluate the effect of cortical perforation on stability, union rate, and outcomes.

Can a Single Screw Be Used for Bilateral Sacroiliac Fixation?

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Purpose: Screw fixation of the sacroiliac (SI) joint is a well established technique. The ideal screw path across one SI joint is not coincident with the ideal path across the contralateral joint. It is hypothesized that there is sufficient space for a straight line path across both SI joints to place a bilateral screw in both the S1 and S2 segments.

Methods: 432 pelvic CT scans were processed to obtain high-definition 3-dimensional (3D) digital models of the pelvis at the S1 and S2 segments. Bone cortex was identified by voxel density producing a 3D mesh of the cortical contours. S1 and S2 were analyzed similarly. A straight line path was digitally placed within the cortical contours of the sacral segment, and extended from the outer table of one posterior ilium, across the SI joint through the S1 or S2 sacral segment, across the opposite SI joint, and out the opposite posterior ilium. The diameter of the path was increased until it contacted cortex geometrically defining the position, alignment, and maximum diameter (Dmax) of the single path across either the S1 or S2 segment. The Dmax available for a screw was documented for S1 and S2 and was associated with gender, age, and body mass index (BMI). 10 mm was defined as the smallest diameter in which a skilled surgeon could consistently and safely place a 7.3-mm screw, allowing a 2.7-mm margin for error. Binomial logistic regression was used to associate the path diameter with gender, age, and BMI with $\alpha < 0.05$.

Results: 49% of pelves had 10 mm or more at both the S1 and S2 segments. 67% had 10 mm or more in S1 only and 76% had 10 mm or more in S2 only. In 6% of pelves, neither S1 nor S2 had a 10-mm path for the bilateral screw. 15% of S1s had <7 mm. Dmax was smaller in females than in males at S1 (P = 0.049) and S2 (P < 0.001) but did not associate with age or BMI.

Conclusions: One in three pelves (33%) lacked sufficient bone to pass a bilateral screw across both SI joints in the S1 segment, one in four (24%)lacked sufficient bone to pass a bilateral screw across the Pd a S2 segment, and 6% lacked sufficient bone in both the S1 and S2 segments. Separate unilateral SI screws on each side may be safer than a long bilateral screw traversing both SI joints when experience with this procedure is limited.



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Critical Analysis of Pelvic Angiography for Trauma and Development of a Scoring System

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Purpose: The purpose of this study is to critically assess the indications used for pelvic angiography and embolization at a trauma center over a 7-year period, and to identify preprocedure factors associated with arterial hemorrhage.

Methods: Review of medical records revealed 44 patients with pelvis fractures had pelvic angiography over 7 years. The average age was 53.1 years and the mean ISS was 25.5. Medical records were reviewed for patient age, hemodynamic status, transfusions received, contrast extravasation ("blush") on CT scan, laboratory values, and associated injuries. The fractures were classified according to the Young-Burgess and OTA classification systems.

Results: 33 of 44 patients (75%) had active arterial hemorrhage and all had embolization performed. 11 patients did not have arterial hemorrhage, yet the interventional radiologist performed embolization in 7 (64%). In 7 additional patients, selective embolization of the bleeding vessel was not done, and instead the entire internal iliac artery was embolized. Patients who were transfused ≥ 3 units of blood and patients with contrast extravasation on CT scan had significantly greater risk of arterial hemorrhage at angiography (P = 0.016, P =0.042). The presence of hypotension (systolic blood pressure ≤ 90), abnormal laboratory values (base deficit, lactate), and receipt of inotropic medication were found to have a nonsignificant correlation with the presence of arterial bleeding (see Table 1). Arterial hemorrhage was present in 66% (19 of 29 patients) with OTA type A/B fractures, and in 92% (12 of 13) with OTA type C fractures (see figure) (P = 0.13). Branches of the internal iliac artery were injured in 28 of 33 cases (85%) compared with branches of the external iliac artery in 8 cases (24%). Patients >65 years were more likely to have arterial hemorrhage despite sustaining a less severe fracture. Based on the above findings, we have developed a scoring system based on 5 categories: fracture type, age >65 years, receipt of inotropic medication, number of packed red blood cell units transfused, and contrast extravasation on CT scan (Table 2). A score \geq 4 had a positive predictive value of 95% for the presence of arterial hemorrhage.

Conclusions: Selective embolization should be used when possible to avoid devascularization of important structures. The scoring system presented predicts the presence of arterial hemorrhage at angiography.

Table 1

| Parameter | Sensitivity | Specificity | PPV | NPV |
|--|-------------|-------------|-------|-------|
| Age > 65 | 36.4% | 72.7% | 80.0% | 27.6% |
| ≥3 units PRBCs | 84.8% | 54.5% | 84.8% | 54.5% |
| Inotropic medication | 24.2% | 90.9% | 88.9% | 28.6% |
| Base deficit ≥6 | 67.9% | 42.1% | 82.6% | 25% |
| Lactate >2.5 | 86.2% | 14.3% | 80.6% | 20% |
| SBP ≤90 | 66.7% | 27.2% | 73.3% | 21.4% |
| Blush on CT | 86.7% | 45.5% | 81.3% | 55.6% |
| Pelvic arterial hemorrhage score ≥4 | 70% | 90.9% | 95.4% | 52.6% |
| Pelvic arterial hemorrhage score ≥5 | 33.3% | 100% | 100% | 35.5% |

PRBC, packed red blood cells; SBP, systolic blood pressure.

Table 2

| Factor | Points |
|---|-------------|
| Fracture type: LC-I, APC-I, simple acetabular fracture LCII, APCII LCIII, APCIII, VS, associated acetabular fracture | 0 1 2 |
| • Age >65 | 1 |
| • \geq 3 units PRBCs | 1 |
| Inotropic medication | 2 |
| • Blush on CT | 2 |

LC, lateral compression; APC, anteroposterior compression; VS, vertical shear.

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The Importance of Trauma Center Care on Mortality and Function Following Pelvic Ring and Acetabular Injuries

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Purpose: Lower mortality and improved physical function following major polytrauma has been associated with treatment at Level 1 trauma centers compared with that at non-trauma centers. The purpose of this study was to investigate the impact of trauma center care on outcomes after pelvic injuries, recognizing that these results could have important implications for appropriate triage of these severely injured patients.

Methods: Mortality and quality of life–related measures were compared among patients treated in 18 hospitals with Level 1 trauma centers and 51 hospitals without trauma centers in 14 states. Complete data were obtained on 829 adult trauma patients (18-84 years of age) with at least one pelvic ring or acetabular injury (OTA 61 or 62). We used inverse probability of treatment weighting to adjust for observable confounding between patients treated at trauma centers versus those treated at nontrauma centers.

Results: After adjustment for case mix, inhospital mortality was significantly lower at trauma centers versus nontrauma centers (relative risk [RR] 0.10; 95% confidence interval [CI], 0.02-0.47), as was death by 90 days (RR 0.10; 95% CI, 0.02-0.47), and 1 year (RR 0.21; 95% CI, 0.06-0.76) for patients with more severe acetabular injuries (OTA 62-B and 62-C). Patients with combined pelvic ring and acetabular injuries treated at trauma centers had lower mortality by 90 days (RR 0.34; 95% CI, 0.14-0.82) and 1 year (RR 0.30; 95% CI, 0.14-0.68). Average differences in Short Form-36 physical functioning and Musculoskeletal Functional Assessment at 1 year were 11.4 (95% CI, 5.3-17.4) and 13.2 (1.7-24.7) respectively, indicating statistically and clinically significant improved outcomes with treatment at trauma centers for more severe acetabular injuries.

Conclusions: Our findings show that risk of mortality is significantly lower for patients with severe acetabular injuries and that these patients also enjoy improved physical functioning at 1 year when care is provided in a trauma center than in a nontrauma center. Patients with severe acetabular injuries and any combined acetabular and other pelvic ring injuries should be triaged to trauma centers.

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OTA-2011

Quality of Life and Sexual Function Following Traumatic Pelvic Fracture

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Purpose: Pelvic fractures are indicators of severe trauma and high-energy absorption. They are associated with multiple local or distant concomitant injuries, which explain their high mortality and morbidity. The aim of this study is to investigate the late sequelae of traumatic pelvic fractures (PFX), focusing on quality of life and sexual-function.

Methods: From a database of prospectively documented data, patients who had suffered a PFX and had been treated operatively in our institution from January 2008 to January 2009 were eligible to participate in this study. Ethics committee approval was obtained. Exclusion criteria were patients less than a year postinjury, pathologic fractures, patients <18 or >65 years of age, and patients with comorbidities linked to sexual dysfunction. **Demographics**, injury mechanisms, fracture patterns (Young-Burgess classification), injury severity score (abbreviated injury scale [AIS]/05-ISS), urogenital injuries, and clinical outcome were recorded and analyzed. Health-related quality of life was assessed using the EuroQol 5D (EQ-5D) and sexual function using the international index of erectile function and the female sexual function index. Patients were asked to fill in the questionnaires twice (once documenting their state prior to their injury and the second time recording their state after the injury). The minimum follow-up was 12 months (range, 12-30 months).

Results: Out of 85 patients that met the inclusion criteria, 67 patients (24 females) with a mean age of 44 years (range, 19-65 years) consented to participate in this study. Their mean ISS was 25 (range, 9-58), while 5 (7.4%) had isolated PFX. There was shown to be a significant decrease in quality of life (P < 0.0001) and sexual function (P < 0.0001). The decrease was significant in all 5 EQ-5D domains with mobility, usual activities, and pain as the most significantly affected (P < 0.0001). 50.7% (34) patients reported a significant (P < 0.0001) decrease in their postinjury sexual function score (55.5% males, 47.8% females). Linear regression showed urinary tract injury to be an independent risk factor for sexual dysfunction (P < 0.0001), while a Mann-Whitney U test identified that the PFX severity (fracture types VS-AP3-LC3-CMI vs LC1-LC2-AP1-AP2-ILBL) correlated to sexual dysfunction (P = 0.0463).

Conclusion: Both genders, irrespective of age subgroups, suffering a PFX severe enough to undergo surgery are at risk of a significant decrease of their quality of life and sexual-function. The presence of certain fracture types and urinary tract injuries can be used as predictors of late morbidity and early multidisciplinary management.

Quality of Life Following Acetabular Fracture Surgery, Importance of Reduction *Tomas Borg, MD, PhD*; *Sune Larsson, MD, PhD; Dept. of Orthopaedic Surgery, Uppsala University, Uppsala, Sweden*

Purpose: This study was conducted to determine patient-reported outcome following internal fixation of acetabular fractures using quality of life (QoL) instruments.

Methods: 136 patients (108 men, 28 women), aged 17 to 83 years and operated for an acetabular fracture during 2004 to 2008, were prospectively included and followed for 2 years. QoL was evaluated via Short Form-36 (SF-36) and Life Satisfaction-11 (LiSat-11) at 6, 12, and 24 months. Radiographs were evaluated according to Matta at 2 years.

Results: 129 patients could be assessed, 4 did not respond, and 3 had died; 115 patients responded at all 3 time points. The most frequent fracture types were posterior wall (n = 31), associated anterior-posterior hemitransverse (n = 34), and associated both-column (n = 29). Patients scored significantly lower than norms in all SF-36 domains with significant improvement over time for Physical Function (P < 0.001) and Role Physical (P < 0.001). Patients with anatomic reduction (n = 92) scored significantly better (P < 0.001 to 0.039) in all domains except vitality (P = 0.070) when compared with patients with residual displacement of 2 mm or more (n = 23). There were no significant differences in SF-36 between patients with preserved hip joint and 19 patients who had undergone arthroplasty. LiSat-11 was significantly lower for patients compared with norms in 9 of 11 items with no change between 6 months and 2 years. For the items "friends/acquaintances" and "financial situation," there was no difference between patients and norms.

Conclusions: Anatomic reduction in acetabular fracture patients results in better QoL when compared with patients with residual displacement. Physical SF-36 domains improve with time, although at 2 years patients still had lower QoL than norms.



Figure 1. SF-36 scores (mean) in acetabular fracture patients at 6, 12, and 24 months following surgery. Divided in 2 groups, anatomic reduction (light gray, n = 92) and residual displacement 2 mm or more (dark gray, n = 23), compared with normative data.

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Δ •Measurement of Tissue Oxygenation as a Novel Approach to Diagnosis of Compartment Syndrome

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Purpose: The goal of treatment in compartment syndrome is to avoid irreversible muscle and nerve tissue damage. Acute compartment syndrome remains challenging due to diagnostic difficulty. The purpose of this study is to investigate the feasibility of continuous measurement of intramuscular tissue oxygenation (PmO_2) of the leg, its sensitivity to tourniquet ischemia, and to compare the predetermined warning criteria for compartment syndrome based on compartment pressure (CP) and PmO^2 after tibia fracture.

Methods: The control arm consisted of patients undergoing ankle fracture fixation with tourniquet (n = 5). In the observational arm, patients undergoing intramedullary nailing for closed tibia fracture received continuous measurement of PmO_2 and CP of the anterior compartment for 48 hours postoperatively (n = 11). The number of measurements meeting the tissue oxygenation warning criterion ($PmO_2 < 10 \text{ mm Hg}$) was compared to the number of measurements meeting warning criteria for CP (CP >30 mm Hg, delta P (DBP–CP) <30 mm Hg).

Results: In the control group, mean PmO_2 was 26.75 mm Hg and decreased rapidly after tourniquet application to 0.52 mm Hg (range, 0.1-1.4). In the experimental group, mean CP was 27.2 mm Hg and mean PmO_2 was 27.7 mm Hg. No patient developed compartment syndrome. All 11 patients had CP greater than 30 mm Hg (mean, 46% of measurements; range, 3.8%-100%). For delta P <30 mm Hg, 8 patients met warning criteria (mean, 31%; range, 0-98%). Only 2 patients had $PmO_2 <10$ for 178 minutes and 167 minutes respectively. PmO_2 tended to show less variability than CP (18% vs 25%; P = 0.09).

Conclusion: Our data establish the feasibility of measuring continuous tissue oxygenation and its responsiveness to ischemia. CP measurements met warning criteria more often than PmO_2 in the absence of compartment syndrome. $PmO_2 < 10 \text{ mm Hg may represent a clinically important threshold. Measurement of direct tissue oxygenation can be considered as physiologic and a more specific method for diagnosing compartment syndrome as an indicator of muscle tissue viability.$

Fasciotomy for Acute Compartmental Syndrome Increases the Incidence of Infection, Nonunion and Delayed Union of Operatively Treated Tibial Fractures

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Purpose: This study was conducted to evaluate and compare the rates of union and secondary complications in patients treated with and without fasciotomy for acute compartment syndrome in operatively managed tibia fractures. Our hypothesis is that the presence of fasciotomy for compartment syndrome increases the risk for complications associated with the treatment of tibial fractures.

Methods: This study is a retrospective review of prospectively collected data from a Level 1 regional trauma center between January 2000 and August 2010 on 149 patients with acute compartment syndrome and concomitant operatively treated tibial fractures (group 1). Patients were excluded from the study if they were skeletally immature, Gustilo IIIC, or had incomplete medical records and insufficient follow up to determine time to union. 19 patients with a tibial plateau fracture and 18 patients with a fracture of the diaphysis were included in the analysis. A 1:4 matched control cohort was constructed for comparison against patients with similar fracture patterns without compartment syndrome or fasciotomy (group 2). Tibial plateau fractures were treated with plate fixation and tibial shaft fractures were treated with intramedullary nail fixation. All fasciotomies were 4-compartment and 2 incisions, with early internal fixation and staged closure of the fasciotomy sites. Data recorded included age, OTA fracture classification, Gustilo classification, time to union, presence of nonunion, secondary operations, incidence of infection, and smoking status.

Results: All results were internally controlled for age, injury pattern, and method of fixation. Group 1 tibial plateau fractures demonstrated union on average at 28 weeks; 48% had delayed union and 11%, nonunion. Group 2 tibial plateau fractures demonstrated union on average at 15 weeks; 12% with delayed union and 6%, nonunion. Late infection developed in 10% of group 1 tibial plateau fractures versus 5% in group 2. Tibial shaft fractures in group 1 demonstrated union at 30 weeks; 67% had delayed union and 22%, nonunion. Tibial shaft fractures in group 2 demonstrated union at an average of 19 weeks; 28% with delayed union and 1%, nonunion. Late infection developed in 17% of group 1 tibial shaft fractures versus 2% in group 2. All reported differences between groups 1 and 2 were statistically significant (P < 0.05). Smoking status was strongly correlated with delayed union in both groups independent of presence or absence of compartment syndrome.

Conclusion: The presence of acute compartment syndrome and the need for fasciotomy in patients with either tibial shaft or tibial plateau fractures is associated with a significant increase in the rate of delayed union, nonunion, and deep infection.

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Do Intracompartmental Pressure Measurements Have a High False-Positive Rate in Diagnosing Compartment Syndrome?

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Purpose: Intracompartmental pressure measurements are frequently used to aid in the diagnosis of compartment syndrome, particularly in patients whose physical examination is equivocal or limited by altered sensorium. Despite their widespread use, little work has been done to validate the clinical use of intracompartmental pressures, particularly in identifying the false-positive rates. Our hypothesis was that there would be a high false-positive rate if the diagnosis of compartment syndrome were made based on one-time pressure measurements alone.

Methods: 48 consecutive patients with tibial shaft fractures who were not suspected of having compartment syndrome based on the attending orthopaedic surgeons' standardized physical examination were prospectively enrolled in this study. Compartment pressure measurements were taken in all 4 compartments at a single point in time immediately after induction of anesthesia using a commercially available pressure-monitoring device. The patients' preoperative and intraoperative blood pressures were recorded. The same standardized examination was performed by the attending surgeon postoperatively and in clinical follow-up for 6 months to demonstrate that the patients did not develop clinical evidence of compartment syndrome either acutely or late.

Results: No patients demonstrated clinical evidence of compartment syndrome postoperatively or in clinical follow-up for 6 months from the date of injury. Using the accepted criteria of a delta of 30 mm Hg from preoperative diastolic blood pressure, 35% of patients (n = 17; 95% confidence intervals (CI): 48.5%, 21.5%) qualified as meeting criteria for compartment syndrome. Raising the threshold to a delta of 20 mm Hg reduced the false-positive rate in this cohort to only 23% (n = 11; 95% CI: 34.9%, 11.1%). 21% (n = 10; 95% CI: 32.5%, 9.5%) of patients exceeded an absolute pressure value of 45 mm Hg.

Conclusion: We found there was a relatively high false-positive rate (35%) for the diagnosis of compartment syndrome in patients with tibial shaft fractures using currently accepted criteria for the diagnosis based solely on one-time compartment pressure measurements using a commercially available pressure-monitoring device. To our knowledge, this is the first prospective study to use rigorous methodology to demonstrate the false-positive rate in patients not suspected of compartment syndrome using this technique. These data suggest that reliance on one-time intracompartmental pressure measurements alone may substantially overestimate the true rate of compartment as a tool to diagnose compartment syndrome may lead to unnecessary fasciotomies.

See pages 77 - 115 for financial disclosure information.

The Insertion of Intramedullary Nail Locking Screws Without Fluoroscopy: A Faster and Safer Technique

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Purpose: This study was designed to compare standard free-hand ("perfect circles") insertion of intramedullary nail (IMN) locking screws using fluoroscopic assistance (FA) against screw insertion using an electromagnetic (EM) tracking device. Our hypothesis was that EM would be simpler to use, require less time, and eliminate radiation.

Methods: This was a prospective, IRB-approved study. There were a limited number of EM units; therefore, this study could not be effectively randomized. Instead, when an EM unit was available it was used, and compared to screws placed with fluoroscopy, when it was not. Tibial and femoral locking screw insertion data were combined because the screw insertion technique was similar when used in either the femur or tibia for either method. Start to finish (incision to driver removal) time and mrads were recorded for each screw. Measurements collected for FA insertion included (1) technician arrival wait time, (2) radiation (mrads) and times for perfect circle set-up, (3) insertion time/screw, (4) fluoroscopic time and amount of radiation (mrads)/screw. As neither a technician nor a fluoroscopy unit was required for EM, data collected included EM set-up time and insertion time/screw. Data collected were then compared using standard analysis of variance.

Results: There were a total of 18 femoral (F) and 32 tibial (T) nails placed. 41 locking screws were inserted using the FA technique (16F/9T nails), while 60 screws were inserted using the EM technique (2F/23T). There were no missed insertions in either group. On average, technician wait time was 77 seconds with a perfect circle set-up time of 105 seconds. Average fluoroscopy time during this phase was 10 seconds, with 9.2 mrads exposure. FA screw insertion time averaged 342 seconds/screw (~5.5 minutes/screw) requiring 18 seconds of fluoroscopy time and 32.9 mrads of radiation. In the EM group, average set-up time was 94 seconds (1.56 minutes) and insertion time was 234 seconds/screw (~4 minutes/screw). This was significant (P = 0.006). There was also no radiation in this group. Direction of screw insertion was also evaluated; however, there were not enough in each subset for a clear evaluation.

Conclusions: When placing IMN locking screws, the use of EM decreases operative time as compared to standard techniques. In addition, accuracy is maintained, and as there is no radiation during this procedure, we conclude it is safer and faster than the standard fluoroscopic technique of "perfect circles."

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A Comparison of Efficacy and Resource Utilization Between Acute BMP-2 and Standard Treatment in Type III Tibia Fractures: A Multicenter Prospective, Randomized Controlled Trial

OTA Study Group: **Michael J. Bosse, MD**¹; Robert D. Zura, MD²; Andrew N. Pollak, MD³; David A. Volgas, MD⁴; William T. Obremskey, MD⁵; David P. Barei, MD⁶; Rachel Seymour, PhD¹; ¹Carolinas Medical Center is in Charlotte, North Carolina, USA; ²Duke University is in Durham, North Carolina, USA; ³Shock Trauma/University of Maryland is in Baltimore, Maryland, USA; ⁴University of Alabama at Birmingham is in Colombia, Missouri, USA; ⁵Vanderbilt University Medical Center is in Nashville, Tennessee, USA; ⁶Harborview Medical Center is in Seattle, Washington, USA

Purpose: The use of expensive therapies in the treatment of trauma patients is often difficult to justify without efficacy and resource utilization data. The acute use of BMP-2 in open tibia fractures is restricted in many centers related to its cost. We hypothesized that a reduction in later hospital system resource utilization related to the treatment of tibia fracture-site complications might justify BMP-2 therapy in severe open tibia fractures.

Methods: Six trauma centers participated in a multicenter prospective, randomized controlled trial. Type III open tibial diaphyseal fractures with less than 4 cm bone loss were randomized to standard treatment (SOC) or early/acute BMP-2 collagen sponge treatment (no allo/autograft or filler materials). All fractures were treated with reamed locked intramedullary nails. Patients were followed until hospital readmission for a complication, fracture union, or 1 year. Cohorts were compared based on post–initial hospital discharge resource utilization related to the tibia fracture site. The number of readmissions, related surgeries, and additional hospital days were used as measures of resource utilization.

Results: 65 patients were randomized. Three patients randomized to BMP were crossovers to the SOC cohort (2 were lost to follow-up). In total, 11 BMP-2 and 7 SOC patients were lost to follow-up. The difference in loss to follow-up was not significant (P = 0.13). 47 patients (19 BMP-2 and 28 SOC) were included in the analysis. 88% were male (average age, 39 years) and 83% had type III B injuries. 74% of BMP and 75% of SOC had OTA 42B/42C fractures. There were no significant differences between the cohorts on demographics or other injury characteristics. 58% (11/19) of BMP-2 patients versus 25% (7/28) of SOC patients achieved primary union (no fracture site readmission and union by 1 year) (P = 0.023). There was no difference in deep infection (11% in both) or amputation rates (BMP 5% vs 7%). By 1 year, only 74% of the BMP-2 and 54% of the SOC patients were united (P = 0.16). We calculated that a BMP-2 patient averaged 0.5 fewer additional surgeries and 1.7 fewer additional hospital days per patient than those entered into the SOC cohort.

Conclusions: BMP-2 patients had significantly higher primary union rates and lower post–primary hospitalization resource utilization rates. Despite the increased cost associated with the use of BMP-2 during the initial admission, overall treatment costs are decreased related to fewer readmissions and revision surgeries. Early BMP -2 use in type III tibia fractures might be considered as a "loss avoidance" strategy.

Δ The Role of Antibiotics in Open Fractures Revisited: Characteristics of *Staphylococcus aureus* (SA) and Susceptibility Profile

Carla C. Saveli, MD; Steven J. Morgan, MD; Robert W. Belknap, MD; Erin Ross, BS; Philip F. Stahel, MD; David J. Hak, MD; Walter L. Biffl, MD; George W. Chaus, MD; Connie S. Price, MD; Denver Health Medical Center, University of Colorado School of Medicine, Denver, Colorado, USA

Purpose: The benefits of antibiotic prophylaxis in open fractures have been clearly demonstrated in several randomized controlled trials, but the choice of antibiotic remains controversial since the current guidelines do not recommend agents with methicillin resistant SA (MRSA) activity. Our objective was to develop preliminary data on the incidence of SA colonization and surgical-site infections (SSIs) in orthopaedic trauma patients with open fractures who receive standard antibiotic prophylaxis compared to a regimen including targeted MRSA coverage.

Methods: In order to compare the safety and benefits of adding MRSA coverage to standard antibiotic prophylaxis, a randomized prospective clinical trial was performed. Between April 2009 and June 2011, all consecutive adult patients who presented to the emergency department (ED) with an open fracture and met study criteria were included. Patients were randomly allocated to receive either cefazolin alone (control arm) or vancomycin and cefazolin (experimental arm) from presentation to the ED until 24 hours after the surgical intervention. Screening for SA carriage was performed with nares swabs, predébridement, and postdébridement open fracture wound swabs. Standard surgical management of the open fractures involved surgical débridement and fracture stabilization. Patients underwent prospective assessment for the development of SSI within 30 days of the initial surgery.

Results: 132 patients with an open fracture were randomized to one of the prophylactic antibiotic regimens. Study demographics and baseline characteristics were balanced between the two groups. 24% of the subjects were identified as colonized with SA. The prevalence of methicillin-sensitive SA (MSSA) and MRSA colonization among the sample were 21% and 4%, respectively. The overall rate of SSI was 16% (16/106)—6 superficial and 10 deep incisional. Selected characteristics of patients who developed a deep incisional SSI are summarized in Table 1. No adverse or severe adverse events in either of the study arms were reported during the study period.

Conclusions: Preliminary findings demonstrate that addition of vancomycin to standard antibiotic prophylaxis is safe. SA colonization in orthopaedic trauma patients is similar to the general population and methicillin resistance was shown in 4% of these patients. SA was a causative pathogen in 60% of the deep incisional SSIs and MRSA accounted for 20% of them. Further data are needed to determine whether the addition of vancomycin to standard antibiotic prophylaxis prevents the development of SSI compared to standard regimens.

Δ OTA Grant

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| Case # | SA Colonization | Antibiotic Prophylaxis | SA SSI | |
|--------|-----------------|------------------------|------------------|--|
| 1 | NEG | Cefazolin | MRSA | |
| 2 | NEG | Cefazolin | MSSA | |
| 3 | NEG | Cefazolin | No | |
| 4 | NEG | Cefazolin | No | |
| 5 | NEG | Cefazolin + vancomycin | MSSA | |
| 6 | MSSA | Cefazolin + vancomycin | MSSA | |
| 7 | NEG | Cefazolin + vancomycin | MSSA | |
| 8 | MRSA | Cefazolin + vancomycin | Culture negative | |
| 9 | NEG | Cefazolin + vancomycin | No | |
| 10 | MRSA | Cefazolin + vancomycin | MRSA | |

Table 1. Selected Characteristics of Subjects Who Developed a Deep Incisional SSI

Tibia Nonunion Prediction: Is It Possible?

Justin S. Yang, MD; Jesse Otero, MD; Christopher M. McAndrew, MD; William M. Ricci, MD; Michael J. Gardner, MD; Orthopaedic Trauma Service, Washington University School of Medicine, St. Louis, Missouri, USA

Purpose: Treatment of tibial delayed unions and nonunions following intramedullary fixation has been a controversial topic among orthopaedic surgeons. The timing and indication of secondary surgical intervention have not been clearly defined. A recent multicenter prospective study (SPRINT [Study to Prospectively Evaluate Reamed Intramedullary Nails in Patients in Tibial Fractures]) concluded that delaying surgical interventions for at least 6 months may decrease the need for reoperation. However, at 3 months postoperatively, if the surgeon is able to accurately predict that the patient will progress to nonunion at 6x months, prompt treatment can proceed, minimizing patient morbidity, discomfort, and debilitation. The purpose of this study was to determine if it was possible to reliably predict at 3 months after index intramedullary nailing if a patient would proceed to nonunion.

Methods: 56 patients who underwent intramedullary fixation for tibia fractures between 2005 and 2009 and had incomplete healing at 3 months were identified. A clinical vignette was created for each patient that included the 3-month radiographs, age, gender, weight, mechanism of injury, Gustilo type if open fracture, medical and smoking history, and if any biologics were used. The vignettes and a questionnaire were distributed to 3 fellow-ship-trained trauma surgeons, who were asked to predict if each fracture would go on to nonunion, and if so the reasons. 29 patients subsequently developed a nonunion at 6 months postoperatively, based on radiographic and clinical criteria, and all underwent nonunion repair. 27 patients achieved full union by 6 months without additional surgery, defined as painless ambulation and radiographic bridging of all 4 cortices. A comparison of the surgeon predictions and actual clinical outcomes were used for statistical analysis, which included calculation of the diagnostic accuracy, sensitivity and specificity, and positive and negative predictive values.

Results: The combined overall diagnostic accuracy of all 3 surgeons was 74% (73%, 73%, and 75%). Sensitivity and specificity were 62% and 77%, respectively. Positive and negative predictive values were 73% and 69%, respectively. In patients who were correctly predicted to proceed to nonunion, radiographic features, such as lack of callus formation, and mechanism of injury were the most common reasons cited. In 10 patients where all 3 surgeons correctly predicted nonunion, 4 of the 10 patients had diabetes, 8 patients had high-energy open fractures, 8 patients smoked, and none had callus formation. In 4 patients where all 3 surgeons failed to correctly predict nonunion, none had diabetes, 3 of the 4 patients had open fractures, 3 patients smoked, and none had callus formation. In 9 patients with diabetes, the diagnostic accuracy was 88%. Of the 30 patients who smoked, the diagnostic accuracy was 76%. Of the 31 patients with signs of radiographic healing, the diagnostic accuracy was 74%.

Conclusion: Clinical judgment at 3 months allows for correct prediction of eventual nonunion development in a substantial percentage of patients. Lack of callus formation and

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mechanism of injury were the most common reason for a surgeon to predict nonunion. Predicting nonunion in diabetic patients had a higher success rate than other patient factors. We suggest that analysis of the entire clinical picture be used for patient management. A protocol of waiting for 6 months before reoperation in all patients may unnecessarily subject patients to prolonged disability and discomfort. Nonunion prediction may be even higher in clinical practice, when additional subtleties are available, such as serial radiographs and a pain with weight bearing.

MINI SYMPOSIA

The "Not So Simple" Ankle Fracture – Avoiding Problems and Pitfalls to Improve Patient Outcome (#*F*6) Moderator: *David J. Hak, MD* Faculty: *Kenneth A. Egol, MD; Michael J. Gardner, MD* and *Andrew Haskell, MD*

Amputations in Trauma: Getting the Most Out of Your Limb (#F7)

Moderators: Paul J. Dougherty, MD and Lisa K. Cannada, MD Faculty: Romney C. Andersen, MD and Rahul V. Vaidya, MD

Preoperative Nightmares – What is the Evidence? (#F8)

Moderator: John T. Gorczyca, MD Faculty: Michael A. Miranda, MD; Kevin J. Pugh, MD and Jeffrey M. Smith, MD

Fundamentals in Trauma I (#F9)

Moderator: Robert F. Ostrum, MD Faculty: Frank A. Liporace, MD; Steven J. Morgan, MD; Thomas F. Varecka, MD and J. Tracy Watson, MD

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SKILLS LABS

ORIF Distal Radius Fractures (#F10)

Moderator: Erik Kubiak, MD Faculty: Gregory T. Altman, MD; Michael D. McKee, MD and Milan K. Sen, MD

ORIF Periprosthetic Fractures of the Femur (#F11)

Moderator: George J. Haidukewych, MD Faculty: Cory A. Collinge, MD; Joshua Langford, MD and Bruce H. Ziran, MD

ORIF Distal Tibia and Fibula Fractures (#F12)

Moderator: Jason W. Nascone, MD Faculty: Brett J. Bauer, MD; Matt L. Graves, MD; Christopher T. LeBrun, MD; Robert V. O'Toole, MD and Marcus F. Sciadini, MD

SIGN Nailing (#F13)

Moderator: Lewis G. Zirkle, Jr., MD

 Faculty: Dipak Maharjan, MD; Tobias Otieno, MD; Prof. Dr. Shahab-uddin; Carla S. Smith, MD; John W. Staeheli, MD; David C. Templeman, MD; M. Ismail Wardak, MD and Frederick B. Wilson, Jr., MD

PRESIDENT'S MESSAGE Andrew N. Pollak, MD "Overcoming Challenges to Fulfilling our Mission in Patient Care and Education"

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Definitive Plates Overlapping Provisional External Fixator Pin Sites: Is the Infection Risk Increased?

Chirag M. Shah, MD; Olubusola Brimmo, MD; William M. Ricci, MD; Michael J. Gardner, MD; Washington University School of Medicine, St. Louis, Missouri, USA

Purpose: Staged management of high-energy tibial plateau and pilon fractures typically involves acute spanning external fixation followed by later definitive internal fixation. Current practice is to attempt to avoid external fixator pin placement within anticipated surgical incisions to prevent contamination of the surgical field during definitive open reduction and internal fixation (ORIF). However, with the recent popularity of percutaneous plate applications, as well as the biomechanical advantages of long plates for metaphyseal fracture components, this overlap may be unavoidable. The purpose of this study was to compare the infection risk when plates either overlap or do not overlap previous external fixator pin sites in patients with bicondylar tibial plateau fractures and pilon fractures treated with a 2-staged protocol.

Methods: Over a 5-year period from 2005 to 2010, all OTA type 41C bicondylar tibial plateau fractures and all OTA type 43C pilon fractures that were treated via 2-staged external fixation followed by ORIF were reviewed. Patients with follow-up available through fracture healing were included and the incidence of a deep infection that required surgical intervention was recorded. 71 OTA type 41C bicondylar tibial plateau fractures and 67 OTA type 43C pilon fractures were included in the study. The mean duration of follow-up was 8 months. Complete radiographic information was available on all patients. Preoperative and immediate postoperative radiographs were evaluated to determine the positions of definitive plates in relation to external fixator pin sites. In all cases, there was no evidence of active pin-site infection at the time of conversion to definitive ORIF. Patients were grouped into an "overlapping group," which included those with definitive fixation overlapping or within 5 mm of an external fixator pin site, and a "non-overlapping group." All patient records were reviewed to determine the incidence of deep infection.

Results: Overall, 19 patients developed a deep wound infection—9 in the pilon group and 10 in the tibial plateau group. For the pilon fractures, 5 of 17 patients (29%) who had overlapping plates and pin sites developed a deep infection, compared to 4 of 50 patients (8%) in the non-overlapping group (P = 0.04). Within the overlapping group of tibial plateau fractures, 8 of 35 patients (23%) had deep infections compared to 2 of 36 (6%) in the non-overlapping group (P = 0.046).

Conclusions: Placement of definitive plate fixation overlapping previous external fixator pin sites significantly increases the risk of deep infection in the 2-staged treatment of bicondylar tibial plateau and pilon fractures. Surgeons must make a conscious effort to place external fixator pins outside of future definitive fixation sites to reduce the overall incidence of deep wound infections. Additionally, consideration must be given to the relative benefit of a spanning external fixator in light of the potential for infection associated with their use.

Computed Tomography (CT) Scan to Detect Traumatic Arthrotomies of the Knee Joint *Sanjit R. Konda, MD*; Roy I. Davidovitch, MD; Kenneth A. Egol, MD; NYU Hospital for Joint Diseases, New York, New York, USA

Purpose: This study was undertaken to determine the efficacy of the use of CT scans to detect traumatic arthrotomies of the knee joint.

Methods: A standardized protocol was developed to evaluate patients presenting to the emergency department (ED) with a laceration about the knee suspicious for a traumatic arthrotomy with a CT scan of the knee. We identified 62 patients with 63 knees who underwent this protocol. A traumatic arthrotomy of the knee (TAK) was defined as the presence of intra-articular air on the CT scan as viewed on either 2.0-mm axial slices or 2.0-mm sagittal or coronal reconstruction slices on either bone and/or lung viewing windows. All patients with intra-articular air on the CT scan (+iaCT) were taken to the operating room (OR) for the "gold-standard" diagnostic test of direct visualization of joint capsule integrity. Otherwise, if no intra-articular air was evident on the CT scan, then these patients were discharged from ED after routine bedside irrigation and débridement and primary closure. Follow-up information regarding development of knee complications were recorded for these patients.

Results: There were 49 males and 13 females with a mean age of 28.0 ± 15.0 years. 21 knees (33%) had associated periarticular fractures of the knee. The average skin wound size was 3.6 ± 3.9 cm. All 32 knees with +iaCT had OR confirmation of a TAK. Six of the 31 knees with –iaCT had concomitant injuries that required surgical repair in the OR and wound exploration revealed no TAK. None of the remaining 25 knees with –iaCT who were discharged from the ED had complications of their injured knee at a mean follow-up of 22.0 ± 33.8 days. Based on these results, the sensitivity and specificity of the CT scan to diagnose a TAK based on the presence of intra-articular air is 100%.

Conclusion: CT scan is a sensitive and specific test to diagnose traumatic arthrotomies of the knee joint. Consideration should be given to utilizing this test as the primary diagnostic modality for detecting TAKs in the appropriate clinical setting.

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Immediate Primary Repair and Early Range of Motion of Acute Multiligamentous Knee Injuries: A Prospective Cohort Study

Philipp N. Streubel, MD; Justin E. Richards, MD; William T. Obremskey, MD; Vanderbilt Medical Center, Nashville, Tennessee, USA

Purpose: Acute knee dislocations are complex injuries that lead to significant morbidity if not adequately managed. Most authors recommend ligamentous reconstruction within 3 weeks of injury. This approach, however, often requires staged procedures and prolonged periods of immobilization. The purpose of this study is to evaluate the clinical outcomes of a prospective cohort of patient with multiligamentous knee injuries, treated with a standard protocol of immediate primary repair (within 1 week of injury) and early postoperative range of motion. We hypothesize that this method of treatment can yield similar results to those of reconstruction.

Methods: After IRB approval, patients with combined anterior and posterior cruciate ligament tears with injury to the medial and/or lateral collateral ligaments (KD III and IV injuries) were prospectively enrolled after informed consent had been obtained. Diagnosis was performed with a combination of clinical examination, MRI, and intraoperative evaluation. Injuries with midsubstance tears and vascular injuries were excluded. Patients underwent open primary ligamentous repair within 1 week of injury, and were postoperatively started on continuous passive motion. Evaluations were performed at admission and at 3, 6, and 12 months after surgery using the International Knee Documentation Committee (IKDC) knee evaluation form, which includes both an objective physical examination (KT-1000 arthrometer) and a subjective patient questionnaire. Complications and reoperation rates were recorded at each follow-up visit.

Results: From July 2007 to January 2010, 25 patients were enrolled. Two patients were lost and 2 died before completing follow-up, leaving 21 for final evaluation (67% males; average age, 35 years; range, 19-56 years, 65% smokers). Mechanisms of injury included traffic accidents in 20 and sports-related injury in 1 case. Injuries were classified as KD IIIL in 13, KD IIIM in 6, and KD IV in 2 cases. After 12 months of follow-up, all knees achieved full extension with a mean arc of motion of 126° (range, 100°-140°). In the interim, 1 patient had required surgical arthrolysis, while 3 patients had required manipulation under anesthesia. According to the IKDC knee examination form, 35% of knees were found to be normal, 57% near normal, and 7% (1 case) severely abnormal. Mean subjective IKDC score was 62 (range, 41-88).

Conclusions: A standard protocol of early primary repair and early range of motion of severe multiligamentous knee injuries can yield near-normal results or better in over 90% of cases.

Predictors of Knee Stiffness After Periarticular Fracture

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Purpose: Knee stiffness after periarticular fracture is poorly understood in contrast to the relatively advanced understanding of stiffness after total knee arthroplasty or knee ligament injury. Knee stiffness has been reported as an important complication after fracture but a systematic evaluation of risk factors and outcomes has not yet been undertaken. Therefore, the aims of this study were to evaluate risk factors for knee stiffness requiring manipulation after periarticular fracture and to document the clinical outcomes.

Methods: This study was designed as a case control study in which patients requiring manipulation under anesthesia after periarticular fracture were compared to those who did not. Using billing data from a regional Level 1 trauma center, we identified 24 knees requiring manipulation for refractory stiffness over a 6-year period. These were matched based on AO/OTA classification with 43 control knees that did not develop stiffness requiring manipulation. Descriptive statistics were used for frequency and mean analysis.

Results: Univariate analysis revealed that extensor mechanism disruption ($\chi^2 = 0.05$), fasciotomy ($\chi^2 = 0.020$), the presence of wounds requiring ongoing management and precluding knee motion (P = 0.001), and the need for more than 3 surgical procedures to achieve definitive fracture fixation and soft-tissue coverage (P = 0.021) all put patients at increased risk for stiffness requiring manipulation. Time spent in a spanning external fixator was not a statistically significant predictor of stiffness (P = 0.16) but was clinically significant, with cases spending a mean of 21 days in a fixator compared to 8 days for controls. The average improvement in knee motion following all procedures targeting knee stiffness was 62°. Mean final flexion was significantly less in the case group at 107° as compared to the control group at 124° (P = 0.01).

Conclusions: This is the first study to systematically evaluate the risk factors for knee stiffness after periarticular fracture and document the outcomes of manipulation under anesthesia. It demonstrates that injury characteristics that delay or prevent postoperative knee motion put patients at increased risk for refractory knee stiffness. Although knee motion remains compromised, late surgery aimed at improving knee motion does lead to improvements in flexion.

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Is Fixation of the Medial Malleolus Necessary?

Paul Tornetta, III, MD; **Virginia Mooney, MD**; Jason Pittman, MD, PhD; James Daley, MPH; William R. Creevy, MD; Boston University Medical Center, Boston, Massachusetts, USA

Purpose: The current standard for the treatment of the medial malleolus in bi- and trimalleolar fractures is reduction and fixation. However, multiple clinical and biomechanical studies have demonstrated that while supracollicular fractures (which have the deep deltoid attached) contribute to ankle stability, anterior collicular fractures do not. Intercollicular fractures may add to stability depending on the amount of deep deltoid attached. The most common reason cited for open reduction and internal fixation (ORIF) of the medial malleolus is to avoid the pain of a possible fibrous or nonunion. The purpose of this study is to review the results of a protocol for fixation of the medial malleolus in bi- and trimalleolar fractures based on stability and fragment size and the resultant medial-sided pain and tenderness for both operative and nonoperative treatments.

Methods: Over an 8-year period, we followed a general protocol for fixation of medial malleolar injuries. This included fixation of supracollicular medial malleolar fractures unless there were soft-tissue concerns (13) or if the lateral side was done first and the medial side was well aligned (5). Intercollicular fractures were fixed if they were felt to be large enough to contain some of the deep deltoid ligament or if they were widely displaced after lateral fixation, and anterior collicular fractures were fixed only in active patients or by patient choice. We evaluated these patients specifically looking for medial-sided pain, symptoms, or the need for surgery on the medial side after the definitive treatment. Pain was determined on a 10-point scale. For the purposes of this study, we report any patient who reported >2 (on the 10-point scale) to have medial "pain".

Results: 192 patients, 88 men and 104 women with a mean age of 44.6 years (range, 18-83 years) had bi- or trimalleolar fractures treated with ORIF of the lateral malleolus and either operative or nonoperative management of the medial malleolus. Follow-up averaged 15 months (range, 6-56 months) after their definitive ORIF by either clinic visit or recontact by phone and all patients were followed at a minimum to union and full weight bearing. They were specifically asked about pain on the medial aspect of the ankle and the medial ankle was palpated to determine tenderness. Six patients (4%) who had medial malleolar fixation had symptomatic hardware removed. There were 3 patients who had late ORIF due to symptomatic nonunion (4.5%), of which 2 were in supracollicular patterns. The results are summarized in the table below for each type of medial malleolus fracture:

| Туре | N/ORIF/Nonop | ORIF | Pain ORIF | Pain Nonop | Late Fixation |
|-----------------|--------------|------|--------------|---------------|------------------|
| Anterior | 42/10/32 | 24% | 50% | 9% | 1 (planned) |
| Intercollicular | 46/31/15 | 67% | 13% | 7% | 1 |
| Supracollicular | 104/86/18 | 83% | 12% | 50% | 4 (2 planned) |

Conclusions: This series reports on a general protocol of fixation of larger medial malleolar fractures if they are believed to add to ankle stability, or if they are widely displaced after lateral fixation. Smaller malleolar fractures were fixed only in active patients. While pain was more common after fixation than nonoperative treatment of anterior collicular fractures, this was reversed in supracollicular fractures. This study supports fixation of larger fragments to avoid pain and tenderness, but suggests that smaller fragments may be best left unfixed, especially anterior collicular fractures.

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Posterolateral Antiglide Versus Lateral Plating for SE Pattern Ankle Fractures: A Multicenter Randomized Control Trial

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⁷University of Oklahoma, Oklahoma City, Oklahoma, USA;
⁸Orthopaedic Associates – Fort Worth, Fort Worth, Texas, USA;
⁹Halifax Infirmary, Halifax, Nova Scotia, Canada

Purpose: Rotational ankle fractures are among the most common injuries seen by orthopaedic surgeons, yet there is no agreement regarding plate positioning when fixing these fractures. The purpose of this study was to evaluate the patient-based and local outcomes of posterolateral antiglide versus lateral plating of SE (supination–external rotation) pattern ankle fractures in a randomized trial.

Methods: 233 patients were randomized to posterolateral antiglide (119) or laterally based (114) distal fibular plates. There were 130 women and 103 men, with a mean age of 43 years (range, 18-77 years). Patients were assessed with a physical examination looking for lateral tenderness, peroneal symptoms, palpable or irritating hardware, range of motion, and an AOFAS (American Orthopaedic Foot & Ankle Society) and SMFA (Short Musculoskeletal Function Assessment) at 3, 6, and 12 months. Wound sensitivity was graded on a 5- point scale.

Results: AOFAS scores averaged 80.5, 86.4, and 89 at 3, 6, and 12 months and did not differ between groups (P = 0.76). SFMA scores averaged 26, 17, and 13, and the bother index averaged 24, 16, and 13.5 at 3, 6, and 9 months and did not different between groups (P = 0.5). Hardware was not palpable in 71%, 61%, and 52% of patients after antiglide plating, and 55%, 65%, and 44% of those after lateral plates at 3, 6, and 12 months (different only at 3 months; P = 0.03). Peroneal tendons were normal in 90% of antiglide and 94% of laterally based plated patients, with only 3 patients reporting irritation with activities of daily living (all in the lateral group). Wound sensitivity was completely absent in 83%, 77%, and 90% of antiglide and 72%, 80%, and 82% for lateral plates at 3, 6, and 12 months. Wound sensitivity was not different between the groups at any time point (Fisher's exact test; P = 0.37). There were 3 wound complications (2 infections) in the antiglide group and 2 in the lateral group. Eight patients had plate removal (5 lateral and 3 antiglide). Range of motion averaged 11° dorsiflexion to 35° of plantar flexion in both groups.

Conclusions: We compared posterolateral antiglide with lateral plating for SE pattern fibula fractures; no differences in patient-based outcomes (AOFAS and SMFA), wound complica-

tions, wound sensitivity, or peroneal irritation were noted up to 1 year. Minor differences favoring antiglide plates were seen at 12 weeks, which were not present in further followup. The rates of hardware and peroneal irritation are similar in both groups. We found no advantage of one technique over the other in any outcome parameter despite prior reports of hardware irritation for lateral plates and peroneal irritation with antiglide plates.

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Δ Efficacy of Popliteal Block in Postoperative Pain Control After Ankle Fracture Fixation: A Prospective Randomized Study

Rachel Y. Goldstein, MD, MPH; Nicole Montero, BA; Toni M. McLaurin, MD; Kenneth A. Egol, MD; Nirmal C. Tejwani, MD; NYU Hospital for Joint Diseases, New York, New York, USA

Purpose: Postoperative pain management after ankle fracture fixation often requires narcotic administration and overnight hospitalization. Previous studies have proven the efficacy of regional blocks for a wide variety of knee, ankle, and foot surgeries, and found success rates with popliteal regional block anesthesia for foot and ankle surguries. The purpose of this prospective randomized study was to compare postoperative pain control in patients treated surgically for ankle fractures who receive popliteal blocks with those who received general anesthesia alone.

Methods: All patients being treated with open reduction and internal fixation for ankle fractures at a single institution were asked to participate in this study. Patients who agreed to participate were randomized to receive either general anesthesia (GETA) or intravenous sedation and a popliteal block. Intraoperatively, patients were assessed for location of incisions, duration of procedure, and total time in the operating room. Postoperatively, all patients were monitored for their postoperative pain at 2, 4, 8, 12, 24, and 48 hours after surgery using a visual analog scale (VAS). Patients were also monitored for signs of allergic or toxic reactions and postoperative nausea and vomiting. All patients were followed up to 6 months to confirm fracture healing.

Results: 43 patients agreed to participate in the study; 21 patients received popliteal block, while 22 patients received GETA. The 2 groups were similar with regard to age, sex, type of ankle fracture, and tourniquet time. The popliteal block took 54.86 minutes from the time the patient entered the room until the skin incision was made, while the GETA group took 42.75 minutes (P < 0.001). At 4 hours postoperatively, patients who underwent GETA demonstrated significantly higher pain based on VAS (P = 0.017). However, by 24 hours, those who had received popliteal blocks had significantly higher pain (P = 0.05). There was no significant difference between the 2 groups with regard to satisfaction with postoperative pain control.

Conclusions: Popliteal block provides equivalent postoperative pain control to general anesthesia alone in patients undergoing operative fixation of ankle fractures. However, patients who receive popliteal blocks do experience a significant increase in pain between 12 and 24 hours. Recognition of this phenomenon of "rebound pain" with early narcotic administration may allow patients who receive popliteal blocks to have more effective postoperative pain control.
Twenty-Year Follow Up of Conservatively Treated "Isolated" Posterior Malleolar Ankle Fractures: A Case Series

*Christian Donken, MD*¹; A.J.F. Goorden¹; Michael Verhofstad, PhD²; Michael J. Edwards, PhD¹; Cees van Laarhoven, PhD¹; ¹Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands; ²St. Elisabeth Hospital, Tilburg, Netherlands

Purpose: The present study shows the long-term results of 24 patients with isolated posterior malleolar fractures between 1985 and 1990.

Methods: Outcome parameters used were (1) a functional outcome questionnaire (Olerud score), (2) physical examination (loaded dorsal range of motion [ROM]), (3) radiologic signs of instability (medial clear-space widening), (4) radiologic anatomic result (Cedell score), and (5) posttraumatic long-term damage (osteoarthritis).

Results: After a median of 20 years (range, 17-24 years), follow-up was achieved in 95% (n = 19) of living available patients. All patients were treated conservatively. The median Olerud score was 100 points, with 53% of the patients in the "excellent" result group. Excellent results were scored in 63% (loaded dorsal ROM), 32% (medial clear-space widening), 37% (osteoarthritis), and 47% (Cedell score). "Good" results were scored in 21% (Olerud score), 32% (loaded dorsal ROM), 68% (medial clear-space widening), 58% (osteoarthritis), and 37% (Cedell score). "Moderate" results were scored in 26% (Olerud score), 5% (loaded dorsal ROM), 5% (osteoarthritis), and 16% (Cedell score). Not 1 patient scored a "poor" result in any of the outcome parameters (Figure).

Conclusions: Conservative treatment of iso-lated posterior malleolar fractures resulted in good clinical and radiologic outcome in this series, with proof of little osteoarthritis at longterm follow-up.



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TEFTOM – A Promising General Trauma Outcome Measure?
Results of a Validation Study of Pan–American Ankle Trauma Patients
Michael Suk, MD, JD, MPH¹; Monica Daigl Cattaneo, MS²; Richard E. Buckley, MD³; Cleber A.J. Paccola, MD⁴; Dean G. Lorich, MD⁵; David L. Helfet, MD⁶; Beate Hanson, MD, MPH²;
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⁶Hospital for Special Surgery, New York, New York, USA

Purpose: Orthopaedic outcomes research lacks an instrument specifically designed for trauma populations to assess the role of a patient's expectations prior to surgical intervention and actual outcomes. To assess this, a 10-question, patient self-rating outcome instrument, the Trauma Expectation Factor Trauma Outcome Measure (TEFTOM) has been developed. TEFTOM is composed of 2 parts: (1) TEF, administered preoperatively, assesses patient expectations for their outcome at 1-year after surgery; and (2) TOM, administered postoperatively, to assess the degree to which the surgical outcome fulfills their expectations. The TEFTOM instrument was tested to demonstrate its content, construct and criterion validity as well as its reliability and sensitivity to change.

