International Orthopaedic Trauma Care Forum

October 15, 2014

Tampa Convention Center
Tampa, Florida, USA

Program Chair:
Peter V. Giannoudis, MD

7.5 AMA PRA Category 1 credits™
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(as of July, 2014)
Welcome to the International Orthopaedic Trauma Care Forum.

Wednesday, October 15, 2014

Peter V. Giannoudis, MD, Program Chair
William G. DeLong Jr, MD, Saqib Rehman, MD, Amir M. Matityahu, MD, Program Committee

Attendees of this activity can earn up to 7.5 AMA PRA Category 1 Credits™

Objectives

Attendees of the International Orthopaedic Trauma Care Forum will:

- Learn about the varied methods of treating fracture and trauma complications from around the world
- Understand the pros and cons of getting involved in humanitarian orthopaedic care overseas
- Increase knowledge and understanding of global clinical research
- Become familiar with unique approaches to fractures around the knee joint treated in Brazil

Program

7:00 am - 7:30 am
Registration and Continental Breakfast

7:30 am
Introduction
William G. DeLong Jr, MD
Peter V. Giannoudis, MD

7:35 am - 8:05 am
Symposium I
Trauma Care Systems-An Update
Moderator: Saqib Rehman, MD
Panelists: Christopher G. Moran, MD, FRCS
João Antonio Matheus Guimarães, MD

8:05 am - 10:10 am
Paper Session 1
Femoral and Pelvic Injuries
Moderators: Saqib Rehman, MD
Amir M. Matityahu, MD

8:05 am (p. 10)
Outcome of Femoral Fractures in Post-Poliomyelitis Patients
Yoram A. Weil, MD;
Yechiel N. Gellman, MD;
Amal Khoury, MD; Rami Mosheiff, MD;
Meir Liebergall, MD
Hadassah Hebrew University, Jerusalem, Israel

8:13 am (p. 11)
Atypical Femoral Fractures Associated with Bisphosphonate Use: A Case Series and Discussion on Surgical Treatment
Andrew Riddick, FRCS (ORTH0), MBBS;
Tom Fleming;
Michael Kelly, MBBS, MD, FRCS (Ortho);
Mehool R. Acharya, MD
Frenchay Hospital, Bristol, United Kingdom

8:21 am (p. 12)
Periprosthetic Cortical Bone Remodeling in Patients with Osseo-Integrated Leg Prosthesis
Lisanne M. Haket, MSC;
Jan Paul M. Frölke, MD, PhD;
Nico J.J. Verdonschot, MSC;
Paweł K. Tomaszewski, MSc;
Henk van der Meent, MD, PhD;
Radboud University Medical Center, Nijmegen, The Netherlands

8:29 am
Discussion

8:44 am (p. 13)
Predictors of Intraoperative Fractures in Uncemented and Cemented Hip Hemiarthroplasty for the Treatment of Intra Capsular Neck of Femur Fractures
Nayef Aslam-Pervez; Fahad Hossain;
Mohamed A. Musa; Jan L. Marciniak;
Shiva Gopal;
Hull Royal Infirmary, Hull, United Kingdom

8:52 am (p. 14)
Are Dislocations Following Hip Hemiarthroplasty a Predictor of Increased Mortality?
Michalis Panteli, MD; Tasos Lampropoulos, MD;
Peter Giannoudis, MD, FRCS;
Academic Unit of Trauma and Orthopaedics, University of Leeds, Leeds, United Kingdom

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<tr>
<th>Time</th>
<th>Paper</th>
<th>Title</th>
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<tr>
<td>9:00 am</td>
<td>Paper</td>
<td>The Longevity and the Complication Rates of Proven Cemented Taper-Slip Femoral Stem Hemiarthroplasties in Fracture Neck of Femur Patients: Exeter Trauma Stem as an Example</td>
<td>Salah Hammouche, MRCS; Catherine Holt, PhD; Jonathan Phillips, FRCS; Brigitte Scammell, DM; Christopher G. Moran, MD; Nottingham University Hospital, Nottingham, United Kingdom</td>
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<td>9:08 am</td>
<td></td>
<td>Discussion</td>
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<td>9:13 am</td>
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<td>Break</td>
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<tr>
<td>9:33 am</td>
<td>Paper</td>
<td>Time to Surgery is Not a Risk Factor for Complications in Garden 3 and 4 Femoral Neck Fractures Treated with Cannulated Screws</td>
<td>Kodl Kojima, MD, PhD; Jorge Silva, MD, PhD; Marcos Leonhardt, MD, PhD; Fernando Brandão, MD, PhD; Tales Guimaraes, MD; University of São Paulo, São Paulo, Brazil</td>
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<td>9:41 am</td>
<td>Paper</td>
<td>Microvascular Function Following Open (DHS) Versus Less Invasive (PCCP) Extramedullary Fixation of Intertrochanteric Hip Fractures</td>
<td>Matthias Knobe, MD, MSc; Gertraud Gradl, MD; Franziska Böhle; Hagen Andruszkow, MD; Klemens Horst, MD; Frank Hildebrand, MD, MSc; Hans-Christoph Pape, MD; Department of Orthopaedic Trauma, RWTH Aachen University, Aachen, Germany</td>
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<td>9:49 am</td>
<td>Paper</td>
<td>Low-Energy Pelvic Fractures of the Elderly Population: Clinical/Radiological Outcome and Associated Prognostic Factors</td>
<td>Tess Greven, MSc; Jack Henry Gilmore; Robert M. West, MSc; Arie B. Van Vugt, PhD; Peter V. Giannoudis, MD; Nikolaos K. Kanakaris, MD; 1Medisch Spectrum Twente, Enschede, The Netherlands; 2Academic Department of Trauma and Orthopaedics, Leeds University, Leeds, United Kingdom; 3Department of Biostatistics, University of Leeds, Leeds, United Kingdom</td>
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<tr>
<td>9:57 am</td>
<td>Paper</td>
<td>Outcome Following Fixation of Comminuted Quadrilateral Plate Fracture: Single Surgeon’s Experience</td>
<td>Theodoros Tosounidis; Sunibabu Gudipati, MBBS, MRCS; Nikolaos K Kanakaris, MD; Peter V. Giannoudis, MD University of Leeds, Leeds, United Kingdom</td>
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<tr>
<td>10:05 am</td>
<td></td>
<td>Discussion</td>
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See pages 67 - 72 for financial disclosure information.
**Paper 15**

**Inhaled and Oral Corticosteroids in Chronic Lung Disease Patients with Ankle Fractures: Effect on Fracture and Wound Healing**

Waseem Jerjes, MD, PhD; Peter V. Giannoudis, MD
Academic Unit of Trauma and Orthopaedics, University of Leeds, Leeds, United Kingdom

**11:07 am**

**Paper 16**

**Posterior Malleolar Fracture Patterns**

Lukas Mangnus, MD; Diederik Meijer, MSc
Jos J. Meilema, MD; Sjoerd A. Stufkens, MD
Ernst P. Steller, MD, PhD; Peter Kloen, MD, PhD
Gino Kerkhoffs, MD, PhD
Job N. Doornberg, MD, PhD
1 Academic Medical Center, Amsterdam, The Netherlands;
2 Sint Lucas Andres Ziekenhuis, Amsterdam, The Netherlands

**11:15 am**

**Paper 17**

**Treatment of Deltoid Ligament Injuries in Ankle Fracture: Should it Be Repaired or Not?**

Ting Li, MD; Xie-yuan Jiang, MD; Manyi Wang, MD
Xu Sun, MD; Ming-hui Yang, MD
Department of Orthopaedics and Traumatology, Beijing Jishuitan Hospital, Peking University 4th Hospital, Beijing, China

**11:31 am**

Discussion

**11:36 am**

Lunch

**12:30 pm – 2:02 pm**

**Paper Session III:**

**Basic Science and Fracture Healing Complications**

Moderators: William G. DeLong Jr, MD; Hans-Christoph Pape, MD

**12:30 pm**

**Paper 18**

**What is the Cell Composition and Characteristics of Fibrous Tissue Harvested from the Nonunion Site of Long Bone Atrophic Nonunions?**

Richard J. Cuthbert, BSc; Ahmed Lotty;
Hiang Boon Tan, MBBS; Elena Jones, PhD
Peter V. Giannoudis, MD
1 University of Leeds, Leeds, United Kingdom;
2 Mansoura University, Mansoura, Egypt

**12:38 pm**

**Paper 19**

**Predictors for Nonunion, Reoperation and Infection after Surgical Fixation of Patellar Fracture**

Assaf Kadar, MD; Haggai Sherman, MD
Ely L. Steinberg, MD
Orthopaedic Trauma Unit, Tel Aviv Sourasky Medical Center, Tel Aviv, Israel

**12:46 pm**

**11:30 am**

**Paper 20**

**Multipotent Stromal Cell Abundance in Cellular Bone Allograft: Comparison with Fresh Age-Matched Iliac Crest Bone and Marrow Aspirate**

Thomas G. Baboolal, PhD; Sally A. Boxall, PhD
Yasser El-Sherbiny, MBBS, MSc, PhD
Timothy A Moseley;
Richard Cuthbert, BSc;
Peter V. Giannoudis, MD; Elena Jones, PhD
1 University of Leeds, Leeds, United Kingdom;
2 NuVasive Inc, San Diego, California, USA

**12:46 pm**

**Discussion**

**12:54 pm**

**Paper 21**

**The Free Vascularized Medial Femoral Condyle Corticocancellous Flap for Treatment of Challenging Upper Extremity Nonunions**

Wu Fei, MD; Xing Danmou, MD; Ren Dong, MD
Feng Wei, MD; Kyle R. Eberlin, MD; Chen Yan, MD;
Kan Wusheng, MD
1 Department of Hand Surgery and Microsurgery, Affiliated Pu Ai Hospital of Tongji Medical College of Huazhong University of Science and Technology, Wuhan City, People's Republic of China;
2 Division of Plastic Surgery, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts, USA

**12:59 pm**

**Paper 22**

**Long Bone Defects Managed with the Induced Membrane Technique: Treatment Protocol and Clinical Outcomes**

Peter V. Giannoudis, MD
Suribabu Gudipati, MBBS, MRCS;
Paul J. Harwood, MD; Nikolaos K. Kanakaris, MD
University of Leeds, Leeds, United Kingdom

**1:07 pm**

**Paper 23**

**Tibial Plateau Fractures: Will I Need a Knee Replacement?**

Eleanor Davidson, MB, CHB;
William M. Oliver, MBBS;
Timothy O. White, MD, FRCS;
John F. Keating
Orthopaedic Trauma Unit, Royal Infirmary of Edinburgh, Edinburgh, United Kingdom

**1:15 pm**

**Paper 24**

**Hormone Replacement Therapy in Proximal Humerus Fracture Patients: Effect on Fracture Severity and Fracture Healing**

Waseem Jerjes, MD, PhD
Peter V. Giannoudis, MD
Academic Unit of Trauma and Orthopaedics, University of Leeds, Leeds, United Kingdom

**1:23 pm**

**Paper 25**

**Are Individuals with TNF-β NCO1 Polymorphism at a Higher Risk of Developing Postoperative Sepsis?**

Rajeshwar N. Srivastava; Kavita Baghel; Saloni Raj;
KG Medical University, Lucknow, India

See pages 67 - 72 for financial disclosure information.
1:39 pm  Paper 26
(p. 36)
A Simple Technique for the Correction of Coxa
Vara Deformity With the Use of a SIGN
Intramedullary Locking Nail
Henry T. Ndasi MD; Dr. Levis Nguku, MD, FCS;
1Baptist Hospital Mutengene, Cameroon, West Africa;
2Cure International Children’s Hospital, Kijabe, Kenya

1:47 pm  Discussion

2:02 pm –
3:20 pm
Guest Nation Symposium
Fractures Around the Knee Joint
Introduction: William G. DeLong Jr, MD

2:05 pm
Brazil – Distal Femoral Fractures: What to Do with the Difficult
Multifragmented Fracture Patterns
Daniel Balbachevsky, MD

2:20 pm
US – Comminuted Patella Fractures: Is There an Ideal Method of Treatment?
Andrew H. Schmidt, MD

2:35 pm
Brazil – Posterior Shearing Tibial Plateau Fractures: My Preferred Method of Treatment
Paulo Barbosa, MD

2:50 pm
Brazil – Floating Knee Injuries: How Can We Optimize the Outcome?
João Antonio Matheus Guimarães, MD

3:05 pm  Discussion

3:20 pm  Break

Combined Basic Science Focus Forum
and International Symposia
Global Clinical Research:
Bigger Data-Bigger Problems

3:45 pm –
4:50 pm
Symposium 4
Bigger Data-Bigger Problems?
(p. 38)
Moderators: Mohit Bhandari, MD, PhD
Gerard P. Slobogean, MD, MPH, FRCSC

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

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

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

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

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

4:40 pm  Discussion

4:50 pm –
5:30 pm
Paper Session IV
International Research Studies
Moderators: Mohit Bhandari, MD, PhD
Gerard Slobogean, MD, MPH

4:50 pm
INORMUS Invited Paper
(p. 39)
Trauma Worldwide Data Set
Mohit Bhandari, MD, PhD

4:56 pm  OTA BSFF Paper 22
Changing the System: Improving Outcome from Major Trauma by Developing a National System of Regional Major Trauma Networks
Christopher G. Moran, MD, FRCS(Ed);
Maralyn Woodford; Fiona Lecky, FRCS, MSc, PhD;
Antoinette Edwards, BA;
Timothy Coats, MBBS, FRCS, MD;
Keith Willett, MD, FRCS;
NHS England, Nottingham University Hospital, Nottingham, United Kingdom;
Trauma Audit and Research Network, University of Manchester, Manchester, United Kingdom;
NHS England, Oxford, United Kingdom

5:02 pm  OTA BSFF Paper 23
Increased Systemic Complications in Open Femoral Shaft Fractures Are Associated with the Degree of Soft-Tissue Injury Rather Than New Injury Severity Score (NISS) Values — A Nationwide Database Analysis
Christian D. Weber, MD; Rolf Lefering, PhD;
Thomas Dienstknecht, MD; Philipp Kobbe, MD, PhD;
Richard M. Sellei, MD; Frank Hildebrand, MD, PhD;
Hans-Christoph Pape, MD, PhD, FACS;
Trauma Registry of the German Trauma Society;
RWTH Aachen University Medical Center, Department of Orthopedic Trauma, Aachen, Germany;
Institute for Research in Operative Medicine (IFOM), University of Witten/Herdecke, Cologne-Merheim Medical Center, Cologne, Germany

5:08 pm  OTA BSFF Paper 24
Anatomic Region and the Risk of Adverse Events in Orthopaedic Trauma: An Analysis of 19,000 Patients
Cesar S. Molina, MD; Rachel V. Thakore, BS;
Eduardo J. Burgos, MD;
William T. Obremskey, MD, MPH, MMHC;
Manish K. Sethi, MD;
Vanderbilt University, Nashville, Tennessee, USA