Methods: 201 patients with ankle or pilon fractures were recruited at 5 international centers in Canada, the United States, and Brazil and followed for a period of 12 months. TEF was administered preoperatively, following consultation with the orthopaedic surgeon to collect data regarding the patient's 1-year expectation of outcome. TOM was tested postoperatively. To confirm validity, TOM results were compared against the American Academy of Orthopaedic Surgeons Foot and Ankle Scale (AAOS), the Foot and Ankle Outcome Score (FAOS), and the Short Form–36 (SF-36) health survey.

Results: TEF showed good internal consistency (Cronbach alpha = 0.69) and reproducibility. The agreement between scores yielded on the first and second testing occasions was always higher than 0.67 over a 6-month testing period. TOM showed good criterion validity when validated against the AAOS, with correlation coefficients ranging from 0.70 to 0.77 over a 1-year testing period. Internal consistency proved to be excellent, with Cronbach alpha ranging from 0.75 to 0.85. There was sound agreement between TOM scores yielded on the first and second testing occasions. The correlation was higher than 0.92, suggesting the excellent reproducibility of TOM. TOM also proved to be responsive to changes in patient condition over time.

Conclusion: The TEFTOM instrument is a short and sound trauma patient outcome questionnaire that is easy to score and interpret. It proved to be valid, reliable, and responsive to change in assessing the condition of ankle and pilon fracture patients after surgery and is a first of its kind musculoskeletal trauma instrument that associates a patient's preoperative expectation with actual outcomes in ankle and tibial pilon fracture surgery.

Payer Status Negatively Influences Initial Treatment at Community Hospitals Compared to a Tertiary Care Center: A Prospective Study of 300 Operative Ankle Fractures

Michael T. Archdeacon, MD, MSE; Sudhir R. Belagaje, MD; Theodore Toan Le, MD; John D. Wyrick, MD; University of Cincinnati Medical Center, Cincinnati, Ohio, USA

Purpose: Ankle fractures are common injuries, and their initial and definitive management should fall within the skill set of most board-certified orthopaedic surgeons. The purpose of this study is to evaluate the association of payer status with initial treatment (attempted reduction) and transfer or referral to a tertiary care center for definitive treatment. Our null hypothesis states that no difference in initial treatment or payer status will be observed in operative ankle fracture patients who present primarily to our tertiary care center compared to patients who are transferred or referred.

Methods: We prospectively enrolled 300 consecutive operative ankle fracture patients who were definitively managed at our tertiary care center into this IRB-approved study. A power analysis demonstrated a sample size of 288 patients would be required in order to detect an odds ratio of 2.0 with a power of 0.8. Demographic, injury, initial and definitive treatment, and payer status data were obtained from the medical record and by direct patient interview. Adequacy of reduction was assessed radiographically by an independent orthopaedic surgeon not involved in the definitive care or surgery.

Results: 79% of the patients (236 of 300) presented primarily to our tertiary care center (LEV 1 group) and 21% (64 of 300) were transferred or referred (OUTSIDE group). In considering demographic and injury data, the only significant difference was noted in the distribution of race categories between groups (P = 0.04); however, there was a trend toward a higher percentage of unemployed patients in the referred group (LEV 1, 59%; OUTSIDE, 72%; P = 0.06). In terms of initial treatment, a significant difference was observed in attempted reduction (LEV 1, 73%; OUTSIDE, 42%; P < 0.0001), but not in adequacy of reduction (LEV 1, 65%; OUTSIDE, 48%; P = 0.11). Definitive treatment (surgery) occurred at a median of 1 day after injury in the LEV 1 group and a median of 3 days after injury in the OUTSIDE group (P < 0.0001). When considering payer status, a significant difference was observed for underinsured patients between the groups (LEV 1, 53%; OUTSIDE, 73%; P = 0.003).

Conclusions: This prospective study of 300 operative ankle fractures demonstrates the negative influence that an underinsured payer status has on both initial and definitive treatment. Underinsured patients were significantly less likely to have an attempted reduction at a community hospital compared to similar patients who presented primarily to the tertiary care center, and the interval from injury to surgery was significantly longer for the referred group. Additionally, a significantly higher proportion of patients transferred or referred to a tertiary center were underinsured compared to patients who presented primarily to the tertiary center were underinsured compared to patients who presented primarily to the tertiary center.

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Payer Status and Increased Distance Traveled for Fracture Care in a Rural State *William Lack, MD; Julian Carlo, MD; J. Lawrence Marsh, MD;*

University of Iowa Hospitals and Clinics, Iowa City, Iowa, USA

Purpose: Orthopaedic patients that require emergent care and have severe injuries are often appropriately referred to rural trauma centers over great distances but similarly patients with less severe injuries that do not require specialized treatment are also referred for care over similar distances. The goal of this study was to assess changes in distance traveled for rural fracture care and how this varies by case type, injury severity, and payer status.

Methods: A retrospective review of the electronic records was performed at a rural Level 1 trauma center. Adults who presented for the operative management of a defined set of orthopaedic injuries between 1990 and 2007 were divided into simple, complex, and emergent categories. Distance traveled to the tertiary care center and ISS were calculated. Case volume and distance traveled for care were compared by injury type, early (1990 to 1997) and late (1998 to 2007) time periods, and by payer status.

Results: There was an increase in simple, complex, and emergent orthopaedic procedures over time (all P < 0.01). Distance traveled increased over time for simple (P = 0.04) and complex (P = 0.03) but not for emergent injuries. Medicaid patients with simple and emergent injuries traveled further than non-Medicaid patients (P < 0.01). Expanded Medicaid patients traveled even further than standard Medicaid patients (P < 0.001) for the care of simple injuries. The ISS was lower for simple than for complex and emergent cases (P < 0.001); there was no change in ISS for complex and simple cases over time, while the ISS increased for emergent cases with time (P < 0.03). The percentage of patients presenting to the Level 1 trauma center with simple injuries for whom Medicaid was their payer increased from 11.8% to 35.5% (P < 0.001).

Conclusions: As the referral of orthopaedic trauma has increased over time, Medicaid patients with simple and emergent injuries have traveled further than patients with other payers and the proportion with simple injuries presenting to the Level 1 trauma center with Medicaid as their payer increased dramatically over time despite no change in injury severity for these patients. Appropriate resources are necessary to handle a rising volume of orthopaedic trauma at regional centers and to ensure that care is equitable. The referral of orthopaedic patients over great distance deserves further study as it affects patient outcomes, cost, and convenience of care.





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CASE PRESENTATIONS

Proximal Humerus Fractures – Current Concepts (#*S1*)

Moderator: Michael J. Gardner, MD Faculty: Clifford B. Jones, MD; Utku Kandemir, MD; Samir Mehta, MD and James R. Ringler, MD

Practical Issues in Clinical Research (#S2)

Moderator: Theodore Miclau, III, MD and Mohit Bhandari, MD Faculty: Gerard P. Slobogean, MD, MPH

Evaluation and Management of Complex Pediatric Elbow Fractures (#S3) Moderator: David A. Podeszwa, MD Faculty: Christine A. Ho, MD; Anthony I. Riccio, MD and Robert L. Wimberly, MD

Pelvic Ring Injuries: Surgical Treatment of Instability (#S4)

Moderators: James C. Krieg, MD and M.L. Chip Routt, Jr., MD Faculty: Mark C. Reilly, MD

Scapula Fracture Injuries and Treatment (#S5)

Moderator: William T. Obremskey, MD Faculty: Peter A. Cole, MD; Clifford B. Jones, MD and Paul Tornetta, III, MD

NOTES

SYMPOSIUM III: MANAGING AN ORTHOPAEDIC TRAUMA PRACTICE: STRATEGIES FOR TURBULENT TIMES

Moderator: William R. Creevy, MD

- Faculty: Lisa K. Cannada, MD Patricia Hofstra, JD John Martin, CEO OrthoIndy
 - 8:00 am Introduction William R. Creevy, MD
 - 8:15 am **OTA Survey Data and MD Perspectives** *Lisa K. Cannada, MD*
 - 8:30 am Legal and Fair Market Issues Patricia Hofstra, JD
 - 8:45 am Hospital Administration Perspectives John Martin, CEO OrthoIndy
 - 9:00 am Discussion

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SYMPOSIUM III: MANAGING AN ORTHOPAEDIC TRAUMA PRACTICE: STRATEGIES FOR TURBULENT TIMES

BIOGRAPHIES



Patricia S. Hofstra, JD Partner, Duane Morris LLP

Patricia S. Hofstra practices in the area of health law. Ms. Hofstra advises healthcare professionals and healthcare companies in corporate, regulatory and litigation matters.

Ms. Hofstra's clients include physicians and physician practice groups, hospitals, long-term care providers, retail clinics, home health

agencies, ambulatory care centers, medical device manufacturers, pharmaceutical companies and other healthcare companies. She has extensive experience in business transactions involving healthcare entities, medical staff matters, licensure and regulatory matters, managed care contracting, hospital/physician contracting, joint ventures and information technology. She regularly advises clients on fraud and abuse, governance, Stark and intermediate sanction issues.

Ms. Hofstra is a graduate of Ohio Northern University College of Law and a graduate of the Pennsylvania State University (B.S.N.).

Areas of Practice

- Healthcare Law
- Medical Staff Law
- Healthcare Fraud and Abuse
- Physician Practices
- Employment Law
- Regulatory Compliance

Representative Matters

- Represented physician-owned specialty in sale of 20 percent interest to not-for-profit hospital system.
- Counsel to providers regarding Stark and fraud and abuse with respect to joint ventures, physician recruitment matters managed care contracts and negotiations.
- General counsel to several physician group practices.
- Drafted medical staff bylaws and related documents for numerous hospital clients.
- Counsel to several hospitals, group practices and individual physicians with respect to credentialing and peer review matters.
- Represented primary care practice in corporate reorganization, drafting compensation agreements, establishing ancillary services, revising shareholder and employment agreements.
- Negotiated numerous hospital-based physician contracts for physician and hospital clients.
- Successfully represented vascular surgeon in ZPIC audit.
- Represented two different anesthesia groups where physician member of the group was alleged to have diverted and used illegal substances.

- Successfully represented anesthesiologist before state licensing agency on allegations of impairment and drug diversion and negotiated severance package for physician.
- Successfully represented orthopedic practice in workers compensation and unemployment state tax matter pertaining to independent contractor vs. employee status of physician.
- Represented several anesthesia and emergency medicine hospital-based physician groups with hospital contract negotiations resulting in additional compensation for groups and contract terms the client found favorable.
- Represented several long term care facilities for developmentally disabled in federal and state involuntary discharge proceedings.
- Assisted large orthopedic practice in establishing a consulting company.
- Represented physician in Medicaid audit.
- Represented physician groups in managed care audit.
- Represented hospital in on call and coverage dispute.
- Advised sports medicine practice regarding NCAA team physician obligations and establishment of athletic training program.
- Advised orthopedic practice regarding establishment of athletic training program.
- Counsel to hospitals and ambulatory surgery centers with respect to accreditation matters.
- Counsel to Fortune 50 manufacturer with respect to establishment of company based medical services.



John D. Martin, Chief Executive Officer of OrthoIndy

John Martin boasts more than 22 years of progressive financial management, strategic planning and operational experiences within the health care industry.

Martin began his professional career in 1986 as an accounting manager for Indiana Home Health Services. By 1993, Martin became chief

financial officer for Fairbanks Hospital in Indianapolis and two years later, Martin joined Radiology Associates of Indianapolis as an administrator. After many successes in the clinical setting, Martin transitioned his wealth of financial health care experiences into a consulting position with BKD, LLP in 1999. Martin then served as director of financial planning and business development at St. Francis Hospital in Indianapolis.

In August, 2004, Martin became chief executive officer of the Indiana Orthopaedic Hospital (IOH). During Martin's tenure as chief executive officer, IOH won several awards from HealthGrades, the nation's leading healthcare ratings company.

Martin then moved into the position of chief executive officer for OrthoIndy in October, 2006. The largest private, full-service orthopaedic practice in the Midwest, OrthoIndy is comprised of an over 75 physician practice, providing bone, joint, spine and muscle care to patients.

Martin is a graduate of Indiana University's Kelly School of Business. He is an advanced member of the Health Care Financial Management Association and resides in Greenfield, Indiana with his wife and three daughters.

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A Prospective Evaluation of Posttraumatic Stress Disorder and Parent Stress in Children Exposed to Orthopaedic Trauma

Meagan Wallace, MD; Aki Puryear, MD; Lisa K. Cannada, MD; Saint Louis University, Dept. of Orthopaedic Surgery, St. Louis, Missouri, USA

Purpose: Trauma has more than just physical effects on pediatric patients and their families. The purpose of this study was to evaluate pediatric orthopaedic trauma patients, and pediatric patients with isolated nonoperative upper extremity fractures along with their parents for emotional / psychological symptoms associated with posttraumatic stress disorder (PTSD). We hypothesized pediatric orthopaedic trauma patients with high-energy injuries would have significant rates of PTSD compared to the patients with isolated low-energy upper extremity fractures.

Methods: An IRB-approved prospective study was conducted of pediatric patients 8 to 18 years of age who sustained a traumatic injury or an isolated upper extremity fracture at least 3 months prior to being seen in clinic. Data were collected from October 2009 to May 2010. Exclusion criteria included a traumatic brain injury with Glascow Coma Score <15. Demographic data, injury details, and information on the child's school and extracurricular activities were obtained. The Child PTSD Symptom Scale (CPSS) was utilized to evaluate the patients for PTSD. The Parent Stress Index (PSI) was utilized to evaluate the stress of the parents/guardian. For 80% power, we needed to recruit 32 children per group. *P* value was set at <0.05.

Results: A total of 76 children and their parent/guardian participated in the study. The mean age was 12.6 years (range, 8-17 years). There were 56 males (74%) and 20 females (26%). The average time since injury was 12 months (range, 3-89 months). 32 children in the trauma group had surgery, with 10 having more than 1 surgery. No patients in the isolated upper extremity group had surgery. The data were evaluated based on 4 groups: trauma patients with PTSD, trauma patients without PTSD, upper extremity patients with PTSD, and upper extremity patients without PTSD. Overall 33% of our total patients had PTSD: 24% of the trauma group and 9% of the upper extremity group. We found pediatric patients who experience high- or low-energy trauma can have PTSD. Involvement in music was found to be protective against PTSD (P = 0.037). In our population, the stress of the parent was not associated with PTSD in the child.

Conclusion: PTSD commonly affects pediatric patients who sustain injuries as a result of a traumatic event, whether low- or high-energy mechanisms. We found no factors significantly associated with or predictive of PTSD in our 4 patient groups. Awareness of PTSD is important and we need to have a high index of suspicion in all pediatric trauma patients regardless of the energy associated with the traumatic event. Patients who exhibit signs of PTSD should be provided with resources so that an intervention can be done in a timely manner.

Sat., 10/15/11 Peds, Ger, Hip, Femur & IP, Paper #68, 10:06 am OTA-2011

Does Following the AAOS and AAP Guidelines for Trampoline Use Decrease the Severity of Pediatric Trampoline Injuries? A Prospective Study

*James R. Phelps, MD, MPT*¹; Christine A. Ho, MD²; Neil Evans, MD³; Pam Okada, MD²; ¹University of Texas Southwestern Medical School, Dallas, Texas, USA; ²Children's Medical Center–Texas Scottish Rite Hospital, Dallas, Texas, USA; ³Cook Children's Medical Center, Fort Worth, Texas, USA

Purpose: As the popularity of recreational trampoline use continues to increase, the number of pediatric trampoline injuries has also followed this trend, despite both AAOS (American Academy of Orthopaedic Surgeons) and AAP (American Academy of Pediatrics) policy statements detailing guidelines to improve the safety of these devices. The purpose of this study was to prospectively analyze all patients seen in the pediatric emergency department (ED) or orthopaedic clinic who sustained a trampoline-related injury and evaluate the risk factors affecting the severity of their injury, with special attention to the recommendations issued by the AAOS and AAP.

Methods: 300 consecutive patients that sustained a trampoline-related injury were evaluated in the ED or orthopaedic clinic and consented to participate in the study. Measures of severity included the Abbreviated Injury Scale (AIS), Glascow Coma Score (GCS), need for surgical intervention, and need for a sedated closed manipulation of the patient's fracture. Risk factors included presence of adult supervision, number of participants, trampoline height, use of protective safety devices, age of the patient (recommendation is to prohibit use in children younger than 6 years old), and whether a high-risk maneuver was performed at the time of injury. These data were analyzed to identify any statistically significant correlation between risk factors and measures of severity of injury.

Results: Of the 300 patients, over 99% (299/300) were found to have severe/serious or moderate severity of injury according to the AIS. Of these injuries, 91% (273/300) were fractures, and 1% were visceral injuries (3/300). 49% (147/300) required an intervention; of these, 31% (93/300) required an operation and 18% (54/300) required a procedure with conscious sedation. An adult was present during 71% (214/300) of the injuries, and protective safety devices were used in 55% (164/300) of injuries. 58% (174/300) of injuries occurred in children 6 years of age and older, and a high risk maneuver was attempted in only 23% (70/300) of the injuries. There were no correlations found between risk factors and measures of severity.

Conclusion: Trampoline recreation can result in severe injuries consisting of not only fractures but visceral injuries that often lead to surgery or a need for reduction under conscious sedation. Also, children are at risk of an injury on a trampoline regardless of age, adult supervision, trampoline height, use of protective devices, performance of high-risk maneuvers, and number of participants, and following the guidelines set by the AAP and AAOS does not necessarily correlate to less severe injuries. Our results demonstrate that despite following the AAP and AAOS recommended guidelines, there is no such thing as "safe" trampolining, and severe injuries can occur despite the best vigilance of parents.

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Sat., 10/15/11 Peds, Ger, Hip, Femur & IP, Paper #69, 10:17 am OTA-2011

Pediatric Type 2 Supracondylar Humerus Fractures: Does Time to Surgery Matter? A. Noelle Larson, MD¹; Sumeet Garg, MD²; Amanda L. Weller, MD³; Nicholas D. Fletcher, MD⁴; Jonathan R. Schiller, MD⁵; Michael Kwon, MD⁶; Lawson A.B. Copley, MD⁷; Christine A. Ho, MD⁷; ¹University of Minnesota, Minneapolis, Minnesota, USA; ²Denver Children's Hospital, Denver, Colorado, USA; ³University of Texas Southwestern, Dallas, Texas, USA; ⁴Emory University, Atlanta, Georgia, USA; ⁵Brown University, Providence, Rhode Island, USA; ⁶Texas Scottish Rite Hospital for Children, ⁷Children's Medical Center, Dallas, Texas, USA

Purpose: Due to changing referral patterns, increasing numbers of pediatric supracondylar humerus fractures are treated at tertiary centers. To expedite patient flow, type 2 fractures are sometimes pinned in a delayed fashion or in an outpatient setting. We hypothesized that delay in surgical treatment of Gartland type 2 supracondylar humerus fractures would not affect the generally excellent outcomes following closed reduction and percutaneous pinning.

Methods: We performed a retrospective review of a consecutive series of 1297 supracondylar fractures treated operatively at a tertiary referral center over 4 years. 31% (399 fractures) were Gartland type 2 fractures. Mean patient age in the type 2 group was 5 years (range, 1-15 years). 48% were pinned within 24 hours, 25% pinned from 1 to 5 days, and 27% pinned 5 days or more after the injury.

Results: 16 patients (4%) sustained a complication, but there was no association between complications and time to surgery. There were no compartment syndromes, vascular injuries, or permanent nerve injuries. Three patients sustained nerve injuries. All underwent surgery within 24 hours of injury. One patient developed an ulnar motor and sensory nerve palsy after fixation with crossed Kirschner wires. This resolved by 7 weeks postoperatively. One patient presented with an anterior interosseous nerve palsy that resolved at 7 weeks and 1 with a posterior interosseous nerve palsy, which resolved at 8 weeks postoperatively. Other complications included physical therapy referral for stiffness (3), pin-site infection (2 treated with oral antibiotics, 4 treated with surgical irrigation and débridement), refracture (2), and loss of fixation or broken hardware (2).

Conclusions: Satisfactory outcomes are possible even with delayed treatment of type 2 supracondylar humerus fractures. Delay in surgery did not result in increased complications following closed reduction and percutaneous pinning of type 2 supracondylar humerus fractures in children. Further prospective work is necessary to see if operative time or techniques differ or if there are subtle functional benefits with emergent treatment of type 2 supracondylar humerus fractures.

Management of the Pediatric Pulseless Supracondylar Humerus Fracture: Is Vascular Exploration Necessary?

Amanda L. Weller, MD¹; Sumeet Garg, MD²; A. Noelle Larson, MD³; Nicholas D. Fletcher, MD⁴; Jonathan R. Schiller, MD⁵; Michael Kwon, MD⁶; Lawson A.B. Copley, MD⁷; Christine A. Ho, MD⁷; ¹University of Texas Southwestern Medical School, Dallas, Texas, USA; ²Denver Children's Hospital, Denver, Colorado, USA; ³University of Minnesota, Minneapolis, Minnesota, USA; ⁴Emory University, Atlanta, Georgia, USA; ⁵Brown University, Providence, Rhode Island, USA; ⁶Texas Scottish Rite Hospital for Children ⁷Children's Medical Center, Dallas, Texas, USA

Purpose: The purpose of this study is to examine the management of vascular injury in a large case series of pediatric patients with supracondylar humerus fractures who initially presented with a nonpalpable pulse.

Methods: 1297 consecutive operatively treated supracondylar humerus fractures that presented to a Level 1 pediatric trauma center from 2003 to 2007 were reviewed retrospectively. Clinical records were reviewed to determine vascular examination, Gartland classification, neurologic examination, associated injuries, timing of surgery, and postoperative complications.

Results: 1266 patients had documented radial pulse examinations, of which 54 (4%) had absent pulses. All 54 patients had type 3 fractures. Five patients (9%) underwent open exploration of vascular structures based on clinical findings of cool, pale hand, sluggish capillary refill; and/or weak or no dopplerable pulse after closed reduction; 1 of these 5 presented with an open fracture. All 5 were found to have a vascular injury needing repair to restore blood flow. The 4 patients who underwent immediate vascular exploration and repair were all noted to have nondopplerable pulses following reduction and pinning. Twenty patients (37%) had a documented dopplerable pulse and pink hand after closed reduction but the radial pulse remained nonpalpable. These patients were observed in the hospital for signs of ischemia, and one of these did require delayed vascular repair after developing a cool, pale hand; the remaining 19 regained a palpable pulse prior to discharge or by the first postoperative visit. Compared to all type 3 fractures included in the study, those patients with pulseless presentation had a higher rate of nerve palsy documented postoperatively (32% vs 9%; *P* <0.0001). Time from injury to surgery was also significantly less than other type 3 fractures (8.4 hours vs 16.8 hours; *P* <0.0001.)

Conclusions: This study demonstrates that almost 10% of patients who presented with a type 3 supracondylar humerus fracture and nonpalpable pulse underwent vascular repair to restore blood flow. However, in our series, a nonpalpable pulse after closed reduction was not an absolute indication to proceed with vascular exploration if clinical findings suggest that the limb is perfused (Doppler signal, capillary refill). Further prospective study is needed to define the role of the Doppler study in the pink, pulseless hand. In addition, pulseless patients also have a significantly higher rate of nerve palsy than patients with palpable radial pulses.

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Functional Outcomes of Nonoperative Treatment of Geriatric Acetabular Fractures Meeting Operative Criteria

Scott P. Ryan, MD; Theodore T. Manson, MD; Christopher T. LeBrun, MD; Jason W. Nascone, MD; Marcus F. Sciadini, MD; Renan C. Castillo, PhD; Robert V. O'Toole, MD; R Adams Cowley Shock Trauma Center, Dept. of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland

Purpose: Controversy exists regarding the best treatment for displaced geriatric acetabular fractures. The purpose of this study is to report the functional outcomes in patients older than 60 years, who sustained an acetabular fracture and were treated nonoperatively despite having fracture patterns that would be treated operatively in younger, healthier patients. Our hypothesis is that this treatment results in worse outcomes than open reduction and internal fixation (ORIF).

Methods: We contacted 24 patients 60 years of age or older who sustained an acetabular fracture and were treated nonoperatively with early mobilization over a 7-year period at one Level 1 trauma center. No patients were treated in traction. Radiographic review (at least 3 of 5 independent traumatologists agreed that based on fracture pattern alone that the patient would have qualified for operative treatment if the patient were young and healthy) determined that 15 patients (average follow-up 2.2 years) would have been treated with ORIF if young. Reasons for nonoperative treatment included advanced age, medical comorbidities, and preexisting arthritis. Our control group (n = 46, average follow-up 4.6 years) was a previously reported group of patients older than 60 years, who sustained an acetabular fracture and were treated operatively at the same institution over the same time period. The primary validated outcome measures were the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) hip and Short Form–8 (SF-8) scores. Secondary outcome was failure of nonoperative treatment, defined as conversion to ORIF or total hip arthroplasty and 1-year mortality.

Results: Patients in the nonoperative group were significantly older (74 vs 68 years; P < 0.05) and had more medical comorbidities per patient (1.76 vs 1.13; P < 0.05). There was no statistical difference in the overall, or any subsets, of the WOMAC or SF-8 (P > 0.05; 80% power to detect differences between 15% and 20% in functional outcomes). This remained true when analyzing patients treated nonoperatively with fracture patterns that met traditional operative criteria and when controlling for fracture pattern. There were no differences in the failure rates (16% vs 28%; P = 0.38) or 1-year mortality (24% vs 21%; P > 0.05) between the groups.

Conclusion: Elderly patients with a fracture pattern that would qualify for operative treatment in a younger patient had surprisingly good outcome scores when treated nonoperatively. These scores were similar to our control group of geriatric patients treated operatively and to historic controls after primary total hip replacement. These data further cloud the debate on the best treatment for these fractures and argue for the importance of a randomized trial to delineate the best treatment for this growing cohort of complex patients.

Functional Outcomes in Elderly Patients With Acetabular Fractures Treated With Minimally Invasive Reduction and Percutaneous Fixation Joshua L. Gary, MD; Michael VanHal, MD; Steven D. Gibbons; Charles M. Reinert, MD; Adam J. Starr, MD; University of Texas Southwestern Medical Center, Dallas, Texas, USA

Purpose: The incidence of osteopenic geriatric fractures continues to rise as the population ages. There has been much recent interest in the treatment of acetabular fractures in geriatric patients, and no consensus exists in the optimal treatment of these difficult injuries. We seek to present the functional outcomes of elderly patients treated with percutaneous reduction and fixation and compare them to those treated with traditional open reduction and internal fixation in previously reported series.

Methods: Our institutional trauma database was searched for all patients \geq 60 years of age who had been treated with percutaneous screw fixation for an acetabular fracture from 1994 to 2007. Survivorship to present day and conversion to total hip arthroplasty were determined with patient and/or family contact; the Social Security Death Index was used to determine mortality when no one could be contacted. Living patients were evaluated using the SMFA (Short Musculoskeletal Function Assessment) and Harris hip score; radiographs were obtained if the patient was able to visit the office. Our functional outcomes were then analyzed against data from other published series with similar outcome measures.

Results: 79 consecutive patients with 80 fractures were identified. 36 patients (including the patient with bilateral fractures) died before functional outcomes were obtained, leaving 43 patients and fractures in our study group. Follow-up was obtained in 36 of 43 patients (83.7%) and functional outcomes were obtained in 35 of 43 patients (81.3%) at an average of 6.8 years after the index surgery. One patient could not complete surveys due to severe dementia. Average age at time of injury was 69.9 years, with 25 males and 10 females. 11 of these 36 (30.5%) patients had undergone conversion to total hip arthroplasty at time of latest follow-up. Average SMFA dysfunction and bother indices were 23.3 and 21.3, respectively, in 24 patients who maintained their native hip. When compared with SMFA data from 2 other series of patients treated with formal open reduction and internal fixation, no differences existed in the dysfunction (P = 0.49) or bother (P = 0.55) indices. Average Harris hip scores in patients with their native hip was 77 (range, 33-100). In the 11 patients converted to total hip arthroplasty, average SMFA dysfunction and bother indices were 24.3 and 23.9, respectively. No differences were found in the dysfunction (P = 0.93) or bother (P = 0.16) indices when compared to patients converted from open reduction and internal fixation to total hip arthroplasty. Average Harris hip score in patients converted to total hip arthroplasty was 83 (range, 68-92).

Conclusion: Functional outcomes and rates of conversion to total hip arthroplasty of acetabular fractures in elderly patients treated with percutaneous reduction and fixation show no significant differences when compared with published series of patients treated with formal open reduction and internal fixation.

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Sat., 10/15/11 Peds, Ger, Hip, Femur & IP, Paper #73, 10:46 am OTA-2011

Surgical Treatment Improves Clinical and Functional Outcomes for Patients Who Sustain Incomplete Bisphosphanate-Induced Femur Fractures

Kenneth A. Egol, MD; Colin J. Prensky, BA; Ji Hae Park, BS; Zehava S. Rosenberg, MD; Nirmal C. Tejwani, MD; NYU Hospital for Joint Diseases, New York, New York, USA

Purpose: Recently increasing evidence has shown a pattern of subtrochanteric femur fractures associated with long-term bisphosphonate use. The purpose of this study is to describe the ultimate outcomes for patients treated at a single institution, for incomplete bisphosphonate-induced femoral fractures.

Methods: Between 2004 and 2011, 65 patients with 101 femur fractures were identified as having radiographic findings consistent with bisphosphonate-induced atypical femur fractures and were enrolled in our database. Incomplete fractures were defined by a pattern of lateral cortical thickening on radiographs with or without obvious fracture. For all incomplete fractures, bisphosphonate therapy was discontinued and patients were treated with conservative management. Surgery was performed for fractures with refractory symptoms or failure to alter radiographs with nonsurgical treatment. 34 patients with 47 incomplete fractures were identified and analyzed. Three patients with four fractures went on to complete fractures and were excluded from this study. Patients were assessed at a mean 16.4 months with the Short Musculoskeletal Functional Assessment (SMFA). Patient demographics, initial radiographic diagnosis, treatment modality, time to healing, and self-reported functional status were retrospectively documented. Healing was documented radiographically. Functional status and clinical data were analyzed by Student *t* test and Fisher exact test.

Results: This cohort had been treated with bisphosphonates for an average of 10 years (range, 7-15 years). The average healing time for all incomplete fractures was 8.2 months (range, 1.5-24 months), with 2 fractures failing to unite at latest follow-up. 50% of fractures were ultimately treated with surgery for failure of or pain refractory to nonsurgical management. At latest follow-up, 91% of patients treated with surgery reported no pain and 78% of fractures were radiographically united. 71% of surgical patients self-reported a return to baseline functional status. In contrast, 31% of nonoperative patients were asymptomatic at latest follow-up with 31% of fractures showing radiographic evidence of healing. Standardized dysfunction index from the SMFA was 19.7 in the surgical group and 25.7 in the nonsurgical group (P = 0.0017).

Conclusions: While bisphosphonate therapy is an important tool in the fight against postmenopausal vertebral fractures and typical hip fractures, its long-term use is not without risk. We found that nearly half of the patients with nondisplaced bisphosphonate-induced femoral fractures ultimately required surgical intervention for relief of symptoms. At an average of 16.4 months, patients who had surgery reported significantly better functional outcomes according to the SMFA. Functional outcomes support radiographic findings and clinical signs of healing. Surgical intervention is effective for relief of symptoms when treating incomplete bisphosphonate-induced femur fractures and patients should be advised of the potential benefits of prophylactic surgery. Sat., 10/15/11 Peds, Ger, Hip, Femur & IP, Paper #74, 10:57 am OTA-2011

Patient Variables That May Predict Length of Stay and Incurred Hospital Costs in Elderly Patients With Low-Energy Hip Fracture

Anna E. Garcia, BS; J. V. Bonnaig, BS; Zachary T. Yoneda, BS; Justin E. Richards, MD; Jesse M. Ehrenfeld, MD, MPH; **Manish K. Sethi, MD**; A. Alex Jahangir, MD; William T. Obremskey, MD, MPH; Vanderbilt University Medical Center, Nashville, Tennessee, USA

Purpose: Operative fixation of low-energy hip fractures in the elderly is a common orthopaedic procedure that is expected to increase in frequency as the population of older Americans increases. By 2025, incidence and cost of fractures is expected to increase by over 50% as the number of persons over 50 years of age increases by 60% as compared to 2000. In the era of significant healthcare reform aimed at decreasing healthcare costs and transforming reimbursement models, it is critical to identify factors that impact the prognosis and costs of this population. One parameter that can potentially result in increased healthcare costs is increased length of stay during the postoperative period following surgical management of a hip fracture. The purpose of this study is to identify the factors that contribute to increased length of stay after hip fracture surgery, and therefore lead to increased overall costs in the treatment of the elderly hip fracture.

Methods: From January 2000 to December 31, 2009, all patients over the age of 60 yearswho presented to the only Level 1 trauma center in a large metropolitan area with an isolated low-energy hip fracture were reviewed. These patients' charts were reviewed and information was gleaned including gender, height, weight, body mass index (BMI), length of surgery, length of operative procedure, method of fixation, American Society of Anesthesiologists (ASA) classification, and medical comorbidities. Analysis of the variance was conducted to determine significant trends.

Results: 720 patients were identified, for whom 660 had complete records able to be analyzed. There was no significant correlation between BMI or a specific medical comorbidity and the length of stay. However, ASA classification proved to be a reliable predictor of postoperative length of stay for patients undergoing operative fixation of a hip fracture. For every ASA increase of 1, average subsequent length of hospitalization increases 2.053 days (*P* <0.001). Utilizing the fact that the average total daily cost to the hospital was determined to be \$4530 per day for patients who had fixation of their hip fracture and an uncomplicated postoperative course at our institution, each increase in ASA classification resulted in an increase of \$9300 in hospital cost. Thus a patient who is an ASA of 4 will incur on average \$27,900 more expense to the hospital than a patient with an ASA of 1 for the fixation of a hip fracture.

Conclusion: This study demonstrates the usefulness of ASA classification in estimating the length of stay for patients undergoing operative fixation of a hip fracture and, subsequently, a predictor of the potential cost to a hospital for treating a patient with a hip fracture. Given that ASA classification and daily cost are universally collected data, this method can easily be employed in almost any hospital system. This study highlights a potential role for the ASA classification in the preoperative estimation of the elderly patient's cost to a hospital.

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Furthermore, as reimbursement systems change from a fee-for-service model to a more fixed reimbursement for a specific diagnosis, this study highlights the need for a tiered reimbursement model for each diagnosis based on patient factors.

DVT Prophylaxis and Mortality After Hip Fracture

*Pierre Guy, MD*¹; Rik W. Nienhuis, MD²; Kelly A. Lefaivre, MD¹; Lisa Kuramoto¹; Boris Sobolev, PhD¹; ¹University of British Columbia, Vancouver, British Columbia, Canada; ²University of Groningen, Groningen, The Netherlands

Purpose: DVT chemoprophylaxis following hip fracture is increasingly recommended. The elderly hip fracture population is known to be at risk for development of postoperative deep vein thrombosis (DVT) and pulmonary embolism (PE), grouped as VTE (venous thromboembolism). These risks are recognized for hip fractures in the literature; however, the benefits of prophylactic anticoagulation to lower the risk of VTE and death with low molecular-weight heparins or other measures are not as well quantified. Recently, low molecular-weight heparin has been recommended by the American College of Chest Physicians for postoperative prophylaxis in hip fracture cases. We took the opportunity of a varied VTE chemical prophylaxis practice in our institution to assess clinical risks and benefits related to complications and 30-day mortality.

Methods: 1297 admissions for >65-year-old patients with operatively treated hip fractures were identified by our orthopaedic trauma database between January 2003 and December 2007. The medical records were reviewed to ascertain the prophylaxis method, clinical data, complications, and in-hospital mortality. Postdischarge mortality and pharmacologic therapy were captured through our governmental Vital Statistics office and Pharmanet databases, using personal health number and date of birth as matching criteria.

Results: 1202 files had complete information and formed the cohort. Mean age was 83.6 years (range, 66-106 years). 75.4% were female. 431 patients (35.9%) received low molecular-weight heparin (LMWH) chemoprophylaxis. 91 patients (7.6%) developed a wound problem and 8 required repeat surgery. χ^2 test revealed no association between wound problems and LMWH chemoprophylaxis (P = 0.94). Overall, "all causes" mortality rate was 7.4% (89 patients) with 70 patients dying in hospital (5.8%) or discharged and dying within 30 days of surgery (19 patients [1.6%]). Discharged deaths occurred at a mean 19 days (standard deviation 8) postsurgery. χ^2 test revealed no association between mortality and LMWH chemoprophylaxis separately for all 3 time periods (P = 0.66, 0.190, 0.124, respectively).

Conclusion: Review of this "natural experiment" in a real-world setting of varied VTE prophylaxis practices after hip fracture failed to demonstrate an association between the use of LMWH chemoprophylaxis and wound complications or mortality. This constitutes the first larger scale "comparative effectiveness" assessment in this clinical setting. Strengths include the reliable outcome measure; limitations include surgeon randomized, retrospective data and small event count. These findings could raise controversy in clinical and policymaking settings by quantifying the association between VTE preventative measures and mortality in a real-world setting, but it will also importantly help define the sample size required for large clinical trials or population-based assessments using death, wound problems, and cost-effectiveness as an outcome. As our aged population steadily grows, clinicians, health administrators, and policymakers will seek such important studies for decision-making.

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Influence of Displacement and Treatment Method on Survivorship of the Index Procedure for Femoral Neck Fracture

Donavan K. Murphy, MD, MSc, MBA; Timmothy Randell, MD; Kindyle L. Brennan, PhD, PT; Juhee Song, PhD; John M. Hamilton, BA; Michael Brennan, MD; Robert A. Probe, MD; Scott & White Memorial Hospital, Temple, Texas, USA

Purpose: This study was designed to assess the effect of fracture displacement and treatment modality on the rate of revision surgery following femoral neck fracture (FNF).

Methods: A single-institution retrospective review of medical records and radiographs was performed on 580 patients (612 hips) treated surgically for FNF between 1998 and 2009. Exclusion criteria included age less than 60 years, high-energy etiology, and neoplasia. A multivariable Cox proportional hazards regression model was created to investigate factors associated with greater risk of revision.

Results: The average patient age (±standard deviation) was 82 (±8) years and 484 cases (79%) were females. 291 cases (48%) were treated with CRPP (closed reduction percutaneous pinning), and 321 (52%) were treated with HA (hemiarthroplasty). 181 fractures (30%) were classified as nondisplaced (170 treated with CRPP; 11 treated with HA), while 431 cases (70%) were classified as displaced (121 treated with CRPP; 310 treated with HA). 95 cases (15.6% [2 bilateral]) received revision surgery. CRPP resulted in a 17% (29 of 170) rate of revision in the nondisplaced group and a 40% (50 of 121) failure rate in displaced FNFs. The 3 most common reasons requiring revision following CRPP were loss of fixation (n =29), nonunion (n = 28), and avascular necrosis (n = 10). HA resulted in no revisions (0/11)in the nondisplaced group and a revision rate of 5% (16/310) in the displaced FNFs. In this revision group, the etiology was infection (n = 9), femoral loosening (n = 2), acetabular wear (n = 2), hematoma evacuation (n = 2), and periprosthetic fracture (n = 1). Revisionfree survival estimates at 1 year for the nondisplaced group were 100% for HA, and 83% for CRPP. The displaced group survival estimates were 95% for HA, and 64% for CRPP. Univariate analysis showed that surgery type was the only significant variable associated with increased risk of revision (P <0.001). Multivariate analysis showed that fracture displacement (hazard ratio [HR], 2.79; 95% confidence interval [CI], 1.77-4.40; P <0.001) and CRPP surgery type (HR, 9.15; 95% CI, 5.22-16.05; P < 0.001) were independent risk factors associated with increased risk of revision.

Conclusion: This study demonstrates that fracture displacement and CRPP are combined risk factors associated with increased rates of revision following surgical treatment of FNFs. This affirms previously reports showing high failure rates of CRPP in displaced fractures. However, this study reports a higher than expected failure rate of 17% for CRPP in nondisplaced FNFs.

Sat., 10/15/11 Peds, Ger, Hip, Femur & IP, Paper #77, 11:20 am OTA-2011

Δ Pain and Satisfaction with Pain Management in Hospitalized Trauma Patients

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Purpose: The primary objective of this study was to determine the level of pain and satisfaction with pain management in hospitalized orthopaedic trauma patients. A secondary objective was to examine the association between patient self-efficacy and pain beliefs and pain and satisfaction outcomes at hospital discharge, after controlling for demographics, injury characteristics, and psychological distress. The main hypothesis was that decreased self-efficacy and negative pain beliefs along with psychological distress would be associated with increased pain and decreased satisfaction at hospital discharge.

Methods: This study prospectively enrolled 213 patients (representing 265 surgeries), 19 to 86 years of age, admitted to a Level 1 trauma center for surgical treatment of lower-extremity (80%), upper-extremity (12%), and pelvis/acetabular (8%) injuries between November 2009 and November 2010. The current analysis excluded 15 patients without a discharge assessment, resulting in 250 surgeries requiring at least 24 hours in the hospital (94% follow-up rate). Participants were enrolled postoperatively on the orthopaedic unit and answered questions on demographics and preinjury health. A discharge assessment measured pain intensity and interference with activity (Brief Pain Inventory [BPI]); satisfaction with pain management, self-efficacy, and pain beliefs (American Pain Society Patient Outcome Questionnaire); and depression and posttraumatic stress disorder (PTSD). Clinical characteristics were abstracted from the medical record. Associations between patient variables and pain and satisfaction outcomes were analyzed using multilevel multivariable logistic regression techniques.

Results: 241 trauma patients (96%) reported pain at the time of hospital discharge. Of the patients with pain, 37% reported mild pain (BPI 1-4); 35%, moderate pain (BPI 5-6); and 24%, severe pain (BPI 7-10). 14% of trauma patients were dissatisfied with pain treatment overall. 22% of patients with moderate to severe pain were dissatisfied and 2% of patients with no to mild pain were dissatisfied (P < 0.001). Separate multilevel multivariable regression analyses demonstrated that decreased self-efficacy for pain management and increased levels of depressive symptoms were associated with moderate to severe pain intensity and interference with activity at hospital discharge, after controlling for demographics and PTSD (P < 0.05). Moderate to severe pain and increased levels of depressive symptoms were associated with decreased satisfaction at hospital discharge, after controlling for self-efficacy, pain beliefs, and PTSD (P < 0.05).

Conclusions: A significant minority of hospitalized trauma patients report severe pain and dissatisfaction with pain treatment. Results imply that efforts to improve pain assessment and management among hospitalized orthopaedic trauma patients are needed. Address-

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ing patient self-efficacy and depression during the hospital stay may improve pain and satisfaction outcomes among patients with traumatic orthopaedic injury. Improved communication between physicians who are responsible for care and mental health providers is recommended.

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Sat., 10/15/11 Peds, Ger, Hip, Femur & IP, Paper #78, 11:26 am OTA-2011

Clinical Outcomes of Locked Plating of Distal Femoral Fractures Martin F. Hoffmann, MD¹; Clifford B. Jones, MD, FACS^{2,3}; Debra L. Sietsema, PhD^{2,3}; Paul Tornetta, III, MD⁴; Scott J. Koenig, MD⁴; Benjamin T. Maatman, BS⁴; ¹Grand Rapids Medical Education Partners, Grand Rapids, Michigan, USA; ²Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA; ³Michigan State University, Grand Rapids, Michigan, USA; ⁴Boston University Medical Center, Boston, Massachusetts, USA

Purpose: Locked plating (LP) of distal femoral fractures is very popular. Despite technique suggestions from anecdotal and some early reports, risk factors for failure, nonunion (NU), and revision are limited. The purpose of this study was to investigate the risk factors for failure and to confirm suggested technical recommendations.

Methods: From 2 academic trauma centers, 261 consecutive distal femoral fractures (OTA 33) were retrospectively identified. 133 fractures in 127 patients (56% female) had an average age of 55 years (range, 18-95 years). 40% of the cohort was obese, 18% were smokers, and 20% were diabetic. 35% of the fractures were open, with 76% type III. Fixation constructs for plate length, working length, and screw concentration were delineated. NU, infection, and implant failure were used as independent complication variables. Demographics were assessed.

Results: *Nonunion*: 100 (75.2%) of the fractures healed after the index procedure. 26 (19.6%) of the patients developed NU. 31 of 133 (23.3%) had staged bone grafting (BG) with 3 of 31 (9.7%) resulting in a recalcitrant NU requiring repeat BG. Length of comminution is related to NU (P = 0.04). *Implant Failures*: 14 (10.5%) of the patients had an implant failure. Independent variables for implant failure were staged BG (P < 0.01) and periprosthetic fractures (P < 0.01). *Fixation Constructs*: No failures occurred with plates with ≥ 14 proximal holes. A 6-fold higher relative risk of failure is noted utilizing plate lengths of ≤ 10 holes compared to >11-hole plates (8 of 21 [38.1%] vs 7 of 123 [5.7%]). In the failures, a proximal screw concentration of >70% had a 10-fold relative risk of failure.

Conclusion: Compared to prior reports, demographics were not related to failures of locked plating for distal femoral fractures. Comminuted fractures requiring staged bone grafting were independent risk factors of failure. We recommend plates of \geq 14 holes, >10 holes proximal to the fracture, and proximal screw concentration of <70%.

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Locking Plate Fixation Versus Cephalomedullay Nailing of Unstable Proximal Femur Fractures: A Comparative Cohort Study

Philipp N. Streubel, MD; Michael J. Moustoukas, MD; William T. Obremskey, MD; Vanderbilt Medical Center, Nashville, Tennessee, USA

Purpose: Locking plate fixation is gaining acceptance as a tool for the treatment of unstable proximal femur fractures. The available literature on this method of fixation is, however, limited to isolated case reports. The purpose of this study is to compare clinical outcomes of proximal femur locked plating (PFLP) with those of cephalomedullary nailing (CMN) in a consecutive cohort of acute unstable proximal femur fractures. We hypothesized that both treatment methods would yield similar fracture healing rates.

Methods: After IRB study approval, 80 consecutive patients with 83 unstable proximal femur fractures (OTA 31A3) treated at a single Level 1 trauma center between 2003 and 2007 with either CMN were identified. Patient (age, gender, diabetes, smoking, morbid obesity, mechanism of injury) and surgical variables (delay and duration of surgery, estimated blood loss) were extracted from operative records, charts, and radiographs. Primary end point was nonunion. Secondary end points included mechanical failure, reoperation, and infection. Outcomes were compared between groups using univariate analysis (P < 0.05). 23 patients (13 CMN, 10 PFLP) were lost to follow-up, and 5 died within 12 months of surgery (4 CMN, 1 PFLP). A total of 53 (66%) patients (30 PFLP and 23 CMN; 45% male; average age, 60 years; range, 21-94 years; 56% caused by high-energy trauma) were available for analysis with an average follow-up of 18 months.

Results: Gender distribution and diabetes were similar in both groups. CMN patients were on average 11 years older. PFLP-fixed fractures had been caused by high-energy trauma in 63% of cases (compared to 48% of CMN cases), and occurred in smokers in 44% of cases (compared to 22% for CMN). Nonunions occurred in 3 patients (13%) treated with CMN and 8 (25%) of those fixed with PFLP (P = 0.16). Deep infections occurred in 4% of CMN and 6% of PFLP. While no mechanical failures were observed in the CMN group, 11 (34%) occurred in the PFLP group (P < 0.01). Malunions occurred in 9% of CMN and 22% of PFLP patients, respectively (P = 0.13). Three (13%) CMN and 9 (28%) PFLP patients required reoperation (P = 0.13). Mean estimated blood loss was higher (537 cc vs 264 cc, P < 0.01) and duration of surgery longer (2 hours vs 3.3 hours, P < 0.01) with PFLP.

Conclusions: Unstable proximal femur fractures appear to be at higher risk for construct failure, nonunion, and reoperation when treated with PFLP compared to CMN.

See pages 77 - 115 for financial disclosure information.

Postsplinting Radiographs of Minimally Displaced Fractures: Good Medicine or Medicolegal?

Sonia Chaudhry, MD; Edward M. DelSole, BS; Kenneth A. Egol, MD; NYU Hospital for Joint Diseases, New York, New York, USA

Purpose: Many institutions perform radiographic documentation following orthopaedic splint application even in the case when no manipulation has been performed. The purpose of this study was to evaluate the utility of postsplinting radiographs of acute minimally displaced fractures that do not undergo manipulation. Our hypothesis is that postsplinting radiographs do not demonstrate changes in fracture alignment or impact the management of the patient.

Methods: After IRB approval was obtained, consults performed by orthopaedic residents at a Level 1 trauma center from September 2008 to April 2010 were reviewed. Of 2862 consults, 1321 involved acute fractures that were splinted. Radiographs revealed 342 fractures (25.9%) that were minimally displaced and angulated (defined as <5 mm and <10°, respectively). Consults were reviewed to ensure patients had not undergone manipulation prior to or during splinting. Consult notes and radiographs taken in the emergency department, as well as follow-up radiographs, were reviewed to assess ultimate outcome.

Results: None of the 204 fractures (134 nondisplaced and 70 minimally displaced/angulated) demonstrated changes in alignment following splint application. Two splints were reapplied and reimaged for undocumented reasons. Patients were subjected to an average of 10 radiographs (range, 4-25) of their extremities. On average, 3 postsplinting radiographs (range, 1-10) were performed. The mean time between initial and postsplinting radiographs was 3 hours and 30 minutes (range, 9 minutes-24 hours). The most common injury was fractures about the hand or wrist. These 121 patients waited almost 3 hours for an average of 3 additional postsplinting radiographs, contributing to a total of 9 radiographs performed acutely. Emergency department visits were longer for patients with postsplinting radiographs compared to those without (P = .06). Follow-up radiographs were available for 82 patients. All fractures demonstrated maintained alignment.

Conclusions: Postsplinting radiographs of nondisplaced and minimally displaced fractures that do not undergo manipulation before or during immobilization result in longer waits, additional radiation exposure, and increased healthcare costs without providing helpful information. While certain circumstances may call for additional imaging, the routine performance of postsplinting radiographs should be discouraged.

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Sat., 10/15/11 Peds, Ger, Hip, Femur & IP, Paper #81, 11:49 am OTA-2011

Beyond the 5-Second Rule: What To Do With Drop-Contaminated Bone? *Chad A. Krueger, MD*¹; Daniel J. Stinner, MD¹; Brendan D. Masini, MD¹; Joseph C. Wenke, PhD²; LTC Joseph R. Hsu, MD²; ¹Brooke Army Medical Center, Fort Sam Houston, Texas, USA; ²United States Army Institute of Surgical Research, Fort Sam Houston, Texas, USA

Purpose: The purpose of this study was to quantify the reduction in the bacterial burden of grossly contaminated bone segments using different chlorhexidine solutions. We hypothesize that 4% chlorhexidine will be the most efficient decontaminate.

Methods: 54 diaphyseal bone segments were harvested from 16 cadaveric porcine legs. Each specimen was dropped onto a Mueller-Hinton medium that was inoculated with *Staphylococcus aureus* (lux). These genetically engineered bacteria emit photons in proportion to their number, allowing for quantification. The bone segments were retrieved after 5 seconds, simulating the act of dropping a bone segment onto a nonsterile surface. Baseline imaging was obtained to determine the initial bacterial load on each segment. The specimens were then divided into 3 groups and an equal number of specimens were soaked in normal saline (NS), 2% chlorhexidine (2%CHL), or 4% chlorhexidine (4%CHL). Specimen reimaging occured at the 5, 10, 20, 30, and 60-minute marks.

Results: The average bacterial count on the bone segments were: 2.18×10^7 for NS, 2.31×10^7 for 2% CHL, and 2.00×10^7 for 4% CHL. The percent reduction in bacterial counts at the 5, 10, 20, 30, and 60-minute marks were NS: 0%, 0%, 0%, 29.84%, 72.23%; 2% CHL: 93.09%, 98.16%, 99.21%, 99.63%, 99.81%; and 4% CHL: 94.32%, 97.60%, 99.25%, 99.63%, 99.82%. At all time intervals, there was a significant difference between the 2% CHL and 4% CHL groups compared to the NS group (*P* <0.0001) and no difference between the 2% CHL and 4% CHL and 4% CHL groups.

Conclusions: Gross contamination of a critical segment of bone during an operative procedure or by traumatic extrusion can have a devastating impact on reconstruction. This is especially true when dealing with periarticular bone or in cases where replacement options are limited. To maximize efficiency and decrease potential untoward effects, we recommend 20-minute soaks using 2% chlorhexidine for contaminated bone segments.