5:14 pm  Discussion

5:30 pm  ADJOURN TO INTERNATIONAL RECEPTION

See pages 67 - 72 for financial disclosure information.
Int’l Poster #1
(p. 43)
Early Prediction of Tibial and Femoral Fracture Healing: Are We Reliable?
Emily Skuyer, MD; Greg Dikos, MD; David Kaehr, MD; Dean Maar, MD; Renn Crichlow, MD; Ortho Indy Trauma, St. Vincent’s Trauma Center, Indianapolis, Indiana, USA

Int’l Poster #2
(p. 44)
Long-Term Follow-up of Patella Fractures in the Elderly
Eleanor Davidson, MB, CHB; Andrew Duckworth, MSc, MRCSEd; Timothy White, MD, FRCS; Orthopaedic Trauma Unit, Royal Infirmary of Edinburgh, Edinburgh, United Kingdom

Int’l Poster #3
(p. 45)
Subtrochanteric Femoral Fractures Treated With Intramedullary Fixation: Our Institutional Experience
Michalis Panteli, MD; Jonathan Lamb, MBBS; Peter Giannoudis, MD, FRCS; Academic Unit of Trauma and Orthopaedics, University of Leeds, Leeds, United Kingdom

Int’l Poster #4
(p. 46)
Factors Affecting Overall Mortality After Hip Fractures
Yechiel Gellman, MD, MSc; Josh E. Shroeder, MD; Amal Khoury, MD; Rami Mosheiff, MD; Meir Liebergall, MD; Yoram A. Weil, MD; Hadassah Hebrew University Hospital, Jerusalem, Israel

Int’l Poster #5
(p. 47)
Posteromedial Tibial Plateau Fracture Characteristics
Rik J. Molenaars, MSc; Job N. Doornberg, MD, PhD; Jos J. Meijer, MD; Peter Kloen, MD, PhD; Department of Orthopaedic Surgery, Academic Medical Center; Orthotrauma Research Center, Amsterdam, The Netherlands

Int’l Poster #6
(p. 48)
Electromagnetic Navigation: A New Technique for Minimally Invasive Iliosacral Screw Placement?
Miguel Pishnamaz, MD1; Hong Na1; Max Janssen1; Christoph Wilkmann, Dipl Ing2; Prof Thomas Schmitz-Rode2; Hans-Christoph Pape, MD1; 1University of Aachen Medical Center, Aachen, Germany; 2Institute of Applied Medical Engineering, Helmholtz Institute of RWTH Aachen University, Aachen, Germany

Factors Influencing the Accuracy of Percutaneous Iliosacral Screw Positioning: A Cohort Study
Miguel Pishnamaz, MD; Thomas Dienstknecht, MD; Barbara Hoppe; Christina Garving, MD; Philipp Kobbe, MD, PhD; Hans-Christoph Pape, MD; University of Aachen Medical Center, Aachen, Germany

Virtual Transsacral Implant Positioning Is Critical in S1 Whereas in S2 a Transsacral Corridor Always Is Present
Daniel Wagner, MD1; Lukas Kamer, MD2; Takeshi Sawaguchi, MD3; Hansruedi Noser, PhD1; Pol M. Rommens, MD1; Centre of Orthopaedics and Trauma Surgery, University Medical Center Mainz, Mainz, Germany; AO Research Institute Davos, Davos, Switzerland; Department of Orthopedics & Joint Reconstructive Surgery, Toyama Municipal Hospital, Toyama, Japan

A New Definition of Polytrauma: Results From an International Consensus Process and a Database Analysis
Hans-Cristoph Pape, MD, FACS1; Rolf Lefering, MD2; Nerida Butcher, MD3; Andrew Peitzman, MD4; Luke Leenen, MD1; Ingo Marzi, MD2; Philipp Lichte, MD1,7; Christoph Josten, MD6; Bertil Bouillon, MD6; Uli Schmucker, MD9; Philip F. Stahel, MD10; Peter V. Giannoudis, MD11; Zsolt J. Balogh, MD, PhD3; 1Department of Orthopaedics/Trauma, Aachen University Medical Center, Aachen, Germany; 2Institute for Research in Operative Medicine, IFOM, University of Witten, Herdecke, Germany and Department of Orthopaedics at Cologne, Merheim, Germany; 3Department of Traumatology, John Hunter Hospital and University of Newcastle, Newcastle, New South Wales, Australia; 4Department of Surgery, University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA; 5Department of Trauma, Utrecht University, Utrecht, The Netherlands; 6Department of Trauma, Hand, and Reconstructive Surgery, J. W. von Goethe University, Frankfurt, Germany; 7Harald Tschern Lab for Orthopaedic Trauma, Aachen, Germany; 8Department of Orthopaedic Trauma, University of Leipzig, Leipzig, Germany; 9AUC - Academy for Trauma Surgery, Munich, Germany; 10Department of Orthopaedic Surgery, Denver Health Medical Center, Denver, Colorado, USA; 11Department of Trauma, Academic Unit of the University of Leeds, Leeds, United Kingdom

See pages 67 - 72 for financial disclosure information.
Int'l Poster #10 (p. 52)  
Predicting Multiple Organ Failure Following Major Trauma: Clinical Variable Models in the First 48 hours After Injury  
Lynn Hutchings, MRCS\textsuperscript{1,2}; Peter Watkinson, MD\textsuperscript{1,2}; Duncan Young, DM\textsuperscript{1,3}; Keith Willett, FRCS\textsuperscript{1,2};  
\textsuperscript{1}Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, University of Oxford, Oxford, United Kingdom;  
\textsuperscript{2}Kadoorie Centre for Critical Care Research, University of Oxford, Oxford, United Kingdom;  
\textsuperscript{3}Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom; 

Int'l Poster #11 (p. 53)  
Treatment of Exposed Fractures of the Tibia: A Comparative Study Between Biplane External Fixator and Locked Intramedullary Nail  
Fabio Lucas Rodrigues, MD; André Valente Lage, MD; Rafael da Costa Pereira Cestari, MD; Pedro Pohl, MD; Gabriel Ferraz, MD; Faculdade de Medicina ABC, São Paulo, Brazil

Int'l Poster #12 (p. 54)  
Effect of Chronic Heavy Smoking on Proximal Humerus Fracture Healing  
Waseem Jerjes, MD, PhD; Peter V. Giannoudis, MD; Academic Unit of Trauma and Orthopaedic Surgery, School of Medicine, University of Leeds, Leeds, United Kingdom

Int'l Poster #13 (p. 55)  
Decision-Making in Displaced Fractures of the Proximal Humerus: Fracture- or Surgeon-Based?  
Gertraud Gradl, MD\textsuperscript{1}; P. Valentin Neuhaus, MD\textsuperscript{1}; Matthias Knobe, MD\textsuperscript{1}; Thierry Guitton, MD\textsuperscript{1}; David Ring, MD\textsuperscript{1}; Martin F. Hoffmann, MD\textsuperscript{1};  
\textsuperscript{1}Department for Trauma and Reconstructive Surgery, University of Aachen Medical Center, Aachen, Germany; \textsuperscript{2}Hand and Upper Extremity Service, Department of Orthopaedic Surgery, Massachusetts General Hospital, Boston, Massachusetts, USA; \textsuperscript{3}Department of Orthopaedic Surgery, Academic Medical Center Amsterdam, Amsterdam, The Netherlands