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MINI SYMPOSIA

Complex Trauma from Combat – Reconstruction, Rehab and Orthotics (#S6) Moderators: COL Romney C. Andersen, MD and LTC Joseph R. Hsu, MD Faculty: Ryan Blanck, CPO; CDR Mark Fleming, MD; Lt COL Wade Gordon, MD; LTC Kevin Kirk, MD and Johnny C. Owens, MPT

Making Medicine's Voice Heard: Media Relations and Political Advocacy (#S7) Moderator: Jeffrey M. Smith, MD Faculty: Patricia Clark and Andrew N. Pollak, MD

2 Minutes/ 2 Slides: Upper Extremity Technical Tips and Tricks (#S8)

Moderator: Pierre Guy, MD, MBA Faculty: Edward J. Harvey, MD; Michael D. McKee, MD; David C. Ring, MD and Paul Tornetta, III, MD

Fundamentals in Trauma II (#S9)

Moderator: Robert F. Ostrum, MD Faculty: Jeffrey O. Anglen, MD; Frank A. Liporace, MD; Thomas F. Varecka, MD and J. Tracy Watson, MD

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SKILLS LABS

IM Fixation of Proximal Tibial Fractures (#*S10*)

Moderator: Saam Morshed, MD Faculty: Christopher Finkemeier, MD; Jason W. Roberts, MD and Kenneth Wilkins, MD

IM Fixation of Proximal Femur Fractures (#*S11*)

Moderator: Kenneth J. Koval, MD Faculty: Michael Charlton, MD; Kenneth A. Egol, MD; Hassan R. Mir, MD; Mark Munro, MD; John Riehl, MD and Anjan Shah, MD

ORIF Distal Femur Fractures (#*S*12)

Moderator: Steven J. Morgan, MD Faculty: Michael S. Sirkin, MD and Bruce H. Ziran, MD

NOTES

JOHN BORDER MEMORIAL LECTURE "Femoral Neck Fracture Management – WWJD (John)?" Marc F. Swiontkowski, MD

CEO, TRIA Orthopaedic Center; Professor, Orthopaedic Surgery, University of Minnesota, Minneapolis, Minnesota, USA

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The Fate of Patients After a Staged Nonunion Procedure for Known Infection *Paul Tornetta, III, MD*¹; *Kevin Dale, MD*¹; *Clifford B. Jones, MD*²; *Brian H. Mullis, MD*³; *Kenneth A. Egol, MD*⁴; *Elliot Robinson, MD*⁵; *Michael J. Bosse, MD*⁵; *Andrew H. Schmidt, MD*⁶; *Robert A. Hymes, MD*⁷; ¹Boston University Medical Center, Boston, Massachusetts, USA ²Orthopaedic Associates of Michigan, Michigan State University, Grand Rapids, Michigan, USA ³Indiana University, Indianapolis, Indiana, USA; ⁴NYU Hospital for Joint Diseases, New York, New York, USA; ⁵Carolinas Medical Center, Charlotte, North Carolina, USA; ⁶Hennepin County Medical Center, Minneapolis, Minnesota, USA; ⁷Inova Fairfax Hospital, Fairfax, Virginia, USA

Purpose: Patients who had prior surgery and develop an infected nonunion typically undergo a staged reconstruction including multiple débridements, hardware removal, and antibiotics. The purpose of this study is to review a large series of patients who underwent staged procedures for the treatment of infected nonunions, highlighting the course of treatment and the ultimate result with respect to union and eradication of infection.

Methods: Patients treated for nonunion at 7 academic medical centers who were treated with a staged protocol for an infected nonunion were evaluated. The course of the patients was documented including the use of antibiotics, number of débridements, hardware treatment, dead space management, coverage, definitive surgery performed, and the outcome regarding infection and union.

Results: There were 137 staged procedures for infected nonunions of the tibia (92), femur (25), humerus (8), or other (14) in 94 men and 43 women with an average age of 43.7 years. All patients had operative treatment of their initial fractures. 104 (76%) became infected after their initial operative procedure and 33 (24%) after an additional procedure. 26 different bacteria were cultured with methicillin-sensitive Staphylococcus aureus (MSSA) (25), methicillin-resistant Staphylococcus aureus (MRSA) (20), coagulase-negative Staphyloccus (15), Enterococcus (13), and Enterobacter (11) most common. 31% were polymicrobial. The initial hardware was removed (78), retained (25), or exchanged (10), with 2 patients treated initially with no internal hardware. Adjuvant defect management consisted of antibiotic beads (34), intramedullary nail (IM) (32), or spacer (13). Patients had an average of 2.9 débridements and received antibiotics for an average of 6.4 weeks prior to their definitive nonunion procedure. Definitive procedures for nonunion included IM nail (51), open reduction and internal fixation (48), bone grafting (16), Taylor Spatial Frame external fixation (10), and, in 4 patients in whom the infection was not resolved, amputation. Closure was primary (63), vacuum (15), free flap (25), or split-thickness skin graft (5). 65 patients (55%) were supplemented with osteobiologic products. 102 patients had cultures at the definitive procedure resulting in 41 (40%) positive cultures and 61 (60%) negative cultures. The C-reactive protein and erythrocyte sedimentation rate prior to the definitive procedure was 4.1 and 45 for those with (+) and 2.1 and 23.5 for those who had (-) cultures at the definitive procedure. The table below shows the results for all patients as well as the breakdown of those with (+) and (-) cultures at the time of definitive management. After union, 76 (67%) of the patients with hardware retained their hardware and 37 (33%) patients had their hardware removed.

| Group/n | Union After Index | Union After Additional Procedures | Persistent Nonunion | Amputation | Lost to FU |
|-----------|-------------------------|--|------------------------|------------|---------------|
| All/137 | 99 (75%) | 113 (86%) | 19 (14%) | 7 (5%) | 5 |
| Cx (+)/41 | 22 (54%) | 32 (78%) | 9 (22%) | 2 (5%) | 0 |
| Cx (-)/61 | 51 (88%) | 54 (93%) | 4 (7%) | 1 (2%) | 3 |

Table: Outcomes for the Patients Based on Index Culture Results^a

^{*a*}FU, follow-up; Cx, culture.

Conclusions: Even with multiple débridements and antibiotics, 41% of patients had positive cultures at the time of their definitive management, which led to a disparate union rate as compared to those with a negative culture. This large series of staged procedures for infected nonunions demonstrates the difficulty in eradicating the infection even with modern dead space management and multiple débridements. This information will be helpful in setting the expectations of patients with this complex problem.

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• Does BMP-2 Increase the Incidence of Perioperative Wound Complications or Reoperation?

Daniel Steven Chan, MD¹; **Joshua Garland, MD**²; Anthony F. Infante, Jr., DO¹; Roy Sanders, MD¹; H. Claude Sagi, MD¹; ¹Orthopaedic Trauma Service, Florida Orthopaedic Institute, Tampa, Florida, USA; ²Naval Medical Center, Portsmouth, Virginia, USA

Purpose: The purpose of this study is to document the incidence of postoperative wound complications thought to be directly attributable to the use of bone morphogenetic protein–2 (BMP-2) in a large series of patients for both acute traumatic and reconstructive extremity cases. Our hypothesis was that BMP-2 contributed to these wound complications.

Methods: A retrospective chart review was performed on cases between January 1, 2002 and December 31, 2009 in which Infuse BMP-2 was used in acute trauma (open fractures) or posttraumatic reconstruction (nonunion repair). The following data were collected: age, surgical site, purpose (acute vs reconstructive), type of supplemental bone graft used, associated wound factors (open fractures, soft-tissue injury requiring coverage, or history of infection), signs of infection (seroma, erythema, prolonged drainage, abscess), the need for reoperation secondary to wound complication, and union. These cases were then compared to 1:1 matched cohorts for age, type of case (acute/reconstructive), anatomic site, open injury, and soft-tissue reconstruction.

Results: A total of 193 BMP-2 cases were reviewed. There were 138 nonunions and 56 open fractures. Sixty patients (31%) had documentation of at least 1 postoperative wound concern. There was no difference between the acute traumatic and reconstructive groups. The most commonly documented (29%) wound concern was prolonged serous drainage. 17 patients (9%) required postoperative antibiotic therapy longer than would routinely have been prescribed. Six patients (3%) required reoperation for presumed wound infection secondary to prolonged drainage and erythema. Four of the six patients (2%) had infection and two (1%) had a sterile seroma/hematoma. Age, sex, anatomic site, acute trauma, open fracture, and the need for soft-tissue reconstruction did not correlate with the need for return to the operating room for presumed or actual wound infection. There were 182 patients in the matched control cohort. 33 patients (18%) had documentation of at least 1 wound concern; significantly less than with BMP-2 use (P = 0.004). The most common concern was wound drainage (22 out of 33). 15 patients (8%) required a reoperation for wound infection after prolonged drainage or wound dehiscence—significantly higher than the BMP-2 group (P =0.04). Among the wound concern subgroups, the reoperation incidence in BMP-2 patients was significantly lower (P < 0.0001). The most common anatomic site that required a reoperation was the distal tibia (11 out of 15).

Conclusion: The use of BMP-2 in both acute and reconstructive extremity surgery increased the incidence of prolonged serous drainage requiring additional antibiotic therapy that typically resolves. This does not appear to be indicative of a postoperative infection requiring a reoperation. Importantly, reoperations for presumed wound infection were significantly lower than in the matched group of cohorts. We suggest that when postoperative drainage is seen after the use of BMP-2, treatment should be limited to antibiotic coverage until the wound resolves.

Sat., 10/15/11 Recon, UE, Wrist & Hand, Paper #84, 3:47 pm O

Δ Improved Outcome Following Primary Operative Fixation of Displaced Midshaft Fractures of the Clavicle Persists at 2 Years Post Injury: Implications for Clinical Treatment, Future Trials, and Economic Analysis

Laura A. Schemitsch; Emil H. Schemitsch, MD; Christian Veillette, MD; Olivia Y.Y. Cheng, **Michael D. McKee, MD**; St. Michael's Hospital, University of Toronto, Toronto, Ontario, Canada

Background: There is increasing evidence that primary fixation of displaced midshaft fractures of the clavicle results in superior short-term outcomes when compared to traditional nonoperative methods. However, the results from published studies are limited to relatively short-term (1 year or less) follow-up. Accurate data of longer follow-up is important for a number of reasons, including patient prognostication, counseling and care, the design of future trials, and the economic analysis of treatment.

Purpose: The purpose of this study was to examine the results of the 2-year follow-up of patients enrolled in a previously published randomized clinical trial of operative versus nonoperative treatment of displaced fractures of the clavicle.

Methods: Using a comprehensive and standard assessment that included DASH (Disabilities of the Arm, Shoulder and Hand) and CSS (Constant Shoulder Scores) scores, we evaluated 95 patients of the original cohort of 132 patients at 2 years following their injury. We also assessed general health status with the Short Form–36 (SF-36).

Results: Statistical analysis performed on the 2-year follow-up data revealed that DASH and CSS scores remained essentially unchanged at 2 years post injury compared to 1 year post injury for both operative and nonoperative groups (P > 0.05). Additionally, outcome scores in the operative group remained superior to the nonoperative group (DASH operative 4 ± 7 versus DASH nonoperative 11 ± 20, P < 0.014; CSS operative 97 ± 4 versus CSS nonoperative 92 ± 14, P < 0.012) at 2 years after injury. SF-36 scores were also significantly improved in the operative group.

Conclusions: The improvement in outcome seen with primary fixation of displaced clavicle fractures persists at 2 years but does not differ significantly from values seen after 1 year of follow-up, suggesting that clinically a steady state has been reached whereby outcome is unlikely to change with time. This has clinical, economic, and research implications.

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Acute Versus Late Intervention in Clavicle Fractures

Benjamin Ollivere, MD, FRCS; Avishek Das, MRCS; Katie Rollins, MRCS; Kathleen Elliott, MBBS; Phillip Johnston, MD, FRCS; Lee van Rensburg, FRCS; Graham Tytherleigh-Strong, FRCS; Addenbrooke's Hospital, Cambridge University NHS Trust, Cambridge, United Kingdom

Purpose: The evolution of locked anatomic clavicular plating in combination with evidence to suggest that fixation of clavicle fractures yields better outcome than conservative treatments has led to an increasing trend towards operative management. There is no evidence, however, to compare early fixation with delayed reconstruction for symptomatic nonunion or malunion. We hypothesize that early intervention yields better functional results to delayed fixation.

Methods: Between August 2006 and May 2010, 97 patients were managed with operative fixation for their clavicular fracture—68 with initial fixation and 29 delayed fixation for clavicular nonunion or malunion. Patients were prospectively followed up to radiographic union, and outcomes were measured with the Oxford Shoulder Score, QuickDASH (a shortened version of the Disabilities of the Arm, Shoulder and Hand questionnaire), the EuroQol EQ-5D, and a patient interview. Mean follow-up was to 30 months. All patients were managed with Acumed anatomic clavicular plates.

Results: The radiographic and clinical outcomes were available for all patients. Scores were available for 62 of 97 patients. There were no statistically significant differences in age (P > 0.05), sex (P > 0.05), energy of injury (P > 0.05), or number of open fractures (P > 0.05) between the 2 groups. The mean quickDASH was 8.9 early, 9.1 delayed (P < 0.05); Oxford Shoulder score was 15.7 early, 16.1 delayed (P < 0.05). In the early fixation group, 5 patients had wound healing complications, and 8 went on subsequently to have removal of prominent metalwork. In the delayed fixation group, 2 had wound healing complications and 4 had removal of prominent metalwork. There were no statistically significant differences in the EQ-5D quality of life questionnaire.

Conclusion: There are no statistically significant differences in shoulder performance, or wound or operative complications between early and delayed fixation of clavicular fractures. Our series does not support early fixation of clavicular fractures, as results for delayed intervention in those who become symptomatic appear comparable.

Clinical and Financial Comparison of Operative and Nonoperative Treatment of Displaced Clavicle Fractures Peter L. Althausen, MD, MBA¹; Steven Shannon, BS²;

*Timothy J. O'Mara, MD*¹; *Timothy J. Bray, MD*¹; ¹*Reno Orthopaedic Clinic, Reno, Nevada, USA*; ²*University of Nevada School of Medicine, Reno, Nevada, USA*

Purpose: Surgical stabilization of displaced clavicle fractures was once considered to have rare indications. Over the past few years, several studies have demonstrated the clinical effectiveness of this procedure. A recent study presented a cost-effectiveness analysis of open reduction and internal fixation after acute fracture utilizing event probabilities and decision-tree analysis. However, no study to date has collected actual financial data from the patients themselves.

Methods: From January 2005 to January 2010, our fracture database was queried to identify patients treated for clavicular fractures. Radiographs were reviewed by a blinded author and total displacement was calculated by the sum of displacement on AP and cephalic tilt radiographs of the involved shoulder. 220 patients with displaced fractures were identified and financial questionnaires were mailed to patients.

Results: 182 responses were received, with 97 surgical and 85 nonsurgical responses. In our study, surgical patients had less chronic pain (4.0% vs 18.9%), less cosmetic deformity(13% vs 35.8%), less weakness(4.4% vs 43.4%), less loss of motion (4.4% vs 35.8%), and fewer nonunions (0 vs 1.9%). Operative patients were more likely to be satisfied with their outcome (96% vs 79%). Surgical patients missed an average of 9.2 days of work while nonoperatively managed patients missed a mean of 36.9 days. They also required less family assistance (2.6 days vs 7 days) for care at home. Mean income lost due to injury was \$275 vs \$13,092. Operative care had a mean emergency room bill of \$1,924 versus \$2,336, a mean hospital bill of \$9,196 versus \$4,103, and anesthesia charges averaged \$949. Operative patients required fewer physical therapy visits and mean physical therapy cost was \$770 versus \$1,920. Nonoperative patients required slightly more pain medication (\$45 vs \$55). Overall, cost differential was \$13,265 for patients treated with surgical stabilization and \$27,636 for nonoperatively managed patients.

Conclusions: Patients with displaced clavicle fractures benefit clinically and financially from surgical stabilization. Clinically they have less chronic pain, less deformity, less weakness, and better range of motion. They return to work sooner, take less pain medication, and require less physical therapy. Their initial hospital bill is higher due to surgical charges but this is balanced by less income loss, resulting in a cost difference of \$14,371 in operatively managed patients.

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Determining the Efficacy of Screw and Washer Fixation as a Method for Securing an Olecranon Osteotomy Following the Treatment of Intra-Articular Distal Humerus Fractures

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Purpose: Utilization of a transolecranon exposure for the reduction and fixation of complex distal humerus fractures significantly improves visualization of the articular surface. However, complications following olecranon osteotomy have resulted in some controversy as to what is the optimal method of fixation. The use of screw and washer fixation alone has been called into question as an effective method of securing an olecranon osteotomy. Thus the purpose of this study was to critically evaluate the efficacy of screw and washer fixation in comparison to other methods for securing an olecranon osteotomy. The hypothesis is that screw and washer fixation is a safe and effective means of olecranon osteotomy fixation with fusion and complication rates similar to other currently utilized methods of fixation.

Methods: We retrospectively reviewed all patients at our institution over the past 20 years with type C3 comminuted intra-articular distal humerus fractures who required open reduction and internal fixation and received an olecranon osteotomy. Included patients received 1 of 4 types of fixation (screw, tension band, tension band and screw, plate) following osteotomy. The primary outcome measure was the presence of osteotomy union. Secondary outcome measures were olecranon nonunion, loss of articular reduction (LOR), and removal of hardware (ROH). Comorbidities were stratified using the Charlson comorbidity index.

Results: A total of 187 patients were identified of whom 160 met inclusion criteria. Of the 160 patients 39 had screw fixation, 47 had tension band fixation, 16 had plate fixation, and 58 had tension band and screw fixation. There was no significant difference in olecranon fusion rates between screw (89.7%), plate (87.5%), or tension band and screw (91.4%) fixation. Tension band fixation alone had a significantly lower osteotomy fusion rate (78.7%) in comparison to the other methods of fixation (P < 0.05).

Table 1: Complication Rates

| FIXATION | ROH | LOR | NON UNION |
|--------------|------------|-----------|------------|
| Tension Band | 19 (40.4%) | 8 (17%) | 10 (21.3%) |
| Plate | 6 (31.3%) | 1 (6.3%) | 2 (12.5%) |
| Screws | 6 (15.4%) | 1 (7.7%) | 4 (10.3%) |
| TB/Screws | 10 (19%) | 3 (5.2%) | 5 (8.6%) |
| Total | 41 (26.9%) | 13 (8.8%) | 18 (11.9%) |
Table 2: Charlson Comorbidity Score

| CHARLSON | OVERALL | NON UNION |
|--------------|---------|-----------|
| Tension Band | 0.53 | 1.10 |
| Plate | 0.75 | 2.50 |
| Screws | 0.82 | 3.00 |
| TB/Screws | 0.83 | 1.20 |
| Total | 0.75 | 1.95 |

Table 1 illustrates complications rates with each type of fixation. Tension band fixation had significantly higher complication rates for each outcome measure compared to other types of fixation (P < 0.05). Table 2 illustrates the Charlson comorbidity score. For the patients who developed nonunion, the Charlson score on average was higher in comparison to patients who healed their osteotomy.

Conclusions: Screw and washer fixation appears to be a safe and effective means of securing an olecranon osteotomy, with fusion and complications rates similar to other methods of fixation. Tension band fixation had a significantly lower fusion rate and higher complication rate compared to the other studied methods of fixation. Charlson score appears to be one factor that may influence the development of nonunion following osteotomy.

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OTA-2011

Simple Dislocation of the Elbow Is Associated With Good Long-Term Patient-Reported Outcomes but Persisting Pain and Stiffness are Common Raymond E. Anakwe, MD; Scott D. Middleton, MD; Paul J. Jenkins, MD; Margaret M. McQueen, MD; Charles M. Court-Brown, MD; Orthopaedic Trauma Unit, Royal Infirmary of Edinburgh, Edinburgh, Scotland, United Kingdom

Purpose: This study describes the epidemiology, long-term clinical outcomes, and patient-reported outcomes following simple dislocation of the elbow.

Methods: We identified all adult patients treated at our trauma center for a simple dislocation of the elbow over 10 years. 140 patients were identified and 110 (79%) patients were reviewed at a mean of 88 months (95% confidence interval [CI], 80-96) after injury. This included clinical examination, the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire, an Oxford Elbow questionnaire, and a patient satisfaction questionnaire.

Results: Patients reported long-term residual deficits in range of movement. The mean DASH score was 6.5 (95% CI 4 to 9). The mean Oxford Elbow score was 90.6 (95% CI, 87.9-93.3). The mean satisfaction score was 85.6 (95% CI, 82.2-89). 62 patients (56%) reported persistent subjective stiffness of the elbow. Nine (8%) reported subjective instability and 68 (62%) complained of continued pain. The satisfaction, DASH, and Oxford Elbow scores (including the pain and function component scores) all showed good correlation with absolute range of movement in the injured elbow. After multivariate analysis, loss of elbow flexion (P = 0.001) and female gender (P = 0.002) were both independent predictors of poorer DASH scores. Reduced elbow flexion also predicted poorer scores in the function component of the Oxford Elbow score (P = 0.02). A reduced flexion-extension arc of movement predicted poorer scores for the overall Oxford Elbow score (P = 0.02), the pain component of the Oxford Elbow score (P = 0.02), and overall satisfaction (P = 0.005). Female gender predicted a poorer psychosocial component of the Oxford Elbow score (P < 0.05).

Conclusion: Patients report good long-term functional outcomes after simple dislocations of the elbow; however, these are not entirely benign injuries. There is a high rate of residual pain and stiffness. Functional instability is less common and does not often limit activities.

Predictors of Fracture Following Suspected Injury to the Scaphoid Andrew D. Duckworth, MSc, MRCSEd¹; Geert A. Buijze, MD²; Stuart A. Aitken¹; Matthew Moran¹; Alasdair Gray, MD³; Charles M. Court-Brown, MD¹; David C. Ring, MD²; Margaret M. McQueen, MD¹; ¹Edinburgh Orthopaedic Trauma Unit, Royal Infirmary of Edinburgh, Edinburgh, Scotland, United Kingdom; ²Orthopaedic Hand and Upper Extremity Service, Massachusetts General Hospital, Boston, Massachusetts, USA; ³Emergency Dept., Royal Infirmary of Edinburgh, Edinburgh, Scotland, United Kingdom

Purpose: The assessment of diagnostic tests for suspected scaphoid fractures must account for the low prevalence of true fractures among suspected fractures. The development of a clinical prediction rule might improve the diagnostic performance characteristics of radiologic diagnostics tests by increasing the prevalence of true fractures. The aim of our study was to develop a clinical prediction rule using demographic and clinical factors predictive of a true scaphoid fracture.

Methods: We performed a prospective study of 260 consecutive patients with a clinically suspected or radiographically confirmed scaphoid fracture. Patients were evaluated within 72 hours of injury and at 2 and 6 weeks after injury. Demographic data, results of 7 clinical examination maneuvers, and treatment were recorded. Standard scaphoid radiographs were performed at each visit. A scaphoid fracture was defined as a fracture confirmed on radiologic imaging by 6 weeks. Statistical analysis used multivariate binary logistic regression analysis to determine significant predictors of a true scaphoid fracture.

Results: Of the 223 patients with complete data, 116 were female and the mean age was 33 years (range, 13-95 years). 62 patients (23.8%) sustained a fracture. Demographic predictors were younger age (P = 0.002), male gender (P < 0.001), and sports mode of injury (P < 0.001). Signs predictive of fracture within 72 hours of injury were thumb index finger pinch (P = 0.002), scaphoid tubercle tenderness (P = 0.005), and anatomic snuff box (ASB) on ulnar and radial deviation of the wrist (both P < 0.001). Using multivariate regression, the independent predictors of fracture were male gender (P = 0.002), sports injury (P = 0.004), ASB pain on ulnar deviation of the wrist within 72 hours (P < 0.001), and day 14 scaphoid tubercle tenderness (P < 0.001). No subjects without ASB pain on ulnar deviation of the wrist within 72 hours had a fracture (n = 72). With the 4 independently significant factors positive, the risk of fracture is 91%.

Conclusion: We have developed a clinical prediction rule using demographic and clinical factors that could potentially increase the prevalence of true scaphoid fractures among suspected fractures. This could improve the diagnostic performance characteristics of radiologic diagnostics tests for the suspected scaphoid fracture.

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Sat., 10/15/11 Recon, UE, Wrist & Hand, Paper #90, 4:33 pm OTA-2011

A Prospective Randomized Controlled Trial Comparing Occupational Therapy With Independent Exercises After Volar Plate Fixation of a Fracture of the Distal Radius J. Sebastiaan Souer, MD; Geert A. Buijze, MD; David C. Ring, MD, PhD; Orthomastic Land and Linner Extension Managements Compared Linnited

Orthopaedic Hand and Upper Extremity Service, Massachusetts General Hospital, Boston, Massachusetts, USA

Background: The effect of formal occupational therapy on recovery after open reduction and volar plate fixation of a fracture of the distal radius is uncertain. We hypothesized there would be no difference in wrist function and arm-specific disability between patients who receive formal occupational therapy and those with instructions for independent exercises 6 months after open reduction and volar plate fixation of a distal radius fracture.

Methods: 96 patients with an unstable fracture of the distal radius fracture treated with open reduction and volar locking plate fixation were enrolled in a prospective randomized controlled trial comparing exercises done under the supervision of an occupational therapist with surgeon-directed independent exercises. The primary study question addressed combined wrist flexion and extension 6 months after surgery. Secondary study questions addressed wrist motion, grip strength, Gartland and Werley scores, Mayo wrist scores, and DASH (Disabilities of the Arm, Shoulder and Hand) scores at 3 months and 6 months after surgery.

Results: There was a significant difference in the arc of wrist flexion and extension 6 months after surgery (118° vs 129°) favoring patients prescribed independent exercises. Three months after surgery, there was a significant difference in pinch strength (80% vs 90%), grip strength (66% vs 81%), and Gartland and Werley scores favoring patients prescribed independent exercises. At 6 months, there was a significant difference in wrist extension (55% vs 62%), ulnar deviation (82% vs 93%), supination (84° vs 90°), grip strength (81% vs 92%), and Mayo score favoring patients prescribed independent exercises. There were no differences in arm-specific disability (DASH score) at any time point.

Conclusions: Prescription of formal occupational therapy does not improve the average motion or disability after volar locked plate fixation of a fracture of the distal radius.

Sat., 10/15/11 Recon, UE, Wrist & Hand, Paper #91, 4:39 pm OT

A Randomized Prospective Clinical Trial Comparing Treatment of Distal Radius Fractures with Volar Locking Plate and Conventional Percutaneous Methods Alexia Karantana, MRCS¹; Nicholas D. Downing, DM, FRCS(Orth)¹; Daren P. Forward, MA, FRCS, DM¹; Mark Hatton, FRCS(Orth)¹; Professor Chris G. Moran, DM, FRCS(Ed)¹; Andrew M. Taylor, DM, FRCS¹; Professor Brigitte E. Scammell, DM, FRCS(Orth)²; Professor Tim R. Davis, FRCS, MCh¹; ¹Queens Medical Centre, Nottingham University Hospitals NHS Trust, Nottingham, United Kingdom; ²Division of Orthopaedic and Accident Surgery, University of Nottingham, Nottingham, United Kingdom

Purpose: The aim of the study was to compare outcomes of distal radial fractures after treatment with either a volar locking plate, or percutaneous Kirschner-wiring \pm spanning external fixator. The hypothesis was that the use of volar locking plates improves clinical and functional outcome.

Methods: This was a single-center pragmatic prospective randomized controlled surgical trial with intention-to-treat analysis. Recruited patients were randomized to treatment with either a volar locking plate, or percutaneous Kirschner-wiring \pm spanning external fixator. The inclusion criteria were: (1) skeletally mature adult with no concomitant systemic disease, no previous associated fractures of either arm, and no preexisting radiographic abnormality; and (2) fracture of the distal radius that was dorsally displaced, extra-articular (with or without an undisplaced intra-articular component) with dorsal cortical comminution OR displaced intra-articular with an articular step or gap of >2 mm. The main outcome measure was the Patient Evaluation Measure (PEM) hand function questionnaire. Additional measures included the QuickDASH (shorter version of the Disabilities of the Arm, Shoulder and Hand questionnaire) score, the EuroQol-5D (EQ-5D) standardized health status measure, grip strength, and range of motion. The level of significance was set at *P* <0.01.

Results: 130 participants aged 18 to 73 years were randomized (plate, n = 67; control, n = 63, of whom 54 were treated with Kirschner wires [K-wires] alone and 9 treated with external fixator ± K-wires). Follow-up at 1 year was 95%. Groups were balanced. The plate group had significantly better PEM and QuickDASH scores and range of motion at 6 weeks (*P* <0.001), but there were no differences in these measures at 3 months or 1 year. Grip strength was significantly better at 6 weeks (*P* <0.001) and 3 months (*P* <0.01), but not at 1 year for the plate group. Significantly more participants from the plate group were back to driving at the end of 6 weeks (*P* <0.001), but this did not translate to a difference in those returning to work by that time.

Conclusion: Use of a volar locking plate resulted in a faster recovery of function. There was no significant difference in the long-term outcome with the use of K-wires \pm an external fixator.

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Do Changes in the Economy Impact Orthopaedic Trauma Volume?

Daniel S. Chan, MD¹; Brandon Burris, MD²; **Gerald Alexander, MD**; Roy Sanders, MD¹; ¹Orthopaedic Trauma Service, Florida Orthopaedic Institute, Tampa, Florida, USA; ²University of South Florida, Tampa, Florida, USA

Purpose: The effect of an economic recession on a population has been thoroughly studied, and, interestingly, a struggling economy is associated with overall health improvements. Human behavior also changes: as unemployment rises, job absenteeism decreases, more time is spent working, and less engaging in leisure / recreation activities. Similarly, decreases in motor vehicle collisions have been reported as well. To our knowledge, the fluctuation of orthopaedic trauma volumes related to economic changes has not previously been reported. This study compares the changes in orthopaedic trauma patients at a Level 1 regional trauma center to the dynamic health of the regional economy over a 10-year period.

Methods: This retrospective analysis (2001-2009) of our institution's trauma registry compared changes in general trauma admissions and orthopaedic trauma surgical volumes to select local economic indicators (unemployment, building permits, and number of construction employees in the metropolitan area) and regional population growth.

Results: For the decade, the local county population experienced a steady annual growth between 0.9% and 2.9%. During that same period, all economic indicators showed extreme variability. The unemployment rate peaked in 2002 at 5.4% and bottomed out at 3.3% in 2006 before the most recent recession (10.7% in 2009). Construction workers were employed at a decade high in 2006, but also underwent a steady 36% fall by 2009. Annual county building permits behaved similarly, peaking in 2005, and by 2009 dropped 80%. The changes in trauma volume were observed most accurately in relation to the county's annual unemployment rate. Orthopaedic trauma surgical cases had a



Metro Construction Employees (10K units)

2005

2006

2007

2009

2008

County Building Permits (1K units) County Unemployment rate (%)

2004



2002

2003

2001

6.0

4.0

2.0

0.0

significantly negative association with the county unemployment rate of the previous year (Pearson correlation coefficient = -0.84, P = 0.0098).

Conclusion: The answer is yes—the economy does impact orthopaedic trauma volume. The unemployment rate of the previous year is the best predictor. The county unemployment rate is inversely related to our Level 1 trauma center's orthopaedic trauma surgical volume and demonstrates a 1-year lag effect.

The Use of Routine Thoracoabdominal CT Scans in the Polytrauma Patient to Estimate Obesity

*David F. Ferguson, MD*¹; Bryce J. Busenlehner²; Mark D. Rahm, MD¹; Sachin M. Mehta²; Juhee Song, PhD¹; Matthew L. Davis, MD¹; H. Wayne Sampson, PhD²; Christopher D. Chaput, MD²; ¹Scott & White Hospital, Temple, Texas, USA; ²College of Medicine, Texas A&M Health Science Center, College Station, Texas, USA

Purpose: Obesity is reaching epidemic proportions in the United States, and investigation into its effect on orthopaedic trauma is increasing. There are several limitations to using body mass index (BMI) to evaluate obesity in the trauma setting including difficulty obtaining height and weight, rapid fluid shifts, and the inherent inaccuracies of the BMI measurement. An accurate method of quantifying obesity is needed to assist in assessing obesity's economic and clinical impact on orthopaedic trauma. The purpose of this study was to utilize data from routine CT scans to quantify obesity in polytrauma patients without the need to obtain a height and weight.

Methods: This study is a retrospective analysis of a comprehensive database including multidetector CT thoracoabdominal images of polytrauma patients admitted to a Level 1 trauma center. Charts of 1174 patients were reviewed from 2006 to 2008, and of these, 162 had previous documentation of BMI or height and weight as an outpatient within 6 months of trauma activation and had CT scans meeting inclusion criteria. Age, gender, height, weight, and radiographic measurements were recorded. The Truncal Adipose Volume (TAV) from T10-coccyx was calculated from 3-dimensional reconstructions (3DRs) of the CT scans of the thorax and abdomen obtained in the emergency department.

Results: The intraobserver and interobserver correlations in measuring TAV were high—0.99 and 0.98, respectively. Statistical analysis showed a good correlation between TAV and BMI (correlation coefficient = 0.77; *P* value <0.0001). A linear regression equation of BMI on TAV was estimated and it had a form: 3DR BMI = $20.81 + 0.00064 \times TAV$.

Conclusion: TAV provides a reproducible means of evaluating obesity in trauma patients from routinely obtained CT scans. The TAV eliminates the often problematic task of obtaining a height and weight in a trauma patient and it correlates fairly well with the most commonly used clinical method of quantifying patient adiposity, BMI. This method may provide a more direct measurement of adiposity than does BMI, and holds promise for improving trauma care and research in the obese patient. As outcome data is increasingly scrutinized and payment becomes more linked with outcomes, understanding and accurately quantifying obesity and its effect on outcome is critical.

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Bedside Fasciotomy Under Local Anesthesia for Acute Compartment Syndrome *Nabil A. Ebraheim, MD¹; Amr A. Abdelgawad, MD²; Molly A. Ebraheim¹; Sreenivasa R. Alla, MD¹;* ¹Dept. of Orthopedic Surgery, University of Toledo Medical Center, Toledo, Ohio, USA; ²Dept. of Orthopedic Surgery & Rehabilitation, Paul L. Foster School of Medicine, Texas Tech University Health Science Center at El Paso, El Paso, Texas, USA

Purpose: Fasciotomy for compartment syndrome is an emergent procedure that is usually done in the operating theater under general anesthesia. Various reasons can cause delay in performing the surgery. Bedside fasciotomy under local anesthesia can be done in these cases to avoid delay in release of the compartments. The purpose of this study was to assess the efficacy and the safety of performing the fasciotomy at bedside in patients with acute compartment syndrome.

Methods: We retrospectively reviewed 34 cases of acute compartment syndrome that had bedside fasciotomy under conscious sedation with local anesthesia in our department. Patients were followed for a minimum period of 6 months.

Results: All patients had immediate and marked improvement in pain. 33 patients regained their normal muscle strength. 32 patients regained normal range of motion of adjacent joints. One patient developed flexion contracture of the great toe. There was no deep infection, chronic osteomyelitis, or amputation. Superficial wound infection was noted in 3 patients. One patient had persistent foot drop.

Conclusion: Bedside fasciotomy under local anesthesia is a feasible, safe, and effective choice for the treatment of compartment syndrome in patients with delayed presentation or those with anticipated delay to undergo surgery in the operating theater under general or regional anesthesia. This is the first description of this procedure in the literature with a relatively large number of patients.

Can Patient Follow-Up After Orthopaedic Trauma Surgery be Improved? *Guillaume Dumont, MD*; Jeffery Padalecki, MD; Akas Siddiqui, MPH; William Robertson, MD; Rahul Banerjee, MD; University of Texas Southwestern Medical Center, Dallas, Texas, USA

Purpose: The assessment of outcomes after orthopaedic trauma surgery is frequently limited by poor patient follow-up. The purpose of this study was to identify factors that influence the clinic attendance rate for orthopaedic trauma patients at an urban Level 1 trauma center and to study the effect of a telephone call reminder system on the rate of follow-up for this patient population.

Methods: After IRB approval, a retrospective chart review identified all scheduled postoperative visits for orthopaedic trauma patients during a 2-year period (October 2008 to October 2010) at our Level 1 trauma center. These patients all underwent surgery for fractures or other traumatic injuries. For each patient, we obtained demographic data and determined the distance between the patient's home and the clinic. In the 90-day postoperative period, we determined whether the patients completed their scheduled clinic visit, canceled the appointment, or did not show. We performed a univariate analysis to assess the impact of patient age, sex, race, and distance from home to clinic on clinic follow-up attendance rates after surgery. A paired *t* test was used to analyze the impact of the distance from home to clinic. In October 2009, our clinic instituted a telephone call reminder system 1 day prior to the appointment to notify patients of upcoming appointments. We analyzed the data to assess if this phone call reminder affected the follow-up rate.

Results: There were 3967 scheduled postoperative orthopaedic trauma clinic visits for patients who underwent trauma-related surgery at our institution between October 2008 and October 2010 (1467 from October 2008 to October 2009, 2500 from October 2009 to October 2010). Between October 2008 and October 2009, 1297 patients (88.4%) attended their appointments in the 90-day postoperative period, 41 (2.8%) canceled their appointments, and 117 (8.3%) did not show up for their scheduled appointment. After the reminder phone call was instituted in October 2009, 2178 patients attended their appointments in the 90-day postoperative period (87.1%), 105 (4.2%) canceled, and 210 patients (8.8%) did not show up for their scheduled appointment. There was no difference in the 90-day postoperative follow-up rate (88.4% vs 87.1%) or no-show rate (8.3% vs 8.8%) after the institution of the telephone reminder (P = 0.233). Instead, there was a significant increase (2.8% vs 4.2%) in the cancellation rate (P = 0.023). During the 2-year studied period, patients who were 30 to 50 years of age were more likely to complete their follow-up appointment than those who were younger than 30, or older than 50 (P = 0.003). Male patients more frequently did not show up for their appointments than females (P = 0.028). White patients completed their follow-up more frequently than non-white patients (P = 0.002). Patients who lived further from the clinic completed their follow-up appointment more frequently than those who lived closer.

Conclusion: Our study demonstrates that the rate of completion of a follow-up visit (within the first 90 days after surgery) is relatively high in patients who have undergone

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orthopaedic trauma surgery. A telephone reminder prior to the appointment did not have a significant impact on the rate of follow-up, but instead increased the cancellation rate. Although the short-term follow-up rate for our study was high, it is well known that longterm follow-up is frequently limited in orthopaedic trauma patients. Additional methods to improve follow-up rates are necessary and we are continuing to study the factors that impact both short-term and long-term follow-up.

Injury Severity But Not Head Injury Is Associated With Heterotopic Ossification in Patients Admitted to a Level 1 Trauma ICU

*Erika J. Mitchell, MD*¹; Patrick R. Norris, PhD²; Judith M. Jenkins, RN, MSN²; John A. Morris, MD²; ¹Loyola University Medical Center, Maywood, Illinois, USA; ²Vanderbilt University Medical Center, Nashville, Tennessee, USA

Purpose: The etiology of heterotopic ossification (HO) has been difficult to assess and numerous publications report conflicting results. We have analyzed data on 1313 consecutive patients with fractures admitted to the trauma unit at Vanderbilt University Medical Center for associations between HO and age, gender, ISS, abbreviated injury scale (AIS) head score (AISH), hospital days, ICU days, and days on a ventilator.

Methods: Data were retrieved for 1313 consecutive patients with long-bone and pelvic/ acetabulum fractures from the Trauma Registry of the American College of Surgeons (TRACS) database between April 2005 and May 2007. Radiographic studies for these patients were independently reviewed for HO by a fellowship-trained orthopaedic traumatologist and a musculoskeletal radiologist. Patients with and without HO were compared using Wilcoxon rank-sum tests for the continuous variables and χ^2 or Fisher exact tests for the categorical variables.

| | No HO | НО | P Value |
|-----------|-------------------|-------------------|---------|
| Age, y | 40.67 ± 17.89 | 42.69 ± 16.38 | 0.087 |
| ISS | 24.84 ± 12.08 | 28.35 ± 11.75 | 0.003 |
| AISH | 2.13 ± 1.84 | 1.70 ± 1.80 | 0.016 |
| Hosp days | 12.81 ± 12.84 | 18.42 ± 17.28 | <0.001 |
| ICU days | 5.61 ± 7.32 | 8.14 ± 8.75 | < 0.001 |
| Vent days | 4.66 ± 7.11 | 6.60 ± 6.91 | < 0.001 |

Results: Of the 1313 patients, 1128 (830 male, 298 female) survived and had the data elements of interest available in TRACS. HO was identified in 125 patients (9.5%). Results are summarized in the table. Gender was not significantly associated with HO.

Conclusions: Previous studies have demonstrated a relationship between injury severity and the development of HO and our data support this. However, in contrast to numerous studies, we do not show a correlation of head injury with HO formation. We used AIS scores for head injury instead of Glasgow Coma Scale (GCS), which has been used in prior studies. We believe AIS is more specific for head injury compared to GCS, which includes a component of a patient's overall injury severity and pharmacologically induced alterations in mental status. While injury severity may explain increased ICU, hospital, and ventilator

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days, there may also be a component of differences in the physiologic response of a given patient to a traumatic insult that affects these outcomes as well as the development of HO.

Disclaimer: This work was supported by the US Army Medical Research and Materiel Command, Orthopaedic Extremity Trauma Research Program, under Award No. W81XWH-08-1-0384. Opinions, interpretations, conclusions, and recommendations are those of the authors and are not necessarily endorsed by the US Army.

Scientific Poster #6 Polytrauma

Civilian Gunshot Wounds of the Humerus

Anil Sethi, MD; Vic Gibson, DO; Robert Colen, DO; Daniel Hoard, MD; Robert Meehan, MD; **Rahul V. Vaidya, MD**; Detroit Receiving Hospital, Detroit, Michigan, USA

Purpose: The purpose of this paper is to present a series of humeral fractures following civilian gunshot injuries and evaluation of its management.

Methods: From 1999 to 2008, there were 2808 cases of gunshot wounds that reported to our hospital. 1235 patients had an associated fracture that included 54 patients with fractures of the humerus. All patients had survived the initial injury and were referred for orthopedic consultation. There were 48 males and 6 females with an average age of 30 years. The middle third was the most common location of fracture, followed by the distal and proximal third. There were 16 nerve (10 radial, 3 ulnar, 2 median, 1 axillary) and 4 brachial artery injuries requiring repair. 34 patients were treated with coaptation splints followed by functional braces. 13 patients underwent open reduction and internal fixation (ORIF) of the fracture. Six patients had an application of an external fixation device (ex-fix), and 1 patient underwent fixation with an intramedullary rod.

Results: Operative indications included polytrauma, patients with concomitent vascular injury, and those with significant soft-tissue defects that required multiple surgeries. 49 patients healed uneventfully, 2 patients underwent ORIF due to lack of compliance with splinting, and 3 patients went on to nonunion requiring further intervention(1 ORIF, 1 ex-fix, and 1 splinted patient). Complications also included posttraumatic arthropathy in 2 patients, 1 pin-site infection from an ex-fix, and 1 wound infection in an operated patient.

Conclusions: Fracture of the humerus following civilian gunshot wounds often is associated with limited soft-tissue damage. The decision for surgical stabilization of the fracture is similar to blunt injuries (polytrauma, obesity) except in cases where there is vascular injury requiring repair or extensive soft-tissue damage that requires further management. Fracture healing rates are high following this injury, with low infection rates.

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Does Anemia or Transfusion Increase the Risk of Complications in Orthopaedic Trauma Patients?

Brian H. Mullis, MD; Erica Fisk, MD; DeWayne Weaver, MD; Qianqian Zhao, MS; Joanne Daggy, PhD; Indiana University School of Medicine Dept. of Orthopaedics, Indianapolis, Indiana, USA

Purpose: Transfusion of young, healthy, asymptomatic orthopaedic trauma patients is routine at many institutions due to concerns for anemia. The purpose of this study was to assess whether anemia, with or without allogeneic blood transfusion, contributed to an increased complication rate in healthy orthopaedic trauma patients and whether the transfusion itself might be an independent risk factor for a complication.

Methods: A retrospective review of 104 patients treated at a Level 1 trauma center by a single surgeon from September 2006 to February 2009 was conducted. Inclusion criteria were patients 18 to 50 years of age and a hemoglobin concentration of 9.0 g/dL or less at any time during their admission. Patients with head injury, pregnancy, or patients with a preexisting history of pulmonary, cardiac, or renal conditions were excluded. The patients were initially divided into 2 cohorts by their lowest hemoglobin level prior to first transfusion of <7.0 g/dL and >7.0 g/dL; this was followed by further division depending on whether the patients were transfused. Logistic regression analysis was performed. Patients' charts were reviewed for complications extending through a 1-year period after initial discharge from the inpatient service. Patients who had not received follow-up treatment through a known outpatient clinic were contacted by telephone to ascertain outcome. Overall, 5 out of 104 patients were lost at 1-year follow-up. Among other variables, postoperative complications were recorded as our primary outcome. Superficial wound infection was defined as cellulitis within 1 year requiring oral antibiotics; deep wound infection was defined as any infection within 1 year of injury that required intravenous antibiotics or surgical débridement in the operating room. Complications included (not all were found but the following were specifically searched) superficial infection (defined as cellulitis requiring oral antibiotics), deep infection (defined as requiring intravenous antibiotics or surgical débridement), urinary tract infection, pneumonia, pulmonary embolism, deep venous thrombosis, acute renal failure or insufficiency, nonunion, delayed union, compartment syndrome, osteomyelitis, nerve palsy, anoxic brain injury, cardiac ischemia or infarct, pancreatitis, or death.

Results: There was no increased risk for complication related to anemia itself (P = 0.3). However, there was a significant risk for complication related to transfusion (P < 0.01); furthermore, there was a dose-dependent effect with complication risk increasing with each unit transfused (P = 0.02). Other factors such as age, ISS, and gender were considered and when adjusted did not change these results.

Conclusion: In young, healthy orthopaedic trauma patients, anemia does not appear to act as an independent risk factor for complications; however, allogeneic blood transfusion does appear to be a significant independent risk factor for complication and has a dose-dependent effect. Based on our findings from this retrospective study, we are designing a multispecialty prospective study on orthopaedic trauma patients at our institution to determine if transfusion simply acts as a marker for patients at higher risk for complication due to injury or if transfusion might contribute directly to these complications.

Early Stabilization of Thoracolumbar Injuries in Polytraumatized Patients

Timothy A. Moore, MD; Heather A. Vallier, MD; MetroHealth Medical Center, Cleveland, Ohio, USA

Purpose: Polytrauma patients often present with unstable thoracolumbar injuries. While most surgeons feel these injuries need to be stabilized, the timing of such an operation remains a topic of debate. We present a consecutive series of 98 thoracolumbar injuries stabilized in an early or late manner.

Methods: 98 skeletally mature patients with an ISS >18 presenting to our Level 1 trauma center were retrospectively reviewed. There were 79 men and 19 women. The average age was 37.3 years (range, 18-71 years). The average ISS was 37.3 (range, 18-50). The "early" group was defined as definitive stabilization within 24 hours (21 patients [21.4%]) and "late" group after 24 hours (77 patients [78.6%]). Associated injuries of the chest, abdomen, and head were documented along with ISS, Abbreviated Injury Scale scores, and Glasgow Coma Scale. Transfusion requirements, length of ventilator assistance, length of ICU stay, and length of hospitalization were determined. Complications were reviewed, including wound infection, pulmonary complications (adult respiratory distress syndrome [ARDS], pneumonia, pulmonary embolism [PE]), renal failure, multiple organ failure (MOF), and deep venous thrombosis (DVT).

Results: The average ISS was 29.1 ± 9.3 for the early group and 32.5 ± 11.3 for the late group (P = 0.001). The late group had a longer hospital stay and ICU stay. The early group had a lower rate of ARDS, pneumonia, and sepsis compared to the late group. Rates of DVT, PE, wound infection, renal failure, MOF, and death were not statistically significant between the 2 groups.

Conclusion: In polytraumatized patients with thoracolumbar injuries, prolonged recumbency has been shown to negatively impact pulmonary function. Pain reduction achieved by stabilization limits sympathetic discharge and reduces narcotic consumption causing less pulmonary suppression. 98 unstable thoracolumbar injuries in polytraumatized patients were reviewed. Patients who underwent definitive stabilization within 24 hours achieved shorter ICU and hospital stays and lower rates of pulmonary complications than those treated later than 24 hours. We feel surgical timing should be a multidisciplinary decision based on the patient's physiologic and resuscitation status and the extent of the stabilization procedure.

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Minimally Invasive Surgery (MIS) Techniques and Outcomes for Stabilization/Correction of Single-Level Thoracolumbar Spinal Fractures Amit Kumar, MRCS; Christopher Lee, FRCS; Lincoln County Hospital, Lincoln, United Kingdom

Purpose: We hypothesized whether MIS techniques confer any benefit when treating thoracolumbar burst fractures.

Methods: This was a prospective, nonrandomized study over the past 7 years comparing conservative (bracing: n = 27), conventional surgery (open techniques: n = 23), and MIS techniques (n = 21) for stabilization and correction of all thoracolumbar spinal fractures with kyphosis of >20°, using the Camlok S-RAD 90 system. All patients previously had normal spines, sustaining only a single-level burst fracture (T12, L1, or L2) as their only injury. Age range was 18 to 65 years. All patients in both operatively treated groups were corrected to under 10° of kyphosis, posteriorly only. All pedicle screws/rods were removed between 6 months and 1 year postsurgery to remobilize the stabilized segments once the spinal fracture had healed, using the original incisions and muscle-splitting/sparing techniques. Patients were assessed via Oswestry Disability Index (ODI) and work/leisure activity status 1 year after fracture.

Results: The conservatively treated group fared worst overall, with highest length of stay, poorest return to work/activity, and with a proportion (5 of 27) requiring later intervention to deal with posttraumatic deformity. 19 of 27 returned to original occupation, at average 9 months; ODI 32%. Conventional open techniques fared better, with length of stay 5 days, most (19 of 23) returning to original work/activity, and none requiring later intervention. Average return to work was at 4 months; ODI 14%. The MIS group fared best, with shorter length of stay (48 hours), all returning to original work/activity at average 2 months, and none requiring later intervention; ODI negligible. There was no loss of correction in either operatively treated groups.

Conclusions: The Camlok S-RAD 90 system is a powerful tool for correction of thoracolumbar burst fractures, and maintains an excellent correction. MIS techniques provide the best outcomes in treating this group of spinal fractures, and offer patients the best chance of restoration to prefracture levels of activity.

A Modified Ollier Approach for the Treatment of Acetabular Fractures

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Purpose: Our objective was to describe the surgical technique for the modified Ollier transtrochanteric (Ollier) approach and evaluate the rates of wound and neurologic complications and clinically significant heterotopic ossification (HO), Brooker stage III and IV, with the modified Ollier approach for the treatment of acetabular fractures.

Methods: A retrospective clinical study was performed at a university Level 1 trauma center. A consecutive series of 93 patients (94 acetabuli) with unstable acetabular fractures requiring surgical fixation were included. All patients were treated with open reduction and internal fixation of an acetabular fracture via the Ollier approach by a single surgeon. Demographic and clinical information regarding rates of wound and neurologic complications as well as remaining articular step-off at the time of fixation was obtained from a chart review. The degree of HO was graded from standard AP pelvis radiographs according to the Brooker classification.

Results: Six patients (6%) had reoperation for infection; however, only 3 of these patients (3%) had a deep infection. hree patients (3%) had iatrogenic sciatic nerve injury; only 1 patient had persistent sensory changes at final follow-up. 13 of the 73 patients (18%) with radiographs available for review at a minimum of 3 months' follow-up had Brooker grade III HO and 1 patient (1%) had grade IV. Five patients (5%) underwent excision of HO.

There were 14 of 81 patients (17%) without radiographic union of the greater trochanteric osteotomy, but none of these patients required further surgery.

Conclusions: The complication rates of the Ollier approach in this study compare favorably with alternative surgical approaches reported in large series. We believe this approach provides excellent exposure (figures) for the reduction of complex fracture patterns without increasing the risk of complications.



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What Outcomes Are Important for Patients Following Pelvic Trauma? Subjective Responses and Psychometric Analysis of 3 Published Pelvic Specific-Outcome Instruments

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Purpose: The measurement of functional outcomes in pelvic fracture patients remains difficult for authors. We aimed to test the construct validity, respondent burden, and patient perception of 3 previously published pelvic outcome questionnaires.

Methods: We recruited patients who were more than 1 year from surgical treatment of Tile B and C pelvic fractures. Subjects completed 3 pelvic-specific outcome instruments (Majeed score, Iowa pelvic score, and Orlando pelvic score), and 3 general functional outcome instruments (SF-36 [Short Form–36], SMFA [Short Musculoskeletal Function Assessment], and WOMAC [Western Ontario and McMaster Universities Osteoarthritis Index). Time of completion for each pelvic instrument was recorded, as was which score the patient felt best addressed their symptoms. Finally, patients were asked to state the 3 most significant impacts the pelvic fracture had on their life.

Results: We recruited 33 patients, 13 Tile C and 20 Tile B fractures, who were a mean of 61 months from surgery (range, 13-115 months). Patients cited recreational / mobility difficulty (26), emotional stress and family strain (20), employment and financial difficulty (15), sleep disturbance and anxiety (7), and sexual function (4), as the most important consequences of their injuries. Each of the 3 pelvic outcome questionnaires showed a high correlation with the physical component summary of the SF-36 (Majeed 0.877, Iowa 0.876, Orlando 0.868). None had a high correlation with the mental component summary of the SF-36, indicating these scores do not capture psychological distress and well-being, social functioning, and overall vitality. Correlations between instruments were also very high. All 3 questionnaires demonstrated ceiling effects, with 24%, 21%, and 18% of respondents reporting the highest possible scores, on the Iowa, Majeed, and Orlando scores, respectively. The time for completion was 3.6 ± 0.4 minutes for the Iowa score , 7.4 ± 0.4 for the Orlando score (not including radiographic assessment), and 2.6 ± 0.2 for the Majeed score. 12 patients each preferred the Iowa and Orlando questionnaires, and 9 preferred the Majeed instrument.