Int'l Poster #14 (p. 56)  
Treatment of Floating Knee Injuries  
Professor Shahabuddin, MBBS, FCPS (Ortho)\textsuperscript{1}; Faseeh Shahab, MBBS\textsuperscript{1}; Lewis G. Zirkle, MD\textsuperscript{1};  
\textsuperscript{1}Lady Reading Hospital, Peshawar, Pakistan; \textsuperscript{2}Rehman Medical Institute, Peshawar, Pakistan; \textsuperscript{3}SIGN Fracture Care International, Richland, Washington, USA

Int'l Poster #15 (p. 57)  
Anchor Suture Fixation of Distal Pole Fractures of the Patella: 27 Cases and Comparison to Partial Patellectomy  
Assaf Kadar, MD; Haggai Sherman, MD; Ely L. Steinberg, MD; Orthopaedic Trauma Unit, Tel Aviv Sourasky Medical Center, Tel Aviv, Israel

Int'l Poster #16 (p. 58)  
Elastic Stable Intramedullary Nailing in Pediatric and Adolescent Forearm Fractures: Analysis of 210 Patients  
Marcel Dudda, MD; Christiane Kruppa, MD; Pamela Bunge, MD; Thomas A. Schildhauer, MD; Department of Surgery, University Hospital Bergmannsheil, Ruhr-University of Bochum, Bochum, Germany

Int'l Poster #17 (p. 59)  
Systematic Review of Complications of Percutaneous Iliosacral Screw Fixation of Traumatic Pelvic Fractures  
Mehool R. Acharya, MBChB, FRCSOrth; Daniel Yeomans; Pelvic and Acetabular Reconstruction Unit, Frenchay Hospital, Bristol, United Kingdom

Int'l Poster #18 (p. 60)  
Proximal Third Tibia Fractures: Do We Really Need Retropatellar Nailing?  
Alexander N. Chelnokov, MD; Dmitry A. Bekreev, MD; Orthopaedic Trauma, Ural Scientific Research Institute of Traumatology, Ekaterinburg, Russia

Int'l Poster #19 (p. 61)  
The Association Between Body Mass Index and the Severity of Proximal Humerus Fractures: Effect on Fracture Union and Soft-Tissue Healing  
Waseem Jerjes, MD, PhD; Peter V. Giannoudis, MD; Academic Unit of Trauma and Orthopaedic Surgery, School of Medicine, University of Leeds, Leeds, United Kingdom

Int'l Poster #20 (p. 62)  
Biomechanical Evaluation of a Variable Angle Locked Periprosthetic Femur Plate System Using Three Different Options of Fixation  
Martin F. Hoffmann, MD\textsuperscript{1,2,3}; Travis A. Burgers, PhD\textsuperscript{1}; Debra L. Sietsema, PhD\textsuperscript{1,2}; Clifford B. Jones, MD\textsuperscript{1,3};  
\textsuperscript{1}Van Andel Research Institute, Grand Rapids, Michigan, USA; \textsuperscript{2}Grand Rapids Medical Education Partners, Grand Rapids, Michigan, USA; \textsuperscript{3}Orthopaedic Associates of Michigan, Grand Rapids, Michigan, USA; \textsuperscript{4}Department of Surgery, BG-University Hospital Bergmannsheil, Ruhr University Bochum, Bochum, Germany

Int'l Poster #21 (p. 63)  
Guesstimation of Posterior Malleolar Fractures on Plain Lateral Radiographs  
Diederik T. Meijer, MSc; Job N. Doornberg, MD, PhD; Wouter H. Mallee, MD, Gino Kerkhoffs, MD, PhD; C. Niek van Dijk, MD, PhD; Sjoerd A. Stufkens, MD; Academic Medical Center, Amsterdam, The Netherlands

See pages 67 - 72 for financial disclosure information.
Options of Fixator-Assisted Internal Fixation in Periprosthetic Femoral Shaft Fractures
Alexander N. Chelokonov, MD; Igor M. Piven1; Igor L. Shlykov, PhD, ScD2; Konstantin I. Piastopulo3; Leonid N. Solomin, MD, PhD4; Alexey Semenisty, MD, PhD5; 1Ural Scientific Research Institute of Traumatology and Orthopaedics, Ekaterinburg, Russia; 2Vreden Russian Research Institute of Traumatology and Orthopedics, St. Petersburg, Russia; 3City Hospital N13, Moscow, Russia

Treatment of Extra-Articular Open Tibial Fractures
Hyung Keun Song, MD; Department of Orthopaedic Surgery, Ajou University School of Medicine, Suwon, Korea

Role of Autologous Bone Marrow–Derived Mononuclear Cells as a Synergetic Aid in Neurological Recovery in Spinal Cord Injury
Rajeshwar N. Srivastava, MS; Tulika Chandra, MD; Ashok Agrahari, MSc; Abhishek Agarwal, MS; Saloni Raj; KG Medical University, Lucknow, Uttar Predesh, India

Congratulations to the 2014 OTA/SIGN Scholarship Winners:
Hilario M. Diaz, MD
Southern Philippines Medical Center
Davao City, Philippines

Henry Ndasi, MD
Baptist Hospital Mutengene
Cameroon, West Africa

See pages 67 - 72 for financial disclosure information.
Symposium I: Trauma Care Systems - An Update

7:35 am - 8:05 am

Moderator: Saqib Rehman, MD
Panelists: Christopher G. Moran, MD, FRCS
           João Antonio Matheus Guimarães, MD
Paper Session I: Femoral and Pelvic Injuries

8:05 am  Paper 1

Outcome of Femoral Fractures in Post-Polio Myelitis Patients

Yoram A. Weil, MD; Yechiel N. Gellman, MD; Amal Khoury, MD; Rami Mosheiff, MD; Meir Liebergall, MD

Hadassah Hebrew University, Jerusalem, Israel

Background/Purpose: Poliomyelitis (polio) was prevalent in certain parts of the world in the 1950s. As post-polio patients age, low-energy proximal, shaft, and distal femoral fractures are becoming more common in this population. Unique problems include altered bony anatomy affecting reduction and conventional implant placement. Impaired bone quality and muscle strength pose significant challenges in the postoperative rehabilitation in this special population. Very little is known in the existing literature about the outcome of post-polio patients following lower extremity fracture surgery. The aim of the study was to describe the outcome of femoral fractures in post-polio patients.

Methods: A retrospective analysis of all femoral fractures in polio patients between the years 1990 and 2011 was performed. A total of 68 post-polio patients were admitted to our center with femoral fractures involving the affected (paretic) extremity. The patient charts and radiographs were surveyed for demographic information, fracture types, fracture treatment, and functional outcome. Fractures were classified according to the AO/OTA classification. All surgeries were performed by fellowship-trained trauma surgeons.

Results: The female-to-male ratio was 1.7:1. The average age on injury was 59.4 years and the average hospital stay was 11 days. The most common mechanism of injury was low-energy trauma (85%). More than half of the fractures were at the proximal femur (OTA 31A), 30% at the distal metaphysis (OTA 31C) and the rest shaft fractures (OTA 31B). A total of 53 patients underwent operative treatment, while 15 patients were treated nonoperatively. The vast majority of proximal fractures (95%) were operatively treated while 48% of the distal fractures and 36% of the shaft fractures were treated nonoperatively. Operative fixation techniques varied with individual cases and consisted of sliding hip screw systems or cannulated screw fixation for proximal fractures, intramedullary nail and plate fixation for more distal fractures. Five cases of proximal fractures required reoperations due to hardware failure while one shaft and one distal fracture required hardware removal after fracture healing. 23 out of 45 (51%) regained their preoperative ambulatory function at the final follow-up. Almost all patients with either proximal or midshaft femoral fractures who avoided weight bearing on their affected extremity did not regain their preinjury ambulatory status. All patients with distal femur fractures managed to return to the preinjury ambulation. No correlation was found between fracture types to postinjury ambulation.

Conclusion: Femoral fracture management in post-polio patients remains problematic with a high complication rate in proximal fractures. Return to preinjury ambulatory status is guarded in many cases. Postoperative non-weight-bearing status harbors a worse prognosis in post-polio patients with femoral fractures.
Atypical Femoral Fractures Associated with Bisphosphonate Use: A Case Series and Discussion on Surgical Treatment

**Andrew Riddick, FRCS (ORTHO), MBBS; Tom Fleming; Michael Kelly, MBBS, MD, FRCS (Ortho); Mehool R. Acharya, MD**
Frenchay Hospital, Bristol, United Kingdom

**Purpose:** Atypical fractures of the proximal femur associated with long-term bisphosphonate use are a rare occurrence but are associated with high rates of complications and reoperation. The aim of this study was to review all patients treated for atypical proximal femoral fractures in our unit over a 4-year period and study the time to union and reoperation rate.

**Methods:** Patients who had suffered an atypical pattern proximal femoral fracture in our unit over a 4-year period (2009-2013) were identified from a prospectively collected database. Radiographs were reviewed to determine the accuracy of reduction, type of fixation, and any augmentation used. Follow-up radiographs and clinical notes were then reviewed to determine progression to bony union (separated to medial and lateral union). Any failure of fixation or revision surgery was also noted.

**Results:** 18 primary operations were identified in 16 patients. Six procedures were excluded due to the location of the fracture, early death, or prophylactic procedures. Of the 12 remaining procedures (0.38% of proximal femoral fractures in our unit over the same period), only 50% achieved full union at 2 years. Complete union after primary operation took an average of 295 days (range, 82-524) and lateral union took 167 days longer than medial union. Revision surgery was necessary in 42% (n = 5) of patients for nonunion with or without implant failure.

**Conclusion:** These rare fractures occur in patients with multiple comorbidities and currently have an unacceptably high revision rate. We describe a novel aggressive initial surgical management, excising the nonunited stress fracture via a valgus subtrochanteric osteotomy and fixation with an anterolateral tension band plate over a dynamically locked cephalomedullary nail. This strategy is based on optimizing the biological and mechanical environment to maximize the chance of union following primary surgical intervention.
Periprosthetic Cortical Bone Remodeling in Patients with Osseo-Integrated Leg Prosthesis
Lisanne M. Haket, MSC; Jan Paul M. Frölke, MD, PhD; Nico J.J. Verdonschot, MSC; Pawel K. Tomaszewski, MSc; Henk van der Meent, MD, PhD; Radboud University Medical Center, Nijmegen, The Netherlands

Background/Purpose: Stress shielding in periprosthetic bone may lead to decrease of cortical bone resulting in periprosthetic fractures and insufficient bone stock for future revision surgery when indicated. We sought to quantify the effect of osseointegrated prosthesis on periprosthetic bone changes and skeletal remineralization for safety purposes.

Methods: All consecutive patients from 2009-2012 with transfemoral (1 bilateral) or through-knee amputation who underwent implantation of osseointegrated femoral leg prosthesis were included in this study. Periprosthetic cortical thickness was analyzed from standard AP radiographs taken directly postoperative, and at 12 months and 24 months follow-up. All measurements were performed by one researcher. According to validated methods, the area around the implant was divided into 6 zones of equal length (3 medial and 3 lateral) and the periprosthetic cortical thickness was digitally measured in the middle of each zone and corrected for radiologic distortion. Dual x-ray absorptiometry (DXA) scans were used to measure bone mineral density (BMD) at the femoral neck of healthy and amputated leg before surgery and at 12 and 24 months follow-up. Outcomes were analyzed by the two-sided paired Student t-test in SPSS software. This study was approved by the institutional ethical committee.

Results: 27 patients (6 female, 21 male) with 25 transfemoral (1 bilateral) and 2 through-knee amputations with 12 to 24 months follow-up, who underwent implantation of osseointegrated femoral leg prostheses, were eligible to participate in the study. The mean age at ILP implantation was 48 years (range, 23-68). One amputation was caused by infection, four by tumor, and 22 by trauma. The average time between amputation and treatment with ILP was 18 years (range, 2-45). Significant increase of the mean cortical thickness of all 6 zones was found at 12 and 24 months follow-up. The largest increase of cortical thickness, 18.60%, was observed in the distal medial periprosthetic zone ($P = 0.016$) with a mean increase of 9.44% of all 6 zones ($P = 0.001$). There was no significant increase of the BMD of the femoral necks as measured by DXA scans.

Conclusion: Instead of bone resorption, which has been suggested by mathematical model calculations regarding periprosthetic stress shielding, significant periprosthetic cortical bone growth was observed in patients with a femoral osseointegrated leg prosthesis. No additional risk of periprosthetic fractures is to be expected with sufficient bone stock for future revision surgery when indicated.
Predictors of Intraoperative Fractures in Uncemented and Cemented Hip Hemiarthroplasty for the Treatment of Intracapsular Neck of Femur Fractures
Nayef Aslam-Pervez; Fahad Hossain; Mohamed A. Musa; Jan L. Marciniak; Shiva Gopal; Hull Royal Infirmary, Hull, United Kingdom

Background/Purpose: Cemented hemiarthroplasty is the gold standard for treatment of intracapsular hip fractures. Uncemented hemiarthroplasty is considered to be associated with a high rate of intraoperative fracture (IOF) although there is a paucity of information regarding this. Proximal morphological indices such as the Metaphyseal Diaphyseal Index (MDI) and Canal Bone Ratio (CBR) have been implicated as determinants of IOF. The aim of our study was to evaluate the rate of IOF in uncemented and cemented hemiarthroplasty. We also aim to ascertain preoperative predictors of IOF.

Methods: A retrospective review of intracapsular hip fractures using the National Hip Fracture Database was undertaken in a regional high-volume major trauma center. We identified 626 patients who underwent hemiarthroplasty using either a contemporary hydroxyapatite (HA)-coated uncemented or cemented prosthesis. After exclusion of patients with erroneous and incomplete data, 472 patients were available for analysis. We collected patient demographic data, surgeon grade, time to surgery, and operative duration. Radiographs for all patients were analyzed by three independent assessors to measure the MDI and CBR. Univariate and multivariate analysis was undertaken to identify preoperative predictors of IOF in hemiarthroplasty.

Results: There were 10 (6.7%) and 23 (7.1%) IOFs in cemented and uncemented groups, respectively. There was no statistically significant difference with respect to cement usage, surgeon grade, operative duration, MDI and CBR, and time to surgery between patients with an IOF compared to those that did not. The subsidence rate was 3.4% in the uncemented group. MDI and CBR did not help predict subsidence. Multivariate regression analysis identified age as the strongest predictor of IOF after hemiarthroplasty surgery (overall relative risk [RR] = 1.06; 95% confidence interval [CI] 1.01-1.12). Subgroup analysis of the uncemented cohort alone also revealed age as the strongest predictor (RR = 1.06; 95% CI 1.00-1.13). There was no significant difference in revision (P = 0.9), dislocation (P = 0.058) and 30-day mortality (P = 0.8) between patients receiving an uncemented or cemented hemiarthroplasty.