Conclusion: In this cohort, all 3 previously published pelvic outcome instruments demonstrated strong construct validity based on correlation with the physical component summary of the SF-36. Similar patient preference was observed for each instrument. Subjects identified mental and emotional outcomes as important consequences of their injury; however, none of the pelvic questionnaires measure these domains, as they all correlate poorly with the mental component summary of the SF-36. Ceiling effects and respondent burden limit the utility of the current instruments, and their reliability and responsiveness remain unknown. No currently available outcome instrument appears to captures all of the important consequences of these injuries.

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Does Early Treatment of Acetabular Fractures Lead to Increased Blood Loss? *Caroline R. Gross, BS*¹; Robert V. O'Toole, MD¹; Renan C. Castillo, PhD²; Theodore T. Manson, MD¹; ¹R Adams Cowley Shock Trauma Center, Dept. of Orthopaedics, University of Maryland School of Medicine, Baltimore, Maryland, USA; ²Center for Injury Research & Policy, Johns Hopkins Bloomberg School of Public Health,

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Purpose: Our goal was to determine the relationship between the timing of surgery and estimated surgical blood loss (EBL) in the treatment of acetabular fractures. We hypothesized that acetabular fractures treated within 1 or 2 days of injury would result in a clinically significant increase in blood loss, particularly in more complex fracture types.

Methods: Our study group was 375 consecutive patients with an acetabular fracture treated with open reduction and internal fixation at a single Level 1 trauma center over 7 years. Inclusion criteria included complete EBL data (from prospective anesthesia record), injury and surgical timing data (from a prospective trauma registry). We excluded patients who had additional operative procedures that may have contributed to EBL. Analyses compared total and EBL per unit time in patients treated within 24 hours of injury (n = 49) versus patients treated more than 24 hours after injury (n = 326) and in patients treated within 48 hours of injury (n = 152) versus patients treated more than 48 hours after injury (n = 223). To account for differences between the early and late groups, a multiple variable regression model adjusted for type of fracture, defined as complex (T-type, PC [posterior column]/PW [posterior wall], TRV [transverse]-PW, AC [anterior column]-PHT [posterior hemitransverse], BC [both-colum]) versus simple (AC, AW [anterior wall], PC, PW, TRV), surgical approach (posterior versus anterior or extensile), age, and gender.

Results: Bivariate analysis yielded no difference in total EBL between patients treated less than 24 hours (883 ± 651 cc) and more than 24 hours (980 ± 865 cc) after injury (P = 0.45). There was also no difference in EBL per minute between patients treated less than 24 hours (3.8 ± 1.9 cc/min) and more than 24 hours (4.1 ± 2.9 cc/min, P = 0.45). The multiple variable model demonstrated a trend towards a slightly lower EBL for cases occurring beyond 48 hours (-124 cc; P = 0.07; 95% confidence interval [CI]: -485, 11). This trend was more clinically significant among complex fracture patients treated with anterior or extensile surgical approaches, with those treated beyond 48 hours having, on average, 430-cc lower EBL (95% CI: -114, 973; P = 0.12).

Conclusion: Even with this relatively large patient group, our data demonstrate that early treatment of acetabular fractures is not associated with increased total blood loss or blood loss per unit time in the operating room, particularly in simpler fracture types. However, our multiple variable model does hint at a trend toward more EBL in those treated before 48 hours, particularly in the more complex patterns. We believe this trend warrants further investigation as confirmation of this finding might argue to delay complex, higher EBL cases.

See pages 77 - 115 for financial disclosure information.

Pelvic CT-Based Graphical Modeling for Safe Insertion of Anterior and Posterior Column Screws

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Purpose: Percutaneous screw fixation of the pelvis has been described, but placement of these screws remains challenging due to the complex 3-dimensional (3D) structure of the pelvis and the danger to surrounding neurovascular structures. The objectives of this study were (1) to identify and describe a safe, extra-articular pathway for the insertion of anterior and posterior column screws based on computer modeling derived from CT scans, (2) to determine if all pelvises could safely accommodate a 6.5-mm or 7.3-mm screw in both columns, and (3) to determine the effect of age and gender on screw placement.

Methods: 95 sets of uninjured axial pelvic CT images (28 females and 67 males) were analyzed by a Java-based computer program designed by the primary author. This program distinguished bone from soft tissues and modeled these structures into polygons, using a pelvis-specific algorithm to map the anterior and posterior column of each pelvis. For each pelvis, the polygons from each image were stacked upon each other and graphed using C++ and OpenGL, generating a digital 3D model of each column. At every possible entrance point along the pelvis, a potential 6.5-mm or 7.3-mm screw was graphically projected along the anterior column, exiting inferior and distal to the acetabulum. All screws that did not

safely remain within the bone were eliminated. The same process was then repeated for the posterior column. The precise entry point and length of each safe screw were compiled. The mean and standard deviation for the entry points were calculated to create a zone of entry containing the optimal area in which to start the screw for each column. The longest screw that originated from the zone of entry was determined.

Results: The computer algorithm was able to map the pathway for a safe anterior column screw and posterior column screw and determine an optimal zone of entry in all 95 cases. Nearly every patient could accommodate both a 6.5-mm and a 7.3-mm screw in both the anterior and posterior column. Males had greater longest anterior column screw lengths for both 6.5-mm (P=0.0004) and 7.3-mm (P <0.0001) screws. We found no correlation between age and screw length among females, males, or the entire study population.

Conclusion: We have designed a CT-based computer modeling algorithm that describes the anatomy of the pelvis for the safe insertion of anterior and posterior column screws. Most of the pelvises analyzed could accommodate



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either a 6.5-mm or a 7.3-mm screw in both columns. However, among the 95 patients, there was significant variation in the starting point that would best accommodate a safe screw. Therefore, based upon these data, screw fixation of the columns must be individualized and CT-based computer guidance may have a role in the safe placement of these screws.

AIIS, anterior inferior iliac spine; ASIS, anterior superior iliac spine.

• Stability of an Anterior Internal Fixator for Vertically Unstable Pelvic Fractures Jonathan M. Vigdorchik, MD¹; Amanda O. Esquivel, PhD¹; Xin Jin, PhD²; King H. Yang, PhD²; David C. Markel, MD¹; Rahul V. Vaidya, MD¹; ¹Detroit Medical Center/Providence Hospital Orthopaedic Residency Program, Detroit, Michigan, USA; ²Wayne State University, Detroit, Michigan, USA

Purpose: The purpose of this study is to evaluate the biomechanical stability and the compressive forces across the sacroiliac (SI) joint of an anterior internal fixator compared to the femoral distractor and external fixator for vertically unstable pelvic fractures. The anterior internal fixator uses the same techniques as external fixation; however, the entire construct is subcutaneous, combining the benefit of rapid placement, while avoiding many of the complications associated with external fixation.

Methods: Six composite pelvises with a simulated APC (anterior posterior compression) type III injury fixed with a femoral distractor, external fixator, or anterior internal fixator were tested. First, a pressure-sensitive film was placed in the disrupted SI joint recording the magnitude and distribution of the force. Then, in a single-leg stance model, a compressive load was applied through the sacrum. We recorded displacement at the pubic symphysis and SI joint using high-speed video. Ultimate load and displacement were measured, and axial stiffness was calculated. alues were compared using a Student *t* test (P < 0.05).

Results: The SI joint was compressed significantly (P < 0.001) more using the anterior internal fixator (18.9 N) and femoral distractor (18.6 N) than the 2-pin external fixator (2.5 N). There

was no significant difference between the anterior internal fixator and the femoral distractor in displacement at the SI joint. The pubic symphysis displaced less with the femoral distractor than the anterior internal fixator (5.5 mm vs 4.1 mm; P < 0.05).

Conclusion: Although the anterior internal fixator demonstrated lower ultimate loads and stiffness than the femoral distractor, the displacement at the SI joints was equal. It is unclear whether these differences have clinical significance. Combined with the pre-



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sumed benefit of minimizing the complications associated with external fixation, the anterior internal fixator may be a better option for temporary anterior pelvic fixation in situations where external fixation or the femoral distractor may have otherwise been used.

Percutaneous Retrograde Posterior Column Acetabular Fixation: Is the Sciatic Nerve Safe? A Cadaveric Study

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Purpose: Percutaneous screw fixation has been advocated for minimally displaced posterior column acetabular fractures with the potential benefit of allowing early mobilization and preventing further displacement. This is particularly useful when there is an associated anterior column fracture to avoid more extensile exposure and in polytrauma cases where multiple associated extremity fractures warrant early mobilization and possibly fixation. Little has been published on the safety of the retrograde technique, especially with regard to neurologic structures. The purpose of this cadaveric study was to determine the proximity of the neurologic structures to the path of the screw inserted percutaneously utilizing a guidewire into the ischial tuberosity. Our hypothesis was that the sciatic nerve is at a safe distance from the trajectory of the screw.

Methods: Ten screws were inserted percutaneously in 10 limbs (5 cadavers) under fluoroscopic guidance. Dissection was then performed to expose the head of the screw as it entered through the ischial tuberosity and was then extended laterally to expose the sciatic nerve, the inferior cluneal, and the posterior cutaneous nerve of the thigh. The distances from the head of the screw to these neurologic structures were measured. The axis of inclination of the guidewire was also noted to determine the ideal pathway.

Results: The distance from the center of the screw head to the sciatic nerve averaged 6.3 cm (range, 4-7 cm). The average distance between the center of the screw head and the posterior cutaneous nerve of the thigh was 5 cm (range, 3-6 cm). The inferior cluneal branches were the closest to the path of the screw with an average distance of 0.3 cm in 7 specimens (range, 0.1-0.6 cm) and were injured by the screw in 2 and could not be located in another specimen. The inclination of the guidewire was approximately 15° from the midline in both the sagittal and the coronal planes.

Conclusion: The sciatic nerve and the posterior cutaneous nerve of the thigh appear to be safe during retrograde percutaneous screw fixation of a posterior column acetabular fracture through a central entry point in the ischial tuberosity and following the inclination shown in this study. However, care must be taken to avoid injury to the inferior cluneal nerves.

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Can MRI Detect Ligamentous Injury in Pelvic Ring Disruptions?

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Purpose: Despite its theorized importance in determining pelvic stability after injury, little is known regarding the integrity of the ligamentous pelvic constraints in patients with pelvic fracture. Our hypothesis was that MRI could be used to visualize these ligamentous structures.

Methods: Our study group was composed of 8 patients with an acute pelvic ring injury and 26 controls without pelvic ring injury. The patients with pelvic ring injury were prospectively enrolled and MRI scans were obtained within 14 days of injury for purposes of this IRB-approved study. Injuries were classified by Young-Burgess. The control group was created from already obtained MRI of the pelvis for other reasons in nontrauma patients. In both groups, 2 MRI sequences (axial T1 and 3D volume with T2-weighting) were reviewed by the same attending musculoskeletal radiologist to determine the integrity of the sacrotuberous (ST), sacrospinous (SS), anterior sacroiliac (ASI), posterior sacroiliac (PSI) ligaments, and pelvic floor musculature.

Results: Clear visualization of intact SS, ST, ASI, PSI ligaments, and pelvic floor musculature was possible in 96%, 100%, 89%, and 87% of the control patients, respectively. All 6 patients with anterior posterior compression type II injuries had rupture of the ASI (0% intact, *P* <0.001 Fisher exact compared with controls) and none had rupture of PSI. Four of 6 (33% intact, *P* <0.001) had injury to the SS ligament (3 partial tears, 1 complete) and 3 of 6 had partial tearing of the pelvic floor musculature. Only 1 patient had a partial tear of the ST ligament (nonsignificant). The other 2 patients had an anterior compression type I and lateral compression type III and showed injury to multiple ligaments consistent with these injuries.

Conclusion: The ligaments that are thought to be significant in pelvic stability appear to be easily visualized using MRI of injured and noninjured pelvises. This noninvasive imaging modality may hold great promise in helping to differentiate stable from unstable mechanical patterns and helping to determine who would benefit from operative treatment as it has in other areas of orthopaedic surgery.

Biomechanical Analysis of Posterior Pelvic Ring Fixation in a Vertically Unstable Pelvic Fracture Model

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Purpose: This biomechanical evaluation of various posterior pelvic ring constructs applied to a zone II sacral fracture gap model addresses 3 questions: (1) Is transsacral (TS) screw fixation superior to iliosacral (IS) screw fixation? (2) Is 2-level (S1 and S2) fixation superior to single-level (S1 only)? (3) How much does compression of the posterior pelvic ring contribute to pelvic ring stability in zone II sacral fractures?

Methods: A transforaminal sacral fracture with ipsilateral vertical rami fractures was created in 6 fourth-generation composite epoxy–coated full pelvic models. Load to ultimate failure or 1000 N was tested on an MTS servohydraulic test frame in a single-leg stance model. Displacement was measured by a 3-dimensional motion tracking camera. Ultimate load to failure and displacement of hemipelves were evaluated using a custom MATLAB program. The following 8 posterior fixation constructs were tested: (1) tension band plate (TBP) at S1, (2) IS screw at S1, (3) 2 IS screws at S1, (4) IS screw at S1 and S2, (5) IS screw at S1 + TBP at S2, (6) TS screw at S1, (7) TS screw at S1 and S2, and (8) TS screw at S1 + TBP at S2. All were tested both with and without a 5-mm gap in sacrum to simulate comminution.

Results: Tension band plating could not withstand preload in both the gap and non-gap model, and was considered failure. The TS screw demonstrated greater resistance to load than all other constructs. Two-level fixation improved the resistance to load for all constructs. One-level fixation yielded 71 of 96 failures and 2-level yielded 22 of 96 failures. Compression of the posterior ring led to greater stability of the pelvic ring.



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Conclusion: TS screw fixation demonstrates superior resistance to load to failure compared to IS screw. Also, when possible, surgeons should strive to obtain 2 levels of fixation (at S1 and S2) as these constructs demonstrated significantly fewer failures and were able to tolerate greater loads before failure. This may become increasingly important for dysmorphic pelves with the difficulty in applying posterior ring screw fixation. While many surgeons fear that compression of these injuries risk neurologic damage, cortical contact greatly enhances construct strength and decreases the number of failures compared to those pelves left with a posterior gap.

Can Experts in Acetabular Fracture Care Determine Hip Stability After Posterior Wall Fractures Using Plain Radiographs and Computed Tomography?

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Purpose: Hip stability status after posterior wall acetabular fracture involving 20% to 50% of the posterior wall is difficult to determine. However, noted experts have professed that hip stability can be accurately determined by careful review of good-quality AP and oblique plain radiographs and a CT scan. The purpose of this study was to evaluate the interobserver and intraobserver reliability and accuracy of fellowship-trained orthopaedic traumatologists who specialize in acetabular fracture care in the determination of hip stability status for these fractures. We hypothesized that expert assessment of these plain radiographs and CT scans is reliable and accurate.

Methods: Plain radiographs and axial CT images of 15 fractures involving 20% to 50% of the posterior wall were reviewed by 4 expert, fellowship-trained orthopaedic traumatologists specializing in acetabular fracture care in 2 separate sessions, the second after at least a 1-month washout period. A determination of hip stability status was made for each fracture at each of the 2 time points based on the images along with any history of dislocation of the hip at the time of injury. These determinations were compared to the findings of examination under anesthesia (EUA), which served as the gold standard.

Results: Although intraobserver reliability was good (0.65), interobserver reliability was poor (0.12). In addition, percent correct was only 53.3% for the initial reading and only 51.7% for the second. For the initial reading, sensitivity and specificity were 100% and 12.5%, respectively. For the second reading, the sensitivity and specificity were 57.1% and 46.9%, respectively.

Conclusion: Orthopaedic traumatologists expert in acetabular fracture care cannot adequately determine hip stability status for fractures involving 20% to 50% of the posterior wall using plain radiographs and CT. EUA is vital in determining hip stability status for these fractures.

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Long-Term Outcome After Displaced Sacral Fractures Treated With Internal Fixation Aron Adelved, MD^{1,2}; Anna Tötterman, MD, PhD³; Thomas Glott, MD⁴; Jan Erik Madsen, MD, PhD²; Olav Røise, MD, PhD²; ¹Akershus University Hospital, Oslo, Norway; ²Oslo University Hospital, Oslo, Norway; ³Karolinska University Hospital, Stockholm, Sweden; ⁴Sunnaas Hospital, Nesodden, Norway

Purpose: Displaced sacral fractures are associated with considerable morbidity. There are some reports on short and medium-term outcome; however, there is little knowledge about the long-term morbidity after these severe injuries. Our objectives are to (1) describe neurologic deficits in the lower extremities and impairments involving the urogenital, bowel, and sexual functions from a long-term perspective; and (2) compare the long-term results with the previously published (2006) data after 1 year follow-up.

Methods: 39 consecutive patients with displaced sacral fractures were prospectively registered at Oslo University Hospital, Ullevål between 1996 and 2001. Tötterman et al. published 1-year results on 32 of the 39 patients in 2006. In the present study, we followed 28 of these 32 patients for a mean 10.7 years (range, 8.1-13.4 years). Sensorimotor function was classified according to ASIA (American Spinal Injury Association) score and the modified Gibbons classification. Urinary voiding function was assessed with uroflowmetry and ultrasound. Bowel function was assessed with a structured questionnaire with regard to frequency, urge, diarrhea, and incontinence. Open questions were used to address any problems associated with sexual function. For male patients, selected questions from the International Index of Erectile Function were used. For comparison with previous data from the 1-year follow-up we used the Wilcoxon signed-rank test for paired samples.

Results: 26 patients (93%) had neurologic deficits in the lower extremities. Compared to preinjury, 5 had slightly changed,11 significantly changed, and 3 completely changed urinary voiding pattern. Six had slightly changed and 2 completely changed bowel pattern. Comparing our results with the data published in 2006, we found deterioration in urinary voiding function in 11 patients (39%) (P = 0.005), while no significant changes in neurologic deficits (P = 0.47) or bowel function (P = 0.13) were observed. 45% reported sexual dysfunction versus 38% at the 1-year follow-up.

Conclusion: In this long-term follow-up study, urinary voiding and sexual problems deteriorated over time, while neurologic deficits and bowel function showed no significant changes. These problems should therefore be adressed early and the patients should be followed by adequate expertise for many years after the injury.

Reexamination of Pelvic Inlet and Outlet Images Using Three-Dimensional Computed Tomography Reconstructions

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Purpose: Pelvic inlet and outlet views were historically defined as 45° cranial and caudal to the AP view. A recent study recommended 25° caudal tilt for the inlet and 60° cephalad tilt for the outlet image, based on measurements obtained from sagittal reconstructions of pelvic CT scans. The purpose of this study is to determine the optimal angles for obtaining ideal inlet and outlet views using virtual radiographs and 3-dimensional (3D) CT reconstructions.

Methods: A review was performed of 70 CT scans of nonfractured, adult pelves. Raw data from the CT scans were used to generate 2 new 3D reconstructions of each pelvis. The first CT scan reconstruction is a 3D radiolucent pelvis (sometimes called a ghost image or a virtual radiograph). The second reconstruction is a solid rendering of the bony pelvis. Each of these 3D reconstructions can be rotated by the surgeon in 1° increments about the horizontal axis, and can be used to generate inlet and outlet views. Two fellowship-trained orthopaedic traumatologists independently evaluated these reconstructions. They were blinded to the numeric value of the angle of rotation. They selected the inlet view where the anterior aspect of S1 and S2 vertebral bodies overlap, and the outlet view where the top of the pubic symphysis is at the level of the S2 body. An independent observer recorded the angle of pelvic tilt (from the AP plane) for each inlet and outlet view. A third orthopaedic surgeon measured the sagittal reconstructions for each pelvis as described by Ricci et al.

Results: 26 females and 44 males formed the study group. The mean age was 45.3 years (range, 19-80 years). The mean inlet angles that were measured with virtual radiographs and 3D reconstructions were $26.7^{\circ} \pm 8.5^{\circ}$ and $24.3^{\circ} \pm 8.6^{\circ}$, respectively. The mean outlet angles that were measured with virtual radiographs and 3D reconstructions were $43.7^{\circ} \pm 6.4^{\circ}$ and $43.8^{\circ} \pm 6.3^{\circ}$, respectively. The measurements obtained from the sagittal reconstructions were very similar to those reported by Ricci et al. The average inlet angle to profile the anterior bodies of S1 and S2 was 25.5^{\circ}, and the average outlet angle to be perpendicular to the S1 body or S1 foramina was 60.1° and 56° , respectively.

Conclusions: The results of this study confirmed that 25° of caudal tilt is the best angle for routine pelvic inlet radiographs. However, 60° of cranial tilt would result in inadequate outlet views as the pubic symphysis would overly the S1 body and neural foramen instead of the S2 body in 91% of the patients. 45° of cranial tilt is still the most reliable way to create an ideal outlet view.

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The Incidence and Significance of L5 Transverse Process Fractures in Adult Blunt Trauma Patients

Derek Ward, MD; Sina Akhavan, MS; Utku Kandemir, MD; **Murat Pekmezci, MD**; Dept. of Orthopaedics, University of California, San Francisco, San Francisco, California, USA

Purpose: Unlike the other lumbar transverse processes, fractures of the transverse process of the fifth lumbar requires high energy because strong iliolumbar ligaments connect it to the ilium, and a deep-seated position within the pelvis provides protection from direct trauma. Tile et al stated that L5 transverse process fractures are almost always associated with posterior pelvic ring injuries. However, to date no study has specifically examined transverse process fractures of the fifth lumbar vertebrae in a large number of patients. The purpose of this study is to describe the incidence of L5 transverse process fractures in an adult blunt trauma population and determine associated injuries.

Methods: A database review was performed in a Level 1 trauma center between May 2008 and June 2010. Inclusion criteria were age >18 years, nonpenetrating blunt trauma patients, and having abdominopelvic CT scan at the time of admission. Two trauma-trained orthopaedic surgeons reviewed the studies. The radiology reports were also reviewed to cross-check the findings. Specifically, incidence of L5 transverse process fractures, lumbar transverse process fractures (L1-L4), posterior pelvic ring injuries, and spine fractures were reviewed..

Results: 813 patients qualified for the study. There were 40 (4.9%) L5 transverse process fractures, 83 (10.2%) L1-L4 transverse process fractures, 124 (15.3%) posterior pelvic ring injuries, and 106 (13.1%) spine fractures. The incidence of posterior pelvic ring injuries was 72.5% in the patients with L5 transverse process fractures, whereas it was 12.3% in the patients without L5 transverse process fractures. There was no association with L5 transverse process fractures and spine fractures. The correlation analysis revealed significant association between L5 transverse process fractures and pelvic ring injuries (P < 0.01, $R^2 = 0.36$). There was no significant association between lumbar TP fractures, spine fractures, or pelvis fractures.

Conclusion: This study is the largest study to date that evaluated the incidence of L5 transverse process fractures and showed that there is 73% incidence of pelvic ring injury in the presence of an L5 TP fracture. Therefore, whenever an L5 TP fracture is noted on imaging studies, a pelvic ring injury should be searched for.

Condition-Specific Discomfort in Patients With Pelvic Ring Injuries Following Internal Fixation

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Purpose: Our objective was to construct a valid questionnaire for self-assessment of specific discomfort in patients with pelvic ring injuries treated with internal fixation.

Methods: An expert group developed a questionnaire consisting of questions in 11 different areas of pelvis-related discomfort in a 6-grade Likert scale from "no discomfort" to "very severe discomfort". Additionally 3 open questions concerning postoperative discomfort were asked to which patients could respond without restraint, in order to gain information of unidentified areas of discomfort in this patient group. 73 consecutive patients (29 female, 44 male) were prospectively followed during a 4-year period at 6, 12, and 24 months. The Short Form–36 (SF-36) was used for comparison at all 3 time points.

Results: There were 47 OTA-B type and 26 OTA-C type injuries, with the most common fracture types OTA-B2 (n = 22) and OTA-C1 (n = 18). 65 patients (89%) completed the questionnaires one or several times. Principal component analysis followed by varimax rotation lead to a reduction of the instrument. Thorough analysis of freely formulated patient responses to the open questions was done in order to influence the construction of a final questionnaire. The resulting Pelvic Trauma Questionnaire (PTQ) consists of 6 questions regarding "pain," "walking," "hip motion," "leg numbness," "sexual life," and "operation scar." There was a high correlation with SF-36 scores (r = 0.63-0.70). Discomfort level at 6 months was predictive of 2-year results, albeit discomfort was in general reported low. Pelvic pain reported at 1 and 2 years showed significant changes in relative position (0.16, 0.02-0.29 confidence interval [CI]) and concentration (0.25, 0.06-0.44 CI). Construct validity, reliability, internal consistency, content validity, and responsiveness of the proposed questions were adequate.

Conclusion: The PTQ self-assessment of patients with pelvic ring injuries following internal fixation yields a high response rate giving information of condition-specific functional outcome. Six areas of interest were identified with a high correlation to the generic qualityof-life instrument SF-36.

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Can Tibial Fracture Gap Volume Be Measured From Plain Radiographs?

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Purpose: The volume of bone defects is an important parameter in the treatment of open tibial shaft fractures. Currently there are no validated techniques to determine the volume of bone defects based on radiographs alone. Our goal was to create and validate such a technique.

Methods: 15 standardized synthetic models of the tibia were divided into 3 different types of bone defects. Each model was tested with a protocol of 3 increasing standardized bone defects to create our sample group of 45 bone defects with 9 different types of defects. The defect size ranged from 4 to 27 mL. The actual volume of each defect was determined using a customized and validated "Eureka can." Orthogonal radiographs were obtained for each specimen. Several candidate equations were compared for their ability to predict the actual volume based on radiographic measurements.

Results: A simple equation modeled after the volume of a triangular prism performed best: $V = [(Long Gap + Short Gap)/2 \times W_{AP} \times W_L]/1.6$, where V = volume of defect, Long Gap = longest bone gap on any view, Short Gap = shortest gap on any view, W_{AP} = width of bone on AP radiograph, and W_L = width on lateral radiograph. This relatively smple linear equation predicted the actual volume well with a mean error of only 12.8% (95% confidence interval, 10.0% to 15.6%).

Conclusion: To our knowledge this is the first validated technique for measuring tibial fracture gap volume based only on 2-dimensional radiographic measurements. This technique may prove useful as a research tool as it could provide an accurate determination of the size of tibial fracture gaps for clinical trials. Further, it may have use as a clinical tool to guide treatment by more accurately determining bone gap volumes from radiographs alone.
Intramedullary Fixation of Fibular Fractures Associated With Complicated Tibial Shaft and Pilon Fractures

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Purpose: The purpose of this retrospective study was to evaluate the clinical efficacy of locked retrograde Ender nail fixation of axially stable fibular fractures associated with complicated distal tibial fractures.

Methods: From 2006 to 2010, 23 fibular fractures associated with either tibial pilon or shaft fractures were treated at a Level 1 university trauma center with an intramedullary nail. Patients averaged 42.4 years of age (range, 22-78 years) at time of injury. Follow-up averaged 27 months (range, 12-50 months). All fibular fractures were treated with a retrograde 3.5-mm Ender nail that was distally locked with a 2.7-mm unicortical screw. Tibia fractures were treated with either intramedullary nail fixation or standard screw and plate fixation. Chart and radiographic analysis was performed to determine fibular and tibial fracture healing, fibular alignment, malunion, hardware complications, wound complications, need for bone grafting, use of a bone stimulator, and need for revision surgery.

Results: 12 of 23 patients (52%) had no complications. All 23 patients healed their fibular fractures, with an average of 1.6° of angulation. 6 of 23 patients (26%) developed tibia nonunions. Nine patients (39%) used a bone stimulator to aid in fracture healing. Eight patients (35%) required some type of bone grafting during their course of treatment; 3 of these 8 patients (38%) received their bone grafting during revision surgery for tibial nonunion. Five of 23 patients (22%) received supplemental oral or intravenous antibiotics. Two patients (7%) developed osteomyelitis. Only 1 patient had symptomatic fibular hardware. Initial tibia union was 74%, and the overall tibia union rate was 87%.

Conclusion: Locked intramedullary fixation with an Ender nail is clinically applicable for the treatment of axially stable fibular fractures that are associated with complicated tibial pilon or shaft fractures. The procedure is minimally invasive, provides rigid internal fixation, and can be utilized in compromised soft tissue.

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Injury Factors That Influence Outcome in Severe Open Tibia Fractures From Combat Travis C. Burns, MD¹; Daniel J. Stinner, MD¹; Andrew W. Mack, MD²; Benjamin K. Potter, MD², Rob Beer, MD²; Daniel R. Possley, DO¹; Michael J. Beltran, MD¹; Roman A. Hayda, MD³; COL Romney C. Andersen, MD²; John J. Keeling, MD²; Harold M. Frisch, MD⁴; Clinton K. Murray, MD⁵, Joseph C. Wenke, PhD⁶; James R. Ficke, MD¹; LTC Joseph R. Hsu, MD^{1,6}; Skeletal Trauma Research Consortium (STReC); ¹Dept. of Orthopaedics and Rehabilitation, Brooke Army Medical Center, Fort Sam Houston, Texas, USA; ²Dept. of Orthopaedics and Rehabilitation, Walter Reed National Military Medical Center, Washington, District of Columbia, USA; ³Dept. of Orthopaedics, Brown University Warren Alpert School of Medicine, Providence, Rhode Island, USA; ⁴Mission Hospital, Asheville, North Carolina, USA; ⁵Dept. of Medicine, Brooke Army Medical Center, Fort Sam Houston, Texas, USA; ⁶US Army Institute of Surgical Research, Fort Sam Houston, Texas, USA

Purpose: What injury factors influence the outcome in severe open tibia fractures sustained in combat?

Methods: We conducted a retrospective study of all combat-related open Gustilo and Anderson type III tibia fractures treated at Brooke Army Medical Center, Walter Reed Army Medical Center, and National Naval Medical Center between March 2003 and September 2007. We reviewed electronic medical records and radiographs to record treatment, outcome, and complication data.

Results: 193 Operation Iraqi Freedon/Operation Enduring Freedom military personnel with 213 type III open tibial shaft fractures were identified. There were 112 type III A, 76 type III B, and 25 type III C open fractures. Limb salvage was achieved in 167 limbs, while 46 extremities ultimately underwent amputation. 57 extremities (27%) developed a deep infection and 47 extremities (22%) ultimately underwent amputation. The average time to radiographic union was 9.2 months. OTA type C fractures took significantly longer to achieve osseous union (P = 0.02). Gustilo and Anderson type III B and III C fractures were both more likely to undergo an amputation and took longer to achieve fracture union (P= 0.0001, P = 0.001). Extremities with a deep infection or osteomyelitis were more likely to undergo an amputation, require revision operation, and have a prolonged time to union. Initial surveillance cultures were positive in 64% of cultures, and 93% of initial positive cultures isolated gram-negative species. Positive surveillance cultures were associated with subsequent development of deep infection, osteomyelitis, and need for amputation. However, 74% of deep infection cultures did not match the initial surveillance culture species. Although initial surveillance cultures were most commonly gram-negative species, subsequent infecting organisms were predominantly gram-positive.

Conclusions: Severe open tibia fractures from combat injuries unite in 80.3% of cases at an average of 9 months. At an average follow-up of 24 months, we recorded a 27% deep infection rate and a 23% amputation rate. The Gustilo and Anderson type is associated with development of a deep infection, need for amputation, and time to union. Positive

surveillance cultures are associated with development of deep infection, osteomyelitis, and ultimate need for amputation. Surveillance cultures, however, are not predictive of the infecting organism if a deep infection subsequently develops.

Acknowledgments: This study was conducted under a protocol reviewed and approved by the US Army Medical Research and Materiel Command Institutional Review Board, and in accordance with the approved protocol. The authors acknowledge Joint Theater Trauma Registry (JTTR) for providing data for this study.

Disclaimer: The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or reflecting the views of the Department of the Army, the Department of Defense, or the US government. This work was prepared as part of their official duties and, as such, there is no copyright to be transferred.

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A New External Fixation System for Tibial Shaft Fractures

Peter B.M. Thomas, FRCS(Orth); Peter J. Ogrodnik, PhD; Christopher I. Moorcroft, PhD; Matthew Ockendon, MD; University Hospital of North Staffordshire. Staffordshire University, United Kingdom

Purpose: In a new external fixation system for tibial fractures, accurate reduction was achieved with a complex temporary device, the Staffordshire Orthopaedic Reduction Machine (STORM) following which the fracture was fixed using a simple titanium bar fixator (IOS). The fixator was designed to allow controlled bending to optimize movement at the fracture site for callus growth. Ideal mechanical properties are approached: elastic return is to the reduced position; epicentric placement minimizes shear and distraction on weight bearing; integral healing assessment measures bending stiffness. The device is single-use.

Methods: Closed unstable tibial shaft fractures in 60 patients were externally fixed using the STORM in the operating theater to reduce the fracture prior to application of an IOS fixator. Immediate full weight bearing was encouraged. Bending characteristics of the fixator allowed 1 mm of axial movement for 20-kg loading. Fixator removal time was determined by fracture stiffness measurements against which the integral IOS stiffness measurement was compared.

Results: Mean healing time was 18.1 weeks; the shortest time was 8.5 weeks. The healing end point was fixator removal at a bending stiffness of 15 Nm/deg in 2 orthogonal axes. There was no subsequent creep or refracture. Good reduction, defined as less than 3° of maximum angulation and less than 3 mm of maximum translation, was achieved and maintained.

Conclusion: The IOS/STORM system allows safe and effective treatment of tibial shaft fractures. With the fracture reduced, the external fixator screws can be placed in optimum positions. Good reductions were achieved and maintained. The IOS bending characteristics appear to approach the optimum for callus growth. The simple integral fracture stiffness measurement method has been validated against more complex devices.

Results of Tibial Plateau Fractures Treated Through a Posteroloateral Transfibular Approach

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Purpose: Open reduction of tibial plateau fractures is traditionally performed through an anterolateral, anteromedial, or a posteromedial approach. These allow satisfactory access to the majority of plateau fracture patterns with the exception of some posterolateral fractures. In this study, we investigate the results of a posterolateral transfibular approach to the tibial plateau for a specific pattern of fractures involving the posterolateral corner of the tibia.

Methods: 15 patients with tibial plateau fractures underwent open reduction and internal fixation that included a posterolateral transfibular approach. There were 5 females and 10 males. Patients' age ranged from 20 to 76 years. There were 10 OTA 41B3 fractures and 5 41C3 fractures. Nine fractures were approached through a transfibular approach alone; 2 fractures had a posterolateral and a posteromedial approach; and 4 patients had a posterolateral, posteromedial, and an anteromedial approach. Follow-up at 1 to 3 years included: assessment of fracture reduction and maintenance of fracture reduction on plain radiographs and in 8 patients using radiostereometric analysis (RSA), clinical examination, Short Form–36, and Lysholm scores.

Results: All fractures healed uneventfully. There were no intraoperative or postoperative complications. There were no signs or symptoms of posterolateral knee instability and no symptoms related to the common peroneal nerve. No postoperative fracture displacement was diagnosed on postoperative radiographs while RSA measured displacements of 2 mm or less. Mean and median patients' assessed knee function was 85% (range, 70%-100%). Median Lysholm score was 76 (range, 49-100).

Conclusion: The posterolateral transfibular approach has advantages and should be considered for a specific pattern of fractures involving the posterolateral aspect of the tibial plateau. Our results demonstrated no complications through the learning curve of the development of this technique and satisfactory end results in difficult knee fractures.

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TRUST (TRial to evaluate UltraSound in the treatment of Tibial fractures): A Pilot Study

TRUST Investigators: Jason W. Busse, MSc, DC, PhD¹; Thomas A. Einhorn, MD²; James D. Heckman, MD²; Kwok-Sui Leung, MD³; Emil Schemitsch, MD⁴; Paul Tornetta, III, MD²; Stephen D. Walter, PhD¹; Gordon H. Guyatt, MD, MSc, FRCPC¹; **Mohit Bhandari, MD, PhD, FRCSC**⁵; ¹Dept. of Clinical Epidemiology and Biostatistics, Master University, Hamilton, Ontario, Canada;

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Purpose: Tibial fractures are a common injury associated with a prolonged recovery period. While results of a number of small randomized trials have suggested that low-intensity pulsed ultrasound (LIPUS) accelerates fracture healing, inferences about functional gains remain weak because of the small size, methodological limitations, and inconsistent results of the available trials. The purpose of the present pilot randomized trial was to assess the feasibility of a definitive trial to determine the effect of LIPUS on functional and clinical outcomes in operatively treated tibial shaft fractures.

Methods: We conducted a multicentre, blinded pilot randomized trial of 51 skeletally mature adults with operatively managed tibial fractures who were treated with either LIPUS or a de-activated LIPUS device. The goals of our pilot study were to determine recruitment rates in individual centers, determine investigators' ability to adhere to study protocol and data collection procedures, determine our ability to achieve close to 100% follow-up rates, and determine the degree to which patients were compliant with treatment. Our primary outcome measure was physical function as measured by the Short Form-36 physical component summary (SF-36 PCS) score. Our secondary outcomes included the Health Utilities Index-III (HUI-III), the Short Musculoskeletal Functional Assessment (SMFA) measure, time to radiographic healing, rates of malunion and nonunion, and rates of secondary procedures (operative and non-operative). Patients were followed for one year and a committee, blinded to allocation, adjudicated all outcomes.

Results: A total of 51 patients were randomized across 6 participating centers; 23 to LIPUS and 28 to a sham device. Our overall rate of recruitment for our 6 centres was approximately 0.8 patients per month, and site investigators successfully adhered to the study protocol and procedures. Forty-three patients (84%) completed one year of follow-up. Patient compliance with use of the ultrasound device was high, with 76% (n=39) demonstrating full compliance and 24% (n=12) demonstrating greater than 50% compliance. Both SF-36 PCS scores (mean difference 6.6, 95% confidence interval 0.1 to 13.0) and HUI-III scores (mean difference 0.20, 95% confidence interval 0.01 to 0.39) demonstrated a significant advantage in favour of LIPUS at the 6-month follow-up (p=0.046 and p=0.035 respectively). Other outcome measures were not significant between treatment arms. Tibia fractures at risk,

as defined by any fracture gap, current smoker, or open fracture, demonstrated delayed functional recovery versus fractures not at risk, and this difference was significant at 9 and 12 months of follow-up (p<0.001 and p=0.03 respectively).

Conclusion: Our pilot study supports the feasibility of a definitive trial. A pivotal trial of 500 patients to resolve uncertainty around our pilot trial estimates of function gains, radiographic fracture healing, and reoperations is currently underway. The authors would like to acknowledge the work of the TRUST Investigators and Research Staff.

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Locked Plating Versus Intramedullary Nailing: Management of Closed Distal Tibial Fractures—A Case-Matched Series

Benjamin Ollivere, MD; David Cumming; Sue Deakin; West Suffolk Hospital, Suffolk, United Kingdom

Purpose: The distal tibial locking compression plate is a precontoured locking plate designed for management of distal tibial fractures. Fixation of extra-articular distal tibial fractures has traditionally been addressed with intramedullary nailing or external fixation. The distal tibial LCP provides a new method of management. Our hypothesis is that the distal tibial LCP provides improved functional outcomes for AO type 4.3A fractures over traditional management.

Methods: 20 serial patients with AO type 4.3A fractures previously treated with an LCP were matched to 20 patients treated with a slotted AO tibial nail. In all cases it would have been technically possible to nail the fractures. Case matching was performed for age, smoking status, medical comorbidities, and Gustilo-Anderson grade. Outcome measures included the American Orthopaedic Foot & Angle Society (AOFAS) and Short Form–36 (SF-36) at a minimum of 2 years follow-up and radiographic records.

Results: One patient died, so was lost to follow up. The LCP group had a statistically significantly longer time to union and higher reoperation rates. There was no significant difference in time to weight bearing or complications. Functional scores at a minimum of 2 years were not statistically significantly different between the 2 groups.

Conclusion: Although this is a small case series, there is no current body of evidence to support the use of locked internal fixation over more traditional forms of fixation in these fractures. Although the increased reoperation rate may be due to the learning curve in using these plates, we would advise caution in choosing locking plate fixation over intramedullary fixation where nailing is technically possible.

| | Plates | Nails | Р |
|------------------------------|--------|-------|------|
| Patients | 20 | 20 | - |
| Weeks to union (mean) | 40.7 | 28.5 | 0.04 |
| Weeks to full weight bearing | 10 | 8 | 0.38 |
| Complications | | | |
| Total | 8 | 4 | 0.17 |
| Infection | 4 | 2 | - |
| Failure metalwork | 2 | 1 | - |
| Further surgery | 9 | 3 | 0.04 |

Reamed Versus Unreamed Nailing of Tibial Shaft Fractures in Patients Requiring Two or More Re-Operations: A Subgroup Analysis of the SPRINT Trial SPRINT Investigators: Emil H. Schemitsch, MD¹; Ashesh Kumar, MD, FRCSC¹; Diane Heels-Ansdell, MSc²; Sheila Sprague, MSc²; Michael Saccone, BSc²; Gordon H. Guyatt, MD, MSc, FRCPC²; David W. Sanders, MD³; Marc F. Swiontkowski, MD⁴; Paul Tornetta, III, MD; Stephen D. Walter, PhD²; Mohit Bhandari, MD, PhD, FRCSC⁶; ¹Dept. of Surgery, Division of Orthopaedic Surgery, University of Toronto, Toronto, Ontario, Canada; ²Dept. of Clinical Epidemiology and Biostatistics, McMaster University, Hamilton, Ontario, Canada; ³Dept. of Surgery, London Health Sciences Centre, London, Ontario, Canada; ⁴Dept. of Orthopaedic Surgery, University of Minnesota, Minnesota, USA; ⁵Dept. of Orthopaedic Surgery, Boston University Medical Center, Boston, Massachusetts, USA; ⁶Dept. of Clinical Epidemiology and Biostatistics and Dept. of Surgery, Division of Orthopaedic Surgery, McMaster University, Hamilton, Ontario, Canada

Purpose: The SPRINT trial randomized 1226 patients with tibial shaft fractures treated by intramedullary (IM) nailing to reamed versus unreamed groups. Using data from this trial, we completed a subgroup analysis of those patients who required two or more reoperations following the initial IM fracture stabilization.

Methods: We identified 44 patients with tibial shaft fractures who required two or more reoperations following IM nailing. We considered those that were reamed versus unreamed, open versus closed, those that were planned for reoperation after the 12 month follow up, and the indications for reoperation.

Results: Patients that had two or more reoperations were characterized by having more open fractures and fractures of greater severity. Fifteen of 21 (71%) reamed and 10 of 23 unreamed (43%) patients required reoperation to treat infection as their first surgical intervention. Those patients that were initially reamed who developed an infection required a greater number of subsequent surgical procedures compared to those who were not initially reamed (42, 60.8% versus 27, 39.2%).

Conclusion: Our data suggest that patients whose tibial fractures are reamed and subsequently develop an infection are at risk of requiring more re-operations in the future compared to those whose fractures were not reamed. Further study is required to assess the corroborating consequences of needing multiple re-operations including economic impact, pain and function, as well as strategies to prevent further morbidity in this high risk group of patients. The authors would like to acknowledge all of the SPRINT Investigators and Research Staff.

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The Effect of Two Distal Interlocking Screw Configuration and Orientation on Intramedullary Nail Stability: A Biomechanical Study

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Purpose: Long-bone diaphyseal fractures represent a very common injury encountered in orthopaedic practice. This type of fracture is often treated using an intramedullary (IM) nail. In this day and age, there are many options with regard to the orientation of the distal interlocking screws. The goal of this study was to determine if the distance between two distal locking screws affects the stability of the IM nail, and to determine which screw configuration is the most biomechanically stable for intramedullary nailing of such fractures.

Methods: 18 modified tibial IM nails with 6 different interlocking screw configurations were tested in torsion (sinusoidal cycled at 0.5 Hz at \pm 7.0 Nm for 10 cycles tested with 5 N of compression), compression (range, +15 N to -700 N at a rate of 70 N/sec), and bending (anterior-posterior and medial-lateral, sinusoidal cycled at 0.05 Hz at \pm 15 N for 10 cycles) using simulated long bones consisting of Delrin pipe. Screw orientations tested were: (1 two medial-to-lateral, (2) one medial-to-lateral and one anterior-to-posterior, and (3) one medial-to-lateral and one oblique (30°). Each screw orientation was tested with two different screw gap distances (24 mm and 9 mm).

Results: There were small differences that were detected between all six configurations. The small differences were not statistically significant in the analysis of the stability under compressive loading and rotation torque from the post hoc analysis. The average deflections for all configurations were less than 0.5 mm for compression and approximately 10.9° for rotation. Statistically significant difference was detected between the two screw gap distances for all test modes except for the oblique screw orientation. The two medial-to-lateral screw configuration (configuration 1) was statistically found to be more stable when compared to the other five configurations, and the screw orientation with one medial-to-lateral and one oblique (configuration 3) was found to be the most unstable compared to the other screw orientations. However, all configurations deflected less than 6° with the applied load, which is within the standard of care.

Conclusions: The results of this study show that the two medial-to-lateral screw configuration (configuration 1) was more biomechanically stable for the IM nailing of simulated long bones when compared to the other five configurations. Our results also showed that the oblique interlocking option (configuration 3) did provide less construct stability for the fixation of the nail when compared to the other two interlocking screw options.

Biomechanical Comparison of Posterior Plates and Screw Fixation of Posteromedial Fragments in Tibial Plateau Fractures

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Purpose: Recent experience with bicondylar type B1.2 tibial plateau fractures has led to concern over the stability of the posteromedial fragment. Loss of fixation in this fragment has led to posterior subluxation of the femur, unstable femoral-tibial disarticulation, and stiff arthritic knees. The purpose of this study was to perform a biomechanical comparison of 3 different supplementary fixation techniques that were used in combination with a lateral locking plate.



Figure 1. Fixation of posteromedial fragment with lateral LCP plate in combination with AP screws (A), posteromedial T-plate (B), and LCP posteromedial plate (D).

Methods: All tests were performed in fourth-generation Sawbones tibias with a standardized posteromedial fragment . All specimens were treated with a 3.5-mm LCP (locking compression plate) proximal tibia plate supplemented with 2 bicortical 4.5-mm cannulated screws, a 5-hole T-plate, or with a 10-hole LCP posteromedial plate. A preload of 10 N was applied to the fragment followed by uniaxial displacement to failure at a loading rate of 100 N/sec. Load and displacement data were recorded for analysis. Statistical analysis was performed using a one-way analysis of variance to determine mean differences, and Tukey's post hoc analysis with significance set at P < 0.05.

Results:



Figure 2. Mean and standard deviation for mechanical testing data.

The results of our study are detailed in Figure 2. Constructs with a locked or nonlocked posterior plate were significantly stronger and stiffer than repairs made with AP screws. A significant difference between the T-plate and a posteromedial LCP plate was not observed.

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Conclusions: Our results have shown that the posteromedial T-plate or posteromedial LCP plate improves the strength and stiffness of the posteromedial fragment in tibial plateau fractures. It was observed that AP screws offered limited resistance to shear forces at the fracture site while the posteromedial plates had a buttress effect, preventing downward descent of the fragment under load.

Reduction of Impacted Articular Fragments of the Tibial Plateau: A Cadaveric Evaluation of Inflatable Bone Tamps

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Purpose: Restoration of joint congruity in fractures with articular impaction is an important surgical goal. This is currently accomplished by disimpacting fragments using a cylindrical tamp and mallet. Alternatively, an inflatable bone tamp (IBT) can be used to provide a more broad-based and powerful yet precise reduction force, while at the same time compacting bone and creating a well-defined bone void that facilitates later bone grafting. The purpose of this study is to compare the reduction of IBT-treated fractures to that of fractures treated with a metal conventional bone tamp (CBT) using a standardized cadaver fracture model.

Methods: A prospective, randomized, blinded, matched-pair study was designed. 28 lateral tibial plateau split-depression fractures (OTA type 41-B3) were created in 14 pairs of fresh-frozen cadaver legs using a reproducible direct-impact apparatus. Each fracture was treated with either an IBT or a CBT by 1 of 3 experienced orthopaedic trauma surgeons. Each fracture was reduced under fluoroscopic guidance using the randomly assigned method, then filled with calcium phosphate bone-void filler and stabilized with a lateral tibial buttress plate and nonlocking screws. Each reduction was independently assessed by 3 other blinded observers using fluoroscopic images, 3-dimensional scans (O-arm), and direct visual inspection of the articular surfaces. Each observer used their clinical judgment to compare the quality of reduction within each pair by rating the left side as better, equivalent, or worse than the right side. Observers judged each reduction as good/fair/poor based on fluoroscopic images. A 1-proportion Z test was used ($\alpha = 0.05$) to test the hypothesis that a majority of IBT-treated specimens were rated as better than their control. Volumetric analysis using image-processing software was used to calculate the volume of the depressed and residual defect. Malreduction (defined as total under- and overreduced volume, expressed as a percentage of the depressed volume) was compared between IBT and CBT groups using a paired t test ($\alpha = 0.05$).

Results: The majority of IBT-treated fractures were rated as better than their CBT-treated contralateral control side using all 3 evaluation methods (Table 1). 7 out of 14 (50%) IBT-treated fractures were rated as good reductions (Figure 1, left) while only 3 out of 14 (21%) of CBT-treated fractures were rated as good reductions. The average malreduction for IBT-reduced fractures (28.1% ± 18.7%) was significantly (P = 0.04) less than for CBT-reduced fractures (52.5% ± 35.2%).

Conclusion: Fractures treated with an IBT had qualitatively and quantitatively better reduction than CBT treatment, typically resulting in a smoother articular surface with less residual defect volume. IBT inflation provides pressure and volume feedback during fracture reduction, while exerting significant reduction force distributed over a broad surface, and yet allowing precise volumetric measurement of the resulting void for a predictable fill

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pattern with injectable bone void filler material. Given these findings, a clinical comparison study is warranted.

| Assess method | IBT better | IBT worse | IBT equiv | Р |
|---------------|------------|-----------|-----------|------|
| Fluoro image | 11 | 1 | 2 | 0.03 |
| 3-D scan | 11 | 1 | 2 | 0.03 |
| Direct visual | 9 | 3 | 2 | 0.21 |

Table 1: No. of IBT-Treated Specimens Rated as Better/Worse/Equivalent to CBT



Figure 1. An IBT-treated surface (left) and the contralateral control side treated with a CBT (right).

Complication Rates Following Operative Fixation of Bicondylar Tibial Plateau Fractures

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Purpose: This study was designed to evaluate postoperative complication rates following bicondylar tibial plateau fractures. We hypothesized that complication rates in this population of severe injuries is high and a better understanding of the incidence and risk factors of these complications can help advise patients on expectations and surgeons on prevention.

Methods: Our investigation retrospectively identified all bicondylar (AO/OTA 41-C) tibial plateau fractures treated operatively over an 8-year period at a single, high-volume Level 1 trauma center. 316 patients were identified as undergoing operative fixation during this time period. We identified specific patient demographics, deep infection requiring reoperation, and reoperation for other secondary causes.

Results: 41 (13.0%) of 316 patients developed deep infection. The average length of followup was 14.1 months with 51% follow-up beyond 6 months. Of these 41 patients with a deep infection, the average age was 47.3 years, 76.0% were male, 85.0% Caucasian, mechanism of injury was motor vehicle crash in 54.0%, 63.4% reported smoking, 61.0% reported alcohol use, and 7.3% had a diagnosis of diabetes. 32 (78.0%) of the 41 patients had a 2-incision technique with dual plating. Furthermore, of the 41 patients with a deep infection, 61% developed an acute infection (<30 days) and 29.3% had open fractures classified according to Gustilo as type I (3), type II (5), type IIIB (3), and type IIIC (1). Methicillin-resistant Staphylococcus aureus (MRSA) was cultured in 20 (48.8%) of 41 patients with deep infections, methicillin-sensitive S. aureus (MSSA) in 22.0%, and Enterobacter species in 22.0%; coagulasenegative S. aureus, S. agalactiae, Proteus, and polymicrobial infections were also cultured in the remaining patients. An external fixator was initially placed prior to definitive fixation in 87.8% of patients and definitive surgical treatment was delayed an average of 17.5 days. Compartment syndrome was treated with fasciotomy in 19.5% while soft-tissue coverage was needed in 22.0% of the 41 patients who ultimately developed a deep infection. The average number of procedures before clinical resolution of infection was 2.5 procedures. Two patients ultimately required above-knee amputations. Overall, 85 (27.0%) of the 316 patients required a reoperation following definitive fixation. 49 procedures were completed in 43 patients undergoing reoperation for secondary reasons other than deep infection. The reasons for reoperation included removal of painful hardware (19), manipulation under anesthesia (8), manipulation under anesthesia combined with arthroscopic lysis of adhesions (6), total knee arthroplasty (3), contracture release (2), malunion (2), nonunion (2), dehiscence (2), skin grafting (2), superficial infection (1), postoperative compartment syndrome requiring fasciotomies (1), and heterotopic ossification resection (1).

Conclusion: Bicondylar tibial plateau fractures (AO/OTA 41-C) carry a significant risk of postoperative complication including deep infection and reoperation for secondary procedures in spite of following a staged protocol of temporizing external fixation and delayed fixation. Our patient population was noted to have a very high percentage of smoking and alcohol

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use possibly contributing to the deep infection rate. Patients should be counseled regarding potential complications and reoperations to appropriately set expectations. Surgeons may consider MRSA prophylaxis given the increased incidence of this pathogen.

Patellar Dislocation in the United States: Role of Sex, Age, Race, and Athletic Participation

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Purpose: Patellar instability has been extensively studied in selected, high-risk cohorts, but the epidemiology in the general population remains unclear. A longitudinal, prospective epidemiologic database was used to determine the incidence and demographic risk factors for patellar dislocations presenting to emergency departments of the USA. We hypothesized that patellar dislocation is influenced by sex, age, race, and athletic participation.

Methods: The National Electronic Injury Surveillance System (NEISS) was queried for all patellar dislocations presenting to emergency departments between 2003 and 2008. Incidence rate ratios were then calculated with respect to sex, age, and race.

Results: An estimated 40,544 patellar dislocations occurred among an at-risk population of 1,774,210,081 person-years for an incidence rate of 2.29 per 100,000 person-years in the United States. When compared with males, females showed no significant overall or age-stratified differences in the rates of patellar dislocation (incidence rate ratio [IRR] 0.85; 95% confidence interval [CI] 0.71, 1.00; P = 0.08; P > 0.05]. Peak incidence of patellar dislocation occurred between 15 and 19 years of age (11.19/100,000 person-years). When compared with Hispanic race, black and white races were associated with significantly higher rates of patellar dislocation: IRR 4.30 (95% CI 1.63, 6.97; P = 0.02) and IRR 4.02 (95% CI 1.06, 6.98; P = 0.03), respectively. Roughly half of all patellar dislocations (51.9%) occurred during athletic activity, with basketball (18.2%), soccer (6.9%), and football (6.3%) associated with the highest percentage of patellar dislocation during athletics.

Conclusion: Age between 15 and 19 years is associated with higher rates of patellar dislocation. Sex is not a significant risk factor for patellar dislocation. Black or white race is a significant risk factor for patellar dislocation when compared to Hispanic race. Half of all patellar dislocation occurs during athletic activity.

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Clinical Outcome of Tibial Plateau Fractures Related to Meniscal Injuries

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Purpose: Meniscal injuries have been reported in 25% of associated tibial plateau fractures. In altered knee anatomy with articular step-off, meniscectomy increases average femoral-tibial contact pressure 45% compared to intact knees with the same step-off height and increases shear stress to the underlying cartilage 467%. The purpose of this study was to evaluate the clinical and functional outcome.

Methods: Between 2002 and 2005, 196 consecutive patients with 197 operatively treated tibial plateau fractures were prospectively evaluated in a single large private orthopaedic practice affiliated with a Level 1 teaching trauma center. Following exclusions, the study sample group consisted of 130 tibial plateau fractures in 129 patients. Patients were evaluated clinically and radiographically at 2, 6, 12, 26, 52, and 104 weeks. Short Form–36 (SF-36) and Short Musculoskeletal Function Assessment (SMFA) were performed at 6, 12, and 24 months.

Results: Gender was 62 (48%) males and 67 (52%) females with a mean age of 50 years (range, 19-88 years). The average body mass index was 30.0 kg/m^2 (range, $17.4-49.9 \text{ kg/m}^2$). Mean follow-up was 40 months (range, 18-103 months). OTA / AO classifications included: 3 (2%) 41A, 68 (52%) 41B, 56 (43%) 41C, and 3 (2%) unrecorded. 44 of the 130 fractures (34%) had intraoperative findings of meniscal injuries. Of the 44 meniscal injuries, 34 lateral (79%), 4 medial (9%) and 5 combined (10%) lesions were described in the operative reports (1 not recorded). Articular reconstruction with anatomic reconstruction or less than 2 mm step-off or gap was achieved in 54% of the fractures. Range of motion was correlated with intact menisci. Patients without meniscal injury had a mean flexion of 131°, while patients with status of the meniscus (P = 0.01). When evaluating SMFA and SF-36 scores, patients with intact and repaired menisci had similar outcome measurements and better measurements than patients with torn and débrided menisci.

Conclusion: Functional menisci provide some protection against developing symptomatic posttraumatic osteoarthrosis and improved functional outcome measurement after operative treatment of tibial plateau fractures. Patients with tibial plateau fractures might benefit from meniscal repair.

Clinical Outcome of Tibial Plateau Fractures Related to the Posterior Slope

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Purpose: The geometry of the articular surfaces of the tibiofemoral joint in combination with the menisci and ligaments plays an important role in controlling the biomechanical behavior of the knee joint. Sagittal malreduction is more common than expected. The purpose of this study was to determine if sagittal alignment and posterior slope of the tibial plateau influences range of motion, development of osteoarthritis, and subjective patient-based clinical functional outcome.

Methods: Between 2002 and 2005, 196 consecutive patients with 197 tibial plateau fractures underwent internal fixation at a Level 1 trauma center. Following exclusions, 94 were prospectively evaluated. Imaging and clinical evaluation were performed at 2, 6, 12, 26, 52, and 104 weeks. Short Musculoskeletal Function Assessment (SMFA) and Short Form–36 (SF-36) surveys were obtained from the patients at 6, 12 and 24 months. The inclination of the tibial plateau was measured according to Dejour.

Results: 46 (48.9%) males and 48 (51.1%) females with an average age of 49 years (range 19-88 years) and body mass index of 30.23 kg/m² (range, 17.4-49.9 kg/m²) were followed for 42 months (range, 20-103 months). OTA/AO fracture classifications included: 3 (3.2%) 41A, 58 (61.7%) 41B, and 33 (35.1%) 41C. Posterior tibial slope measured 10.03° (range, -8° to 23°) without a difference between male and female (P = 0.89). 51 patients (54.3%) received allograft augmentation. 44 patients (46.8%) underwent additional surgeries. Patients with posterior slope less than 5.5° had a mean loss of extension of 0.6° and a mean loss of flexion of 30° while patients with posterior slope >11.5° had a mean loss of extension of 2.35° but also a mean loss of flexion of 28°. Patients with anatomic alignment had a loss of extension of 1.4° and a loss of flexion of 20°. Loss of flexion correlates to Schatzker classification (P = 0.04) but not to AO/OTA (P = 0.42). The ability to flex the knee is related to clinical outcome in the short term (6 months) and long term (24 months). A relationship between final clinical outcome and anatomic reduction (step-off <2 mm) existed for bother (P = 0.03), physical functioning (P = 0.01), role physical (P = 0.02), and bodily pain (P = 0.04).

Conclusion: Anatomic reduction should be achieved not only for articular congruity and varus/valgus alignment but also for sagittal alignment. Posterior slope affects final tibial plateau fracture reduction range of motion. Clinical outcome is related to range of motion.

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Complications Following Open Reduction and Internal Fixation of Ankle Fractures in Patients With a Positive Urine Drug Screen

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Purpose: We sought to determine if patients undergoing operative stabilization of ankle fractures with a history of positive urine drug screen (UDS) will demonstrate higher incidence of major and minor complications.

Methods: We retrospectively reviewed 142 patients undergoing surgical stabilization of ankle fracture over a 3-year period. Patients with a history of positive UDS were compared to controls with negative UDS. Outcomes measured were major and minor complications, including nonunion, malunion, superficial or deep infection, amputation, delay in treatment, days to healing, repeat surgery, long-term bracing, and loss to follow-up. Fisher exact test, Wilcoxon rank-sums test, and univariate logistic regression were utilized to determine statistical significance, which was set a priori at 0.05.

Results: There were no significant differences in age, gender, fracture type, prevalence of diabetes, or incidence of open fracture between the groups. The incidence of nonunion was higher in patients with a positive UDS (P = 0.01), as was deep infection (P = 0.05). Incidence of pooled major complications (defined as superficial or deep infection, amputation, malunion, and nonunion) was higher in the positive UDS group (P = 0.03).

| Variable | Absolute Value, UDS– | Percentage | Absolute Value, UDS+ | Percentage | P Value | Odds Ratio |
|-----------------------|----------------------------|------------|----------------------------|------------|------------|---------------|
| Days to healing | 50.7 | | 82 | | 1 | |
| Nonunion | 4 | 3.42% | 5 | 20.00% | 0.01 | 7.37 |
| Malunion | 0 | 0.00% | 2 | 8.33% | 0.08 | |
| Superficial infection | 4 | 3.88% | 1 | 4.17% | 1 | |
| Deep infection | 3 | 2.56% | 4 | 16.00% | 0.05 | 4.27 |

Conclusion: Similar to patients with diabetes mellitus, a history of illicit drug use, as evidenced by positive UDS, results in an increased risk of perioperative complications while undergoing open treatment of ankle fractures. These data suggest the practicing orthopaedist be more vigilant when caring for ankle fracture patients with positive urine drug screens.

Syndesmotic ART: The Anatomic Repair Technique

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Purpose: The anterior inferior tibiofibular ligament (AiTFL) is the primary lateral ligamentous stabilizer of the ankle syndesmosis. Current syndesmosis repair techniques traverse the tibia and fibula, but do not anatomically reconstruct the AiTFL. We compared a novel AiTFL anatomic repair technique (ART) to rigid syndesmosis screw fixation (SCREW).

Methods: 12 cadaveric below-knee specimens were compared radiographically and using a biomechanical testing protocol. All specimens underwent a CT scan of the ankle joint. Next, the AiTFL, interosseous membrane, and deltoid ligament were sectioned, and the posterior malleolus osteotomized, to recreate a trimalleolar-equivalent ankle fracture. The posterior malleolus was repaired with the posterior ligamentous insertions intact and functional (PMALL). Ankles were examined under fluoroscopy with an external rotation stress examination and the medial clear space (MCS) measured. Specimens were then randomized to receive either a conventional syndesmosis screw (SCREW), or the novel anatomic repair technique (ART). Our repair technique consisted of placement of a suture anchor to replicate the primary restraint normally provided by the AiTFL. External rotation stress fluoroscopy was repeated. CT was repeated and the fibular position compared to the preinjury CT. Each specimen was then loaded in external rotation until failure using a custom biomechanical jig.

Results: The MCS during stress examination increased by 1.04 ± 0.31 mm with PMALL only. Repair of the posterior malleolus alone was not sufficient to restore syndesmotic stability in this biomechanical study. MCS increased less using ART (0.30 ± 0.07 mm, P = 0.002) and SCREW (0.28 ± 0.16 mm, P = 0.008). Postrepair CT showed that 33% of specimens were subluxed from the SCREW group compared to 0% for the ART. Mean torque at failure for ART was 24.8 ± 5.5 Nm compared to 16.8 ± 5.8 Nm for SCREW (P = 0.01).

Conclusion: Repair of the posterior malleolus alone demonstrated a >1-mm MCS widening and is not sufficient to reestablish syndesmotic stability. Addition of the ART or SCREW restored syndesmotic stability. None of the ART specimens demonstrated fibular subluxation, while 2 SCREW specimens were subluxed anteriorly on CT. Biomechanical strength of the ART was found to be greater than that of rigid screw fixation.

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Purpose: This study evaluated the mechanical properties of 4 fixation methods for horizontal fractures of the medial malleolus.

Methods: Identical horizontal osteotomies were created in synthetic distal tibiae using a jig. The specimens were randomly assigned to 1 of the 4 fixation groups (n = 10 per)group): (1) plate: a contoured 2.0-mm mini-fragment 10hole T-plate secured to the distal tibia using four 40.0mm × 2.4-mm cortical screws; (2) tension band: a standard figure-of-8 tension band was fashioned with 18-gauge wire and secured distally with two 2.0-mm diameter Kirschner wires placed parallel to each other; (3) parallel screws: two



Figure 1. AP (top row) and lateral (bottom row) fluoroscopic views of representative instrumented synthetic tibia models, from left to right: parallel cancellous screw construct, divergent cancellous screw construct, tension band wire, and contoured mini-fragment T-plate.

40-mm–length, 4.0-mm–diameter cancellous screws were placed parallel to each other; and (4) divergent screws: two 40-mm–length, 4.0-mm–diameter screws were placed with approximately 35° of divergence (Figure 1). The specimens were then tested using offset axial tension at 10 mm per minute until 2 mm of displacement occurred.

Results: The average stiffness was 177.7 ± 26.2 N/mm for the plate group, 124 ± 15.9 N/mm for the tension band group, 141.2 ± 23.9 N/mm for the parallel group, 112 ± 22.2 for the divergent group (Figure 2A). The average stiffness of the plate construct was significantly greater than any of the other constructs (P < 0.05). The average stiffness of the tension band, parallel, and divergent groups were not significantly different from each other (P > 0.05). The average force at 2 mm of displacement was 362 ± 72.2 N for the plate group, 266.7 ± 43 N for the tension band group, 291.7 ± 47.1 N for the parallel group, and 230.5 ± 44 N for the divergent group (Figure 2B). The average force at 2 mm of displacement was significantly greater with the plate construct than any other construct (P < 0.05). The average force at 2 mm of displacement of the tension band, parallel, and divergent group (Figure 2B). The average force at 2 mm of displacement was significantly greater with the plate construct than any other construct (P < 0.05). The average force at 2 mm of displacement of the tension band, parallel, and divergent groups were not significantly different from each other (P > 0.05).

Conclusion: Using a contoured 2.0-mm mini-fragment T-plate as the method of fixation resulted in a stiffer construct that required more force for 2 mm of displacement when used to stabilize an osteotomy model of a horizontal medial malleolus fracture.



Figure 2. A, Bar graph of the stiffness in tension for each construct. B, Bar graph of the load at 2 mm of displacement (defined as fixation failure) in tension for each construct. Error is reported as the mean \pm the standard deviation. The * indicates statistical significance (P < 0.05) when compared to another group.

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Quantification of Posterior Ankle Exposure Through an Achilles Tendon-Splitting Versus Posterolateral Approach

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Background: Optimal surgical exposures to the posterior ankle for trauma and reconstruction are a source of debate. We hypothesized that the Achilles tendon-splitting approach would provide greater exposure of the posterior distal tibia and talus than the posterolateral approach.

Methods: 40 surgical approaches were performed in 20 fresh-frozen hemicorpectomy cadavers. Achilles tendon-splitting and posterolateral approaches were performed using a cross-over randomization design for surgical sequence. Six osseous landmarks (posteromedial medial malleolus, medial gutter, ankle joint, subtalar joint, incisura fibularis, and posterolateral lateral malleolus) were identified by direct visualization or palpation. A calibrated digital photograph was taken and Image J software was used to calculate the surface area of distal tibial and talus exposed in both neutral and maximum dorsiflexion.

Results: Using a posterolateral approach, the average exposed distal tibia was 11.260 cm² in neutral and 10.190 cm² in dorsiflexion. The average talus exposed was 2.032 cm² in neutral and 2.366 cm² in dorsiflexion. Using an Achilles tendon-splitting approach, the average distal tibia exposed was 32.5% more (14.925 cm²) in neutral, and 43.3% more (14.608 cm²) in dorsiflexion. The average talus exposed was 47.4% more (2.996 cm²) in neutral, and 76% more (4.170 cm²) in dorsiflexion. All increases in exposure were statistically significant. The medial malleolus was visualized in 19 tendon-splitting versus 6 posterolateral approaches. The medial gutter was visualized in 20 tendon-splitting versus 13 posterolateral approaches. These differences were statistically significant. All other landmarks could be visualized through both approaches.

Conclusion: The Achilles tendon-splitting approach provides significantly greater exposure of the posterior distal tibia and talus, particularly the far medial-sided structures, as compared to the posterolateral approach. The Achilles tendon-splitting approach can serve as an alternative approach for any surgical procedures that require maximal visualization of the posterior ankle or subtalar joints.

Calcaneal Fixation: Extensile Lateral Versus Sinus Tarsi Approach – Early Outcome Evaluation

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Purpose: Our hypothesis is the limited sinus tarsi approach (STA) has fewer postoperative complications and wound problems, with comparable functional results compared to the extensile lateral approach (ELA) in the treatment of intra-articular calcaneus fractures.

Methods: A retrospective review of medical records and radiographs of intra-articular calcaneus fractures fixed at one institution was conducted. The fractures were treated using either a limited STA or an ELA. Fractures were classified using the OTA / AO classification system. Inclusion criteria were closed intra-articular calcaneus fracture, age \geq 18 years, and operative treatment consisting of limited STA or ELA. Exclusion criteria were age <18 years, open fractures, tongue-type fracture, previous calcaneal injury, and fractures treated nonoperatively or percutaneously. Radiographic outcomes were assessed by measuring the crucial angle of Gissane and Bohler angle.

Results: 44 patients (22 per group) and 48 calcaneus fractures were reviewed. Male-to-female ratio, patient age, fracture classification distribution (OTA / AO8.2 C2 / C3), and time to surgery were similar between the 2 groups. A plate and screw construct was utilized in all cases of the ELA group. Complications of the ELA group included 4 cases of sural neuritis (17%), 4 deep infection (17%), 4 wound necrosis (17%), 3 chronic serous drainage (3%), and 1 superficial infection (4.5%). Fixation in the STA group consisted of either independent screws or a plate and screw construction. Complications in this group included 2 cases of sural neuritis (7.1%). There were no cases of wound necrosis or infection in the STA group. Based on the Bohler angle or crucial angle of Gissane, the radiographic corrections achieved were equivalent between groups regardless of the choice of treatment. The mean hospital length of stay was 1.38 ± 0.15 days (range, 1-3 days) in the STA group and 2.2 ± 0.2 days (range, 1-4 days) in the ELA group (P < 0.05).

Conclusion: Utilization of the limited STA for fixation of intra-articular calcaneus fractures demonstrated similar radiographic outcomes and significantly fewer wound problems at short-term follow-up compared to the ELA. Further studies are necessary to determine long-term functional outcomes and progression of subtalar arthrosis.

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The Impact of Clamp Position on Accuracy of Syndesmotic Reduction *Timothy Judkins, MD; David J. Hak, MD; Denver Health/University of Colorado, Denver, Colorado, USA*

Purpose: Several recent clinical studies have highlighted the difficulty of achieving an anatomic syndesmotic reduction in Weber C ankle fractures. While numerous clinical and biomechanical studies have investigated various controversies regarding the syndesmosis, none has examined the effect of clamp position on the accuracy of syndesmotic reduction. The purpose of this study was to investigate how varying clamp placement affects the accuracy of syndesmosis reduction in simulated Weber C ankle fractures. We hypothesized that anterior and posterior clamp placement would malrotate the fibula and cause syndesmotic malreduction (Figures 1 and 2).



Figure 1. Anterior clamp placement causing internal rotation.



Figure 2. Posterior clamp placement causing external rotation.

Methods: Weber C (OTA 44C2.1) fractures were simulated in fresh-frozen cadaver ankles by osteotomizing the fibula 10 cm proximal to the ankle joint, and sectioning the deltoid, distal tibiofibular, and interosseous ligaments. The ankles were randomized to syndesmotic reduction with the Weber clamp tine placed at the midaxis of the fibula, 5 mm anterior to the midaxis, and 5 mm posterior to the midaxis. The position of the medial tine was standardized in all groups. A fourth group consisted of manual syndesmotic reduction with direct pressure. Optimal syndesmotic reduction was confirmed with fluoroscopy. AP, mortise, and lateral radiographs were taken both prior to fracture creation and after syndesmotic reduction. Standard measurements were made to assess the relationship of the syndesmosis and ankle. CT scans were obtained of the ankle following syndesmotic reduction and the accuracy of the reduction assessed. A line tangent to the incisura surface was used to locate the anterior and posterior facets of the tibiofibular joint and the distance between the facets and the fibula was measured.

Results: All of the reduction methods provided syndesmosis reduction to within 2-mm difference between the fibula and the anterior and posterior facets of the tibial incisura. Reduction forceps placement in the anterior third of the fibula provided the smallest average difference between the tibiofibular distances at the incisura. Central and posterior reduction time placement produced progressively increasing asymmetry with more external rotation deformities in the posterior clamp group. Reduction with manual pressure on the fibula produced satisfactory reduction with the least predictable results.

| Clamp Position | Average Difference Between Anterior and Posterior Syndesmotic Gap on CT (mm ± std. dev.) | External Rotation Deformity (n) | Internal Rotation Deformity (n) |
|--------------------|--|---------------------------------------|---------------------------------------|
| Anterior | 0.2 ± 0.3 | 0 | 1 |
| Midaxis | 0.4 ± 0.4 | 1 | 2 |
| Posterior | 0.5 ± 0.2 | 4 | 0 |
| Manual pressure | 0.8 ± 0.6 | 2 | 2 |

Conclusions: Reduction of Weber C (OTA 44C2.1) fractures using a Weber clamp appears to provide consistently accurate reduction of the syndesmosis. Clamp position more posteriorly can produce an external rotation malreduction of the syndesmosis.

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Comparison of Functional Outcome Between Bony and Ligamentous Injuries in Supination External Rotation Type IV (SER IV) Ankle Fractures

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Purpose: Supination external rotation type IV / type IV equivalent (SER IV) injuries are the most common operative fracture pattern of the Lauge-Hansen classification. It is unclear which configuration of bony and ligamentous injuries present within these SER IV or equivalent fractures portends the worst prognosis. The purpose of this study was to describe and compare outcomes of all possible combinations of fractures and ligamentous injuries within SER IV injuries and identify risk factors for poor outcome. Our group hypothesized that patients with ligamentous injuries would have improved functional outcome when compared to their corresponding bony injuries.

Methods: From 2004 through 2009, all operative SER IV or equivalent ankle fractures treated by a single surgeon were enrolled in a prospective database. Preoperative MRI was performed to precisely identify and characterize ligament injuries. Postoperative CT was used to evaluate reduction. These patients were followed clinically for up to 1 year postoperatively with serial examinations and radiographs. Patients with at least 1 year of clinical follow-up were eligible for retrospective analysis. The primary outcome measure was the Foot and Ankle Outcome Score (FAOS). All combination of SER IV or equivalent fractures were identified and compared.

Results: 254 ankle fractures were available for analysis. 176 of these were SER IV type fractures and 114 met inclusion criteria. The average age was 51.8 years. 4.4% (5 of 114) of these were open fractures and 46.5% (53 of 114) sustained a dislocation. The following number of injury patterns were identified: 51 trimalleolar fractures, 28 bimalleolar fractures involving the fibula and posterior malleolus with a deltoid injury, 27 bimalleolar fractures involving the fibula and medial malleolus with a posterior inferior tibiofibular ligament (PITFL) injury, and 27 pure SER IV equivalent fractures (fibula fracture with PITFL and deltoid injury). All fracture patterns had no clinically significant change in reduction at final follow-up based on tibiofibular and medial clear-space measurements. There was no difference in the incidence of articular or syndesmotic malreductions between groups based on postoperative CT assessment. There was no difference in the rate of open fracture or dislocation between injury pattern groups. SER IV equivalent fractures had superior FAOS scores for sports (P = .042) and activity (P = .041), with a trend toward improved scores for symptoms, pain, and quality of life compared to trimalleolar fractures. When controlling for the remainder of the fracture pattern and isolating the posterior or medial injury, ligamentous injuries had uniformly higher FAOS scores compared to their fracture counterpart (deltoid tear superior to medial malleolus fracture, PITFL tear superior to posterior malleolus fracture).

Conclusion: In SER IV or SER IV equivalent ankle fractures, the presence of a fracture was associated with a worse clinical outcome compared to its ligamentous injury counterpart. This was true of both the posterior and medial injury, and its effect appeared to be additive, with trimalleolar fracture clinical outcome most severely affected.

Outcomes of Calcaneal Lateral Wall Exostectomy as a Treatment for Peroneal Tendon Impingement in Patients With Prior Calcaneal Fractures *Paul Tornetta, III, MD; Joey LaMartina, II, MD; Boston University Medical Center, Boston, Massachusetts, USA*

Purpose: The complications after management of intra-articular calcaneal fractures are wide-ranging. Peroneal irritation and lateral impingement is a common problem after calcaneal fracture. The purpose of this study was to evaluate the outcomes of calcaneal deimpingement as a treatment for those patients with peroneal tendon impingement as a complication of a prior calcaneal fracture.

Methods: Between 1999 and 2010, 16 patients were treated with lateral wall exostectomy and peroneal groove deepening (if tendon instability was present) for peroneal tendon impingement by one surgeon. The initial treatment for the calcaneal fracture was nonoperative (10), closed reduction percutaneous pinning (4), open reduction and internal fixation (1), or subtalar fusion (1). The diagnosis of peroneal tendon impingement ± calcaneofibular abutment required both clinical symptoms and CT confirmation. Prior to undergoing the procedure, each patient had a peroneal injection and kept a pain diary. All patients had maximal pain of >8 of 10 prior to the injection. Surgery was performed only if the injection resulted in significant pain relief (<3 of 10) that in the patient's estimation, "would make them very happy." All patients' charts were reviewed, noting any complaints made at any follow up visit. Patients were called and reassessed using the American Orthopaedic Foot & Ankle Society (AOFAS) ankle score, were asked to rate their current maximum level of pain on a 10-point scale, and to report any restrictions they currently have. Finally, each was asked if he or she would have the operation again given a similar situation.

Results: There were 14 men and 2 women, aged 41 years (range, 22-64 years) at the time of their deimpingement procedure. Their original calcaneal fracture occurred between 6 months and 17 years prior to the deimpingement procedure. Follow-up averaged 44 months and 11 of 16 patients were available for current interview at an average follow-up of 67 months. Eight of 16 patients (50%) had no peroneal tendon pain at follow-up. Five of the remaining 8 patients complained of sural nerve symptoms, and 3 reported continued peroneal tendon pain at some point in follow-up, although both decreased over time. The current maximum level of pain averaged 4.4 out of 10 for the 11 patients reinterviewed. The mean AOFAS score was 64 with the loss dominated by the pain subscale. The patients without subtalar arthritis (all fixed initially) averaged 67, and those without prior surgery, who had some subtalar arthritis, averaged 63. Seven patients cited some limitation in either activities of daily living, work, or recreational activity. Of the 11 patients reinterviewed at an average of 67 months, 8 (72%) said that they would have the surgery again and were satisfied. No patient has yet come to subtalar fusion.

Conclusion: Pain relief from calcaneal deimpingement did not equal the relief from peroneal injections on average, and only 50% had complete relief. Despite this, 72% were pleased with their result, likely based on appropriate preoperative expectations. Deimpingement seems a reasonable treatment in selected cases but should be based on resolution of pain after peroneal injection. Prior surgery and lack of subtalar arthritis did not affect results. Finally, patients should be counseled as to the realistic success rate.

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Long-Term Results in Acute Achilles Tendon Rupture: Fibrin Glue Versus Percutaneous Repair

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Purpose: A number of different surgical procedures have been developed to treat Achilles tendon injuries including open and mini-invasive types. Open surgical repair entails a risk of skin necrosis or infection. Percutaneous methods of fixation have lower complication rates without an increase in the rate of rerupture, but have a certain amount of risk to compromise the sural nerve. Although fibrin glue has been in regular use since the 1980s, suturing remains the standard for surgical repair. The aim of the present work was to compare the functional long-term outcome of 2 different techniques, open repair by fibrin glue versus percutaneous repair using the Paessler technique.

Methods: 72 patients (2 centers, retrospective study, 2003-2006) who had undergone acute Achilles tendon repair with either percutaneous suture (PG, n = 35, mean age 49.2 years) or open fibrin glue (FG, n = 37, 50.7 years) took part in a follow-up examination (ultrasound, visual analog scale [VAS], Thermann score, American Orthopaedic Foot & Ankle Society [AOFAS] score) after an average of 3.7 years (PG) or 5.1 years (FG). Ankle range of motion; thigh, calf, and ankle circumferences of the injured leg and the contralateral side; return to work; and sports activities time were evaluated. Isokinetic evaluation results were retrieved.

Results: There were no reruptures. Four patients (PG, n = 1 [3%] vs FG, n = 3 [8%]; P = 0.331) had superficial wound infections. Lesions of the sural nerve occurred in 3 patients (PG, n = 2 [6%] vs FG, n = 1 [3%]; P = 0.523). The mean AOFAS score was 92.9 (PG) and 90.4 (FG; P = 0.359), the Thermann score was 70.7 (PG) and 71.0 (FG; P = 0.939), and the VAS was 8.1 (PG) versus 8.4 (FG; P = 0.656). Patients returned to work at 9.3 (PG) and 8.0 (FG; P = 0.593) weeks and to preinjury sportive activities at 16.9 (PG) and 19.1 (FG; P = 0.667) weeks. Ankle range of motion, ultrasound, circumference, e and isokinetic measurements did not reveal a significant difference between the 2 methods. Because of fear of possible rerupture, 27 patients (PG, n = 18 [51%] vs FG 9 [24%]; P = 0.018) changed their sport.

Conclusion: These results suggest that minimally invasive and fibrin glue Achilles tendon repair provides satisfactory results with early return to previous functional status with low complication rates and without reruptures. Patients after minimal invasive suture changed often their sports activities for fear of rerupture.

See pages 77 - 115 for financial disclosure information.

The Anterior Distal Tibial Angle: Published Values Are Misleading

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Purpose: The anterior distal tibial angle defines the relationship of the tibial plafond articular surface to the tibial shaft anatomic axis as noted on the lateral tibial radiograph. Normal has previously been defined as an average of 80° degrees (range, 78°-82°). This published finding was based on lateral tibial radiographs. Full-length lateral tibial radiographs are not readily available intraoperatively at the time of tibial plafond fracture reconstruction. We hypothesized that the average value of the anterior distal tibial angle as measured intraoperatively using the available smaller fluoroscopic field of view would be higher than the published value (ie, a larger angle closer to 90°). The significance of this hypothesis lies in defining and evaluating sagittal plane reductions of pilon fractures. The purpose of the study was to redefine the normal anterior distal tibial angle based on intraoperative fluoroscopic lateral films.

Methods: As a part of our standard protocol for ankle and tibial pilon fracture fixation, intraoperative fluoroscopic views are taken of the contralateral uninjured side and saved to assist in fracture reconstruction. These intraoperative films of the uninjured extremity of 72 consecutive patients were retrospectively reviewed to determine the average and range of the anterior distal tibial angle based on imaging that is available intraoperatively. Two observers reviewed the films at two different settings. The average anterior distal tibial angle for an uninjured extremity was calculated and the inter- and intraobserver reliability were evaluated.

Results: The average anterior distal tibial angle as measured on intraoperative fluoroscopic lateral views was 86° (standard deviation of 3°). A one-sample *t* test was used as a comparison to the previously published average. Based on the one-sample *t* test, the *P* value was <0.001, revealing a statistically significant difference between the value that is noted intraoperatively using fluoroscopic imaging and the value that is published using full-length lateral tibial radiographs. High inter- and intraobserver reliability was noted.

Conclusions: The hypothesis was accepted. Using the published value for the anterior distal tibial angle could lead to sagittal plane malreductions of the tibial plafond. The malreductions could be clinically significant as one standard deviation could lead to more than a 10° error. Similarly, using the previously published value as a standard postoperatively for research to determine pilon fracture reduction on lateral ankle radiographs could lead to the impression of a high percentage of malreductions. This finding should help guide future publications with respect to sagittal plane reduction of pilon fractures.

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PACS (Picture Archiving and Communication System) and Plain Radiography Fracture Classification Agreement of the Tibial Plafond

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Purpose: The goal of this study was to compare the interobserver reliability and intraobserver reproducibility of a Picture Archiving and Communication System (PACS) to plain radiography utilizing the AO/OTA fracture classification system of the injuries to the tibial plafond.

Methods: Observers of varying experience were recruited from multiple centers to assess radiographs of 15 tibial plafond fractures of varying severity. Observers were asked to classify fractures according to the AO/OTA scheme to the subtype level using either PACS or plain radiography. PACS users were given the opportunity to manipulate image contrast, magnification, and degree of displacement. A subset of observers reclassified images at a second time point to assess intraobserver reproducibility. The kappa coefficient was employed to calculate agreement with χ^2 analysis to establish statistical significance.

Results: PACS intraobserver reproducibility demonstrated statistically higher agreement for both group ($\kappa = 0.519$) and type ($\kappa = 0.769$). Statistically greater interobserver reliability was noted among the PACS observers at the group ($\kappa = 0.209$) level. Higher interobserver agreement was noted among the plain radiography responses at the type ($\kappa = 0.422$) level. Observers with more experience had higher interobserver agreement at the group level for both PACS (k 0.274) and plain radiography ($\kappa = 0.164$) and for PACS at the type level ($\kappa =$ 0.724). Higher intraobserver agreement was also noted with greater experience at type ($\kappa =$ 0.862) and group ($\kappa = 0.64$) levels with PACS. Less experienced viewers had higher intraobserver agreement using plain radiography at all levels.

Conclusion: While PACS viewing did not result in perfect agreement when compared to viewing plain radiographs using a PowerPoint surrogate, it demonstrated significantly greater intraobserver reproducibility at type and group levels. The absolute magnitude of agreement of both modalities increased for lower levels of classification complexity. More experienced viewers also tended to have significantly higher agreement at coarser levels of classification, particularly with PACS. This effect was less marked at group level. Experience also demonstrated significantly higher intraobserver agreement with PACS but not with PowerPoint images.

Evaluation of Clinical Outcomes Following Mini-Fragment Dual-Plate Fixation of Talar Neck Fractures

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Purpose: Talar neck fractures are uncommon and result from high-energy mechanisms producing comminution and displacement. The purpose of this study was to evaluate the clinical outcomes of talar neck fractures treated with mini-fragment plate fixation.

Methods: Over a 5-year period, from March 2002 through June 2007, a retrospective analysis of 83 consecutive talar neck fractures in 79 skeletally mature patients was performed (IRB-approved). All fractures were treated with mini-fragment dual-plate fixation at a single trauma center. Clinical outcomes included pain at final assessment, ankle range of motion (ROM), return to work (RTW), and complications. Demographic data, fracture type, instrumentation used, and radiographic arthrosis were recorded.

Results: Gender was near equal distribution (38 males [48.1%] and 41 females [51.9%]) with more right talus injuries (44 [53%]) than left (39 [47%]). Average age was 35 years (range, 18-77 years). Hawkins classification was: II, 39 (47%); III, 30 (36%); and IV, 14 (17%). Open injuries were 15 (18.1%). Isolated injuries were 15 (18.1%) and 68 had associated injuries (81.9%). Hardware (HW) complications were screw loosening, 2 (2.4%); and symptomatic palpation of the plate, 8 (9.6%). Radiographic ankle arthrosis was 31 of 83 (37.3%) and subtalar arthritis was 38 of 83 (45.7%). Complications of avascular necrosis (AVN) (20 of 83 [24%]), nonunion (1 [1.2%]), and HW loosening (2 [2.4%]) were noted. Secondary surgeries were 18 (22%) with below-knee amputation, 1 total ankle arthroplasty, and 16 HW removal. Pain was noted to be: none, 19 (23%); and mild (0-3 of 10) pain, 63 (76%). Pain is related to subtalar arthrosis (r = 0.525, P < 0.001) and to ankle arthrosis (r = 0.619, P < 0.001). Ankle arthrosis is related to subtalar arthrosis (r = 0.397, P < 0.001). Ankle arthrosis is related to decreased ankle dorsiflexion ROM (r = 0.344, P < 0.004). RTW was: same job without restrictions, 48 (58%); with restrictions, 19 (23%); and no RTW, 16 (19%).

Conclusions: Talar neck fractures are associated with high rates of complications (AVN and arthrosis). Stable dual-plate fixation produces high union rates and lower AVN rates compared to historical data. Strategic HW placement may reduce HW-related irritation. Chronic pain and stiffness have a devastating effect on function and ability to return to previous activities and employment.

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The Effect of Clamp and Screw Placement on Syndesmotic Reduction

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Purpose: Multiple recent papers have examined ankle fractures, and specifically fixation of syndesmotic injuries. It has been shown that closed syndesmotic screw fixation can lead to malreduction of the syndesmosis, and that malreduction is also possible with open syndesmosis reduction, even with direct visualization. The purpose of this study was to evaluate how variations in angulation of clamp placement to hold syndesmotic reduction and subsequent syndesmotic screw placement can lead to malreduction of the syndesmosis. We hypothesized that inaccurate placement of intraoperative clamps and transsyndesmotic screws can cause malreduction of the ankle syndesmosis.

Methods: We used 14 (7 matched pairs) intact cadaveric lower extremities that included the knee joint. Each of the cadavers had a CT scan of the ankle, including our radiographic markers, to assess their normal anatomic syndesmotic alignment. The cadavers were then dissected from an anterior approach to section their syndesmotic ligaments and the interosseous membrane. Subsequently, using markers placed prior to CT for guidance, pilot holes for clamp application were made in each specimen at 0°, 15°, and 30° angles. The specimens were randomized to 1 of 2 clamp types for comparison. The specimens were then secured with the reduction clamp at each angle, followed by CT to evaluate syndesmotic reduction. Each specimen was then randomized to 0° straight lateral or 30° straight lateral fibular starting points for screw fixation. These cadavers were further used to compare 15° posterolateral and 30° posterolateral fibular starting points. The syndesmosis was stabilized with 1 transsyndesmotic screw (3.5-mm screw) through 4 cortices, placed from lateral to medial. The location for clamp or screw placement was approximately 2 cm above and parallel to the plafond. Another CT scan was obtained after each type of fixation, which was used to assess the reduction, and this was compared with the "preoperative" CT to assess alignment.

Results: Clamps placed at 15° and 30° significantly displaced the fibula in external rotation and caused significant overcompression of the syndesmosis. 30° lateral screws caused significant anteromedial displacement, external rotation, and overcompression of the syndesmosis. 15° posterolateral screws also caused significant external rotation and overcompression of the syndesmosis.

Conclusion: Syndesmotic instability treated with traditional transsyndesmotic fixation methods have high rates of syndesmotic malreduction that is decreased, but not eliminated, with open reduction under direct visualization. No study has previously analyzed the causes of these malreductions or how clamp or syndesmotic screw placement alone may be a cause of ankle malreduction.

Assessing the Utility of Knee and Foot Radiographs for the Evaluation of Ankle Fractures

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Purpose: Orthopaedic surgery and emergency medicine trainees are universally instructed to obtain radiographs of the joint above and below a fracture to rule out associated injuries. Although an accepted practice, this may result in overutilization of resources and unnecessary radiation exposure when evaluating ankle fractures, resulting in undue burden on the patient and healthcare system. We hypothesize that proximal tibia and fibula radiographs and/or foot series radiographs have very low yield when evaluating these injuries and additional radiographs are only warranted if clinical suspicion of an associated injury exists.

Methods: A retrospective review of patients who sustained ankle fractures was performed at our institution. Exclusion criteria included those with no available imaging and pediatric patients with open physes. Patients who received proximal tibia and fibula and/or foot series radiographs in additional to ankle series radiographs were identified. The proximal tibia and fibula and/or foot radiographs were evaluated for additional fractures for the patients who met the inclusion criteria.

Results: 1058 patients met inclusion criteria. Of those 1058 patients, 587 patients (55.5%) had additional proximal tibia and fibula radiographs obtained. 68 of 587 patients (11.5%) demonstrated an associated fracture. Nine of 587 patients (1.5%) demonstrated a Maisonneuve fracture and of those 9, 5 patients (55.5%) had their injuries well visualized on the ankle series radiographs without additional benefit from the proximal tibia and fibula images. 209 patients (19.8%) had foot series radiographs obtained. 20 of 209 patients (9.6%) demonstrated an associated injury as seen on the foot series radiographs. Overall, out of 1058 patients, only 6.4% of patients had an additional proximal fracture seen on proximal tibia and fibula radiographs and 1.89% had an additional fracture seen on foot series images.

Conclusion: The addition of knee and foot radiographs when evaluating for associated injury for patients sustaining ankle fractures has very low yield. Clinical suspicion for associated injuries should direct the treating physician to obtain additional radiographs. The blind addition of knee and foot radiographs places undue burden on the healthcare system as well as the patient.

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Increased Severity of Type III Supracondylar Humerus Fractures in the Pre-Teen Population

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Purpose: We sought to compare Gartland type III supracondylar humerus fractures in children older than 8 years of age with those younger than age 8.

Methods: A retrospective chart review of supracondylar humerus fractures managed at a single Level 1 pediatric trauma institution was performed. Patients with type III fractures were divided into groups based on age at presentation greater or less than 8 years. Baseline demographics, fracture characteristics, operative technique, and complications were analyzed.

Results: A consecutive series of 1297 patients with surgically treated supracondylar humerus fractures was retrospectively reviewed including 873 (67.3%) type III fractures, 160 (18.3%) of which were in children older than 8 years of age at time of injury. Fractures in younger children were more commonly due to low-energy mechanisms (45.1% vs 28.7%, P < 0.001). A higher incidence of postoperative nerve injury (15.6% vs 8.8%, P = 0.009) and open fractures (3.8% vs 1.3%, P = 0.0097) was seen in the older children. There was a trend for a more frequent need for open reduction in older children (4.4% vs 1.7%, P = 0.064) despite a shorter delay between presentation and surgery (217 minutes vs 451 minutes, P < 0.0001). Three or more pins were required more often to obtain a stable construct in the older patients (61.8% in older children vs 43.6% in younger children, P < 0.0001). Major complications including reoperation, loss of fixation, or compartment syndrome were rare in both groups (1.1% in the younger group vs 0.6% in older group, P = 1.000). There was a trend toward more pin-site infections in older children (3.75% vs 1.56%, P = 0.071) Physical therapy was required nearly 4 times more frequently in older children for management of residual stiffness (20.0% vs 5.7%, P < 0.0001).

Conclusions: Children greater than 8 years of age who sustain a supracondylar fracture have a higher rate of nerve palsy, open injury, and need for open reduction. Achieving adequate stability requires more points of fixation in older children. Elbow stiffness requiring physical therapy is also more common in this older population.
Acute Complications Associated With Removal of Flexible Intramedullary Rods Placed for Pediatric Femoral Shaft Fractures

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Purpose: The American Academy of Orthopaedic Surgeons position statement on the treatment of pediatric femoral shaft fractures could not comment on removal of flexible intramedullary (IM) rods because of the paucity of related literature. The purpose of this study is to review the acute complications of flexible IM rod removal from patients treated for femoral shaft fractures.

Methods: This is a retrospective review of the clinical and radiographic histories of subjects undergoing flexible IM rod removal after initial treatment for a femoral shaft fracture at a single institution over a 5-year period. Demographic and radiographic parameters were analyzed to determine their influence on intraoperative and immediate postoperative complications.

Results: 163 subjects (133 male, 30 female), with a mean age of 9.3 ± 2.8 years (range, 2.7-14.8) years) and mean weight of 34.4 ± 15.3 kg (range, 14.0-139.0 kg), underwent femoral flexible IM rod removal a mean 12.4 ± 10.8 months (range, 2.4-63.8 months) after placement with mean operative time of 51.1 ± 22.3 minutes (range, 10-131 minutes). 151 subjects (92.6%) had Enders rods, with the rest being titanium. 19.5 % of rods were "locked" (screw fixation through eyelet of Enders rod). Rods were inserted retrograde medially and laterally (87), retrograde laterally only (55), or antegrade trochanteric (20). Pain at insertion site was the indication for rod removal in 88 (54%), with others removed at the recommendation of the surgeon. Only 13 of 88 symptomatic subjects (14.8%) had locked IM rods. Operative time was significantly different when comparing locked versus unlocked subjects (59.9 vs 48.5 minutes, respectively, P < 0.05) and nail entry site (medial and lateral 55.4 vs lateral only 44.4, P = 0.05). There were 4 (2.5%) minor intraoperative complications, including the inability to remove 1 of 2 rods (1) and complete bone overgrowth at insertion site (3). Two of 3 with bone overgrowth had the rods placed >60 months prior to removal. Immediately postoperative (n = 134), there were 4 (3.0%) complications, including superficial wound infection (3) and knee contracture (1). There were no significant demographic, intraoperative, or radiographic differences comparing subjects with Enders versus titanium rods. Subjects were released to full activities at a mean 4.7 ± 1.8 weeks postoperatively with no known postoperative fractures.

Conclusions: The rate of intraoperative and immediate postoperative complications is low. Intraoperative complications may be minimized with removal of rods before signs of overgrowth. Locked rods and medial and lateral insertion may increase operative time but the difference may not be considered clinically significant.

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Supracondylar Humeral Fractures in Children: Experience of Performing Surgeon and Delay of Treatment Have No Influence on the Incidence of Open Reduction and Complications

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Purpose: Closed reduction and pinning is the accepted treatment of choice for dislocated supracondylar humeral fractures in children. Incidence rates of conversion are reported to be dependent on the experience of the performing surgeon and the delay between trauma and operation. We analyzed if experience of the surgeon or delay of treatment have influence on the incidence of open surgery or adverse events in the treatment of supracondylar humeral fractures at our hospital.

Methods: We retrospective analyzed 353 supracondylar humeral fractures (Gartland II: 145; Gartland III: 219) who underwent surgery between 2000 and 2009. The cohort consisted of 198 males and 155 females. The average age was 6.3 years. Mean follow-up was 6.2 months. The surgeons were categorized into an experienced group (performed >10 operations of pediatric supracondylar humeral fractures) and a less experienced group (performed <10 operations). Delayed treatment was considered if the surgery was done more than 12 hours after trauma. Clinical and radiographic data were collected for each group. Statistical analysis was undertaken and significance was defined as *P* <0.05.

Results: The incidence of open procedures in 353 supracondylar humeral fractures was 3.7%. Complication rates were similar to the literature (14.7%), representing mainly transient neurologic impairments that were all fully reversible by conservative treatment. The experience of the performing surgeon had no influence on the incidence of open surgery (P = 0.53) or complications (P = 0.71), respectively. Delay of the operation of more than 12 hours showed no correlation with the rates of open reduction (P = 0.53) or complications (P = 0.91), respectively.

Conclusions: Closed reduction and pinning with Kirschner wires is a feasible treatment option for supracondylar humeral fractures in the majority of cases. In our hospital, both delay of treatment and experience of the surgeon have no influence on the treatment modality (open vs closed surgery) or the incidence of adverse events.

See pages 77 - 115 for financial disclosure information.

Tibial Shaft Fractures in Adolescents: Analysis of Cast Treatment Successes and Failures

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Purpose: It is generally thought that tibial shaft fractures in children heal quickly with few complications. The purpose of this study is to analyze success and failure of cast treatment of closed tibial diaphyseal fractures in the adolescent population.

Methods: This is a retrospective study from 2002 through 2008 of all males age 12 years old or greater (76%, 57 of 75) and females age 10 years old or greater (24%, 18 of 75) with open physes, who sustained a closed tibia or tibia-fibula diaphyseal fracture that treated initially with long-leg cast treatment. Time to clinical union was determined by length of immobilization and return to full weight bearing.

Results: Average age was 13.3 years (range, 10-17.4 years). 21% (16 of 75 patients) required a unplanned cast change or a wedging of the cast in clinic due to loss of reduction, and 3 patients (4%) had a failure of cast treatment, requiring an unplanned surgical intervention to restore alignment. The patients who required either an unplanned cast change/wedge or unplanned surgery were not statistically significantly different from the patients who did not in regard to patient age, gender, fracture pattern, or mechanism of injury. 69% of fractures (52 of 75) were isolated tibia fractures, and 31% (23 of 75) were combined tibia/fibula fractures. There was no statistically significant difference between the patients with an isolated tibia fracture and the patients with a combined tibia-fibula fracture in regard to the need for a cast change or wedge, need for surgical intervention, mechanism of injury, or fracture pattern. However, patients with an isolated tibia fracture had statistically significant decreased length of immobilization (93 days vs 119 days) and time to return to full activities (14 weeks vs 16 weeks) compared to those with a combined tibia-fibula fracture (P < 0.05). The difference in levels between the ipsilateral tibia and fibula fracture did not affect the need for a cast/wedge, need for surgery, or length of immobilization (P < 0.05). 61% of patients (46 of 75) required over 3 months of cast immobilization, but there was no statistically significant difference between those patients and the ones immobilized for less than 3 months as far as patient age, gender, fracture pattern, mechanism of injury, or whether there was a need for an unplanned cast wedge or cast change.

Conclusion: In this adolescent patient population, 25% of closed tibial diaphyseal fractures treated with reduction and casting required further intervention to maintain alignment, with 61% of patients requiring over 3 months of cast immobilization. Time to union and return to full activities is prolonged compared to what has been described to the younger population. Despite this, the majority of initial manipulations and castings are successful in this older, larger population. Orthopaedists can discuss realistic expectations with families regarding prolonged duration of treatment and possible need for further intervention in adolescents with closed tibial diaphyseal fractures.

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Is Bisphosphonate Usage Associated With Atypical Humeral Diaphyseal Fractures? *Matthew A. Popa, MD*¹; *Clifford B. Jones, MD, FACS*^{2,3}; *Debra L. Sietsema, PhD*^{2,3}; *Shaun Kink, BS*³; *Matthew S. Nies, BS*³; ¹Grand Rapids Orthopaedic Residency Program, Grand Rapids, Michigan, USA; ²Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA; ³Michigan State University, Grand Rapids, Michigan, USA

Purpose: A number of recent case series and retrospective reviews have identified a subgroup of atypical fractures of the femoral shaft associated with bisphosphonate use. These case series have suggested that long-term bisphosphonate use may ultimately alter bone strength, most likely due to suppression of bone turnover. In addition to subtrochanteric femur fractures, we have noted atypical humerus fractures in association with low-energy falls and bisphosphonate usage. Thus far the literature is sparse with regard to the possible association of long-term bisphosphonate use with atypical fractures of the humerus.

Methods: From 2001 to 2010, 1290 consecutive patients with humeral fractures were identified in a retrospective review. Patient charts and fracture images were reviewed. Demographic data of gender, age, history of bisphosphonate usage, length of bisphosphonate usage, mechanism of injury, fracture pattern (OTA/AO classification), and fracture treatment were obtained. Patients who sustained fractures while on bisphosphonates were identified. Patients were assigned into 2 groups, one with bisphosphonate usage prior to the fracture and one with no history of bisphosphonate usage. From this group, we identified and analyzed a subgroup of patients with atypical diaphyseal humeral fractures with a low-energy mechanism of injury (defined as a fall from standing height or less).

Results: A total of 89 humeral fractures were identified in patients with current or prior bisphosphonate usage. 14 of 89 (16%) of these fractures were diaphyseal and 75 (84%) were proximal metaphyseal humeral fractures. Of the diaphyseal fractures, 12 were associated with a low-energy mechanism of injury. These included 10 females and 2 males with a mean age of 73 years (range, 50-89 years). The "atypical" diaphyseal humeral patterns were transverse or short oblique with cortical thickening (type I), lateral bending wedge (type II), and severely comminuted (type III). Patients with these "atypical" fracture patterns had bisphosphonate usage for an average of 4.9 years (range, 0.3-12 years), which was significantly longer (P = 0.03) compared to 1.3 years (range, 0.1-4.5 years) of bisphosphonate usage for those without these fracture patterns. Additionally, we noted that worsening atypical fracture pattern type related to duration of bisphosphonate usage.

Conclusion: Multiple case series have demonstrated that bisphosphonate usage is associated with atypical subtrochanteric femoral fractures. This is the first report to associate atypical diaphyseal humeral fractures with bisphosphonate usage. Additionally we recommend a classification scheme. Further analysis and prospective studies to more fully delineate the association between bisphosphonate usage and atypical fractures in the humerus and other parts of the skeleton are recommended.

See pages 77 - 115 for financial disclosure information.

Functional Outcome, Complications, and Radiographic Comparison of Supination–External Rotation Type IV Ankle Fractures in Geriatric Versus Nongeriatric Populations

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Purpose: Geriatric patients (defined as those >65 years old) provide a unique set of challenges in orthopaedics. Their comorbidities, functional limitations, and bone quality require innovative treatment to return patients to their previous functional status. We have compiled a prospective series of supination–external rotation type IV or IV-equivalent (SER IV/IV-equivalent) injuries between 2004 and 2009. We hypothesize that the geriatric population of this series will have worse functional outcome, maintenance of reduction, increased complications and increased risk of trimalleolar ankle fractures when compared to those patients younger than 65.

Methods: All operative SER IV/IV-equivalent ankle fractures treated by a single surgeon were enrolled in a prospective database (176). 114 patients fulfilled inclusion criteria of 1 year of clinical follow-up, postoperative radiographs, and Foot and Ankle Outcome Scores (FAOS). All patients underwent preoperative MRI to determine the combination of SER IV ankle fracture. Additionally, each patient underwent postoperative CT to evaluate syndesmotic reduction. There were 30 geriatric and 84 nongeriatric patients. The following variables were analyzed: range of motion, presence of comorbidities, pattern of injury, method of fixation, syndesmotic reduction, postoperative complications, and change in postoperative radiographic alignment. The primary outcome measure was FAOS.

Results: Geriatric patients were significantly more likely to have comorbidities including diabetes mellitus (P = 0.0014) and peripheral vascular disease (P = 0.00001) compared with patients younger than 65 years. Despite this, age had no impact on the rate of postoperative wound complications, range of motion, infection rate, or FAOS outcome score (symptoms, P = 0.34; pain, P = 0.65; activities, P = 0.57; sports, P = 0.75; quality of life, P = 0.34). There was no significant difference in the proportion of trimalleolar ankle fractures in the geriatric population (P > 0.99), change in tibiofibular clear space, change in medial clear space (P = 0.71), or postoperative syndesmotic reduction (P = 0.989).

Conclusions: Contrary to our hypothesis, geriatric patients demonstrated similar outcomes, complication rates, maintenance of reduction, and initial reduction despite their comorbidities and expectedly poor bone quality. We conclude that adequate fixation can overcome many of the challenges provided by elderly patients and their comorbidities.

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Open Reduction and Internal Fixation of Proximal Humerus Fractures in Patients Older Than 70 Years Using a Locked Plate: Minimum 1 Year Follow-up Jonathan C. Levy, MD;

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Purpose: Treatment of proximal humerus fractures in patients over 70 years of age has historically been plagued with high rates of complications. Locked plate technology has improved the ability to manage complex proximal humerus fractures even in cases of poorquality bone. The purpose of this study is to evaluate the functional and subjective outcome of the locked proximal humerus plate used to treat proximal humerus fractures in patients over 70 years of age.