Conclusion: We found no difference in the rate of IOF between uncemented and cemented hemiarthroplasty. Increasing age is the strongest preoperative risk factor for IOF in hip hemiarthroplasty surgery. The contemporary HA-coated uncemented hemiarthroplasty can be safely used without increasing the risk of IOF in the treatment of fragility hip fractures. Cemented hemiarthroplasties are known to be associated with intraoperative morbidity related to cement insertion in the elderly.
Are Dislocations Following Hip Hemiarthroplasty a Predictor of Increased Mortality?

Michalis Panteli, MD; Tasos Lampropoulos, MD; Peter Giannoudis, MD, FRCS;
Academic Unit of Trauma and Orthopaedics, University of Leeds, Leeds, United Kingdom

Purpose: The aim of our study was to evaluate the incidence, characteristics, and mortality risk of patients sustaining a dislocation of a hip hemiarthroplasty.

Methods: This is a case series of patients who presented in our institution with one or more episodes of hip hemiarthroplasty dislocation within 2 years from the initial hip operation. Patients having their dislocations reduced at the emergency department, dislocations with an associated implant infection, and patients with dislocations following polytrauma were excluded from the study. All primary hemiarthroplasty procedures were performed on a lateral position and through a lateral incision. Implant selection was based on the physiological age of the patient, life expectancy, preexisting disease, quality-of-life demands, anticipated functional demands, psychological/mental status, bone and joint quality, as well as the surgeon’s preference. Following reduction of the hip the stability was confirmed and the wound was closed accordingly. Check radiographs were taken 48 hours postoperatively. Dislocations were reduced with a closed reduction in theater and under general anesthetic. Image intensifier was utilized to confirm reduction. Prosthesis stability was checked and documented. The following parameters were collected and evaluated: (1) patient demographics, (2) mechanism of injury, (3) type of implant, (4) type of dislocation, (5) complications, and (6) mortality rate. The patients were followed up only in case of complications or repeated dislocations.

Results: Over a 3-year period, out of 881 hip hemiarthroplasties performed in our institution, 31 patients (10 male) had at least one episode of dislocation. The mean age at time of first dislocation was 81.6 years (median, 81.5 years; range, 65-95). The average time between the hemiarthroplasty and the first dislocation was 32.5 weeks (median, 3.3 weeks). The average number of dislocations was 2.3 per patient (median, 2; range, 1-6 dislocations). All dislocations were a result of a mechanical fall and 16 patients had a background of impaired mental capacity. 15 patients underwent an excision arthroplasty as a result of their repeated dislocations. During the same period of time, we identified the patients who died during their initial hospitalization following the hip hemiarthroplasty operation. Out of a total of 81 patients, 7 had sustained a dislocation. The two groups (dislocation vs. no dislocation) were matched in terms of gender, length of hospital stay, and comorbidities. Age was found to be significantly lower in the dislocation group ($P = 0.02$). Although there was a trend that patients in the dislocation group died closer to their initial hip operation, it was not statistically significant ($P = 0.06$). However, this failure to reach significance might be secondary to a type II statistical error. The risk ratio of mortality following a dislocation while still in hospital was 2.30 (95% confidence interval, 1.14-4.65).

Conclusion: This study demonstrates that dislocations in the immediate postoperative period following a hip hemiarthroplasty represent a predictor of increased mortality. In particular, the inpatient mortality was found increased more than twofold.
The Longevity and the Complication Rates of Proven Cemented Taper-Slip Femoral Stem Hemiarthroplasties in Fracture Neck of Femur Patients: Exeter Trauma Stem as an Example

Salah Hammouche, MRCS; Catherine Holt, PhD; Jonathan Phillips, FRCS; Brigitte Scammell, DM; Christopher G. Moran, MD; Nottingham University Hospital, Nottingham, United Kingdom

Background/Purpose: Hip fractures are a major health problem among the elderly, with Europe and the United States having the highest hip fracture rates globally. Displaced intracapsular fracture is often treated surgically with hemiarthroplasty (HA). Recent guidelines about HA configurations advocate the use of femoral stem designs that are “tested and proven” within total hip replacement configurations. The Exeter Trauma Stem (ETS) HA is based on the well-proven Exeter total hip replacement design. This is a prospective survival analysis study to assess the long-term complication rates of these cemented taper-slip femoral HAs in the management of displaced intracapsular femoral neck fractures.

Methods: At our center, data on all hip fracture patients are prospectively collected by independent audit officers using the Hip Fracture Standardised Audit Proforma in Europe. The database is linked to the Office of National Statistics and includes post discharge mortality. It is cross-matched with independently collected database for periprosthetic fractures and revision hip surgery. There is only one emergency room within a well-defined geographical area ensuring excellent follow-up of complications. In bilateral fractures, overall survival was calculated from the time of the first fracture. Death was considered the only event in overall survival analysis. Deep infection, dislocation, loosening, periprosthetic fracture, and revision were considered implant failure events.

Results: Between 2005 and 2013, 6250 consecutive hip fractures were treated at our institution; 1123 were treated with an ETS (36 patients had bilateral ETS for sequential fractures). Patient characteristics were: mean age 82 years; 70% females, 72% with abbreviated mental test ≥7. Follow-up period ranged between 0 days and 8 years. Median overall patient survival time following the first ETS operation was 4.5 years. Out of the 1123 implanted ETS, only 29 implants failed. All failure events were reported within the first year. The risk of implant failure was 2.8% at year 8. The risk of implant dislocation was 1%, the risk of periprosthetic fracture was 0.5%, and the risk of deep infection was 1.1% for year 1 up to year 8. The number of failures was too small to perform Cox multivariate analysis to identify failure risk factors.

Conclusion: The ETS HA has a low implant failure rate. We conclude that using an HA prosthesis based on proven cemented taper-slip total hip replacement design leads to a low failure rate.
**Paper Session I: Femoral and Pelvic Injuries**

9:33 am Paper 7

**Time to Surgery Is Not a Risk Factor for Complications in Garden 3 and 4 Femoral Neck Fractures Treated With Cannulated Screws**

*Kodi Kojima, MD, PhD; Jorge Silva, MD, PhD; Marcos Leonhardt, MD, PhD; Fernando Brandão, MD, PhD; TalesGuimarães, MD;*  
*University of São Paulo, São Paulo, Brazil*

**Purpose:** In femoral neck fractures, osteosynthesis is indicated in patients younger than 70 years, where the complications are more related to the fixation than the general systemic condition. In this study the authors have analyzed various factors that would correlate with failure of the fixation or osteonecrosis. The objective was to evaluate the correlation between the time to surgery and the occurrence of complication.

**Methods:** From January 2009 to December 2010 there were 31 patients with femoral neck fractures Garden types 3 and 4 treated with reduction and fixation with cannulated screws, with minimum follow-up of 2 years. They were analyzed according to the time to surgery, days in the hospital, Pauwels classification, Singh classification for osteoporosis, surgical time, and the Garden index for reduction (considered normal between 155° and 180°). The binary variables (gender, Garden classification, and side) were analyzed with the c² test and odds ratio. The Singh and Pauwels classification were analyzed with c². The other variables were analyzed with logistic regression and odds ratio (OR). The confidence interval (CI) was 95% (P < 0.05). The association between complications and the variables were verified with Fisher test and Pearson coefficient.