Methods: A consecutive series of 27 patients over the age of 70 years (average age, 82.2 years; range 70-100 years) with displaced proximal humerus fractures were treated with open reduction and internal fixation using a locked proximal humerus plate. Patients were evaluated with a minimum of 12 months follow-up for clinical, functional, radiographic, and subjective outcomes. Radiographs were evaluated for fracture healing, final head-to-shaft angle, screw penetration, avascular necrosis (AVN), and fracture displacement. There were 7 patients who did not meet inclusion criteria of 12-month follow-up: 5 died prior to 12-month follow-up (average follow-up, 3 months; range, 0-6 months), 1 was revised for AVN in another state, and 1 moved out of state and did not respond to certified mail inquiry. Of the 20 included patients, there were 17 females and 3 males. Based on Neer criteria, there were 6 2-part fractures, 11 3-part fractures, and 3 4-part fractures. Average follow-up was 22.1 months (range, 12-47 months). Seven patients were being treated for osteoporosis. Eight patients required the use of an intramedullary allograft strut. Eight patients required simultaneous repair of a torn rotator cuff.

Results: All fractures healed with an average head-to-shaft angle of 129.6° (range, 115°-143°). Average forward flexion was 127.5° (range, 80°-160°), abduction 81.4° (range, 65°-120°), and external rotation was 30.7° (range, 0°-60°). Manual external rotation strength averaged 4.9 of 5 (range, 4-5) and supraspinatus strength averaged 4.7 of 5 (range, 4-5). Functional outcomes averaged: visual analog score (VAS) pain, 1.1 (range, 0-9); VAS function, 8.7 (range, 5-10); American Shoulder and Elbow Surgeons (ASES) pain, 47.1 (range, 5-50); ASES function, 39.4 (range, 10-50); total ASES, 86.4 (range, 15-100); and simple shoulder test (SST), 8.6 (range, 2-12). Single Assessment Numeric Evaluation (SANE) averaged 88.1 (range, 70-100), and 17 patients rated their satisfaction as excellent, 1 satisfactory, 1 good, and 1 unsatisfactory. There were 2 complications: 1 superficial infection requiring débridement, and 1 avulsion of 1-cm portion of the greater tuberosity treated nonoperatively. No screws were noted to have penetrated the glenohumeral joint on final radiographs.

Conclusion: Open reduction and internal fixation of proximal humerus fractures in patients over 70 years of age using the locked proximal humerus plate provides reliable healing and restoration of function with an acceptable complication rate. Use of intramedullary allografts may play an important role in maintaining fracture reduction and avoidance of complications related to fracture displacement in this patient population.

Can We Prevent Renal Failure by Using Ciprofloxacin Instead of Gentamicin for the Treatment of Open Fractures in Older Patients?

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Purpose: Type III open fractures require an antibiotic regimen that treats both gram-positive and gram-negative bacteria. Gentamicin is commonly prescribed for gram-negative coverage, but it causes nephrotoxicity and ototoxicity, especially in older patients. We hypothesize that ciprofloxacin is equally as effective as gentamicin in preventing infection, and that it has a lower rate of acute renal failure (ARF).

Methods: We examined the incidence of ARF in all patients in our trauma registry between 2004 and 2010. 92 consecutive patients older than 60 years were treated with gentamicin or ciprofloxacin for gram-negative coverage between 2004 and 2010. For gram-negative coverage, 61 patients received gentamicin alone (group G), 18 received ciprofloxacin alone (group C), and 13 trauma patients with multiple issues requiring antibiotics received both gentamicin and ciprofloxacin during their early admission. These patients were reviewed for development of ARF (elevation of serum creatinine $\geq 0.5 \text{ mg}/\text{dL}$ from baseline), development of infection at the fracture site, and development of *Clostridium difficile* colitis.

Results: 14,672 trauma patients were identified over 6 years. 229 (1.53%) patients developed ARF. This incidence was higher in patients older than 60 years of age (3.69%). 179 patients older than 60 years had open fractures during this period, and 92 (51.4%) received antibiotic coverage for gram-negative bacteria. In patients older than 60 years, the incidence of nephrotoxicity was 6 of 65 (9.2%) in patients who received gentamicin, and was zero (0%) in group C (P = 0.34). The incidence of infection at the open fracture site was 12 of 61 (19.7%) in group G and there were 0 of 18 (0%) infections at the fracture site in group C (P = 0.058). Additionally, 2 of 13 patients (15.4%) who received both gentamicin and ciprofloxacin developed infection at the fracture site. The incidence of *C. difficile* colitis was 1 of 61 (1.5%) in group G and 1 of 18 (5.6%) in group C (P = 0.41).

Conclusions: The incidence of ARF in older trauma patients is significant, and the use of alternatives to nephrotoxic agents is potentially of great benefit in this growing population. The use of ciprofloxacin instead of gentamicin for coverage of gram-negative bacteria in patients older than 60 years with open fractures does not increase the risk of infection based on this patient cohort and may prevent the development of acute renal failure.

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Cemented Hemiarthroplasty Is Associated With a Higher Early Mortality Rate Than Uncemented Hemiarthroplasty—Fact or Fiction?

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Purpose: Cemented hemiarthroplasty for neck of femur fractures has been advocated over uncemented hemiarthroplasty due to better postoperative recovery and patient satisfaction. However, studies have shown adverse effects of bone cement on the cardiorespiratory system that may lead to higher morbidity and mortality. Therefore, in some institutes, the use of an uncemented prosthesis has been adopted for patients with a high number of comorbidities. The aim of this study was to compare early mortality rates for cemented versus uncemented hemiarthroplasties.

Methods: This is a cohort study of displaced intracapsular hip fractures treated with hemiarthroplasty between 1999 and 2009 at one institute. A total of 3094 hemiarthroplasties were performed, of which 1002 (32.4%) were cemented and 2092 (67.6%) were uncemented. 48-hour and 30-day mortality rates for the 2 groups were compared and a multivariate Cox regression model used to eliminate confounding factors. Significant confounding factor included age, sex, mini-mental test score, medical comorbidities, Nottingham Hip Fracture Score, and delay to surgery.

Results: The study showed that, after eliminating confounding factors, 48-hour mortality in the cemented group was 0.3% compared to 0.5% in the uncemented group (P = 0.388). However, the adjusted 30-day mortality rate for the cemented group (4%) was shown to be significantly lower than for the uncemented group (10.8%) (P < 0.001).

Conclusion: The use of cement in hip hemiarthroplasty is not associated with an increased rate of mortality at 48 hours or at 30 days. Along with emerging evidence of better postoperative recovery and patient satisfaction with the use of a cemented prosthesis, we support the use of cement for all patients undergoing hip hemiarthroplasty.

Cortical Width Can Predict Bone Mineral Density and Screw Pullout Strength in the Distal Radius

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Purpose: Estimating local bone mineral density (BMD) and screw pullout strength (SPS) can help choose the type of fixation and postoperative plan of a given fracture in the elderly population. This in turn may improve patient care and cost-effectiveness of surgery. Although BMD measurements have been shown to correlate with SPS, these measurements are not always available at the time of surgery. We hypothesized that the cortical width (CW) measured on radiograph can predict local BMD and SPS.

Methods: Metaphyseal and diaphyseal CW was measured in 16 DEXA (dual-energy x-ray absorptiometry)–scanned cadaver distal radii (age 71 ± 15 years); 3.5-mm screws were inserted into each region and SPS was recorded using a servohydraulic test system (Figure 1). The averaged CW in each region was correlated to the region-specific DEXA BMD and T-score measurements and to SPS.

Results: Diaphyseal CW correlated both to DEXA BMD ($R^2 = 0.7$, P < 0.0001, Figure 2) and T-score ($R^2 = 0.67$, P < 0.0001) and to SPS ($R^2 = 0.5$, P = 0.002). In the metaphyseal region, the correlations were lower but statistically significant for DEXA BMD ($R^2 = 0.46$, P < 0.0025) and SPS ($R^2 = 0.49$, P = 0.0031). The correlations between DEXA BMD and SPS were significant for both the metaphyseal ($R^2 = 0.75$, P < 0.0001) and diaphyseal ($R^2 = 0.52$, P < 0.01) regions.

Conclusion: CW may be used as a simple low-cost assessment of local BMD and SPS in the elderly population. Further biomechanical and clinical studies are needed in order to further test the utility of this method.

Figure 1. Screws placed in the distal radius in the metaphyseal and distal diaphyseal regions were tested for pullout strength, local BMD by DEXA, and average CW.

Figure 2. Screw pullout strength was recorded using a servohydraulic test system.



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Is the Use of Cement Safe When Performing Arthroplasty for Hip Fractures?

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Purpose: There remains controversy over the use of cement for patients undergoing arthroplasty after a hip fracture. Recent case studies have highlighted concern whether the use of cement leads to increase in mortality or complications. The aim of this study was to look the evidence for effectiveness and complications with the use of cement in all previous randomized controlled trials (RCTs) comparing cemented and cementless arthroplasty after hip fracture.

Methods: A meta-analysis was conducted to combine the results of all RCTs in Englishlanguage literature comparing cemented and cementless arthroplasty. Results analyzed were on mortality, number of reoperations, wound-healing complications, functional status, length of stay in hospital, total time to resettlement in the community, quality of life, pain, and place of residence after hip fracture. Fixed-effects (Mantel-Haenszel) techniques were selected to calculate risk ratios (relative risk) for the binary outcomes. The continuous outcomes were analyzed using an inverse variance method for pooling weighted mean differences and where the studies had different scales, standardized mean differences were used. Assessments of potential differences in effect between subgroups were based on the χ^2 tests for heterogeneity statistics between subgroups.

Results: There were a total of 7 RCTs comprising of 1118 patients in total. There is no statistically significant difference in mortality at 30 days (P = 0.66), 90 days (P = 0.9), 1 year, or 2 years. There is evidence of less pain at 3 months (P = 0.03) and 1 to 2 years (P = 0.0002) and better mobility score at 12 months (P = 0.0003) with cemented arthroplasties. There is no statistically significant difference at 1 year in the number of patients requiring reoperations, number of patients pain requiring medication, number of patients unable to walk without aids, Barthel score of less than 19, Harris hip score, EuroQol-5D index score and visual analog score, deep wound sepsis, any wound infection, or length of hospital stay. None of the reported outcomes showed any advantage of uncemented arthroplasty over cemented. There was no increase in mortality with the use of cement.

Conclusions: There is no evidence of increased complication rates, in particular mortality, with the use of cemented arthroplasties. Cemented prostheses led to decreased pain and better mobility and their use is to be recommended for arthroplasty in this population.

Postoperative Outcomes of Femoral Subtrochanteric Fractures in Patients on Bisphosphonate Therapy: A Prospective Study

Bryon J.X. Teo¹; Joyce S.B. Koh, FRCS(Orth)²; Seo Kiat Goh, FRCS(Orth)²; Ai Png Meng, FRCR³; David T.C. Chua, FRCS(Orth)⁴; Howe Tet Sen, FRCS(Orth)²; ¹Yong Loo Lin School of Medicine, National University of Singapore, Singapore; ²Dept. of Orthopaedic Surgery, Singapore General Hospital, Singapore; ³Dept. of Diagnostic Radiology, Singapore General Hospital, Singapore; ⁴Dept. of Orthopaedic Surgery, Changi General Hospital, Singapore

Purpose: Recent reports increasingly suggest that prolonged use of bisphosphonates may be associated with atypical insufficiency fractures in the subtrochanteric region. However, little is known about the outcome of these patients. Most management strategies are currently opinion or consensus-based. This study aims to report on the treatment outcome in a group of patients with such fractures in a single tertiary hospital.

Methods: Prospectively collected data were retrieved from an actively maintained database of patients. They presented with atypical subtrochanteric fractures while on bisphosphonate therapy at a tertiary institution (Singapore General Hospital). A total of 33 patients were identified in the study period between May 2004 and October 2009. We included only fractures sustained in low-energy trauma and excluded those due to road traffic accidents, fall from height, or underlying malignancy. Surgical fixation was done at surgeon's preference. The patients were tracked until the last recorded outpatient visit. They were continually assessed for weight-bearing status and presence of pain at the fracture site. Radiographs were taken preoperatively, postoperatively, and at each follow-up. Two senior practitioners (one orthopaedic surgeon and one musculoskeletal radiologist) reviewed the radiographs to determine union. Patients lost to follow-up for more than 6 months were excluded from analyses.

Results: Patients had a mean age of 67.5 years (standard error $[SE] = \pm 1.75$) and were on bisphosphonates for a mean duration of 4.9 years (standard error of the mean $[SEM] = \pm 0.41$). Extramedullary (EM) devices were used in 23 patients (70%). The remaining 10 (30%) were fixed with intramedullary (IM) devices. Postoperatively, 36.4% of patients required wheelchair mobilization, 39.4% were on no weight-bearing ambulation, and only 21.2% were able to partial weight-bear. 29 fractures united following the index procedure after an average of 10.0 months (SEM = ± 1.20). The average time taken for pain to cease was 6.2 months (SE = ± 0.90) and for full weight bearing was 7.1 months (SE = ± 1.11). Revision surgery was required in 30% of patients. Implant failure was seen in 23% of patients. In the EM group, nearly half the patients (48%) required wheelchair mobilization postoperatively. Radiologic union occurred after an average of 10.9 months (SE = ± 1.49). The majority of IM patients (89%) were able to ambulate with aid (no weight-bear or partial weight-bear). The fractures fixed with IM devices took an average of 7.7 months (SE = ± 1.91) to unite.

Conclusions: Subtrochanteric fractures led to high morbidity in all patients. A large percentage of patients required revision surgery (30%) and suffered implant failure (23%). This fracture is also associated with slow healing and prolonged postoperative immobility.

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A Retrospective Analysis of Patients Who Sustain a Hip Fracture While Taking Warfarin *Frederick Tonnos, DO*; *Paul Gregory, MD*;

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Purpose: The purpose of this study is to investigate elderly patients with hip fractures who are taking warfarin at the time of injury, and determine any difference in the time to operation and total length of hospitalization compared with those who are not taking warfarin.

Methods: We identified all patients treated in a 1-year period at a single institution with a diagnosis of femoral neck fracture (OTA classification 31-B) and pertrochanteric femur fracture (OTA 31-A). A total of 243 patients between June 2009 and May 2010 were identified. A retrospective chart review was then performed. The data of interest included the emergency room arrival time, operating room "in-room" time, and hospital discharge time. Also, the presenting prothrombin time, expressed as the international normalized ratio (INR), was documented for each patient. Patients younger than 60 years of age and polytraumas were excluded, along with 2 patients who died prior to discharge. The remaining 197 patients were divided into 2 groups based on their presenting INR. 178 patients had values of 1.5 or below and the remaining 19 patients with an elevated INR above 1.5. It was verified through the medical record that all 19 patients with an elevated INR above 1.5 were taking warfarin at the time of injury. Iso noted was the method of coagulopathy correction, if any.

Results: The mean time to the operating room for patients with an initial INR >1.5 was 1.78 days, with a mean total hospitalization time of 6.65 days. The mean time to the operating room for patients with an initial INR <1.5 was 1.03 days, with a mean total hospitalization time of 5.49 days. The 2 groups were compared using the unpaired *t* test. There was a statistically significant difference between the 2 groups with respect to the time to operation (P = 0.0002). There was a trend toward increased length of hospitalization in the group taking warfarin, but the difference failed to be statistically significant (P = 0.145). Methods of coagulopathy correction included administration of fresh-frozen plasma and vitamin K (either subcutaneous or oral route). 18 of the 19 coagulopathic patients were treated by one or both of these methods. Despite this medical management, they were unable to get to the operating room as quickly as the patients without a significant coagulopathy.

Conclusion: Patients taking warfarin who suffer a hip fracture have a longer time to operative fixation if the goal INR is below 1.5, and their total length of hospitalization is likely to be increased by an average of 1.16 days. To our knowledge, this has not been directly demonstrated previously in the literature. Also, patients received fresh-frozen plasma and/or vitamin K without any specific algorithm or clear benefit. Our goal is to develop an algorithm for perioperative management that will allow the coagulopathic patient to be safely operated on within the same time frame as the patient without a coagulopathy. Hopefully, this will promote decreased morbidity associated with prolonged bedrest and decrease overall time of hospitalization.

Can Plain Radiographs Differentiate Bisphosphonate Femur Fractures From Nonbisphosphonate Femur Fractures?

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Purpose: This study was conducted to evaluate the diagnostic utility of conventional radiography for diagnosing bisphosphonate-related atypical subtrochanteric femoral fractures.

Methods: Retrospective interpretation of 38 radiographs of subtrochanteric, complete femoral fractures in 2 patient groups, 1 group treated with bisphosphonates (19 fractures in 17 patients) and a second group not treated with bisphosphonates (19 fractures in 19 patients), was performed by 3 radiologists. The readers assessed 4 imaging criteria: focal lateral cortical thickening (FLCT), transverse fracture, medial femoral spike, and fracture comminution. The odds ratios and the sensitivity, specificity, and accuracy of each imaging criterion as a predictor of bisphosphonate-related fractures were calculated. Similarly, the interobserver agreement and the sensitivity, specificity, and accuracy of diagnosing bisphosphonate-related fractures (atypical femoral fractures) were determined for the 3 readers.

Results: Among the candidate predictors of bisphosphonate-related fractures, FLCT and transverse fracture had the highest odds ratios (76.4 and 10.1, respectively). Medial spike and comminution had odds ratios of 3.8 and 0.63, respectively. FLCT and transverse fracture were also the most accurate factors for detecting bisphosphonate-related fractures for all readers. The sensitivity, specificity, and overall accuracy for diagnosing bisphosphonate-related fractures were 94.7%, 100%, and 97.4% for reader 1; 94.7%, 68.4%, and 81.6% for reader 2; and 89.5%, 89.5%, and 89.5% for reader 3, respectively. The interobserver agreement was substantial (κ >0.6).

Conclusion: Plain radiographs are reliable for distinguishing bisphosphonate from nonbisphosphonate-related complete femoral fractures. FLCT and transverse fracture are the most dependable signs, demonstrating high odds ratios and the highest accuracy for diagnosing these fractures.

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Combination Nail-Plate Fixation of Osteoporotic Distal Metaphyseal Femoral Fractures

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Purpose: Elderly patients often have multiple medical comorbidities and upper extremity weakness that makes protected weight bearing or non–weight bearing difficult or impossible. Achieving reliable and stable fixation in the distal epiphyseal segment to allow early weight bearing and motion is essential for minimizing morbidity and mortality associated with prolonged immobilization. The purpose of this paper is to present the technique and results of combination locked lateral distal femoral plating and retrograde intramedullary (IM) nailing for osteoporotic distal femoral fractures permitting immediate weight bearing as tolerated.

Methods: This is a retrospective review, from a Level 1 trauma center. A standard lateral approach for distal femoral locked plating is performed, the fracture is reduced, and a lateral locking plate is provisionally secured to the femur using a Verbrugge clamp and Kirschner wires to maintain the reduction. A standard medial infrapatellar approach for retrograde femoral nailing is then performed. Once the IM rod is inserted, it is statically locked with 2 proximal and 3 distal interlocking screws. Having verified satisfactory position of the nail and maintenance of reduction, a combination of bicortical and unicortical locking screws are placed through the lateral locking plate. Postoperatively, patients are mobilized with physical therapy without a brace and full weight bearing as tolerated permitted. Charts and radiographs were reviewed assessing for implant failure, loss of reduction, time to union, complications, and the need for reoperation.

Results: From 2004 to 2010, the described combination of plate and nail fixation was performed on 12 patients. All patients were elderly females (average age, 77.8 years). Five patients had acute supracondylar femur fractures with no prosthesis, 4 patients had acute periprosthetic fractures, and 3 of the patients presented with a nonunion following prior plate fixation (OTA 33-A2, 33-A3). The average operative time was 220 minutes (range, 135-240 minutes), and the average intraoperative blood loss was 667 cc (range, 300-1100 cc). The average time to union was 9 weeks (range, 8-12 weeks). No patients required reoperation. There was no loss of reduction or alignment, and no implant failures were noted.

Conclusion: When treating elderly patients with metaphyseal distal femoral fractures, we have found the use of combined locked plating and retrograde nail fixation to be an excellent alternative. We believe this construct combines the distal segment fixation of a plate and the load-sharing capacity of a nail, while minimizing the inherent weaknesses of either construct alone. In our experience, this combined fixation technique provides stability for early mobilization and full weight bearing in a difficult patient population.

Hip Fractures: Be Careful This Weekend

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Purpose: Hip fractures are common serious injuries sustained by the elderly community. Literature on care and timing of hip fracture patients demonstrates improved outcomes when surgery occurs within 48 hours of admission. However, nearly all literature assumes uniform treatment of hip fracture patients once admitted. Shiftwork has replaced traditional call schedules at many institutions. Workload and surgery schedules may dictate delay in patient care based on timing of presentation. To assess uniform care, all hip fracture patients admitted to a single institution were reviewed for discrepancy in care based on day of the week. Our hypothesis was hip fracture care does not depend on day of admission or day of surgery.

Methods: 723 patients undergoing surgery for type 31-A and 31-B hip fractures were reviewed from a prospective database. Patients were reviewed for age, gender, procedure, day of admission, day of surgery, delay of surgery from admission, complications, mortality, and preoperative comorbidities. Polytrauma patients were excluded. χ^2 analysis was utilized for categorical correlations. Analysis of variance was incorporated for continuous variable relationships with post hoc testing.

Results: All patients underwent surgery. Mean delay to surgery was 1.9 days. Total complications correlated to delay of surgery (P = 0.02) and when stratified for surgery greater than 48 hours after admission (P = 0.03). Delay was not related to in-hospital mortality. There was a trend toward patients hospitalized during the weekend after Friday surgery enduring the most complications postoperatively (P = 0.06). Patients who underwent surgery on Monday or Tuesday had the longest delay to surgery, averaging 2.2 and 2.7 days respectively (P < 0.005). There was no difference in the number of complications and delay to surgery based on day of admission.

Conclusions: Our findings are consistent with past literature on the relationship between delay to surgery and rate of complications. However, when stratifying by day of week, we find that patients wait over 48 hours for surgery during the weekend to have surgery on Monday or Tuesday. In addition, patients followed clinically on the weekend after Friday surgery sustain more complications. We reject our null hypothesis based on the increase in delay to surgery and trend toward more complications when patients are hospitalized during the weekend. This highlights potential inconsistencies and deficiencies in care when patients are treated during weekends.

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Time Between First and Second Hip Fractures in Elderly Patients: Defining the Prevention Target

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Purpose: The prevention of a subsequent, contralateral hip fracture is targeted as an avoidable event in the elderly. Fall prevention and bone strengthening measures have met with limited success and the urgency of their effect is undetermined. Our objective was to evaluate the time to second hip fracture (the time between a first and a subsequent, contralateral fracture) in elderly patients, using a population-based administrative health dataset.

Methods: The 58,286 records of persons older than 60 years and hospitalized for a hip fracture between 1985 and 2005 were obtained from a Provincial administrative health database. We excluded nontraumatic cases and identified the care episodes related to a subsequent hip fracture for each patient using unique identifiers. We used a 5-year "wash-out period" to avoid counting a second fracture as a first one. We calculated the proportion of first and second fractures and sex distribution over time (fiscal years) and quantified the time between first and second fracture, while correlating it to age, sex, and fracture type.

Results: Overall, 3866 patients sustained a second hip fracture between 1990 and 2005; 3119 (81%) were women, in contrast to 73% for primary fractures ($\chi^2 = 137.8$, df = 1, *P* <0.001). In 33% of cases, the type of a subsequent fracture (transcervical vs pertrochanteric) was different from the first. The median time from first fracture was 3 years; 90% occurred by 9 years. The age at the first fracture most influenced the time to second fracture. The median time (90th percentile in parentheses) between fractures decreased as patients got older and was 5 (13), 4 (10), 3 (7), and 2 (5) years for patients who were correspondingly 60-69, 70-79, 80-89, and 90+ years old at first fracture.

Conclusion: Among survivors of an initial hip fracture, the occurrence of a second hip fracture appears to affect a greater proportion of women than primary fractures. Our results identify the time frame that preventative interventions should target when aiming at reducing second hip fractures, that target being increasingly small (from 5 to 2 years) as patients age. This information identifies a time frame researchers must target as they seek new fracture prevention methods. In the shorter term, however, these data could influence health administrators and policymakers as they decide to support one hip fracture prevention method over another.

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Purpose: Open reduction and internal fixation is utilized to treat the majority of distal femoral fractures. Anatomic reconstruction of the articular surface and restoration of length, alignment, rotation in comparison to the diaphysis is desired. The intercondylar line, or Blumensaat's line, can be referenced as an intraoperative determinant of sagittal alignment, but, postoperatively, the "modern" plate design obscures the line. Therefore, the purpose of this study was to elucidate if other anatomic and radiographic landmarks can be utilized to reproducibly determine sagittal plane alignment.

Methods: 100 consecutive adult normal distal femur/ knee plain lateral radiographs were analyzed in 2010 within a single large private orthopaedic practice affiliated with a Level 1 trauma center. All images were obtained with digital radiographs. All measurements were performed utilizing a picture archiving and communication system (PACS, Kodak Carestream). According to the 3-dimensional models using 2 circular arcs, an ellipse was superimposed on the condyles. To determine the posterior slope of the condyles, the angle between the longest diameter and the anterior femur cortex was measured. In addition, 2 posterior and 3 anterior anatomic landmarks were defined on the outline of the distal femur (Figure 1). Six lines were drawn between these landmarks. Six angles were created and measured between the above-mentioned lines and the anterior femoral cortex. To correlate radiographic landmarks to anatomy, anatomic landmarks were defined and angle measurements performed on 35 previously scanned and digitalized cadaveric distal femurs (Figure 2).

Results: Of the 100 consecutive clinical distal femurs, 94 adults (39 [41.5%] males; 55 [58.5%] females) with a mean age of 54 years (range, 18-92 years) and body mass index (BMI) of 29.9 (range, 16.9-47.2) were included.22(23.4%) had radiographic arthrosis. Of the 35 scanned and digitized distal femurs, the demographics (24 [68%] males, 11 [31.4%] females) and mean age of 53 years (range, 25-85 years) were recorded.

An angle of $101.0^{\circ} \pm 5.7^{\circ}$ from the clinical radiographs was compared to $98.8^{\circ} \pm 3.0^{\circ}$ from the digitalized femurs (no significant difference [P = 0.069]). Interobserver reliability was Cronbach's $\alpha = 0.792$. No significant differences in any measurement for age or BMI were recorded. If arthrosis was diagnosed, AD angle measurement was significantly greater (P







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= 0.001). Females had significantly smaller AC and AE angles (P < 0.001). Comparing the clinical radiographs to the digitized cadaveric femurs, the AC and AE angles were similar (P = 0.441 and 0.642, respectively).

Conclusion: Correct sagittal alignment of the femoral condyles is a relevant factor for a functional knee mechanism. Two different and reliable methods of measuring sagittal plane anatomy and measurements were confirmed utilizing plain radiographic images.

Are Routine Postoperative Radiographs Necessary Following Hip Hemiarthroplasty? *Paul Appleton, MD*; Aron Chacko, BS; Greta Thomsen, BA; Edward K. Rodriguez, MD, PhD; Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA

Purpose: Postoperative radiographs after hip hemiarthroplasty are often obtained at follow-up clinic visits. Routine postoperative hip radiographs can be both time-consuming and expensive. We hypothesized that the management plan of patients following hip hemiarthroplasty would not change based on routine radiographic findings.

Methods: A retrospective review of data gathered prospectively from our trauma database was conducted. Information collected included number of postoperative clinic visits, total number of radiographs, postoperative complications, and any changes in patient management based on radiographic findings. Radiograph interpretation was compared between the orthopaedic surgeon's interpretation at the time of the clinic visit and the final radiology report. Comparisons were made to all prior films.

Results: 257 patients were identified from our database who had undergone hip hemiarthroplasty for displaced femoral neck fractures between April 2005 and December 2010. The average age was 82 years and average follow-up was 53 weeks. Cement was used in 76 patients (30%), while an uncemented technique was used in 181 (70%). The average number of postoperative clinic visits was 2.4 with an average total number of postoperative radiographs of 2.9. 11 patients developed infections, 6 requiring removal of the prosthesis and 5 having a primary washout with retention of the components. There was one periprosthetic fracture and one dislocation. No routine postoperative clinic radiographs showed concerning abnormalities associated with the prosthesis including subsidence or acetabular protrusion. All patients with significant complications presented to the emergency department for evaluation and no radiographs obtained during routine clinic visits changed the management plan.

Conclusions: The routine need for postoperative hip radiographs following hemiarthroplasty is probably unnecessary. In our study, no patients had findings on radiographs that were concerning or initiated clinical intervention. Given the high incidence of hip fracture and hemiarthroplasty nationwide, there are significant costs associated with routine postoperative radiographs. Although our numbers are small, one may want to reconsider routinely ordering postoperative radiographs in patients who appear to be progressing as clinically expected following hip hemiarthroplasty.

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Complications and Injuries Associated with Traumatic Hip Dislocations: What Predicts Outcome?

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Purpose: The purpose of our study was to evaluate the associated injuries, complications, and early follow-up of patients with traumatic hip dislocations.

Methods: After obtaining IRB approval, we utilized our trauma registry to identify all patients with traumatic hip dislocations treated at our Level 1 trauma center from 2003 to 2008. We performed a retrospective review of these patients to identify the type of dislocation, associated injuries, method of treatment, complications, and outcomes.

Results: From 2003 to 2008, we identified 122 patients with 123 hip dislocations that were treated at our institution and followed for an average of 9 months. The average age of these patients was 33 years (range, 13-82 years). 95 patients (78%) sustained the injury as a result of a motor vehicle accident. There were 111 posterior dislocations (90%) and 12 obturator dislocations (9.76%). Retroversion of the acetabulum (crossover sign) was present in only 14% of patients with posterior hip dislocations. 113 dislocations (92%) were able to be successfully reduced in the emergency department. The remaining 10 required general anesthesia and underwent closed reduction in the operating room. The average time from injury to reduction of the dislocated hip was 309 minutes (range, 90-912 minutes). 83 patients (67%) had ipsilateral acetabular fractures and 22 patients (18%) had femoral head fractures. All of these were posterior dislocations; patients with obturator dislocations had no associated injury to the acetabulum or femoral head. The overall rate of complications (including avascular necrosis [AVN], heterotopic ossification, nerve palsy, and conversion to total hip arthroplasty [THA]) in patients with a hip dislocation was 28%. The average time from injury to reduction was longer in patients with AVN (439 minutes vs 300 minutes). Eight patients (6.5%) required a THA at short-term follow-up. Four of these eight patients sustained an associated ipsilateral acetabular fracture with a transverse component.

Conclusion: We have characterized the injury patterns, associated injuries, complications, and outcomes of a large series of traumatic hip dislocations seen at a Level 1 trauma center. We confirmed the previous finding that a greater time from injury to reduction was associated with the development of AVN. The overall high rate of complications (28%) illustrates the importance of early identification, urgent reduction, and need for long-term follow-up. This study will provide guidance for treatment options and counseling patients when managing traumatic hip dislocations.

Skeletal Versus Cutaneous Femoral Traction for Diaphyseal Femur Fractures: Prospective Randomized Controlled Trial

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Purpose: Indications for preoperative skeletal traction for diaphyseal femur fractures in adults are not well defined and there are no clinical studies showing that skeletal traction provides better outcomes in time of reduction in the operating theater or better pain control than cutaneous traction.

Methods: After IRB informed consent was obtained, we randomized the application of skeletal and cutaneous traction. If the patient enrolled in the study, he or she completed a visual analog scale (VAS) in reference to pain upon admission and pain after traction application. We also evaluated multiple data points with concern to the on-call resident's time of application of the traction modality assigned, operative time of reduction, and other demographic data points from the patient's chart.

Results: 37 patients received cutaneous femoral traction while 29 patients received skeletal traction. There was a significant reduction in time of application for the cutaneous traction $(24.30 \pm 24.74 \text{ minutes})$ compared to skeletal traction $(57.10 \pm 33.60 \text{ minutes})$ ($P \le 0.001$). There was not a statistically significant difference in VAS scores when compared to pretraction application pain assessment and posttraction pain assessment between the cutaneous and skeletal traction groups with a decrease in the VAS of $(0.56 \pm 3.73 \text{ and } 0.54 \pm 2.76)$, respectively (P = 0.99). There was not a significant difference in reduction time of the fracture (skin incision to guidewire passage) in the operating room between cutaneous traction (27.81 \pm 11.43 minutes) versus skeletal traction (29.41 \pm 12.32 minutes) (P = 0.59).

Conclusion: Use of cutaneous traction for diaphyseal femur fractures when compared to skeletal traction results in a statistically significant reduction in time of application to the on-call resident with no complications or detrimental change in operative time and no difference in VAS pain scores.

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Factors Leading to Nonunion After Locked Plating of Distal Femoral Fractures

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Purpose: Locked plating of distal femoral fractures has become a widely used technique. Our clinical experience suggests that the current rate of nonunion may be higher than initially reported. The purpose of this study was to determine patient and injury factors that increase the risk of nonunion when locked plating is used in the fixation of distal femoral metaphyseal fractures. Our goal was to define a set of characteristics that will allow the treating surgeon to identify high-risk cases preoperatively and therefore maximize measures to promote healing.

Methods: A retrospective review was conducted of all distal femoral fractures treated with locked lateral plating by the orthopaedic trauma department at our Level 1 trauma center over a 5-year period (August 2004–August 2009). The minimum age for inclusion in the study was 18 years and the minimum follow-up was 3 months. Nonunion was defined as a failure of appropriate radiographic healing and ability to bear full weight by 6 months or secondary procedure performed for treatment of nonunion. Supracondylar fractures were defined as those occurring within 15 cm of the joint and only AO/OTA type 33A and 33C fractures were included; no unicondylar fractures were studied. A total of 101 acute supracondylar femur fractures were identified in 99 patients, and 68 fractures met criteria for inclusion in the study. Each patient chart was analyzed with respect to age, medical comorbidities, history of osteoporosis or prior fragility fracture, tobacco use, and mechanism of injury. Injury radiographs were evaluated for intra-articular extension, adjacent prosthesis, and fracture comminution. Student *t* tests and 2 × 2 tables were used to compare characteristics between the healed fracture group and the nonunion group. Statistical significance was defined as *P* <0.05.

Results: 14 of the 68 fractures analyzed went on to nonunion (21%). Of all the patients studied, 20.4% (20 of 98) died within the first 12 months following their initial procedure. For patients over 65 years of age, the 1-year mortality rate was 28.1% (18 of 64). Age, gender, history of tobacco use, prior fragility fracture, depression, high-energy mechanism, polytrauma, adjacent implant, intra-articular extension, and use of minimally invasive technique all showed no significant difference between groups. Injury characteristics with a statistically significant increase in the nonunion group were open fracture (43% vs 13%, P = 0.01) and fracture comminution (79% vs 39%, P = 0.04). Patient characteristics more prevalent in the nonunion group were diabetes (50% vs 20%, P = 0.06) and obesity (43% vs 11%, P = 0.02). Obesity, diabetes, open fracture, and fracture comminution may have a cumulative effect on nonunion risk. Patients with 0 or 1 of these 4 characteristics went on to healing 91% of the time (40 of 44), whereas patients with 2 characteristics had a 76% percent healing rate (13 of 17) and those with 3 or more only healed 14% of the time (1 of 7).

Conclusions: Previously published rates of distal femoral nonunion following locked plating likely underrepresent the true incidence, which may be as high as 21%. Obesity, open fracture, and fracture comminution may all predispose to nonunion in distal femoral fractures treated with locked plating.

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Accuracy and Precision of the Piriformis and Trochanteric Entry Poin for Intramedullary Nailing in Femoral Shaft Fractures Using Image-Guided Navigation and Conventional Fluoroscopy

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Purpose: Femoral shaft fractures are routinely treated using antegrade intramedullary nailing under fluoroscopic guidance. Malreduction is common and can be due to multiple factors. Correct entry point identification can help minimize malreduction and the risk of iatrogenic fracture. This study aims to compare identification of the piriformis fossa (PF) and the trochanteric tip (T) entry points, via computer navigation and conventional fluoroscopy.

Methods: The location of the PF and T were digitized under direct visualization with a 3-dimensional scribe on 10 fresh-frozen cadaveric right femora (2 male, 8 female) by 3 fellowship-trained orthopaedic surgeons. To estimate inter- and intraobserver reliability of the direct measurements, an intraclass correlation coefficient was calculated with a minimum of 2 weeks between measurements. Each specimen was draped and AP and lateral radiographs of the proximal femur were taken with a c-arm and image intensifier. The c-arm was positioned in a neutral position (0° for AP, 90° for lateral) and rotated in 5° increments, yielding a range of acceptable images. Images, in increments of 5° within the AP range (with a neutral lateral) were loaded into a navigation system. A single surgeon digitized the T and PF directly based on conventional fluoroscopy and again directed by navigation, yielding 2 measurements per entry point per specimen. This was repeated for the lateral range. Hierarchical linear modeling and a Wilcoxon rank test were used to determine differences in accuracy and precision, respectively, in the identification of PF and T using computer navigation versus conventional fluoroscopy.

Results: The average range of suitable images for both the AP and lateral images was 29° (range, 25°-30°). The location of the PF and T was found to be reliable for a single observer (0.98 and 0.99) and between observers (0.96 and 0.93). Similar accuracy was found in identifying PF under navigation and fluoroscopy (0.05 to 1.4 cm and 0.1 to 1.5 cm, respectively; P = 0.26), whereas improved accuracy was found for T using fluoroscopy (0.07 to 2.5 cm) as compared to navigation (0.2 to 2.2 cm, P < 0.001). For both the PF and T, the navigation-based points had greater precision than those selected by fluoroscopy alone (P = 0.001 and P = 0.024).

Conclusions: The ideal entry point, under direct visualization, was highly repeatable, indicating that the surgeons could identify their targeted point of entry for both the PF and T. However, throughout the range of acceptable images, the location of the PF and T can vary up to 1.5 and 2.5 cm, respectively. Navigation was less accurate than fluoroscopy in the T selection, yet had greater precision for both points. Thus, while navigation may decrease accuracy in selection of the T, it is more repeatable overall and equally accurate in selecting the PF.

Risk to the Superior Gluteal Nerve With a Proximal Percutaneous "On-Axis" Insertion Portal for Antegrade Piriformis Femoral Nailing

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Purpose: We hypothesized that a percutaneous insertion path for antegrade piriformis nailng will consistently injure the superior gluteal nerve (SGN). A proximal insertion portal (near the iliac crest and in line with the femoral shaft) more closely approximates the anatomic axis of the femoral shaft and simplifies localization of the piriformis fossa (PF). The purpose of this study was to evaluate the risk to the SGN during instrumentation of the PF using this proximal incision. Prior studies have shown that the SGN is "at risk" when the "standard" incision is made near the tip of the greater trochanter. From these findings, we propose that a more proximal incision would place the nerve at similar risk.

Methods: 12 reamed PF start femoral nails were inserted into 6 matched pairs of fresh-frozen femurs. Each femur was randomized to reaming either with a protective sleeve (group 1) or without a protective sleeve (group 2). Reaming was performed in the supine position with the leg in 15° of adduction and 10° of flexion. The skin incision was made at the level of the anterior superior iliac spine, in line with the femoral shaft, and reaming was performed with specialized long percutaneous instrumentation. Damage to the SGN was evaluated by layered dissection of the buttock musculature. Any injury to branches of the SGN was noted. The distance between the reamer/nail path and branches of the superior gluteal nerve was measured. Data collected for the 2 groups were reported as mean distances from the nail path to the individual nerve branches. Statistical differences between groups 1 and 2 were measured with a Student *t* test (with *P* <0.05 as statistical significance).

Results: A spray nerve pattern was identified in all 12 hips. The average distance between the superior branch of the SGN and the instrument path averaged 17.75 ± 8.58 mm (group 1 measured 17.83 ± 10.53 mm and group 2 measured 17.67 ± 7.15 mm, P = 0.975). The average distance between the inferior branch of the SGN and the reamer/nail path was 22.39 ± 10.52 mm (group 1 measured 21.95 ± 6.68 mm and group 2 measured 22.83 ± 14.08 mm, P = 0.892). There was no injury to the SGN regardless of the presence of a protective sleeve during reaming. The main trunk of the SGN was observed to be posterior and medial to the path of instrumentation for all the specimens. The gluteus medius muscle fibers were observed between instruments and nerve branches in all specimens.

Conclusions: Instrumentation of the PF through a more proximal incision simplifies access to the start site. No published anatomic studies of this technique currently exist. This anatomic study demonstrates that the SGN is not at risk for injury during this technique, with or without the protective sleeve.

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Predictors for Mechanical Failure of Proximal Femoral Locking Plates

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Purpose: Locking plate fixation has been advocated for the management of complex fractures of the proximal femur. The purpose of this study was to analyze modes of mechanical failure in a consecutive cohort of patients and to establish possible patient and implant-related risk factors.

Methods: After IRB study approval, 42 consecutive patients with 43 unstable proximal femur fractures (OTA 31A3) treated at a Level 1 trauma center between 2003 and 2007 using a 4.5-mm LCP proximal femur plate were identified. Patient and proximal fixation characteristics were extracted from operative records, charts, and radiographs. Patient (age, diabetes, smoking, morbid obesity) and fixation variables (number of proximal screws, screw type, "kickstand screw," and reconstruction of the posteromedial cortical buttress) were evaluated as possible predictors for mechanical failure using univariate analysis (P < 0.05). Mechanical failure was defined as loss alignment of at least 10° and/or requiring revision surgery.

Results: At 20 months of follow-up, 12 failures (39%) occurred. Mean time to failure was 18 weeks (range, 2-84 weeks). Cumulative failure rates were 10%, 19%, 29%, and 36% at 1, 2, 6, and 12 months, respectively. The most frequent failure mode was varus collapse with screw cut-out (5 cases). Patients with failures were older (64 vs 53 years), heavier (body mass index [BMI] 32 vs 26), more frequently diabetic (22% vs 14%), and smokers (44% vs 38%) than those without failure. A "kickstand screw" was present in 6 (66%) of the failed cases and 12 cases (55%) without failure. Medial cortical reduction had been achieved in 2 (22%) of cases with and 3 (14%) cases without failure (all P> 0.05). Proximal screw number and type were similar in both groups.

Conclusions: A high rate of mechanical failure can be expected with proximal locking plate fixation of unstable proximal femur fractures. Increased age, BMI, diabetes, and smoking may lead to a higher risk of failure. The use of a "kickstand" screw does not appear to reduce the risk for mechanical failure.

Effect of Varus and Valgus Alignment on Implant Loading After Proximal Femur Fracture Fixation

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Purpose: Fixation of proximal femur fractures in varus has been shown to correlate with an increased rate of implant failure. This study examined the influence of varus and valgus alignment on implant loading.

Methods: A completely unstable fracture (gap) model was made in 12 cadaveric proximal femurs. Six fractures were fixed with a compression hip screw and side plate (CHSP) and 6 with an intramedullary hip screw (IMHS). Both implants were instrumented with strain gauges to allow assessment of implant load bearing (ILB). The specimens were subjected to nondestructive loading up to 1050 N. ILB was measured and expressed as percent of the measured load at neutral alignment.

Results: ILB was $103 \pm 5\%$ (IMHS $103 \pm 5\%$, CHSP $114 \pm 15\%$) of neutral load in 5° of varus (P = 0.057), $130 \pm 26\%$ (IMHS $111 \pm 2\%$, CHSP $142 \pm 28\%$) in 10° of varus (P = 0.009), and $144 \pm 41\%$ (IMHS $110 \pm 7\%$, CHSP $164 \pm 40\%$) in 15° of varus (P = 0.048). When loading the implants in valgus, ILB was $83 \pm 9\%$ (IMHS $81 \pm 3\%$, CHSP $85 \pm 12\%$) of neutral load in 5° of valgus (P = 0.003), $69 \pm 15\%$ (IMHS $74 \pm 9\%$, CHSP $64 \pm 19\%$) in 10° of valgus and $51 \pm 17\%$ (IMHS $61 \pm 10\%$, CHSP 43 ± 19) in 15° of valgus (P = 0.0002).

Conclusions: Proximal femur fractures reduced in varus lead to significantly increased load on the fixation implant. Reducing the fracture in valgus reduces the load on the implant. CHSP constructs seem to be more affected by varus/valgus malalignment than intramed-ullary hip screws.



Figure 1. A completely unstable fracture (gap) model was subjected to nondestructive loading.

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Figure 2. Implant load bearing as a percentage of the load bearing in neutral alignment.

The Effect of Fracture Pattern and Implant Type on Stability of OTA Type 31-A2 Proximal Femur Fractures

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Purpose: Internal fixation of OTA type 31-A2 proximal femoral fractures can be done with either a compression hip screw and side plate (CHSP) or an intramedullary hip screw (IMHS). There is an ongoing discussion as to which is the best implant for these types of fracture. The purpose of this study was define the degree of stability of different 31-A2 fracture patterns in relation to the different fixation constructs.

Methods: Simple intertrochanteric fractures were made in 12 cadaver proximal femurs. Six fractures were fixed with a CHSP and 6 with an IMHS. Both implants were instrumented with strain gauges at the lag screw–nail/plate interface to allow assessment of implant load bearing (ILB). The specimens were subjected to nondestructive loading after which 3 subsequent horizontal cuts in 1-cm increments were made across the posteromedial cortex (Figure 1). Loading was repeated after each cut. ILB after the third cut was taken to represent the state of maximal instability (100% ILB).

Results: After making the initial intertrochanteric fracture, ILB was $52.2 \pm 19.4\%$ ($49.8 \pm 4.2\%$ for CHSP, $53.6 \pm 25.4\%$ for IMHS). ILB after the first 1-cm cut increased to $83.4 \pm 26.9\%$ (70.8 $\pm 18.9\%$ for CHSP, 93.4 ± 29.9 for IMHS; P = 0.0009), and after the second cut increased to $90.0 \pm 20.6\%$ ($82.6 \pm 6.3\%$ for CHSP, 96.0 ± 26.9 for IMHS; P = 0.209).

Conclusions: Type 31-A2 fractures become increasingly unstable with increased posteromedial comminution (or lesser trochanter fragment size). CHSP constructs were more load sharing (implying a higher dependency on stability of the fracture pattern to maintain reduction) than IMHS constructs. This study supports the use of IMHS devices for the more unstable fractures.

Figure 1. Sequential cuts in the proximal

fragment.

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Surgical Preferences of Patients at Risk of Hip Fractures

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Purpose: The optimal treatment of displaced femoral neck fractures in patients over 60 years of age is controversial. While much research has focused on the impact of total hip arthroplasty (THA) and hemiarthroplasty (HA) on surgical outcomes, little is known about patient preferences for either alternative. The purpose of this study was to elicit surgical preferences of patients at risk of sustaining hip fracture using a novel decision board.

Methods: We developed a decision board for the surgical management of displaced femoral neck fractures presenting risks and outcomes of HA and THA. The decision board was presented to 81 elderly patients at risk for developing femoral neck fractures identified from an osteoporosis clinic. The participants were faced with the scenario of sustaining a displaced femoral neck fracture and were asked to state their treatment option preference and rationale for operative procedure.

Results: 85% of participants were between the age of 60 and 80 years; 89% were female; 88% were Caucasian; and 49% had some postsecondary education. 93% (95% confidence interval [CI], 87%-99%) of participants chose THA as their preferred operative choice. Participants identified several factors important to their decision, including the perception of greater walking distance (63%), less residual pain (29%), less reoperative risk (28%), and lower mortality risk (20%) with THA. Participants who preferred HA (7%; 95% CI, 1%-13%) did so for perceived less invasiveness (50%), lower dislocation risk (33%), lower infection risk (33%), and shorter operative time (17%).

Conclusion: The overwhelming majority of patients preferred THA to HA for the treatment of a displaced femoral neck fracture when confronted with risks and outcomes of both procedures on a decision board.

Systematic Review of the Treatment of Periprosthetic Distal Femur Fractures

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Purpose: This study was conducted to systematically review and compare nonoperative and operative treatments for the management of periprosthetic distal femur fractures adjacent to total knee arthroplasties. Specific operative interventions compared included locked plating, retrograde intramedullary nailing (RIMN), and conventional (nonlocked) fixation.

Methods: A comprehensive database search (via PubMed, MEDLINE, Cochrane Database, OTA, and AAOS databases) was completed, yielding 44 eligible studies with a total of 719 fractures for analysis. Pertinent outcomes including nonunion, malunion and the need for secondary surgical procedures were compared statistically.

Results: Both locked plating and RIMN showed significant advantages over nonoperative treatment. Locked plating also had a significantly lower malunion rate when compared with RIMN and conventional fixation. A subset analysis comparing surgical treatments is shown in the table below.

| | Nonunion | Malunion | SSP |
|-----------------------------------|------------------|------------------|------------------|
| Conventional vs locked plating | 9.2% vs 8.8% | 19.2% vs 7.6% | 16.7% vs 13.3% |
| OR (95% CI) | 1.05 (0.55-2.02) | 2.87 (1.53-5.38) | 1.30 (0.78-2.18) |
| P value | 0.87 | 0.001* | 0.32 |
| Conventional vs RIMN | 9.2% vs 3.6% | 19.2% vs 16.4% | 16.7% vs 9.1% |
| OR (95% CI) | 2.68 (0.87-8.25) | 1.21 (0.64-2.29) | 2.00 (0.93-4.29) |
| <i>P</i> value | 0.08 | 0.55 | 0.07 |
| RIMN vs locked plating | 3.6% vs 8.7% | 16.4% vs 7.6% | 9.1% vs 13.3% |
| OR (95% CI) | 0.39 (0.13-1.15) | 2.37 (1.17-4.81) | 0.65 (0.31-1.35) |
| p value | 0.09 | 0.02* | 0.25 |

Conventional, nonlocked fixation; RIMN, retrograde intramedullary nailing; OR, odds ratio; CI, confidence interval; SSP, secondary surgical procedure.

*Denotes significant P value

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Conclusion: Locked plating and RIMN offer significant advantages over nonoperative treatment and conventional (nonlocked) fixation techniques in the management of periprosthetic femur fractures above total knee arthroplasties. When locked plating was compared to RIMN, there were no statistically significant differences in the rates of nonunion and revision surgery. However, this review demonstrated that the rate of malunion was significantly higher with RIMN compared to locked plating (odds ratio, 2.37; 95% confidence interval, 1.17-4.81; P = 0.02). These results suggest that locked plating may offer superior outcomes in the management of periprosthetic fractures of the femur following total knee arthroplasty.

Δ The Impact of Nerve Blocks on Opioid Use, Hospital Length of Stay, and Pain in Patients With Traumatic Lower Extremity Injury

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Purpose: The primary purpose of this study was to determine whether having a nerve block predicted total dose of postoperative opioid analgesic medication and length of hospital stay in patients with traumatic lower extremity injury. Secondary outcomes of pain intensity and interference at hospital discharge were also examined. The hypothesis was that having a nerve block would result in a decrease in total opioid analgesics and a shorter hospital length of stay (LOS).

Methods: This study prospectively enrolled 176 patients representing 203 surgical encounters, 19 to 78 years of age, admitted to a Level 1 trauma center for surgical treatment of a traumatic lower extremity injury. Patients with intracranial hemorrhage, spinal cord deficit, a Glasgow Coma Scale score less than 14, having surgery for an extremity amputation, and an LOS <24 hours were excluded. Surgery was performed on acute trauma (52%), reconstruction (33%), and infection (15%) from a prior traumatic injury. Participants were enrolled in the orthopaedic unit after surgery and answered questions on demographics and preinjury health status. Times, doses, types, and routes of postoperative analgesics administered until discharge, LOS, and injury characteristics were abstracted from the medical record. All opioid analgesics were converted to oral morphine equivalents per 24 hours and a total postoperative dose was calculated. A discharge assessment measured pain intensity and interference with activity (Brief Pain Inventory). Bivariate analyses assessed differences in patient variables by nerve block. Multivariable regression and propensity scoring methods were used to adjust for lack of randomization and assess the association between nerve block and total dose of opioid analgesic medication, LOS, and pain outcomes.

Results: 97 patients (48%) received nerve blocks. The total opioid dose in oral morphine sulfate equivalents for participants ranged from 0 to 9999 mg, with a mean dose of 1095.4 mg (standard deviation (SD), 1545 mg). The mean daily opioid dose was 232.5 mg (SD, 325.9 mg) and LOS was 5.43 days (SD, 5.35). Patients receiving a nerve block were more likely to have private or public insurance compared to no insurance (53% vs 32%, P = 0.03) and surgery for reconstruction (72%) compared to acute trauma (38%) or infection (30%) (P < 0.001). No significant differences were noted for total dose of opioid analgesics (1080 mg vs 1113 mg), pain intensity (5.1 vs 5.3), and pain interference with activity (6.7 vs 6.4) in patients with block compared to no block, respectively (all P values >0.05). However, a shorter hospital stay (4.3 days) was found for patients receiving a nerve block compared to those not receiving a block (5.7 days) (P = 0.01). After controlling for age, injury severity, insurance status, surgery type, and comorbidities, the effect of nerve block on LOS was marginally statistically significant (P < 0.10). Nerve block did not have a statistically significant effect on LOS following propensity score adjustment.

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Conclusions: Use of nerve blocks did not appear to reduce opioid utilization, LOS, and pain in patients with traumatic lower extremity injury. Additional prospective research is needed to examine patient outcomes across types of nerve block (single injection vs continuous) and to assess the impact of nerve blocks following upper extremity traumatic injury.

Funding: Research supported by an OTA grant.

Catastrophic Failure Following Open Reduction and Internal Fixation of Femoral Neck Fractures With a Novel Locking Plate Implant

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Purpose: Prior research from our institution has demonstrated the benefits of length-stable fixation for treatment of femoral neck fractures. Motivated by these results, we sought to improve upon this technique by implementing a user-friendly, fixed-angle implant designed specifically for femoral neck fractures in order to provide a more rigid construct to prevent any loss of reduction. It was our hypothesis that this device would offer more reliable fixation of femoral neck fractures and result in better preservation of intraoperative reduction and improved clinical outcomes compared to historical controls fixed with length-stable constructs.

Methods: 21 consecutive patients were treated with a posterolateral femoral locking plate. This consisted of a side plate accommodating multiple 7.3 and 5.0 locking screws directed into the femoral head at converging / diverging angles and a single shaft screw. Intraoperative compression was achieved with partially threaded screws prior to locking screw insertion. One-year follow-up was required. Maintenance of reduction was assessed by comparing immediate postoperative and final follow-up radiographs, according to the method described by Boraiah et al. Harris hip scores were obtained at 1-year follow-up. Complications and secondary operations were noted.

Results: 18 of 21 femoral neck fractures with mean follow-up of 16 months were analyzed. The average age was 71.7 years, with 56% female. 17 of 18 had anatomic reductions. 11 of 18 (61.1%) achieved bony union; in these patients, the average displacement of the center of the head was 0.78 mm inferiorly and 1.62 mm medially with an average increase of 2.41° of varus. These results do not differ from historical controls treated with length-stable constructs (0.86 mm, 1.23 mm, and 0.6° difference, respectively). In these patients, complications include 1 instance of hardware fracture, 2 total hip replacements, 1 open reduction and internal fixation (ORIF) for a subtrochanteric femur fracture at the level of the distal screw, and 1 instance of heterotopic ossification resulting in hip ankylosis. The average follow-up Harris hip score was 67.9, which was significantly worse compared to our historic failure. Modes of failure consisted of broken screws with varus displacement, intra-articular penetration of the fixed angle screws after collapse of the head fragment, or dissociation of the distal screw from the shaft. Five of these patients required total hip replacement, while the remaining 2 died.

Conclusions: ORIF of femoral neck fractures using a locking plate construct was associated with unacceptably poor outcomes compared to our historical controls treated with length-stable fixation. We submit that femoral neck union requires some amount of micromotion along the axis of the neck to counteract the presence of any fracture site resorption or distraction. The stiffness of this construct prevented any such autodynamization, placing the mechanical burden entirely on the implant, which ultimately resulted in failure at the bone-screw interface or fatigue failure of the implant itself.

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Radiographic Incidence of Cam-Type Impingement in Femoral Neck Fractures Treated With Reduction and Internal Fixation

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Purpose: Cam-type femoroacetabular impingement is recognized as a cause of degenerative hip arthritis and is caused by structural abnormalities of the hip including malunion of femoral neck fractures after internal fixation. The purpose of this study is to identify the incidence of femoroacetabular impingement in this population.

Methods: 70 OTA 31B hip fractures treated with internal fixation were identified from our institutional trauma database. Injury and radiographs at final follow-up were reviewed. Femoroacetabular impingement was evaluated by measuring the alpha angle and femoral head retroversion on lateral radiographs and femoral head sphericity was measured on AP and lateral radiographs with a Mose template.

Results: Alpha angle was elevated in 32 hips (46%), asphericity was present in 46 femoral heads (65%), and femoral head retroversion was present in 26 hips (37%). Displaced subcapital fractures (OTA 31B3) had the highest rate of elevated alpha angle (63%), head retroversion 47%, and head asphericity 68%.

Conclusion: Rates of radiographic impingement are higher than expected based on population-based controls. Surgeons must be vigilant about reduction and fixation of femoral neck fractures, especially OTA 31B3 type. Malunion should be recognized as early intervention may be beneficial in improving outcomes.
Δ Larger Diameter Interlocking Screws Improve the Fatigue Life of Femoral Nail Fixation

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Purpose: Intramedullary fixation, which is the standard for treatment of femoral shaft fractures, usually fails through the breakage of the interlocking screws. The purpose of this study was to investigate the effect of the interlocking screw size on the biomechanical strength of intramedullary fixation of femoral shaft fractures.

Methods: 12-mm–diameter femoral nails were biomechanically tested with either 5-mm or 6-mm interlocking screws. The 6-mm screws were manufactured specifically for this study using the same processes as the standard 5-mm screws. Proximal and distal interlocking screws were passed through polyvinylchloride (PVC) tubes that acted as bone surrogates. Four separate biomechanical tests were performed: (1) on-axis compression fatigue (stepwise cyclic loading scheme from 100-660 N of axial compression and increasing the upper limit by 110 N every 25,000 cycles); (2) multiaxial fatigue simulating gait loading (stepwise loading scheme of 100-660 N of compression and 0-13 Nm of axial torsion; loads increased by 110 N and 1 Nm every 25,000 cycles); (3) on-axis stiffness and load to failure (10 mm/min); and (4) torsional stiffness and torque-to-failure (10°/min). Six specimens of each distal screw size were tested in each loading mode, resulting in a total of 48 specimens for this experiment.

| Outcome Metric | 5-mm Screw | 6-mm Screw | P Value |
|--|-------------------|------------------|---------|
| On-axis compression fatigue, cycles to failure | 227,000 ± 37,705 | 388,000 ± 99,242 | 0.004 |
| Multiaxial fatigue, cycles to failure | 43300 ± 13292 | 54,900 ± 20,762 | 0.33 |
| On-axis stiffness, N/mm | 923 ± 155 | 1055 ± 273 | 0.52 |
| On-axis load-to-failure, N | 6990 ± 267 | 8650 ± 404 | 0.004 |
| Torsional stiffness, Nm/deg | 1.8 ± 0.1 | 1.9 ± 0.1 | 0.025 |
| Torque to failure, Nm | 85 ± 2.1 | 145 ± 12.5 | 0.004 |

Results: The results from biomechanical testing are shown in the table below.

The mode of failure for the 5-mm constructs was failure of the interlocking screws in every loading condition. The 6-mm constructs tended to break through the screws in the on-axis fatigue and on-axis load to failure. For the torque to failure of the 6-mm constructs, the PVC failed while in multiaxial loading the nails broke at the level of the lower proximal interlocking hole.

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Conclusions: Using 6-mm screws greatly increased the strength of the femoral nail constructs. The use of 6-mm interlocking screws may reduce the number of clinical failures of intramedullary fixation of femoral shaft fractures.

Funding: This study is funded by an OTA grant.

Retrograde Nailing of Supraisthmal Femur Fractures: How High Can You Go? *Kevin M. Kuhn, MD*; Ashley N. Haegele, BS; John A. Boudreau, MD; Lisa K. Cannada, MD; J. Tracy Watson, MD; Saint Louis University Hospital, St. Louis, Missouri, USA

Purpose: Retrograde nailing (RGN) was first described nearly 3 decades ago for the treatment of ipsilateral femoral neck and shaft fractures. Since that time, indications have expanded and the technique and instrumentation have been refined. At this institution, RGN technique has been preferentially used to treat the majority of femoral diaphyseal fractures to include fractures proximal to the isthmus, and at times in the subtrochanteric region. Sparse data exist on retrograde treatment of proximal femoral fractures and there is no well-supported recommendation on how proximal is too proximal for RGN. The purpose of this study is to retrospectively examine the results of supraisthmal femur fractures treated with RGN and compare those results to a cohort from the same period treated with anterograde nailing (AGN). Our hypothesis is that the results of those patients treated with RGN and AGN will be similar.

Methods: At a single institution, radiographs from 483 consecutive adult patients with femur fractures within 10 cm of the lesser trochanter (LT) who were treated with intramedullary nails were reviewed. Two groups, one comprised of patients treated with AGN (n = 46), and the other with RGN (n = 59) were compiled. 35 AGN patients and 34 RGN patients had sufficient follow-up to meet inclusion criteria and were included in the study. Clinical records were reviewed and groups were compared with regard to demographic information, comorbidities, associated injuries, operative details, radiographic outcomes, complications, and need for secondary procedures.

Results: Groups were comparable with regard to age, medical comorbidities, tobacco use, and associated injuries. There were no significant differences between the groups with regard to nonunion, malunion, infection, or time until union. There were 2 malunions in the AGN group and 3 in the RGN group. The AGN group had 2 nonunions while the RGN group had 1. These subgroups were analyzed for predictive variables. The presence of an open fracture, the distance of the fracture from the LT, and the number of proximal interlocking screws were not predictive of nonunion or malunion. A higher body mass index (BMI) (P = 0.011) and a higher OTA fracture classification (P = 0.019) were predictive of malunion in both groups. There was no fixation failure within the malunion groups and alignment did not change significantly from immediately postoperatively until final follow-up.

Conclusion: RGN is safe and effective for the treatment of supraisthmal femur fractures. The union rate and complication rate is similar to AGN. In our study there was no difference in the number of secondary procedures, nonunions, malunions, or time until union. Malunion was correlated with higher BMI and fracture severity rather than choice of starting point. Malunion was not due to fixation failure but quality of initial reduction. The numbers in this study were too small to identify a cut-off distance below the LT that is safe to nail in a retrograde manner; however, fractures extending to within 1 cm of the lesser trochanter were successfully treated with RGN.

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Proximal Femoral Locking Plates: Clinical Outcomes at a Level 1 Trauma Center CPT Kelly G. Kilcoyne, MD¹; CPT Jonathan F. Dickens, MD¹; Robert A. Hymes, MD²; ¹Walter Reed Army Medical Center, Washington, District of Columbia, USA; ²Inova Fairfax Hospital, Falls Church, Virginia, USA

Purpose: Complex fractures of the proximal femur, including comminuted and unstable inter- or subtrochanteric fractures, and displaced femoral neck fractures in younger patients remain a challenge to orthopaedic surgeons. While there are many options for fixation, including dynamic hip screws (DHS), dynamic condylar screws (DCS), angular blade plates, and cephalomedullary nails, complications associated with these fractures remain relatively high. As a result, there has been increased use of proximal femoral locking plates (PFLPs) as a method of fixation in these complex fractures. There are biomechanical studies that conclude that the newer generation PFLPs are biomechanically equivalent or superior to DCS plates, and angular blade plates present less of a technical challenge to implant than cephalomedullary nails. To our knowledge there are no studies that present clinical outcomes of PFLPs in the treatment of complex proximal femur fractures in the literature. Our purpose was to determine the radiographic and clinical outcomes of PFLPs in patients with complex or unstable proximal femur fractures at a Level 1 trauma center.

Methods: From 2004 to 2009 42 patients with comminuted and unstable inter- or subtrochanteric femur fractures, or displaced femoral neck fractures were treated with 1 of 3 PFLPs. Radiographs and clinic notes were retrospectively reviewed, with malunion, nonunion, hardware failure, infection, need for revision, and hardware removal secondary to pain used as determiners of outcome.

Results: Of the 34 patients with follow-up included in the study, 56% required a secondary procedure. In our analysis of complications, we found no statistically significant variable, including patient age, fracture classification, type of plate, or patient comorbidities, that was a predictor of secondary procedures. However, over one-third of the required secondary procedures were the result of a malunion or nonunion.

Conclusion: Proximal femoral locking plates are associated with a high complication rate and high rate of revision in the treatment of complex proximal femur fractures. The treating surgeon must be aware of a high potential for complication when applying these plates to complex proximal femur fractures.

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Purpose: This study was designed to evaluate morphologic differences in the femur associated with body morphomics. Our hypothesis was that the radius of curvature (ROC) of the femur is directly related to the length of the femur and height of the patient.

Methods: We retrospectively reviewed morphologic features of 1961 paired femurs from a consecutive series of PE (pulmonary embolism) protocol CT scans obtained on patients without evidence of prior surgery involving the femur. An automated algorithm normalized the axes of the femur, determined the center of the canal along the long axis, thickness of the cortical walls, the ROC, and the length of the femur. Patient records were reviewed for patient demographic information.

Results: Of the 1961 subjects in our sample, 63% were female, 64% Caucasian, 11% African-American, 2% Asian, and 23% other or unknown ethnicity. Mean age was 53.5 years (standard deviation [SD] = 16.5). Mean femur length and ROC were 43.5 cm (SD = 2.9 cm) and 1.11 m (SD = 0.24 m), respectively. Pearson's correlation coefficient demonstrated a moderately strong positive correlation (0.39) between femur length and ROC. Regression analysis showed that ethnicity, gender, age, and body mass index (BMI) do not interact with the association between femur length and ROC.

Conclusion: The ROC of the femur is positively correlated with the length of the femur and the height of the patient. Our study did not find any statistically significant correlation between ethnicity, gender, age, or BMI and the ROC of the femur. The ROC of the femur in our sample is smaller than values reported in the literature and substantially smaller than the ROC of currently available intramedullary nails.



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Reliability of the Open Fracture Classification System

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Purpose: The OTA Open Fracture Study Group has proposed a new classification system for open fractures with 5 variables (skin, muscle, arterial, contamination, and bone loss) that are evaluated and graded to classify the open fracture. This study assesses the interrater reliability of this system.

Methods: Intraoperative videos of 6 open fractures (4 tibia, 2 upper extremity) obtained during initial débridement were edited and presented in PowerPoint. Each case had a short history identifying the mechanism of injury and then demonstrated the radiographs and the intraoperative clinical findings of skin and muscle damage as well as a statement by the surgeon about vascular status. These videos were shown to orthopaedic surgery residents and attending surgeons at institutional grand rounds, a regional trauma conference, and an AO symposium in Davos, Switzerland. 66 raters viewed all 6 videos and graded each component of the scale to make up the study population. To analyze the data, intraclass correlation (ICC) for average measures was calculated for each component of the classification.

Results: Each component resulted in an ICC of 0.99, indicating very high interrater reliability of this classification. However, no component had perfect agreement across all raters. For the individual categories, skin, arterial, and bone achieved excellent agreement across all 6 cases. Muscle and contamination achieved substantial agreement but less than for the other 3 categories.

Conclusion: Across raters, this classification system demonstrated high observer reliability with excellent or substantial agreement in all categories; however, there is still individual variation that may be improved by either a rewording of some descriptors or an education process to address some of the situations that consistently created discrepancies.

The Link Between Texting and Motor Vehicle Collision Frequency in the Orthopaedic Trauma Population

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Purpose: The ubiquity of smart phones and text messaging provides a significant source of driver distraction and inattentiveness. Texting while driving would seem to be an obvious danger; however, the lack of uniform prohibition in the USA is disconcerting. Currently only 30 states, including the state in which this study is conducted, have legislation banning texting while driving. Although it seems intuitive, there is currently a shortage of studies linking texting while driving to trauma caused by a motor vehicle collision (MVC). Previous studies have demonstrated that cell phone use impairs driving performance by increasing driver inattentiveness, thereby significantly increasing the risk of collision. However, most relevant research has been conducted under controlled simulated environments, and there is little information on the connection between texting and real-world trauma. The purpose of this study is to evaluate whether texting is associated with patients who have sustained orthopaedic trauma injuries.

Methods: Patients who presented to the orthopaedic trauma clinic at the only Level 1 trauma center in the region were administered a simple questionnaire to determine background information, overall texting frequency, texting frequency while driving, type of injury, and whether or not the injury was the result of an MVC in which the patient was driving (MVC group).

Results: 239 questionnaires were collected. 60 were excluded due to incompletion. The remaining 179 questionnaires consisted of 59 patients (33%) suffering injuries as a result of an MVC in which they were driving (MVC group) and 120 patients (67%) suffering injuries not from an MVC in which they were driving (non-MVC group). While the majority (84.36%) of both subsets of patients claimed to never text and drive, we noted the MVC group exhibited greater general texting behavior as compared to the non-MVC group. Specifically, individuals who sent more than 30 texts per week ("heavy texters") were 2.37 times more likely to be involved in an MVC compared to individuals who sent less text messages (P = 0.008). Subgroup analysis demonstrated that age had an impact on the likelihood of incurring an MVC. Specifically, patients who were under the age of 25 years and were heavy texters were 7.178 times (P = 0.001) more likely to be involved in an MVC than older non-heavy texters. Additionally, young, non-heavy texters were 6.65 times (P = 0.005) more likely to be involved in an MVC. Finally, patients older than 25 years who were heavy texters were 1.84 times (P = 0.13) more likely to be involved in an MVC than older non-heavy texters.

Conclusions: Patients who sustained orthopaedic injuries as a result of an MVC sent more text messages per week than those patients who were injured in a non-automobile accident. This higher frequency of texting results in an increased likelihood of being involved in an MVC caused by driver inattentiveness due to texting.

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Is It Possible to Train Patients to Bear Limited Weight on a Lower Extremity? *Joshua W. Hustedt, BA*; Daniel J. Blizzard, BS; Michael R. Baumgaertner, MD; Michael P. Leslie, DO; Jonathan N. Grauer, MD; Yale University School of Medicine, New Haven, Connecticut, USA

Purpose: This study was undertaken to evaluate the effectiveness of verbal instructions, scale training, and biofeedback in training subjects to bear limited weight on a lower extremity.

Methods: 20 subjects aged 20 to 30 years were enrolled in a prospective clinical study at our university orthopaedic center. Each subject underwent an educational intervention designed to train them on weight-bearing with the use of crutches. The effect of verbal instructions alone was initially assessed. Then a training session with a bathroom scale and a training session with a biofeedback device were performed and weight-bearing compliance was reassessed after each. Subjects' average weight-bearing for each activity was monitored with SmartStep, a weigh-monitoring and biofeedback system consisting of an inflatable insole and an ankle device that continually measures weight placed on the extremity.

Results: Subjects given touch-down weight-bearing instructions (25 lb) initially bore an average of 63.57 ± 6.24 lbs (average ± standard error) when given verbal instructions. This was reduced to 44.75 ± 5.69 lb after training with a bathroom scale ($P \le 0.001$), and was further reduced to 26.2 ± 1.57 lb after biofeedback training (P = 0.011). Likewise, subjects given partial weight-bearing instructions (75 lb) initially bore an average of 92.28 ± 7.85 lb. There was no improvement with the use of a bathroom scale (at 75 lb), which showed an average of 90.82 ± 7.19 lb (P = 1.000). After training with a biofeedback device, weight bearing improved to an average of 69.67 ± 3.18 lbs (P = 0.014).

Conclusion: Biofeedback training led to superior compliance with touch-down and partial weight-bearing instructions as compared to verbal instructions or training with a bathroom scale. As partial weight-bearing instructions are commonly given to orthopaedic patients, training with such a device may be appropriately considered.

Incidence, Risk Factors, and Diagnostic Evaluation of Postoperative Fever in an Orthopaedic Trauma Population

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Purpose: We sought to determine the incidence of positive diagnostic evaluations during the management of postoperatively febrile orthopaedic trauma patients. Secondary objectives were to describe the incidence and risk factors for postoperative fever in the study cohort.

Methods: Subjects admitted to the orthopaedic trauma service between 2005 and 2008 were identified using our prospective trauma database. Fever was defined as an oral temperature \geq 38.5°C. Subjects with a preoperative fever, preexisting cancer, infection, or extended ICU admission were excluded. Febrile events were identified directly from the nursing notes in the patient chart. Injuries were categorized as either a single orthopaedic injury or multiple orthopaedic injuries; ISS was categorized as either mild (ISS <9) or severe (ISS \geq 9); and comorbidities were quantified using the Charlson Comorbidity Index (CCI). Univariate and multivariable analysis was performed to test predictors of postoperative fever.

Results: 582 subjects with a mean age of 57 ± 23 years were included. 106 subjects (18%) developed a postoperative fever, with a mean temperature of $38.8^{\circ} \pm 0.3^{\circ}$ C (range, 38.5° -40.0°C). The median time from surgery to febrile episode was 14 hours (interquartile range, 8-32). A total of 110 diagnostic investigations were ordered for a first-time febrile event in 59 subjects. A positive result was obtained in 12% of investigations: blood cultures, 1 of 30 (3%); urinalysis, 7 of 28 (25%); urine cultures, 3 of 31 (10%); chest radiographs, 2 of 20 (10%); wound cultures, 0 of 1 (0%). A second febrile event was investigated in 9 subjects and a third event was investigated in 2 subjects; 1 urine culture (1 of 7 [14%]) was positive in the second febrile event out of a total of 23 diagnostic investigations and neither of 2 diagnostic investigations in the third febrile events were positive. Univariate analysis identified age (P = 0.003), gender (P < 0.0001), multiple orthopaedic injuries (P = 0.0002), comorbidities (P = 0.002)= 0.04), and ISS (P = 0.001) as associated predictors of postoperative fever. Multivariable model was unable to demonstrate significant associations between postoperative fever and age (P = 0.19) or CCI (P = 0.633) when adjusting for the other covariates. Additionally, ISS \geq 9 (odds ratio [OR] 3.43; 95% confidence interval [CI], 1.82-6.44), multiple extremity injuries (OR 2.49; 95% CI, 1.38-4.49), and male gender (OR 2.15; 95% CI, 1.29-3.59) were all more likely to experience a febrile event.

Conclusions: Postoperative fever is relatively common among orthopaedic trauma patients. Diagnostic evaluations resulted in a low positive yield. Younger age, male gender, multiple orthopaedic injuries, ISS ≥ 9 , and increasing Charlson Comorbidity Score are all associated with increasing odds of postoperative fever.

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Comparative Effect of Orthosis Design on Functional Performance *Jeanne Cameron Patzkowski, MD*^{1,2}; Ryan V. Blanck, CPO³; Johnny G. Owens, MPT³; Jason M. Wilken, PhD, MPT³; Kevin L. Kirk, DO²; Joseph C. Wenke, PhD¹; LTC Joseph R. Hsu, MD¹; ¹United States Army Institute of Surgical Research, Fort Sam Houston, Texas, USA; ²Brooke Army Medical Center, Fort Sam Houston, Texas, USA; ³Center for the Intrepid, Fort Sam Houston, Texas, USA

Background: High-energy lower extremity trauma is common in combat-wounded soldiers. Surgical advances have increased capabilities for limb salvage, but orthotic advances have not kept pace. A custom energy-storing ankle foot orthosis (AFO), the Intrepid Dynamic Exoskeletal Orthosis (IDEO), was created and used with high-intensity rehabilitation as part of the return-to-run clinical pathway. We hypothesized the IDEO would improve functional performance compared to a noncustom carbon fiber orthosis (BlueRocker [BR]), posterior leaf spring AFO (PLS), and no brace (NONE).

Methods: 18 subjects with unilateral dorsiflexion and/or plantar flexion weakness were evaluated on 6 functional tests wearing the IDEO, BR, PLS, and NONE. Brace order was randomized and 5 trials completed for each functional measure (4-square-step-test, sit-to-stand 5 times, self-selected walking velocity over level and rocky terrain, and timed stair ascent). They also completed 1 trial of a 40-yard dash, a satisfaction questionnaire, and indicated if they had ever considered and still intended to proceed with amputation.

Results: Performance was significantly better in the IDEO on all functional measures compared to all other bracing conditions (P < 0.004), with the exception of the sit-to-stand 5 times, in which there was only a significant improvement against the BR (P = 0.014). The 40-yard dash improved by 37% over the PLS and NONE, and by 28% over the BR. The BR demonstrated a significant improvement in the 40-yard dash compared to NONE (P = 0.033), and self-selected walking velocity on level terrain over NONE and PLS (P < 0.028), but no significant difference was found between the PLS, BR, and NONE in any other functional measure. 13 patients initially considered amputation; after completion of the clinical pathway, 8 desire limb salvage, 2 are undecided, and 3 still desire amputation.

Conclusion: Use of the IDEO significantly improves performance on validated tests of agility, power, and speed. Of those subjects initially considering amputation, the majority now favor limb salvage after completion of this noninvasive intervention.

Long-Term Results and Costs of Free Flap Coverage and Ilizarov Bone Transport in Lower Limb Salvage

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Purpose: It is a common teaching that patients with severe open tibial injuries with infection and bone loss are better served by amputation than complex limb salvage. Our preference is limb salvage with wide débridement, free muscle flap coverage, and Ilizarov bone transport. The purpose of this study was to evaluate the long-term results and costs of this treatment modality.

Methods: A retrospective review was performed of all consecutive patients with lower extremity wounds with tibial defects who were recommended amputation and were instead treated with flap reconstruction and Ilizarov bone transport by a single surgeon. A criterion was at least 5-year follow-up. Outcomes assessed were flap complications, tibial union, infection, need for future surgeries, ambulation status, employment status, and need for chronic narcotic use. Patients were also surveyed regarding their satisfaction with their reconstruction. A cost analysis was also performed for this treatment modality.

Results: 36 patients (mean age, 40 years) were included with 13 acute Gustilo 3B/C defects and 23 chronic tibial defects (infected nonunion with tibial osteomyelitis). 37 muscle flaps were performed with 1 flap loss (2.7%). The mean tibial bone defect length was 9 cm, mean duration of bone transport was 10.6 months, and mean follow-up was 10 years. The non-union rate was 2.8%, malunion rate was 5.6%, and the infection rate was 8.3%. No patients underwent future amputations and 9 (25%) required reoperations. 97% of patients were ambulating without assistance, 87% of patients were working full-time and 6% part-time, and only 5.6% required chronic narcotics. On long-term survey, all patients were happy with their decision to pursue limb salvage over amputation. On cost analysis, the mean cost per year per patient after limb salvage was significantly less than the published mean cost per year for limb amputation patients, costing on average \$780 dollars per year per patient for the first 10 years.

Conclusion: The long-term results and costs of Ilizarov bone transport and free flap coverage strongly support complex limb salvage over limb amputation in this group of patients.

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Heterotopic Ossification Following Total Hip Arthroplasty for Acetabular Fractures: Acute Versus Delayed

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Purpose: The ideal timing for a total hip arthroplasty (THA) remains a highly controversial topic in the treatment of displaced acetabular fractures. Acute THA offers early rehabilitation but a high risk of heterotopic ossification (HO) has been reported. Its incidence and consequences on the patient's function are not clear. The goal of this study is to compare the incidence of HO following acute THA of acetabular fractures compared to delayed THA, and to evaluate its functional effects on the patient.

Methods: In this retrospective case series of acetabular fractures, 20 patients were treated with acute THA and 20 patients with delayed THA after failed conservative or surgical treatment. The incidence of HO (using Brooker's classification) was obtained and functional outcomes were evaluated using the Short Form–12 (SF-12), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and Harris hip score (HHS) surveys.

Results: HO was found in 65% (13 of 20 patients) in the acute group compared to 25% (5 of 20) in the delayed group. The relative risk of having significant HO (grades II-IV) when the prosthesis was done acutely was 3.4 times higher than when it was delayed (P = 0.01). Furthermore, significant difference in functional outcome was noted in the acute THA cohort. In fact, all 7 (100%) patients in the first subgroup of patients with grade 0 or I HO had excellent or good HHS scores; in comparison, only 3 of 8 (38%) patients with grade II or III HO showed excellent or good HHS scores. Moreover, still in the acute group, patients with grade 0 or I HO had significantly better WOMAC activities of daily living (ADL) scores than patients with grade II or III HO (8.9 vs 24.8, P = 0.041). The specific heterotopic ossification grade did not correlate with function.

Conclusion: The incidence of HO was significantly higher in patients with acute THA compared to delayed THA for acetabular fractures. Interestingly, in the acute group, patients with grades II and III HO seem to have worse functional outcomes than patients with no HO or grade I HO.

Single-Stage and Multiple-Stage Coverage of Complex Orthopaedic Wounds Including Exposed Bone and Tendon With a Bioartificial Dermal Substitute and Split-Thickness Skin Graft

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Purpose: Since 2005, our institution has noted success with complex wound coverage employing a bioartificial dermal substitute (BDS) with a split-thickness skin graft (STSG). The purpose of this study was to identify those patients who had success with a staged placement of the BDS and the STSG, and those patients with success from a single-stage protocol. Our institution employs both pathways and the purpose of this study was to identify wound type and other parameters to guide future decisions about treatment at the time of presentation. The goal was to identify complex wounds that would (1) be closed without a flap, and (2) wounds that could be covered in a shorter amount of time with a single-stage protocol of BDS and STSG. The other metric studied were the number of days required with negative-pressure wound therapy (NPWT) between BDS and STSG in the staged group.

Methods: This was a retrospective chart review of 22 patients who had coverage of complex orthopaedic wounds with BDS and STSG. Parameters of study included wound location, size, injury mechanism, and presence of exposed tendons, bone, and/or bone void of periosteum.

Results: 20 of 22 patients had successful healing and wound coverage with BDS and STSG. In the staged group, the average time interval from application of the BDS to STSG was 6 days. Included in this brief staging were 11 exposed bone cases. The single stage was successful in covering exposed tendons, and other soft-tissue structures.

Conclusions: Prior to the advent of NPWT, the clinical recommendation was to wait 21 days between BDS application and STSG application. Adjunct use of NPWT has significantly reduced the time interval between BDS and STSG. No study to date has reported single-stage coverage of complex wounds, and the largest study to date reports on average 19 days between BDS application and STSG. Our study reports our institution's experience and steady decrease in time interval to STSG after BDS application. Our institution reports success in a variety of orthopaedic wounds using on average 6 days between BDS and STSG, and in select cases a single stage of simultaneous BDS and STSG. Application of BDS and STSG is relatively straightforward and will assist the orthopaedic traumatologist in independently covering complex wounds without employing flap techniques.

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Tobacco Use May Delay Recovery of Nerve Function after Combat Injury *Colin M. Dunderdale, PA-C*; *Daniel J. Stinner, MD*; *Jessica D. Cross, MD*; *Benjamin K. Potter, MD*; *Travis C. Burns, MD*; *Michael J. Beltran, MD*; *LTC Joseph R. Hsu, MD*; *Brooke Army Medical Center, Fort Sam Houston, Texas, USA*

Purpose: Extremity injuries account for the majority of combat-related injuries sustained by US military personnel during the current conflicts. These injuries are associated with significant resource utilization and have a higher rate of hospital readmissions than other combat injuries, which has been shown to be a predictor of poor clinical outcomes. One patient-controlled factor that has been associated with fracture healing that has a direct result on patient outcomes is tobacco use. This review evaluated the relationship between tobacco use and outcomes of patients who sustained a combat-related type III open tibia fracture.

Methods: Consecutive combat-related type III open tibia fractures treated at any one of three institutions between March 2003 and December 2008 were included for review. Electronic medical records, to include inpatient, outpatient, and operative databases, and electronic radiographs were reviewed. Relevant data were extracted to include patient demographics, tobacco use, injury characteristics, and outcomes. Patients were excluded if the absence or presence of tobacco use could not be confirmed. Outcomes were compared between those who used tobacco products and those who did not.

Results: There were 214 type III open tibia fractures during the period reviewed. 30 were excluded due to lack of tobacco usage data, leaving a final study group of 184 tibia fractures. 103 were positive for tobacco use and 81 were negative. Average time to union was similar between groups: group 1, 9.45 months and group 2, 9.49 months; P = 0.44. Rates of deep infection and osteomyelitis were also similar between groups (P = 0.42 and P = 0.47, respectively). A similar number of flap failures occurred in both groups (P = 0.62). Although there was no difference in both sensory and motor recovery for patients with peripheral nerve injuries, those in the tobacco use group tended to have worsened during the follow-up period (P = 0.07 and P = 0.13, respectively).

Conclusions: In severe, combat-related open fractures, there was a trend in those who used tobacco products to have worsening of their sensory and motor function if they sustained peripheral nerve injuries. Tobacco use, however, was not associated with time to union or infection. The majority of patients within this study population are younger, an average of 10 to 15 years younger than those in similar civilian cohorts, and likely have fewer comorbid conditions, which may account for the similar outcomes regardless of tobacco use. However, more research is needed to determine if tobacco use is not a factor in young, otherwise healthy patients or if there is a correlation to impaired nerve recovery associated with tobacco usage.

Hardware-Associated Complications in Simple Olecranon Fracture and Osteotomy Fixation

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Purpose: Tension band wiring (TBW) of simple, transverse olecranon fractures and olecranon osteotomies has historically been an effective method of fixation. However, hardware complications, typically necessitating removal, have been reported to be as high as 80% in some series. Newer technology has brought about alternative fixation options, such as intramedullary screws, lag screws, and locking plates. We sought to examine and compare the incidences of hardware irritation, secondary procedures, and associated union rates of the various types of fixation. We hypothesized that the TBW construct would result in a higher incidence of local complications versus the alternative fixation options.

Methods: A retrospective review was performed of cases of simple, transverse, noncomminuted olecranon fractures and olecranon osteotomies employed during intra-articular distal humerus fracture fixation. Inpatient and outpatient records and radiographic examinations were reviewed for cases between January 1, 1999, and December 31, 2006. Exclusion criteria consisted of age under 18, less than 2-year follow-up, any fracture or osteotomy not amenable to TBW, and fixation limited to TBW, plate, or transcortical screw fixation. The incidences of hardware failure, hardware irritation, secondary procedures including hardware removal, union/nonunion, and infection were recorded.

Results: 67 patients were identified who met the inclusion criteria. TBW fixation was used in 30 cases, compared to 17 and 20 in the transcortical and plate fixation group, respectively. All 20 patients went on to union in the plate group, whereas union rates were 94% and 90% in the transcortical and TBW groups, respectively. A significant difference in the incidence of symptomatic hardware was noted between TBW and both plating (P = 0.05) and 4.0-mm transcortical lag screws (P = 0.004). Significantly higher incidence of secondary procedures was also performed in the TBW patients compared to plating (P = 0.026), especially necessitating hardware removal when compared to transcortical screws (P = 0.039). No statistically significant difference was noted in union or infection rates among the fixation types.

Conclusion: Tension band wiring of simple, noncomminuted olecranon fractures and olecranon osteotomies results in a significantly higher incidence of symptomatic hardware and secondary procedures such as hardware removal. Transcortical screws and plate fixation are equally as effective as TBW, but with fewer hardware-associated complications.

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Surgical Repair of Humerus Nonunions: Factors Affecting Functional Outcome and Pain Scores

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Purpose: The purpose of this study was to evaluate the effect of various demographic and fracture characteristics as well as bone-healing augmentation modalities on functional outcomes and pain scores of surgically repaired humerus nonunions.

Methods: We followed 42 consecutive patients with an established humeral nonunion prospectively. All patients underwent open reduction and plate fixation with bone graft or bone morphogenetic protein (BMP) augmentation. We calculated differences in baseline and postoperative function and pain using the Short Musculoskeletal Function Assessment (SMFA) and the visual analog score (VAS) for pain, respectively. We also calculated change in function and pain by risk factor (expressed as regression coefficient, *P* value). Demographic data recorded included age, sex, body mass index, level of education, employment status, and tobacco use. Fracture characteristics recorded included fracture location, nonunion classification, infection, mechanism of injury, preexisting nerve injury, open fracture, initial treatment (operative vs nonoperative), and union time. Bone-healing augmentation modalities recorded included bone graft type, use of BMP, and use of bone stimulator.

Results: The mean follow-up time was 14.1 ± 9.9 months with a mean union time of 7.2 ± 5.2 months. 41 of 42 nonunions (97.6%) successfully healed. There was an overall improvement in patient function (29.9 ± 17.8 vs 12.2 ± 12.8 , P < 0.01) and pain (5.3 ± 2.8 vs 2.1 ± 2.2 , P < 0.01). Union time ≤ 3 months was associated with significant improvements in function (19.6, P < 0.01) and pain (3.0, P = 0.02). Closed fractures were also associated with lower pain scores (2.0, P = 0.03). No other risk factors were found to significantly affect function or pain.

Conclusion: Successful treatment of humeral nonunions significantly improves function and pain. Risk factors that positively affect SMFA function and / or pain (VAS) scores include union time \leq 3 months and an initial closed fracture.

Medial Elbow Exposure: Over-the-Top Versus FCU Split

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Purpose: Fractures of the anteromedial facet of the coronoid are complex injuries that often demand surgical fixation through a medial approach. Both the Hotchkiss over-the-top and flexor carpi ulnaris (FCU)–splitting approaches are commonly described exposure techniques for addressing such fractures; however the optimal interval remains unknown. We aimed to quantitatively and descriptively compare the osseous and ligamentous exposure of the anteromedial coronoid and proximal ulna that is gained through the Hotchkiss over-the-top versus FCU-splitting approach.

Methods: 40 surgical approaches were performed on 20 fresh-frozen cadaveric elbows using a randomized crossover design. After each approach, a calibrated digital image was taken from the surgeon's perspective. Access to key anatomic landmarks (anteromedial facet, coronoid tip, sublime tubercle/anterior bundle of the medial collateral ligament [MCL] posterior bundle of the MCL, and radial head) was assessed. At the conclusion of data collection for the first 20 approaches, the alternate approach was performed and data collected. Digital images were analyzed using ImageJ software to calculate the surface area of coronoid and proximal ulna exposed.

Results: The average surface area exposed was 3 times greater with the FCU-splitting approach (13.3 cm²) compared to the Hotchkiss over-the-top approach (4.4 cm²) (P < 0.0001). All key anatomic landmarks were directly visualized with the FCU-splitting approach in each specimen. Visualization of the sublime tubercle/anterior bundle of the MCL and posterior bundle of the MCL was unobtainable with the Hotchkiss approach in 17 (85%) and 20 (100%) specimens, respectively. There were no statistically significant correlations between exposure and sequence of dissection, specimen age, gender, or laterality.

Conclusions: The FCU-splitting approach provides more extensive exposure of the anteromedial coronoid and proximal ulna as well as the medial ligamentous structures than the Hotchkiss over-the-top approach. Other advantages may include ease of dissection using the natural split between the 2 muscle heads, maintaining the native origin of the flexorpronator mass, and avoidance of the anterior neurovascular structures.

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Relevant Anatomy in Antegrade Humeral Nailing

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Purpose: Antegrade intramedullary nailing is one of several treatment options for fractures of the humeral diaphysis. Concern has been raised about shoulder pain following this procedure. The potential causes of shoulder pain are poorly understood. This cadaveric study describes the relationships of specific soft-tissue structures of the shoulder girdle relative to the position of the humeral canal. This information helps form the basis of an understanding of the soft tissues at risk for injury from antegrade nail insertion.

Methods: Nine cadaver forequarters were examined anatomically. A rigid, 10-mm cannulated reamer was placed in the humeral canal through a supracondylar osteotomy in a retrograde fashion to determine the best-fit path for a straight intramedullary device. It was advanced to the subchondral bone proximally. A guidewire was then passed through the reamer, penetrating the top of the humerus. Radiographs were taken and measurements made to document the location of this best-fit straight axis of the canal, and the relationships of this line to the biceps and supraspinatus tendons, as well as the articular margin of the humeral head. The surface location represents the entry point that would be ideal for a straight nail. Templates for commercially available nails were used to determine the possible entry points for each nail, assuming the straight portion of the nail fits in the straight path of least resistance in the canal. This information was used to map the entry points possible for each nail. This was used to assess the soft tissues at risk from nail entry.

Results: In each of the specimens, the axis of the straight humeral canal correlated with a surface point that was on the articular cartilage of the humeral head, under the tendinous portion of supraspinatus. This spot was an average of 7.44 mm (range, 4-10 mm) posterolateral to the biceps tendon, and 7.22 mm (range, 5-12 mm) medial to the articular margin. This point was also a mean of 9.67 mm (range, 5-15 mm) medial to the bony insertion of the supraspinatus tendon. Multiple commercially available nails were reviewed. They range in diameter from 7 to 11 mm. Each has a proximal bend, ranging 4° to 6°. Assuming the straight portion of the nail seeks the path of least resistance in the canal, an arc can be drawn for the possible entry portals for each. The rotation of the nail at insertion determines where on the arc the entry will be. The entry points for each nail are on an arc that is from 7.5 to 9.0 mm of the point that corresponds to the straight-fit canal. Assuming most are inserted with the bend placed medially (entry point located lateral to canal), the majority of entry points would pass through the insertion of the suprapinatus.

Conclusion: Given the relationships of the supraspinatus insertion and biceps tendon to the best-fit straight humeral canal, it is clear that placement of a nail with a 4° to 6° bend, and a diameter of 7 to 11 mm, involves significant risk of iatrogenic damage to these structures during nail insertion. Of note is the observation that the technique for placement of a humeral nail describes positioning it so that the proximal bend lateralizes the entry point in relationship to the canal. Our results show that this technique places the insertion of the supraspinatus tendon at significant risk of injury during nail insertion.

Operative Treatment of Extra-Articular Distal Humerus Fractures Utilizing Single-Column Plating

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Purpose: Dua- column plating has served as the gold standard for achieving rigid fixation of distal humerus fractures by promoting union while allowing for early elbow motion. However, application of a medial-based plate has been associated with hardware irritation and ulnar nerve dysfunction. The current investigation evaluates the efficacy of utilizing single-column, posterolateral plating with a locked, precontoured implant for extra-articular distal humerus fractures.

Methods: 35 patients were treated using the 3.5-mm LCP extra-articular distal humerus plate. Patients who sustained distal humerus fractures with minimal comminution were included (OTA Classification 1:13:A2 and 1:13:A3). Mean patient age was 37.1 years (range, 16-85 years). A majority of cases (n = 29) were performed using a lateral paratricipital (triceps-sparing) approach and 6 utilized a triceps-splitting approach. After reduction and temporary fixation, the surgeon performed definitive fixation using a single posterolateral plate. After surgery, patients were initially splinted and range of motion was started at 2 weeks postoperatively. All patients were followed both clinically and radiographically until healing was complete.

Results: 34 of the 35 patients (97.1%) achieved successful fracture healing at an average time of 11.7 weeks. There was 1 catastrophic failure that utilized 3 screws distally and 3 screws proximally in the initial construct that ultimately required revision fixation with 2 plates. All patients exhibited full active and passive range of motion of their elbows and none of the patients complained of elbow weakness. There were no cases of ulnar or radial nerve palsy postoperatively.

Conclusion: This is the first report of the utilization of single-column plating for the surgical management of minimally comminuted, extra-articular distal humerus fractures. A lateralbased plate preserves the vascular supply to the fracture site while eliminating risk to the ulnar nerve by avoiding medial dissection of the distal humerus. A minimum of 4 screws distally and 4 screws proximally are needed to prevent loss of reduction or catastrophic failure. Based on this case series, we propose that single-column fixation provides adequate fracture stability to achieve successful union in select fractures.

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Reoperation Following Open Reduction and Plate Fixation of Displaced Midshaft Clavicle Fractures

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Purpose: Open reduction and internal plate fixation (ORIF) of displaced midshaft clavicle fractures has gained significant popularity, however, data describing longer-term outcomes are limited. The purpose of the current study was to determine the incidence and indications for reoperation following ORIF of displaced midshaft clavicle fractures. Secondary objectives were to explore differences in reoperation between plate types and plate positions.

Methods: We conducted a retrospective study to determine the incidence and indications for reoperation following ORIF of displaced midshaft clavicle fractures. Included subjects were >12 months past index surgery and were treated with either a low-contact dynamic compression (LCDC) plate or a contoured plate (precontoured or pelvic reconstruction plate). Radiographs and medical records were used to identify demographic data, perioperative information, and reoperation events.

Results: 144 subjects were included. The mean age was 36 ± 14 years and the median time to reoperation or chart review was 26 months (interquartile range, 18-40 months). Contoured plates were used in 64% of cases and LCDC plates were used in the remaining subjects. 21 subjects (15%) underwent reoperation—17% of subjects treated with LCDC plates and 13% of subjects treated with contoured plates (P = 0.62). Indications for reoperation included implant irritation (86%), implant failure (9%), and nonunion (5%). There was no association between reoperation and age (P = 0.23), gender (P = 0.56), fracture class (P = 0.53), plate type (P = 0.49), or plate location (P = 0.93).

Conclusion: This study represents a large series of displaced clavicle fractures treated with ORIF. Reoperation following plate fixation is relatively common, but primarily due to implant irritation. No difference in reoperation rates between plate types could be detected in the current sample size.

Results of Proximal Ulna Fractures Treated With a Multiplanar, Locked Intramedullary Nail: First Experience With 28 Cases

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Purpose: Hardware irritation and removal has been a common complication of traditional olecranon fixation. The theoretical advantages of intramedullary nailing for olecranon fractures are less risk of soft-tissue irritation and resulting hardware removal. The purpose of this study is to evaluate a new multiplanar, locked 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 multiplanar, locked intramedullary implant and were followed for a minimum of 12 months (range, 12-18 months). Of the 28 fractures, 18 were transverse or oblique (AO/OTA21-B1.1), 10 were comminuted (AO/OTA21-B1.2; B1.3), 4 of which also involved the coronoid, and 7 were nonunions. Average patient age was 45 years (range, 25-65 years). Patient clinical outcome measures were monitored at approximately 6 weeks, 12 weeks, and 1 year following the surgery. Included in this evaluation was range of motion, visual analog pain score, and strength. Patients were immobilized for 3 to 5 days postoperatively, after which motion was allowed. Strengthening was initiated at 6 weeks. Radiographs were taken at each follow-up visit until union. Complications and subjective complaints were noted.

Results: At 4 weeks, patients demonstrated average extension of 20° (range, 0° - 40°) and flexion of 115° (range, 100° - 130°) with full supination and pronation compared to the contralateral side. Patient pain scores averaged 5 out of 10, with a range of 2 to 8. At 8 weeks, all patients were within 10° of full extension-flexion and were able to extend 82% of weight compared to the contralateral side. All fractures progressed to radiographic union by 8 weeks. At 12 months, patient pain scores averaged 2 out of 10, with a range of 0 to 4, motion remained the same, and all patients had resumed normal work, athletic, and leisure activities. Average extension strength was 94% of weight compared to the contralateral side. There were no incidences of nonunion, infection, triceps extension problems, or hardware failure or irritation. No patients were lost to follow-up.

Conclusions: This new multiplanar, locked 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.

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National Health Care Disparities Among the Treatment of Traumatic Thumb Amputations

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Purpose: Digit replantation can be associated with a great deal of cost and rehabilitation. Disparities exist within the type of care the uninsured receive in many fields of medicine when compared to their insured counterparts. This study was designed to determine if disparities exist when comparing treatment modalities in patients with traumatic thumb amputations. The hypothesis was that initial treatment in patients with traumatic thumb amputations will differ based on ethnicity and insurance status.

Methods: The National Trauma Data Bank (NTDB) Version 7.1 was queried for patients with unilateral thumb amputations by ICD-9 (International Classification of Diseases, 9th revision) code from years 2002 through 2006. Only patients with disposition directly to the operating room were included in the study. Patients were excluded if their ISS was greater than 14, had no ISS reported, or had no surgical procedure codes recorded. Treatment groups compared were replantation and revision amputation. Race (white vs non-white), gender, insurance type, hospital charges, age, length of stay, smoking history, comorbidities, time of presentation, geographic treatment region, mechanism of injury, trauma level, and type of institution (teaching vs community) were recorded. Variables were compared using univariate and multivariate analysis.

Results: 432 patients met the inclusion and exclusion criteria with 220 and 212 patients undergoing replantation or primary amputations, respectively. Average hospital charges for replantation versus amputation were \$32,102 and \$16,896, respectively (P < 0.001). Penetrating trauma victims were more apt to undergo replantation than blunt trauma (P = 0.03; odds ratio 1.6; confidence interval [CI], 1.0-2.4). Older patients were more likely to have an amputation (P = 0.001). Whites were more likely to receive replantation (P = .022; odds ratio 1.8; CI, 1.1-3.0). The insured or those with workers' compensation were more likely to undergo replantation when compared to government insurance (P = 0.033, odds ratio 2.0, CI 1.1-3.9; and P = 0.05, odds ratio 2.0, CI 1-4.3, respectively).

Conclusion: Patients of older age or sustaining blunt trauma are more apt to undergo thumb amputation, as are patients of non-white ethnicity and with Medicare or Medicaid. Although the former variables may reasonably influence decision making, the latter finding suggests that a disparity in treatment choice exists. Further studies should be conducted in efforts to elicit what other variables may influence this trend in clinical decision making or to determine if a disparity truly exists.

•A Novel, Multiplanar, and Less Invasive Approach to Distal Radius Fracture Fixation: Early Clinical Experience

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Purpose: The majority of surgically managed distal radius fractures are treated using volar locking plates. Although volar plating is effective for most patients, the need still exists for a solution that minimizes surgical trauma, avoids tendon irritation, and addresses a broad range of fracture patterns. This study introduces a novel fracture fixation system designed to address these needs using a universal, intramedullary scaffold to which fragments can be reassembled and stabilized using screws placed in any plane as dictated by the fracture pattern. The intramedullary fixation device has been previously shown to have comparable axial and bending stiffness to volar locked plates.

Methods: A prospective case study was performed in patients undergoing internal fixation of a distal radius fracture using an expandable, intramedullary scaffold. Study protocol was approved within the clinical investigators' respective institutions and countries. Patient outcome was assessed based on serial radiographs, adverse event reporting, and DASH (Disabilities of the Arm, Shoulder and Hand) scores. *Surgical Technique*: Following provisional reduction with Kirschner wires (K-wires), a small incision and a 5-mm–diameter cortical hole are created on the lateral aspect of the radius, approximately 7 cm proximal to the fracture site. An expandable broach is inserted into the medullary canal and used to prepare the metaphysis for implant insertion. A compressed nitinol scaffold is then introduced into the canal and allowed to expand within the prepared metaphyseal site. Cannulated bone screws are inserted percutaneously over K-wires placed through fracture fragments and into the expanded scaffold to provide stable fixation. Screw quantity, type, and orientation can be tailored to the individual fracture pattern.

Results: 13 patients have undergone surgery (10 female; age range, 54-90 years), with follow-up ranging from 1 to 35 weeks. In all cases, analysis of immediate postoperative radiographs showed acceptable reduction. Review of radiographs at subsequent follow-up revealed no loss of reduction compared to the immediate postoperative images. Only one postoperative adverse event was documented—irritation of the superficial branch of the radial nerve—which resolved spontaneously. DASH scores for 8 patients at 12-week follow-up all exhibited improvements compared with scores at the time of screening, with a mean score improvement of 41.8 points.

Conclusions: Early clinical experience with this new technique for intramedullary management of distal radius fractures is promising. This study demonstrates the technique's ability to deliver stable fixation through a tissue-preserving approach and maintain reduction throughout the healing phase. Additional study is warranted.

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Safety of Pain Exposure: Physical Therapy in Patients with Complex Regional Pain Syndrome Type 1

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Purpose: Pain exposure–physical therapy (PEPT) is a new treatment for patients with complex regional pain syndrome type 1 (CRPS-1) that consists of a progressive-loading exercise program and management of pain-avoidance behavior without the use of specific CRPS-1 medication or analgesics. The aim of this study was to investigate primarily whether PEPT could be applied safely in adult patients with CRPS-1.

Methods: 20 adult patients with CRPS-1 were consecutively enrolled in the study after giving informed consent. The diagnosis of CRPS-1 was defined using the Bruehl/IASP (International Association for the Study of Pain) diagnostic criteria. CRPS-1 was diagnosed between 3 and 18 months after the inciting injury. According to a multiple single-case design (baseline [A1], treatment [B], follow-up [A2]), multiple baseline and follow-up measurements were performed to evaluate changes in CRPS signs and symptoms and to assess functional parameters.

Results: When comparing the baseline with the follow-up phase, patients improved significantly with respect to pain on the visual analog scale (57%), pain intensity (48%), muscle strength (52%), arm/shoulder/hand disability (36%), 10-m walking speed (29%), pain disability index (60%), kinesiophobia (18%), and the domains of perceived health change in the Short Form–36 survey (269%). Three patients initially showed increased vegetative signs but improved in all other CRPS parameters and showed good functional recovery at follow-up.

Conclusion: We conclude that PEPT is a safe and effective treatment for adult patients with CRPS-1.

Acute Complications of Open Distal Radius Fractures: Retrospective Cohort Study of 240 Fractures

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Purpose: There is a paucity of literature regarding the complications of open distal radius fractures (DRFs). The purpose of this investigation is to determine the incidence of infection, identify predictors of complications, and compare the method of fracture fixation.

Methods: This is a retrospective cohort study of 240 DRFs enrolled in the prospectively collected database of 2 Level 1 trauma centers. Adult patients with closed DRFs who underwent operative fixation within 1 day of admission were compared with an open DRF cohort. Acute complications, with primary focus on infection, compartment syndrome, and acute carpal tunnel syndrome (ACTS), were identified based on the necessity for operative intervention. Pearson χ^2 test was calculated to assess the significance between each variable and the percentages of patients who had complications. Multivariate logistic regression was performed to identify predictors of complications and determine the odds ratio (OR) as a measure of risk.

Results: There were 118 closed and 122 open DRFs (90 grade I, 22 grade II, 10 grade III) that met the inclusion criteria. The mechanism of injury and the fracture patterns were similar for both groups. Infections that required operative débridement were identified in 3 patients with open fractures (2%, P = 0.167). Compartment syndromes occurred similarly in both groups (3% closed vs 2% open, P = 0.265). ACTS developed in 12% of closed and 11% of open DRFs. Multivariate predictors of ACTS were grade III open fractures (P = 0.028, OR = 7.3), AO/OTA type C (P = 0.005, OR = 4.7), age ≤ 50 years (P = 0.014, OR = 3.0), and application of external fixation (P = 0.015, OR = 2.9). Postoperative ACTS developed significantly higher with external fixation compared to volar plates in the open fracture cohort (13% vs 3%, P = 0.035) (Figure 1).