**Results:** The mean age of the population was 64.6 years (range, 46-76 years). There were 20 male patients (64.5%) and 11 female (35.5%). Fifteen fractures (48%) were on the right side and 16 (52%) on the left. 16 patients (52%) were considered as type 3 in Singh classification for osteoporosis, 10 patients (32%) were type 4, and 5 patients (16%) were type 5. In the fracture classification, 20 patients (64.5%) were Garden type 3 and 11 (35.5%) were Garden type 4; according to Pauwels classification there were 3 (10%) type 1, 18 (58%) type 2, and 10 (32%) type 3 fractures. The mean time between fracture and surgery was 8 days (range, 3-18 days). The mean hospitalization time was 13 days (range, 5-23 days). The time of surgery varied from 45 to 220 minutes; the mean time was 100 minutes. Five patients (16%) had unsatisfactory reduction on the AP view and 3 patients (10%) had unsatisfactory reduction on the lateral view after surgery, according to the Garden index. Four patients (13%) had complications on the follow-up period and they were: one infection, one failure, one non-union, and one osteonecrosis. The analysis of the correlation between time to surgery and complication showed no association (OR 1.01, 95% CI 0.76-1.35, P = 0.931). The only variable that correlated with complication was varus reduction measured by the Garden index (P = 0.00016, Pearson 0.878).

**Conclusion:** There was association between the time to surgery and complication. The only variable that showed correlation with failure was varus reduction.
Microvascular Function Following Open (DHS) Versus Less Invasive (PCCP) Extramedullary Fixation of Intertrochanteric Hip Fractures
Matthias Knobe, MD, MSc; Gertraud Gradl, MD; Franziska Böhle; Hagen Andruszkow, MD; Klemens Horst, MD; Frank Hildebrand, MD, MSc; Hans-Christoph Pape, MD;
Department of Orthopaedic Trauma, RWTH Aachen University, Aachen, Germany

Background/Purpose: The dynamic hip screw (DHS) is one of the most widely used implants for fixation of intertrochanteric hip fracture and serves as a benchmark in this field. In elderly patients, however, high rates of surgical site infection have been reported due to extensive soft-tissue compromise associated with the open approach. The angular stable percutaneous compression plate (PCCP) may represent a less-invasive alternative. This pilot study aims to evaluate microvascular function and quantify soft-tissue damage in the region of the proximal femur following less invasive and open treatment of intertrochanteric fractures.

Methods: After IRB approval, investigators prospectively investigated local microvascular function in 25 patients (12 DHS, 13 PCCP) prior to and following fixation of an intertrochanteric femoral fracture (8, 24, 48, 96 hours). We used lightguide tissue spectrophotometry, in combination with laser Doppler fluxmetry to determine local blood flow (LF) and oxygen saturation (SO₂) at the proximal femur. Measurements were performed in two different penetration depths at 2 mm as a measure of skin blood flow and oxygenation and at 8 mm as a measure of superficial muscle and adipose tissue blood flow and oxygenation. Differences between groups were analyzed with the Mann-Whitney U test. A p value <0.05 was considered statistically significant.

Results: We enrolled 25 patients (15 females, 10 males), with an average age of 74 years. Patients in the DHS group showed significantly higher flow values and lower SO₂ values compared with patients in the PCCP group (DHS: flow 30 AU vs. PCCP 21 AU; p = 0.049; AU = arbitrary unit). This difference was particularly marked 8 hours after the operation and was maintained until the final measurement after 4 days. Local flow and oxygen saturation were significantly higher in the muscle layer compared with the superficial skin layer in both groups (p < 0.001). There was a strong correlation between flow and SO₂ parameters (p < 0.001). Age, blood pressure, body mass index, and sex showed no correlation with flow or SO₂.

Conclusion: There is a significant difference in local microvascular function following an open versus a less invasive approach to the proximal femur. Less invasive percutaneous compression plating seems to be advantageous in terms of soft-tissue compromise. O2C spectrophotometry is a reliable tool for simultaneous evaluation of microvascular skin blood flow and oxygenation and might allow new insights into the pathophysiology of tissue breakdown associated with different surgical approaches.
Low-Energy Pelvic Fractures of the Elderly Population: Clinical/Radiological Outcome and Associated Prognostic Factors

Tess Greven, MSc; Jack Henry Gilmore; Robert M. West, MSc; Arie B. Van Vught, PhD; Peter V. Giannoudis, MD; Nikolaos K. Kanakaris, MD

1 Medisch Spectrum Twente, Enschede, The Netherlands; 2 Academic Department of Trauma and Orthopaedics, Leeds University, Leeds, United Kingdom; 3 Department of Biostatistics, University of Leeds, Leeds, United Kingdom

Background/Purpose: The incidence of low-energy pelvic fractures in the elderly population increases, and their treatment can be challenging. Comorbidities, decreased bone quality, fracture fixation limitations, and often poor compliance to mobilization restrictions represent some of the specific difficulties in their management. Early multidisciplinary input, focused rehabilitation, as well as recent evidence of fracture healing enhancement due to the use of antiosteoporosis medication, have been investigated in similar fragility fracture cohorts. Our objective was to compare the impact of: the use of different antosteoporotic drug therapies over the period of fracture healing (clinical and radiological), the utilization of a specific clinical pathway (SOP [standard operating procedure] protocol), and different combinations of pelvic ring disruptions to the clinical and radiological outcome of a group of elderly patients with low-energy pelvic fractures.

Methods: A retrospective cohort study of elderly patients (>65 years) referred to and/or admitted to a large trauma center during the period 2010-2012 with fragility pelvic fractures was performed. High-energy fractures, pure acetabular fractures, associated trauma affecting mobility, pathological pelvic lesions, and incomplete documentation were used as exclusion criteria. Patient characteristics (demographics, comorbidities/Charlson index, drug history, and anatomic classification of pelvic fractures [Nakatani, Hannover, Dennis, Rommens/Hofmann FPF systems]) were collected. Primary end point was the time to healing, both radiological and clinical. Secondary end points included length of stay, return to preinjury mobility, union status, mortality, and complications. Patient outcomes were analyzed between groups based on use of antiosteoporotic medication and groups based on following or not the SOP. Multivariate regression analysis was used to determine prognostic factors.

Results: The study cohort (132/209) included 108 females (108/132; 81.8%) and 24 males (18.2%) with a mean age of 85.8 years (SD 7.9; range, 67-108). Under the SOP there were 67, 51% of the whole group, and 108 (82%) were under some form of antosteoporotic treatment during their healing phase. In-hospital early deaths were recorded in 9% and overall mortality within 6 months was 33%. Use of antosteoporotic medication was significantly associated with a shorter time of healing (P = 0.036). Patients who followed the protocol showed a significant protection against malunion (P < 0.001), which was consistent when looking at overall radiological union outcome (P = 0.039). Also, patients following the SOP were more likely to return to their preinjury mobility status with a large variety in combinations of anterior and posterior pelvic ring fractures (missed on plain imaging by 67%), identified via CT/MRI scan (performed in 124, 94%).

Conclusion: The use of antosteoporotic medication in elderly patients with fragility pelvic fractures was associated with faster healing, while the adherence to a structured clinical pathway with less malunion/nonunion and return to preinjury mobility state. An accurate diagnosis via early imaging (CT scan) can direct clinicians on decision-making and guide rehabilitation of these patients.
Paper Session I: Femoral and Pelvic Injuries

9:57 am Paper 10

Outcome Following Fixation of Comminuted Quadrilateral Plate Fracture: Single Surgeon’s Experience

Theodoris Tosounidis; Suribabu Gudipati, MBBS, MRCS; Nikolaos Kanakaris, MD; Peter V. Giannoudis, MD;
University of Leeds, Leeds, United Kingdom

Purpose: The aim of the current study was to assess the functional outcome following fixation using a spring plate in a cohort of consecutive patients treated in our institution.