Conclusion: While the urgency for prompt operative intervention was dictated by the threat of infection, ACTS was more prevailing as a consequence of open DRF. Significant predictors of ACTS include grade III open injury, AO/OTA type C fracture, age \leq 50 years, and application of external fixator. Furthermore, higher incidence of postoperative ACTS was associated with external fixation among patients with open DRFs.

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Figure 1. The development of postoperative ACTS after volar plate versus external fixation.

OTA-2011



RSA Evaluation of an Implant System for Above the Knee Amputee Patients *Charles Bragdon, PhD*¹; *Anne Antonellis, BA*¹; *Rickard Branemark, MD*; *Johan Kärrholm, MD, PhD*; *Orjan Berlin, MD*; *Henrik Malchau, MD, PhD*¹;

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Introduction: Rehabilitation of patients with high, above the knee amputations poses a challenge due to the fact that the standard socket prosthetic devices are difficult or, in some cases, impossible to use. Over the past 15 years, the development of transdermal osseoin-tregrated devices that allow for the application of external prosthetic devices has shown to be a promising solution for these difficult cases. A system has been developed in which a fixture is implanted into the distal femur of the amputee and allowed to osseointregrate into the bone. This fixture is connected to a skin penetrating abutment. An external prosthetic device is able to be easily connected to and disconnected from this abutment. The purpose of this clinical study is to assess the long-term fixation of these components in the femur using radiostereometric analysis (RSA). The RSA system utilizes two simultaneous stereo radiographs that are analyzed using the UmRSA Analysis software (RSA Biomedical, Umea, Sweden).

Methods: Fifty one patients, 28 males and 23 females, with high, above the knee amputations were enrolled into an RSA clinical study. Four of these patients had bilateral amputations, meaning 55 prosthetic systems were enrolled and followed in this study. The procedure for implanting the Osseointregrated Prosthesis for the Rehabilitation of Amputees, (OPRA), involves a two stage surgical procedure. The stage one surgeries took place between May 11, 1999 and December 11, 2007. The average age at time of surgery was 44.9 yrs (range 20.5 to 65.3), while the average Body Mass Index (BMI) was 24.7 (range 15.6 to 37.6). In the first stage the fixture piece of the prosthesis was implanted into the distal femur and the skin incision closed. Tantalum beads were placed in the bone and the implant during this first stage. After 6 months, the muscle and skin were trimmed, the abutment was connected to the femoral fixture, and the skin was closed around the distal end of this permanent portion of the device. A removable prosthetic device was then attached to the abutment and a rehabilitation program was initiated. Plain and RSA radiographic follow up was planned for 6 months, 1, 2, 5, 7 and 10 years after the second stage surgery.



Figure 1. Patient with OPRA prosthetic system.

Plain radiographs were graded in 5 categories: distal bone resorption, near bone resorption, cortical thinning, cancellization, trabecular streaming or buttressing. Distal bone re-

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sorption is resorption of the distal bone causing exposure of the femoral fixture. Near bone resorption is resorption of bone around the fixture with a radiolucent zone being wider than the fixture thread depth. Cortical thinning is a decrease in the width of the cortex along the area of the bone where the fixture is implanted. Cancellization is an increase in the porosity of the cortex surrounding the fixture. Trabecular streaming or buttressing is defined as increase trabecular density at the proximal end of the implant, forming an angle between the inner cortex and the implant. The bone surrounding the implant is divided into Zones A-D and 1-12. Each follow up x-ray is graded in all 5 categories in the appropriate zones.

Results: As of February 2010, we have radiographic follow up and analysis on 40 patients at 6 months, 39 patients at 1 year, 30 patients at 2 years, 11 patients at 5 years, 12 patients at 7 years and 3 patients at 10 years. Nine patients' films were unable to be analyzed in UmRSA due to inadequate visualization of the tantalum beads. One patient was deceased, one was excluded from the study after implantation due to issues with an implant on the nonsurgical side, three were explanted due to loosening, and one was excluded due to infection. Due to the low number of patients with 10 year follow up, the 10 year data is not reported at this time.

Analysis from the UmRSA software showed that the median \pm standard error of the proximal/distal migration of the device was -0.01 \pm 0.02 mm at 1 year; -0.02 \pm 0.02 mm at 2 years, -0.03 \pm 0.06 at 5 years, and -0.03 \pm 0.05 mm at 7 years. A Mann-Whitney test showed no significant difference in the median proximal/distal migrations at any follow up. The median \pm standard error of the rotational movement was 0.04 \pm 0.17 degrees at 1 year; -0.05 \pm 0.17 degrees at 2 years; 0.42 \pm 0.38 degrees at 5 years; and 0.18 \pm 0.82 degrees at 7 years. A Mann-Whitney test showed no significant difference in the median rotations at any follow up time.

Table 1.

| | 1yr y | 2yr y | 5yr y | 7yr y |
|--------|-------|-------|-------|-------|
| median | -0.01 | -0.02 | -0.03 | -0.03 |
| stder | 0.02 | 0.02 | 0.06 | 0.05 |
| min | -0.50 | -0.28 | -0.61 | -0.61 |
| max | 0.26 | 0.24 | 0.11 | 0.11 |
| count | 39 | 30 | 11 | 12 |

Table 1 Proximal/Distal Migration (mm)

Table 1. The proximal/distal migration data of each patient. No implant had clinically significant progressive motion over the follow up period.

Plain radiographic analysis showed that cortical thinning occurred in 1 or more zones in 55% of patients by 5 years. Patients having cancellization in 1 or more zones decreased from 64% at 2 years to 55.5% at 5 years. At 2 years, 22% of patients showed trabecular

streaming in 1 or more zones which increased to 50% by 5 years. Distal resorption was not a significant incidence as 0 patients showed any distal resorption by 5 years.

Discussion: The current RSA analysis of the OPRA system shows no significant migration or rotation of the implant in the bone, and therefore confirms a rigid fixation of the implant system. The surrounding bone remodeling did not compromise implant fixation or performance. The surgical technique for implanting the fixture and securing the skin to the abutment to avoid skin/implant motion and infection has been perfected over 10 years. The OPRA system is a promising new technique for addressing the prosthetic challenges faced by patients with high, above the knee amputations.

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Intramedullary Nailing in Distal Tibial Fractures With an Anatomic Rod *F. Biggi¹; C. D'Antimo¹; S. Di Fabio¹; F. Isoni²; D. Salfi¹; S. Trevisani¹;* ¹*Trauma Department at San Martino Hospital, Belluno, Italy;* ²*Resident at Cagliari University, Cagliari, Italy*

Introduction: The management of unstable distal tibial fractures remains challenging: a variety of treatment methods have been suggested for these injuries, including nonoperative treatment, external fixation, intramedullary nailing, and plate fixation.

Most distal tibial diaphyseal fractures can be treated by intramedullary nailing because modern nails allow the use of very distal cross screws in different planes to prevent malalignment. If the fracture presents an intra-articular extension, different methods can be available such as cortical anatomical plates or external fixators.

Methods: Retrospective cohort analysis of data was collected from the Trauma Unit of Belluno, related to distal tibial fractures treated with a nail in the period January 2008 - December 2010. AO/OTA classification has been used, radiographs were made in two views post-operatively and at 1,3,6 months for alignment and callus formation, and eventual complications recorded.

Results: 23 cases met the inclusion criteria. All operations have been performed in a period ranging from six to forthy-eight hours, and discharge usually after 3/7 days with partial weight-bearing in all patients, regaining full weight-bearing in 4/6 weeks. The mean time to union (assessed as presence of two periosteal bone bridge in A/P and lateral views) was 16 weeks (range 12-24 weeks), without axial or rotational malalignment except one valgus angulation of 8°.

Conclusion: Closed intramedullary nailing with last generation nail allows the treatment of distal tibial fractures because the anatomical design, the primary stability obtained, the opportunity of very distal interlocking with 3 screws placed in different planes, and absolutely no additional soft-tissue trauma.

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Percutaneus Trans-Ileo-Sacral Screw in Unstable Pelvic Injury:
Comparison Between CT-Guided Technique and Image Intensifier Technique
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Aim: The unstable pelvic injuries are caused by major trauma. Completely unstable pelvic injuries are characterized by complete rupture of the complex ligaments of the sacro-iliac joint and require, like other segments, the stabilization in emergency. Several systems are used: the trans-skeletal traction, the C-clamp, the external fixator, the osteosynthesis. The technique is a minimally invasive surgical stabilization of sacroiliac luxations and fractures of the pelvic ring, executable once the patient has stabilized. It is not easy to perform, especially in obese subjects, anatomical variations in the sacrum (sacralization of fifth lumbar vertebra) and if the surgeon's hands are not experienced.

Methods: The technique involves the introduction of one or two cannulated screws directly into the body of S1, in the three-guided scopic projections of Pennal. The greatest difficulty lies in finding the only bone corridor available without damaging adjacent structures: the cauda equina in the sacral canal, the L5 root lateral to the sacral promontory, the root of S1 output from the first sacral foramen. The technique can also be performed under CT guidance and in this case it is essential that cases are non-displaced fractures or dislocations because, unless you have the TC in the operating room, you can not reduce the dislocation well and sterility can not be guaranteed. Our series includes 18 cases of percutaneous screw stabilization in combination with or without the front plate of the symphysis under X-ray guide and 16 cases under TC guide. Of the first 18 cases, four were performed in emergency in association with anterior external fixation.

Results: The long-term results show a restitution ad integrum in 12 cases, 4 cases are still in pain in the posterior sacroiliac region, 2 cases have recently run for hours and show no major problems. Of the 4 cases with pain, two had other associated lesions consisting of acetabular fractures and iliac and two are being studied to evaluate the stability of the residual posterior sacro-iliac complex . Of the 16 cases, CT guided, 14 contain a restitution ad integrum, 1 case complained of back pain, another case has not maintained the reduction in remote control and has a leg length discrepancy of 2 cm posterior lower limbs and chronic pain.

Conclusions: In our opinion it is a relatively quick method, which allows non-invasive surgery and early standing position and allows definitive stabilization of those injuries that otherwise treated, face chronic instability or non union.



Reverse Total Shoulder Replacement Versus Hemiarthroplasty for Proximal Humeral Fractures

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Introduction: Proximal humeral fractures are the third most frequent limb fracture type in elderly patients. Shoulder hemiarthroplasty is indicated in patients with displaced and comminute fractures, where avascular necrosis of the humeral head seems inevitabile. The outcome of hemiarthroplasty for proximal humerus fractures is somewhat unpredictable and appears to be related to the quality of the anatomical reconstruction of the tuberosities. The aim of this study is to compare clinical outcome of reverse shoulder arthroplasty (RSA) versus hemiarthroplasty (HA) in complex fractures of the proximal part of the humerus.

Methods: Retrospective analysis of 20 patients with three- and four-part fractures of the proximal humerus (mean age 72) who underwent RSA against the outcome of 20 patients (mean age 77) who sustained HA for the same indications. Mean follow-up duration for clinical outcomes was 36 months. Outcomes were assessed using the Constant-Murley score.

Results: The mean constant score was 59 (range 38–80) in the RSA group and 61 (range 32-90) in the HA group. Mean active forward elevation was 106 degrees (range 40-180 degrees), active external rotation was 19 degrees (range 0-40 degrees) in the hemiarthroplasty group versus 120 degrees (range 45-160 degrees) and 50 degrees (range 10-80 degrees) in the RSA group. Satisfactory pain relief was achieved in 14 patients in the HA group and in 17 in the RSA group. No statistically significant differences in outcome scores or range of motion were seen.

Conclusion: RSA is a valid and predictable therapeutic option in treating unreconstructable proximal humerus fractures in the elderly patients when the probability of achieving tubersity healing is low.

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The Effect of Reaming of Long Bone Fractures on Translocation of Mesenchymal Stem Cells

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Introduction: The hypothesis that mesenchymal stem cells (MSCs) circulate extensively and home to sites of tissue damage in normal physiological situations is extremely contentious. Whether MSC's circulate following trauma remains also obscure. The purpose of this study was to investigate whether reamed intramedullary nailing of fractured tibias and reaming of intact femurs with the RIA reamers for bone graft harvesting is associated with mechanical translocation of MSCs into the vascular system.

Patients and Methods: 10mls of femoral venous blood from the ipsilateral fractured limb and matched peripheral venous blood from the contralateral median cubital vein was collected from 12 patients immediately following closed reaming for intramedullary nailing of tibia fractures. Similarly, 10mls of femoral venous blood from the ipsilateral limb after RIA reaming and matched peripheral venous blood from the contralateral median cubital vein was collected from 12 patients immediately following closed RIA reaming for bone graft harvesting. Following density centrifugation, colony-forming unit-fibroblast assay (CFU-F) was performed in 10-mm round dishes using 5 and 10x10⁶ mononuclear cells/dish. Individual colonies were then expanded in standard conditions for 14 days and osteogenic assays and multiparameter flow cytometry were undertaken and compared with the "gold standard" iliac crest-derived MSCs.

Results: From fracture tibia cases, four out of 12 (33.33%) of femoral vein aspirates contained classical CFU-F colonies comprised of typical fibroblast-like cells. From the RIA cases, eight out of twelve (66.67%) of femoral vein aspirates were positive for CFU-F colonies and two out of twelve (16.67%) contained CFU-F colonies in the peripheral blood. Colonies with a macrophage morphology were also present in those samples. It was possible to culture-expand CFU-Fs from femoral veins only, with these exhibiting osteogenesis as determined by alkaline-phosphatase activity.

The immunophenotype of CFUF culture expanded from femoral blood was identical to iliac crest bone marrow aspirate MSCs: positive for CD73, CD90 and CD105 and negative for CD45, CD271, CD34, CD31, CD19, CD14.

Conclusions: MSCs were identified within the circulation at sites immediately adjacent to intramedullary reaming (both conventional and RIA) and at a lower frequency in peripheral venous blood presumably being secondary to capillary filtering by pulmonary and systemic beds. This suggests that their presence in the blood is more likely the consequence of biomechanical trauma rather than a specific molecular cascade involving cell migration and homing. We believe that confusion in the literature may relate to the mischaracterisation of adherent myeloid or endothelial colonies as CFU-Fs.

Spinal Shock in Spinal Cord Injuries: Is Duration of Shock Related to Neurological Level?

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Introduction: The definition and etiology of spinal shock remain controversial. The factors influencing this duration and its clinical significance are not well studied. A study was undertaken to study the duration and the factors influencing spinal shock. An arithmetical relationship was seen to exist between the duration of spinal shock and the segmental level of spinal cord injury.

A study was done to determine the duration of spinal shock in spinal cord injury (SCI), the first reflex to return while recovering from spinal shock & the factors influencing duration of spinal shock.

Methods: 116 patients in spinal shock following SCI were included. A detailed neurological examination of sensory, motor and reflex activity was done everyday till the patients were out of spinal shock. The duration of spinal shock by appearance of any reflex, the first reflex to return and the influence of variable factors on duration of spinal shock were studied.

Results: In 76 patients (85.4%) anal wink (AW) was the first reflex to return either alone or simultaneous with BC / DPR. In 7 patients cremastric reflex, in 3 pathological reflexes and in 2 deep tendon reflexes (ankle) were the first to return.

Mean duration of spinal shock (MD of SS) was shorter in children, shorter in malnourished, shorter in untrained/laborers, shorter in patients admitted early and shorter in patients without any complications. "MD of SS" was not influenced by sex of patient, associated injuries and by different modalities of treatment.

Conclusion: On statistical analysis of duration of spinal shock with neurological level as a variable "MD of SS "was 1.7 days in cervical cord lesions, 8.2 days in upper thoracic, 15 days in lower thoracic and 17 days in lumbar cord lesions. Such an arithmetical progression was also found at each segmental level i.e. the duration of spinal shock progressively increased at every segmental level. "MD of SS" was 1.36days at C4, 1.60 at C5, 1.72 at C6, 8.1 at T6, 12.4 at T8, 13.1 at T10, 15.3 at T12 & 21.6 at L2.

An arithmetical relationship exists between the duration of spinal shock and the segmental level of spinal cord injury - the duration of spinal shock was directly proportional to level of injury; higher or proximal the lesion, shorter the duration. We do not have the answer of this important observation. Is the duration of spinal shock dependant on the cord length / neuronal mass involved / spared?

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The Treatment of Ankle Fractures in Patients with Diabetes Mellitus

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Introduction: The management of ankle fractures in diabetic patients can be problematic due to a higher risk of complications. Controversy exists about whether they are best managed by operative fixation or by less invasive techniques. The aim of this study was to identify the safest method of treatment by comparing complication rates in relation to treatment modality.

Methods: Retrospective case-control study of a consecutive series of 70 diabetic and a matched group of 70 non-diabetic patients treated for displaced ankle fractures over a 9 year period at one institute. Patient demographics, medical co-morbidities, fracture personality, treatment methods and subsequent complications were recorded. Statistical analysis was made using Multivariate forward stepwise logistic regression method, Chi square test and Independent samples t test.

Results: The diabetic group (51%) had more complications than the matched control group (23%) following all methods of treatment. This was more pronounced in those diabetic patients with peripheral neuropathy (73.9%). The absence of a dorsalis pedis pulse in the diabetic group was not associated with an increased rate of complications. Diabetic patients managed with closed reduction and casting showed higher rates of non-union (33.3% vs. 9.1%) and skin ulcers (33.3% vs. 5.4%) compared to surgical management.

Conclusion: Unstable ankle fractures in diabetic patients are best treated with open reduction internal fixation with the use of standard techniques whenever possible. This should be performed before the development of pressure sores or skin ulcers as a result of prolonged or poorly applied plaster cast.
Patient Outcomes after Total Hip Replacement for Displaced Hip Fractures: A Matched Cohort Study

Raymond E. Anakwe, MRCS, Ed; Scott D. Middleton, MB, ChB; Paul J. Jenkins, MRCS, Ed; Alison P. Butler, BMed, Sci; John F. Keating, FRCS, Ed (Tr&Orth); Matthew Moran FRCS, Ed(Tr&Orth); Orthopaedic Trauma Unit, Royal Infirmary, Edinburgh, Scotland, United Kingdom

Aim: Total hip replacement (THR) has been shown to outperform hemiarthroplasty and internal fixation in selected fit elderly patients with displaced hip fractures. Elective THR has been shown to result in high levels of satisfaction and large improvements in function for patients with osteoarthritis. It has not been established whether the outcomes for hip fracture patients are as good. We aimed to investigate the early outcomes and results of THR undertaken as a primary treatment for displaced hip fractures and to compare these with those for THR undertaken electively for osteoarthritis in an age and gender matched cohort of patients.

Methods: Over a 3 year period, we identified all patients treated for a displaced hip fracture with primary THR at our trauma center. Patient records, radiographs and the hospital electronic records were reviewed to confirm this information. Patients known to have died were removed from the dataset. Surviving patients were invited to complete a satisfaction questionnaire and validated patient reported outcome measures (the Oxford Hip score and SF-12 form) at least 12 months after surgery. Family physicians were contacted to confirm the status of non responders and surviving non-responders were sent a second request to participate. The responders formed the study group. The medical records for non-responders were examined and compared with the study group to determine if there were no significant differences. Patients in the study group were matched for age and gender in a ratio of 1:3 with patients undergoing elective THR for osteoarthritis over the same period. Functional outcome scores, satisfaction and rates of complications were compared.

Results: We identified 128 patients who underwent THR for a displaced hip fracture over this period. Of these, 9 had died, 2 had been left incapacitated by cerebrovascular accident and were unable to respond. This left 117 patients available for recruitment. Of these, 27 (23%) did not respond leaving a study group of 90 (77%) patients. The patients were well matched for age (p=0.790) and sex (p=0.812). The mean patient age was 70.6 (SD 8.5, 95% CI 68.8 to 72.4) years. Patients in both groups reported excellent functional outcomes and high levels of satisfaction at a mean of 25.3 (SD 10.7) months post operatively (96% satisfaction in the trauma group and 91% satisfaction in the elective group [p=0.259]). The post-operative Oxford Hip Score was better in hip fracture patients (p=0.013). The SF-12 physical score was also better in the hip fracture group (p<0.001), but the mental score was worse (p<0.001). There was a higher rate of dislocation (p=0.014), deep infection (p=0.003) and early revision surgery (0.014) in the trauma group although the rates for these complications were comparable to figures in the literature for elective surgery.

Discussion: THR for displaced fractures in carefully selected patients produces excellent functional outcomes and levels of satisfaction equivalent to those after elective hip surgery.

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Patients treated after hip fracture did have worse SF-12 mental component scores and this may relate to a number of factors including high / normal pre-injury levels of function, residual symptoms after surgery and patient expectation which we would expect to differ from the elective THR group. The merits of THR as a treatment for displaced hip fractures in this selected group may also possibly be further justified particularly in view of the low rate of mortality as shown here (7% at 25.3[SD 10.7] months).

Outcomes after Pipkin Fractures of the Femoral Head

Samuel Molyneux, MRCS, MSc.; Tim White, FRCS, MD; New Royal Infirmary of Edinburgh, Scotland, United Kingdom

Purpose: The aim of this study was to review the outcomes of femoral head fractures treated in our unit over the past 15 years. There is a paucity of information in the literature regarding long term outcomes in these patients, and we believe this is the largest case series of its kind.

Methods: We conducted a computerised search of the medical records to identify all patients with femoral head fractures treated in our level 1 trauma centre between 1995 and 2010. Their records and x-rays were reviewed to determine age, sex, co-morbidities, mechanism of injury, fracture type, associated injuries, treatment methods, complications (early and late) and long term outcome graded excellent (symptom free), good (minor symptoms not impacting on daily life), moderate (symptoms impacting on daily life) poor (symptoms severe enough to consider further surgery) or very poor (further surgery already undertaken).

Results: 20 patients were identified. There were 8 females and 12 males. Their mean age was 39 (SD 17 years, range 14 to 80), and this was the same between the two sexes (39.1 v 39.2, p = 0.91). The right hip was affected in 16 patients. Mechanisms of injury were: road traffic accident (12); falls from height (2); crush injury, assault, motorbike crash, pedestrian hit by a car, sports injury and simple fall. 8 patients had associated major injuries, and these all occurred following an MVC. 19 patients had an associated dislocation requiring reduction; of these one was anterior. Table 1 shows outcome according to Pipkin classification and treatment methods. Average follow up was 25 months (range 2 to 94 months).

Conclusion: Pipkin fractures tend to occur in a relatively young population and are most commonly secondary to MVC. Despite a variety of Pipkin grades and treatment methods outcomes are variable, with a high proportion of patients suffering poor long term functional outcomes.

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| Pipkin Classification | Number | Treatment of Head Fracture (No. of patients) | Outcome (No. of patients) |
|--------------------------|--------|---|--|
| 1 | 8 | Conservative (4) | Excellent (3) Lost follow-up (1) |
| | | Fragment Excised (2) | Poor (1) Very poor (2) |
| | | Internal Fixation (2) | Excellent (1) Poor (1) |
| 2 | 3 | Conservative (2) | Excellent (2) |
| | | Internal Fixation (1) | Very poor (1) |
| 3 | 1 | Conservative (1) | Moderate (1) |
| 4 | 8 | Conservative (1) | Good (1) |
| | | Fragment Excised (3) | Excellent (1) Good (1) Lost follow-up (1) |
| | | Internal Fixation (4) | Excellent (1) Very poor (2) Lost follow-up (1) |

Table 1: Treatment and outcome of different Pipkin fracture types.

Predictors of Patient Mortality with Deep Infection after Hip Fracture Surgery *Andrew D. Duckworth, MSc, MRCSEd; Sally-Anne Phillips; Oliver Stone; Matthew Moran, FRCS, Ed(Tr&Orth); Leela C. Biant; Edinburgh Orthopaedic Trauma Unit, Royal Infirmary of Edinburgh, Edinburgh, Scotland, United Kingdom*

Purpose: There is significant morbidity and mortality associated with infection following hip fracture surgery. There is no data in the literature regarding predictors of mortality in this group of patients. This study analysed incidence and risk factors for mortality in patients who are diagnosed with deep infection following hip fracture surgery.

Methods: Data was prospectively collected for three years from all patients undergoing hip fracture surgery. Infection was defined as positive microbiology culture from deep tissue or fluid samples. Demographic data, treatment, complications and subsequent surgeries were analysed. Potential predisposing factors including chronic medical co-morbidities, ASA grade, alcohol excess and smoking were assessed. The main outcome measure was mortality at one year following diagnosis. Univariate analysis was used to determine significant predictors of mortality at one year. Factors found to be significant or near-significant (p<0.10) on univariate analysis were incorporated and underwent multivariate binary logistic regression analysis.

Results: 2,718 consecutive hip fracture operations were performed in three years. Fortythree (1.6%) patients had a deep post-operative infection, of which the mean age was 73 years (range 25-94) and 65% were female. The primary procedure in 25 (68%) patients was reduction and internal fixation, with 18 (42%) undergoing hemi-arthoplasty. The most common causative organism was coagulase negative staphylococcus (n=13, 30.2%), followed by MRSA and staphylococcus aureus. The one-year mortality was 33% (n=14). Increasing age was the only predictor of mortality at one year (p=0.01). Alcohol (p=0.08), IHD (p=0.09), dementia (p=0.09) and ASA grade (p=0.09) were all approaching significance. Multivariate binary logistic regression analysis showed age to be the only independent predictor of morbidity following infection (p=0.02).

Conclusion: The one-year mortality in patients diagnosed with deep infection following hip fracture surgery is comparable to patients without infection. Age was most predictive for mortality following deep infection.

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Locked Percutaneous Compression Plating versus Third Generation Nailing for Unstable Intertrochanteric Femur Fractures

Matthias Knobe, MD; Pia Antony, MD; Saskia Catharina Mooij, MD; Richard Martin Sellei, MD; Roman Pfeifer, MD; Wolf Drescher, MD, PhD; Hans-Christoph Pape, MD, FACS; Dept. of Orthopedic and Trauma Surgery, Medical Faculty, RWTH Aachen University, Aachen, Germany

Objectives: Despite the recent development of new nails with blades and innovative locked extramedullary implants, a clear preference for an intramedullary or extramedullary approach in the therapy of unstable intertrochanteric femur fractures (AO/OTA 31-A2) has not been established.

Design: Prospective cohort study.

Setting: University trauma center.

Patients: Between April 2006 and April 2009, 108 consecutive patients.

Intervention: Locked percutaneous compression plate (PCCP) or proximal femoral nail antirotation (PFNA).

Main Outcome Measurements: Number of follow-up surgeries required upon the reevaluation 18 months after implantation. Secondary outcomes included mortality, transfusion requirements, operating time, radiographic screening time, functional outcome scores, as well as quality of life (Visual Analog Scale).

Results: A total of 54 patients were included in the PCCP cohort (81.3 yrs, ASA 2.8) and an additional 54 were placed in the PFNA group (77.8 yrs, ASA 2.7). The numbers of follow-up operations due to mechanical problems, (six per group) were identical for both procedures, as was the likelihood of wound complications. Similarly, no observable differences emerged with regard to mortality (35% for PCCP (n=19) and 28% for PFNA (n=15)), implant functionality, and quality of life of patients upon reevaluation 18 months later (Follow-up: PCCP: n=31, PFNA: n=34). The PCCP approach could be completed with reduced operation time when compared with the PFNA approach.

Conclusions: In unstable intertrochanteric femur fractures (AO/OTA 31-A2), in regard to reoperations, functional outcome and quality of life, both the PCCP und PFNA techniques are comparable options for fixation.

Subtrochanteric Fracture Non-unions with Implant Failure Managed with the Diamond Concept

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Background: The management of non-unions of subtrochanteric femoral fractures with associated implant failure is challenging. This study assessed the outcome of a cohort of patients treated according to the diamond concept.

Methods: Between 2005-2010 all patients with subtrochanteric aseptic non-unions presented post implant failure were eligible in the absence of severe systemic pathologies and comorbidities. Demographics, initial fracture pattern, method of stabilisation, mode of failure of metal work, time to revision of fixation, complications, time to union, and functional outcome were recorded over a minimum period of follow-up of 12 months. The revision strategy was based on the "diamond concept"; optimising the mechanical and biological environment (revision of fixation, osteoinduction/BMP-7, osteoconduction/RIA harvested graft, and osteogenicity/concentrate of bone marrow aspirate).

Results: Out of 280 nailing procedures 12 (4.3%) cases met the inclusion criteria. A consistent mode of metalwork failure was recorded with initial breakage of the proximal distal locking screw followed by nail breakage at the lag screw level. Biomechanical SEM analysis of the nails revealed no structural damage besides the standard fatigue striation. Varus malreduction was present in all cases, with an average of 7.3 degrees (5-11). The average time to screw failure was 4.3 months (2-6) and nail failure was 5.9 months (4-10). All but one of the cases were revised to a 95 degrees blade plate and one to a nail. Time to union was 6.5 months (5-10). All but one of the cases by 12 months have returned to their pre-injury level of mobilisation.

Conclusion: Varus mal-reduction must be avoided in the initial stabilisation of subtrochanteric fractures. Proximal distal screw failure is predictive of future fracture non-union and subsequent nail breakage. The diamond concept for optimising mechanics and bone biology is a successful method for managing complex sub-trochanteric non-unions with failed metalwork.

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Prehospital Mortality of Trauma – An Analysis of Patients Declared "Dead on Arrival"

Nikolaos K. Kanakaris, MD^{1,2}; Thomas Goff, MD¹, **Robert M. West, MD**¹; Christos Leukidis, MD³; Iordanis N. Papadopoulos, MD²; ¹Academic Department of Trauma and Orthopaedics, University of Leeds, Leeds, United Kingdom; ²Academic Department of General Surgery, University of Athens, Athens, Greece; ³Forensic Department of Athens, Athens, Greece

Introduction: Prehospital deaths following contemporary trauma account for 45% of the overall trauma mortality. The existing evidence regarding this large cohort of cases is scarce. It is excluded from large databases as the US-NTDB, or the UK-TARN. Aim of this study is to investigate key contributing factors to deaths in trauma patients found alive at the scene but pronounced dead-on-arrival at the hospital (DOA).

Methods: Retrospective cohort analysis of data collected from the Forensic Department of Athens-Greece referring to trauma fatalities between a 5 year period. Demographics, transportation time-to-definitive care, total-survival-time, mechanism of injury according to ICD-9, injuries according to the abbreviated injury scale (AIS-98), injury severity score (ISS), results of toxicology, and co-morbidities were recorded for all cases. Descriptive statistical analysis as well as univariate and multivariate logistic regression analysis was conducted.

Results: 618 cases met the inclusion criteria, males 74.4%, with median age 40years(1–99), median ISS 34(3-75), median transfer time 40min(8-125). Injuries were sustained in an urban environment (504, 81.6%), with road traffic collisions being the commonest mechanism (504, 81.6%), followed by falls (73, 11.8%). Toxicology was found to be positive in 37.7% of these casualties, predominantly alcohol (average 101mg/ml). Co-morbidities were recorded in 24.4%, with ischaemic heart disease in 7.8%. Subgroup analysis for urban vs rural casualties identified prolonged transfer times, different causative mechanisms, and incidence of alcohol intoxication. Fatalities in patients with predominantly head injuries vs polytrauma cases without severe head trauma differed significantly to their ISS, mechanism, post-injury survival time, while demographics and comorbidities were comparable.

Conclusion: Autopsy of the trauma fatalities remains an important tool for the evaluation of trauma services and injury prevention strategies. Patterns of organ injuries, age, as well as location of the accident appear to influence survival times and should be taken into consideration from health authorities taking strategic decisions.

Reduction of the SI Joint With Ilio-Sacral Screws: What is the Correlation With Long Term Outcome?

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Aim: To determine the long-term outcome after reduction of displaced SI joints and fixation with ilio-sacral screws. What the accuracy of reduction correlate with outcome?

Methods: All patients who had undergone percutaneous ilio-sacral screw fixation as part of their operative treatment of displaced pelvic ring fractures treated at a tertiary referral centre with a minimum of a one year follow up were assessed. Functional outcomes were measured using the SF-36, Euroquol (EQ-5D), UCLA index and ad-hoc tools. Sexual function was assessed using elements of the Sexual Function Questionnaire. Injuries were classified using the Young and Burgess (YB) and OTA/AO classification. Post operative CT scans assessed sacro-iliac joint reduction in antero-posterior and vertical planes. Reduction was classified as anatomical, near anatomical or non-anatomical (displacement of 0-5mm, 5-10mmm or >10mm respectively).

Results: Mean follow up was 6.7 years (1.2 – 12.3 years). Complete questionnaire and CT data were available in 82% (64 of 78) of patients. There were 16% Antero-Posterior Compression (APC- AO type B1), 23% Lateral Compression (LC- AO types B2 and B3), 50% Vertical Shear (VS- AO type C) and 11% Combined pattern injuries.

Mean delay to operation was 7 days (0-50 days). 28% of sacral injuries were bilateral and 20% were associated with a concomitant acetabular fracture. 80% of sacral injuries were reduced closed. Bilateral fixation was performed in 22% of cases and S2 screws placed in 18% (the remainder having solely S1 fixation).

Anatomical reduction was achieved in 71% of patients, with 12% near / non-anatomical in only one plane and 17% near / non-anatomical in both AP and vertical planes. 52% of anatomically reduced patients had no or pain only after intense activity, compared with 31% near or non-anatomically reduced (p=0.13, Chi-squared test). 90% of anatomically reduced versus 89% near / non-anatomically reduced could ambulate independently or required a stick only with distance (p=0.85, Chi-squared test). 48% of anatomically versus 31% of near / non-anatomically reduced patients continued in their pre-injury employment (p=0.20, Chi-squared test). 40% of anatomically versus 21% of near / non-anatomically reduced patients returned to their pre-injury level of sport (p=0.14, Chi-squared test).

A sub-analysis of 39 patients whose pain maps suggested SIJ origin pain failed to show a statistically significant relationship between anatomically and near / non-anatomically reduction (p=0.20, Chi-squared test). No statistically significant difference was found between anatomically, near anatomically and non-anatomically reduced patients although a trend

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was seen with pain and return to sport. 30% of patients with non-anatomical reduction in both AP and vertical planes reported no pain with physical activity.

Conclusions: Anatomical reduction of the SI joint continues to be a goal of surgical reduction yet its role is long term outcome is still undetermined.

Pelvic Fracture Classification as a Key to Transfusion Requirements Nikolaos K. Kanakaris, MD; **Oghor Opakponovwe, MD; Vassilios S. Nikolaou, MD;** Giles Moseley, MD; **Peter V. Giannoudis, MD;** Academic Department of Trauma and Orthopaedics, Leeds Teaching Hospitals, School of Medicine, University of Leeds, Leeds, United Kingdom

Introduction: The Young-Burgess classification of pelvic fractures (PFxs) has been shown to correlate with blood transfusion, overall resuscitation requirements and outcomes. Our purpose was to investigate whether this previously reported finding is still valid following in light of the ongoing advances in trauma care, such as; reduced rescue times, designated trauma centres and teams, strict transfusion guidelines and advances in our understanding of the physiological response to injury, general trauma management and interventional radiology.

Materials & Methods: Retrospective subgroup comparative analysis of blunt-PFx with complete hospitalisation documentation of the first-48hrs over a 5-year-period. Children, pathological fractures, and dead-on-arrival cases were excluded. Demographics, ISS, hospital/ITU stay, transfused blood products and mortality were documented. Descriptive statistics were utilised as appropriate.

Results: 110 patients met the inclusion criteria (males 63.6%, average age 38.5years (15-90)). The average overall ISS was 21(5-45), and the average length-of-hospital-stay 23.7days (4-67). 41.8% required ITU treatment of an average duration of 6.3days (2-29). The overall mortality was 6.5%, referring to a subgroup of significantly higher ISS (average 41.6 (17-66)). The average overall transfusion requirements for RBC/FFP/PLT were 4.5 (1-23) / 1.5 (1-12) / 1.1 (1-12) units respectively. The subgroups (Young-Burgess classification) were LC1= 38 cases - 34.2%, LC2= 6 cases - 5.4%, LC3= 2 cases - 1.8%, AP1 = 2 cases - 1.8%, AP2= 29 cases -26.1%, AP3=10 cases - 9%, VS=8 cases - 7.2%, CMI=4 cases - 3.2%, Iliac-Blade=11 cases - 9.9%. The mean ISS was higher in the CMI, VS, AP2 and AP3 groups (30.3, 20.4, 21.8 and 26.7 respectively) when compared with the rest. All these characteristics were comparable with those of the original publication of Burgess in 1990. And consistent with the above study, we found the AP3 group had the highest average red cell transfusion rates, 7 (4-12), followed by VS-injuries 4.5(2-8). AP3-injuries, which required on average 35.4 units of RBC in the landmark study of Burgess, in this series received on average 7.0 (4-12). The mortality was highest between the LC3-group 2 out of 6patients – 33.3% differing from the study of Burgess (higher mortality AP3 3 out of 7 patients -42.8%).

Conclusion: The classification of Young and Burgess appears to withstand the test of time as to its correlation to the resuscitation requirements and the clinical outcome; however substantial differences to the reported quantitative parameters were noticed. Perhaps the increased use of radiological interventions such as embolisation, damage control orthopaedics and transfusion protocols in the unstable patients are altering the need for massive blood transfusions.

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Analysis of Outcomes and Complications in Combined Pelvic and Abdominal Trauma – An Analysis of the Trauma Registry of DGU

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Purpose: Patients with pelvic injuries are at high risk to die due to uncontrolled haemorrhage from either the pelvis or abdominal solid organs. It is still unclear whether severe pelvic injuries, concomitant abdominal injuries or both contribute to worse outcome. We, therefore, analysed the outcome and the occurrence of posttraumatic complications in severely injured patients with pelvic trauma, abdominal trauma and combined pelvic and abdominal trauma.

Methods: 5353 records of severely injured trauma patients treated between 1993 and 1999 were reviewed. The German Trauma Registry (GTR) was used as the source of data. Inclusion criteria: ISS > 16, pelvic and/or abdominal trauma, primary admission to a trauma center, and AIS head < 3. Mortality rate, associated complications, and treatment strategies were recorded.

Results: A total 871 patients, pelvic injuries (n=267), abdominal injuries (n=343), and combined pelvic and abdominal trauma (n=261) met the inclusion criteria. The overall mortality rate was 20.4% (13.5% pelvic injuries; 20.4% abdominal injuries; 27.6% both injuries). The majority (84%) of patients with abdominal trauma underwent a laparotomy. Early definitive pelvic osteosynthesis was chosen in 48.3% of patients with pelvic injuries. Complications like ARDS (16.6%), MOF (20.1%) and sepsis (17.4%) were common in all groups.

Discussion: Patient's sustaining combined pelvic and abdominal injuries were associated with increased injury severity and higher mortality rates. Moreover, this injury pattern places these patients at an increased risk to develop posttraumatic complications. Early surgical intervention has been shown to be advantageous in all groups.

Reconstruction of Segmental Defects in Long Bones of the Lower Limbs

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Purpose/Hypothesis: Segmental bone defects as a result of aggressive bone debridement after an infected non union can be successfully managed by stage reconstruction. Autologus bone, allograft plus specific antibiotic can fill-up the defect and unite.

Material and Method: Fifteen patients were treated for a segmental bone defect in long bones of the lower limbs. All but one were associated to an open fracture as the index injury. One defect was associated to a femur lengthening in patient with a congenital short lower limb. The series consisted of 3 females and 12 males with an average age of 39.5 years old. Nine of them were femurs and six tibias with a segmental defect that averaged 6.3 centimeters (4 to 12 cm) and an immediate history of osteomyelitis.

Aggressive debridement of bone and soft tissue was performed. An external fixator was used temporally until the bacteria were isolated. At that point, a cemented locked nail was inserted. In 10 cases a antibiotic bone cement spacer was left occupying the defect. Six to eight weeks later, the cement rod and the spacer if that was the case were removed. The defect was filled-up with a mixture of autologus bone graft mixed with allograft and specific antibiotic. An intramedullary reaming guide was introduced through the grafted area and the segment was reamed to rebuild the medullar canal. The segment was again stabilized with a locked nail.

Results: Twelve reconstructions healed both clinically and radiologically in an average time of 27 weeks. In 3 cases, a reamed exchange intramedullary nailing was needed due to no signs of union after an average time of 20 weeks. All the patients finally unite in an average time of 30 weeks.

Conclusion: Management of segmental bone defects represents always a challenge in post-traumatic reconstruction. A stage protocol dealing with the infection first followed by grafting of the defect showed in this series acceptable resuts and represents a viable alternative treatment.

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Lengthening Over a Plate in Post-Traumatic Limb Reconstruction Associated to Axial Deformity

Carlos F. Sancineto, MD; Jorge D. Barla, MD; Gabriel Mecozzi, MD; Guido Carabelli, MD; Hospital Italiano de Buenos Aires, Buenos Aires, Argentina

Purpose: During limb-length discrepancy correction, prolonged external fixation time is usually associated to patient discomfort and pin track complications. If this treatment is done over an intramedullary nail, once the length is restored, the nail is locked and the fixator removed. Some post-traumatic deformities associated to the shortening may prevent surgeons from inserting a rod. Nevertheless, the same technique can be performed by generating the lengthening over a plate.

Material and Method: We present three cases of axial and length correction using plate and screws as the stabilization device. Average age was 31.6 years old. The series consisted of two femurs and one tibia with an average discrepancy of 4.3 centimeter. All the patients had an axial malunion deformity due to a previous trauma. One patient had a coxa-valga of 161 degrees with the opposite side of 126 degrees; another patient had a coxa-vara of 150 degrees with the contraleteral side of 136 degrees; and the third one a tibia-vara of 15 degrees.

Technique: An osteotomy was performed to correct the described deformity and then the segment was stabilized with plate and screws. A longer plate than needed to fix the osteotomy was chosen. A new, transverse osteotomy was done distal to the last fixing screw. An external fixator was now set in the anteroposterior plane. A traditional callotasis technique was used to restore the limb-length. At that point, the remaining empty holes from the plate were filled with screws to the distal aspect of the segment and the fixator was removed.

Results: Limb-length discrepancy as well as the axial deformity was both corrected in the three patients. The external fixation time averaged 70 days. The external fixator index was of 0.54 months/centimeter with a union time of 1.13 months/centimeter.

Conclusion: In order to reduce fixator time, limb-lengthening over a plate is an alternative treatment in those cases where an intramedullary nail cannot be used.

Minimally Invasive Tibial Naiing - Does it Avoid the Patella Tendon?

Mr. Gunasekaran Kumar, MS Orth, FRCS Glasg (Tr&Orth); Mr. Badri Narayan, MS Orth, MCh Orth, FRCS (Tr&Orth); Royal Liverpool University Hospital, Liverpool, United Kingdom

Purpose: Anterior knee pain is a common complication following tibial nailing. One of the possible causes for anterior knee pain is patella tendon damage. An open approach for tibial nail entry portal can help identify and protect the patella tendon but incurs a longer incision. The aim of this study was to assess whether a standardised reproducible technique of minimally invasive tibial nailing violated patella tendon.

Method: A consecutive series of 25 patients with isolated tibial shaft fractures underwent tibial nail fixation via a minimally invasive technique. None of these patients had any previous tibial pathology. Under general anaesthesia, the injured limb was placed over a triangle. Patella and patella tendon were identified and surface marking done. Line A (Fig 1A) was drawn along the long axis of the tibial shaft which was identified by placing a guide wire on the skin anteriorly and checking under fluoroscopy. Line A was extended proximally to the level of patella. A 3 – 4cm incision was made about 2 – 3cm proximal to the knee joint line (Fig 1B). Dissection of tissues was performed down to the entry portal. Tibial entry point was made and routine tibial nailing was performed.

In obese patients where patella tendon could not be palpated, tibial tuberosity and patella were identified and surface markings made. Then, two lines were drawn on either side of tibial tuberosity to the inferior pole of patella and this served as a marker for patella tendon.

Results: In all the cases Line A was medial to medial border of patella tendon. Deep dissection in all cases showed that patella tendon was not violated. None of the operations required extension of the wound. BMI (Body Mass Index) was from 22 to 48. Obesity did not cause

any difficulties in performing this minimally invasive technique.

Conclusion: Patella tendon is not violated in the described minimally invasive tibial nailing technique. Smaller incision and with no dissection through the patella tendon has potential for reduced post operative pain and there is no concern about damaging the patella tendon.



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Reducing Fractures: Have You Thought of Using Ultrasound? *Manish Gaur, MCEM; York Hospital NHS Trust, York, United Kingdom*

Purpose: Wrist fracture is a common presentation in an Emergency Department [ED]. It is difficult to predict whether an acceptable position has been achieved until the post manipulation x-rays are done. We aim to evaluate adequacy of reduction in patients who had ultrasound [US] guided fracture manipulation.

Methods and Materials: A pilot study conducted in ED. Convenience sample of closed wrist fractures with no neurovascular deficit was recruited. All patients had US-guided reduction. Adequacy of reduction and the total time took to complete the procedure were measured. Radiographs and ultrasound images after manipulation were compared.

Results: 100% success rate was achieved in all ten patients. Mean age of the sample was 60.1 (21-97) years, 50% were male. Average time to reduce the fracture using ultrasound was 5.9 minutes. There was no complication observed in any patient. Ultrasound provided real time dynamic images during the procedure when the linear probe was used in longitudinal and transverse planes. Hence the 100% result. See figures below comparing ultrasound image with radiograph.



Conclusion: Ultrasound is a hand held, portable, non invasive and radiation free tool. It saves time, facility, indirect cost and reduces re-manipulation rate. This all contributes towards improved quality vare. Well designed prospective randomised control study needed to evaluate the usefulness of ultrasound.



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RESEARCH AWARD LEVELS

| 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 |
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| Telephone Number | | |
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| e-mail address | | |
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| 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 27th Annual Meeting of the Orthopaedic Trauma Association has been planned and implemented in accordance with the Essential Areas and policies of the Accreditation Council for Continuing Medical Education through the joint sponsorship of the American Academy of Orthopaedic Surgeons and the Orthopaedic Trauma Association. The American Academy of Orthopaedic Surgeons is accredited by the ACCME to provide continuing medical education for physicians.

The American Academy of Orthopaedic Surgeons designates this live activity for a maximum of **20** *AMA PRA Category* **1** *Credits*[™]. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

FDA STATEMENT

Some drugs or medical devices demonstrated at this 27th 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 27th 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 27th Annual Meeting are printed in **boldface**.

As an accredited provider of continuing medical education CME, the Academy and OTA are required by the Accreditation Council for Continuing Medical Education (ACCME) to obtain and share with participants of an OTA CME activity any potential conflicts of interest by faculty, program developers and CME planners.

The ACCME Standards of Commercial Support, Standard 2 states the requirements:

- 2.1 The provider must be able to show that everyone who is in a position to control the content of an education activity has disclosed all relevant financial relationships with any commercial interest to the provider.
- 2.2 An individual who refuses to disclose relevant financial relationship will be disqualified from being a planning committee member, a teacher, or an author of CME, and cannot have control of, or responsibility for the development, management, presentation or evaluation of the CME activity.

The AAOS disclosure policy requires that faculty submit all financial relationships occurring within the past 12 months that create a potential conflict.

Each participant in the Annual Meeting has been asked to disclose if he or she has received something of value from a commercial company or institution, which relates directly or indirectly to the subject of their presentations.

Authors who completed their financial disclosures have identified the options to disclose as follows:

- n. Respondent answered 'No' to all items indicating no conflicts;
- 1. Royalties from a company or supplier;
- 2. Speakers bureau/paid presentations for a company or supplier;
- 3A. Paid employee for a company or supplier;
- 3B. Paid consultant for a company or supplier;
- 3C. Unpaid consultant for a company or supplier;
- 4. Stock or stock options in a company or supplier;
- 5. Research support from a company or supplier as a PI;
- 6. Other financial or material support from a company or supplier;
- 7. Royalties, financial or material support from publishers;
- 8. Medical/orthopaedic publications editorial/governing board;
- 9. Board member/committee appointments for a society.

An indication of the participant's disclosure appears after his/her name in the alphabetical listing along with the commercial company or institution that provided the support.

The Academy and OTA do not view the existence of these disclosed interests or commitments as necessarily implying bias or decreasing the value of the author's participation in the meeting.

 Δ Indicates presentation was funded by a grant from the Orthopaedic Trauma Association.

Cameras or video cameras may not be used in any portion of the meeting.

OTA MANDATORY DISCLOSURE POLICY FOR GOVERNANCE GROUPS AND CONTINUING MEDICAL EDUCATION CONTRIBUTORS

PHILOSOPHY

In order to promote transparency and confidence in the educational programs and in the decisions of the Orthopaedic Trauma Association (hereinafter collectively referred to as "OTA"), the OTA Board of Directors has adopted this mandatory disclosure policy.

The actions and expressions of Fellows, Members, and Others providing education of the highest quality, or in shaping OTA policy, must be as free of outside influence as possible, and any relevant potentially conflicting interests or commercial relationships must be disclosed. Because the OTA depends upon voluntary service by Fellows, Members, and Others to conduct its educational programs and achieve its organizational goals, this disclosure policy has been designed to be realistic and workable.

The OTA does not view the existence of these interests or relationships as necessarily implying bias or decreasing the value of your participation in the OTA.

OBLIGATION TO DISCLOSE

Each participant in an OTA CME program or author of enduring materials, and members of the OTA Board of Directors, Committees, Project Teams or other official OTA groups (collectively "OTA governance groups"), has the obligation to disclose all potentially conflicting interests.

Using a uniform form approved by the OTA Board of Directors, participants are responsible for providing information to the OTA (the OTA will accept either disclosure forms submitted directly to the OTA, or disclosure information submitted through the AAOS on-line Disclosure Program). Participants are responsible for the accuracy and completeness of their information. In addition, participants who disclose via the AAOS on-line Disclosure Program have an obligation to review and update their personal information in the AAOS Orthopaedic Disclosure Program at least semiannually (usually April and October). It is recommended that participants note any changes to the AAOS Orthopaedic Disclosure Program as soon as possible after they occur.

Failure of a required participant to disclosure will result in the participant being asked not to participate in the OTA CME program and OTA governance groups.

A list of all participants in OTA CME programs and OTA governance groups, along with their disclosures, will be included in all meeting materials.

Participants in OTA governance groups have an obligation to indicate any potential conflicts they may have during discussions affecting their personal interests during the meeting of the OTA governance group. At each meeting of the OTA governance group, members of the group will be reminded that full disclosure must be made of any potential conflict of interest when a matter involving that interest is discussed.

The chair of the governance group shall also have the prerogative of requesting a participant to provide further information or an explanation if the chair identifies a potential conflict of interest regarding that participant. Based on the information provided in the OTA Orthopaedic Disclosure Program and/or upon a further review, the chair of the OTA governance group may determine that the participant shall:

Disclose the conflict and continue to participate fully in the OTA governance group's deliberations

Disclose the conflict, but abstain from discussing and voting on the matter; or

Disclose the conflict and leave the room until the matter has been fully discussed and acted upon.

If one of the latter two actions is taken, it should be reflected in the minutes of the OTA governance group's meeting.



THE DATES...

October 4 - 6, 2012 Minneapolis, Minnesota, USA Robert A. Probe, MD, OTA 2012-2013 President

Pre-Meeting Courses: October 3 - 4, 2012 **Basic Science Focus Forum** International Orthopaedic Trauma Care Forum Masters Level Trauma Coding Course

Comprehensive Fracture Course for Residents October 3 - 6, 2012



Minneapolis Convention Center - Photo courtesy of 'Meet Minneapolis.'

Why Join the OTA?

• Education

Learn the latest techniques for the management of complex orthopaedic trauma patients from leading orthopaedic trauma educators. The OTA offers educational opportunities for:

- Residents
- Fellows
- Young Practitioners
- Mid Senior level orthopaedic surgeons

*** Scholarships offered for most resident and fellows programs. See the OTA website for details and a course calendar. ***

• Research

OTA Members are eligible to apply for trauma research grants, participate in multi-center studies, subscribe to a trauma registry, and conduct and access OTA member research surveys.

Member Services

Take advantage of the many OTA member services.... residency core curriculum lectures, trauma evidence-based resource list, trauma fellowship match, *Fracture Lines* newsletter, *Journal of Orthopaedic Trauma (JOT)* subscription, orthopaedic trauma discussion forum and list-serve, mentoring programs, resident & fellows career web resources, orthopaedic trauma position statements, coding resources web page, community trauma reference page, and much more...

- **Professional Development and Leadership Opportunities** With over 25 committees and project teams, the OTA offers a multitude of leadership opportunities.
- Health Policy & Practice Management

The OTA affords orthopaedic trauma surgeons a platform to both shape and learn of health policy and practice management issues and solutions.

| What Does Your Membership Buy? Discounted Annual Meeting Registration * Journal of Orthopaedic Trauma (JOT) Society Newsletter | Member Savings: Value: Value: | \$ \$ \$ | 600 515 75 | |
|---|-------------------------------------|----------------|------------------|--|
| Irauma Registry Database | Value: | \$ | 225 | |
| | Total Value: | \$ | 1,415* | |
| Being a part of the OTA community * <i>Total based on active membership dues of</i> \$600. OTA Membership Dues | | Pri | celess | |
| Active/Research/Senior Membership | | | 600 | |
| Community/Associate | | | 500 | |
| Candidate | | | | |
| International | | | | |
| Allied Health | | | | |
| ** does not include JOT subscription | | | | |