Methods: This is a retrospective review of data inserted prospectively to the departmental database of pelvic and acetabular reconstruction cases over an 8-year period. Inclusion criteria were adult (>16 years) patients with quadrilateral plate fractures and a minimum follow-up of 2 years. Open fractures, pathological lesions, fractures with associated metabolic bone diseases, and also cases with incomplete data were excluded. Patients’ characteristics, fracture pattern (Judet and Letournel classification), associated injuries, operative details, complications both intra- and postoperatively, regular follow-up with both radiological and functional assessment using Harris hip scores and Matta’s radiological grading of arthritis were collected at the latest follow-up.

Results: Overall 35 patients were eligible for the study (28 males) with a mean age of 50.1 years (range, 16-79). 45.8% of patients had an isolated acetabular fracture, while the rest had one or more associated injuries. Most common fracture pattern was the associated both-column in 40%, followed by equal distribution of anterior column-hemitransverse and T-shaped fractures (20% each). The most common mechanism of injury was road traffic accident (54%), followed by fall from height (31.4%). The mean period of time from the accident to surgery was 8 days (range, 0-24 days). Patients with associated severe head trauma waited the longest. All fractures were treated operatively via an ilioinguinal approach using spring plates. The mean duration of the surgical procedures was 2 hours and 15 minutes (range, 2-4.5 hours). All patients were mobilized as toe-touch weight bearing for 8-12 weeks following the surgical fixation of the acetabulum. The mean duration of follow-up was 38 months (range, 24-87 months). At the final follow-up 3 patients (8.5%) had undergone a total hip arthroplasty (THA) after a minimum period of 1 year follow-up. Two patients died from causes unrelated to the acetabular trauma. The mean Harris hip score at the final follow up was 89.2. (range, 57.9-100). Matta grading was excellent in 31.4%, good in 45.7%, fair in 2.85%, and poor in 14.3%. Of the 5 patients who had poor Matta grading, 3 were converted to a THA and the other 2 are mobilizing with walking aids and minimal pain. The patient who scored the minimum also had associated severe spinal trauma. All of them were able to perform normal activities without difficulty and 3 patients over 60 continue to ride their pushbikes.

Conclusion: Open reduction and internal fixation of acetabular fractures with involvement of the quadrilateral plate/medial wall using a spring plate has been found to be effective in reducing the risk of posttraumatic arthritis and maintaining the joint congruity.
Symposium II: Orthopaedic Care Overseas: Get Involved!

10:10 am - 10:30 am

Moderators:  Amir M. Matityahu, MD
Panelists:  Christopher T. Born, MD
            Hilario (Larry) Diaz, MD, Philippines
            Henry Ndasi, MD, Cameroon
            Lewis G. Zirkle Jr, MD

Humanitarian Efforts Abroad: Pearls and Pitfalls of Getting Involved in Humanitarian Orthopaedic Care Overseas
The Perceptions of Kenyan Orthopaedic Surgeons Regarding the Role of Visiting Foreign Orthopaedic Surgeons: A Qualitative Study

Luke Harmer, MD, MPH1; Jeff Mailu, MB ChB2; Rachel Seymour, PhD1;
1Carolina's Medical Center, Charlotte, North Carolina, USA;
2CURE Hospital, Kijabe, Kenya

Purpose: Orthopaedic trauma surgeons from high-income countries are increasingly choosing to visit low- and middle-income countries to teach and deliver clinical care. To our knowledge, little is understood about how these well-meaning visitors affect or are regarded by the surgeons in the host country. The purpose of this study is to understand the perceptions of Kenyan orthopaedic surgeons toward visiting orthopaedic surgeons and surgical trainees.

Methods: A questionnaire was designed using the themes identified in our literature review. This questionnaire was piloted by two Kenyan orthopaedic residents and two Kenyan orthopaedic surgeons. The questions where there was uncertainty about the meaning were edited for clarity. The length of the questionnaire was decreased following this process. The questionnaire was designed and administered in English, which is one of the official languages in Kenya. The survey asked three sets of questions. The first captured participants' demographics, training, and current practice environment. The second documented their experience and view toward international surgeons who visit their hospital. The third asked about their experience and views toward visiting international trainees. Each surgeon attending the 2012 Kenya Orthopaedic Association Annual Meeting in Malindi, Kenya was invited to complete the survey in paper format. Informed consent was obtained from each respondent and no compensation for completing the survey was offered. The data were collected and tabulated. Differences between surgeon groups were compared.

Results: 23 orthopaedic surgeons and 15 orthopaedic residents responded to the survey. Most respondents worked at the large teaching hospitals in Nairobi or the surrounding area (33/38). 70% of the surgeons had mixed private and public practices. All surgeons completed some training in Kenya with 35% (8/23) also having training abroad. Only one resident had received training outside East Africa. Kenyan surgeons and trainees hosted a median of 3.5 visiting surgeons and 1 visiting trainee each year. The surgeons stayed for a median of 2 weeks while the trainees stayed for a median of 4 weeks. Visiting surgeons were involved in a wide variety of activities, including performing common and novel operations and teaching in both the clinic and operating room settings. Visiting trainees were mostly involved with performing common operations and assessing patients in clinic. 100% of respondents felt that there was value in having surgeons visit their hospitals with 46% feeling the most valuable part of the visit was their “knowledge”. Respondents felt that visiting surgeons were a more valuable resource for themselves, the hospital staff, and patients than were visiting trainees (P < 0.001), but even so 81% of respondents felt that there was value in having trainees visit from abroad. The most commonly identified benefit was trainee education. The perception of Kenyan orthopaedic surgeons toward visiting surgeons did not correlate to the number of visiting surgeons they had hosted (P > 0.05). Kenyan surgeons and residents did not have significant differences in their responses (P > 0.05).

Conclusion: Visiting orthopaedic surgeons are perceived as a valuable resource by Kenyan orthopaedic surgeons. Knowledge transfer and education was cited as the primary benefit of having visiting surgeons. As orthopaedic trauma surgery becomes more globalized, further research is needed to understand how to design international relationships to best serve surgeons and patients around the world. Focusing on educational opportunities and the impact of learning new techniques and advances in evidence-based medicine will improve care for patients in the host countries.
Characterization of Lower Extremity Fracture Patients in Uganda
Nathan O’Hara, MHA; Jeffrey M. Potter, MD; Rodney Mugarura, MBChB, MMed; Trina V. Stephens, MSc; Piotr A. Blachut, MD; Gerard Slobogean, MD, MPH, FRCSC; 
1University of British Columbia, Vancouver, British Columbia, Canada; 
2Mulago University, Kampala, Uganda

Background/Purpose: Orthopaedic trauma is a common cause of disability in low-income countries, and is thought to disproportionately affect working-age populations. These patients often have a network of dependent individuals indirectly affected by their injury via reduced economic stability. We sought to define the socioeconomic status of patients presenting with long bone fractures of the lower extremity in Uganda, and to define the economic impact of these fractures on the individual and their dependents.

Methods: Patients admitted to Mulago Hospital over 1 month (October 2013) with long bone fractures of the lower extremities were invited to participate. This hospital is the sole tertiary care facility servicing the population of Uganda (population 34,758,809). Participants completed a questionnaire describing their socioeconomic characteristics, and injury information was collected from medical charts. Follow-up assessment was performed 6 months later (April 2014), with a repeat questionnaire. The EuroQol EQ-5D was used to estimate participants’ health status immediately prior to injury, and again at the time of follow-up.

Results: 74 patients with lower extremity long bone fractures were admitted during the study period. The majority (84%) of patients were male, ages 20-34 (43%), and in otherwise excellent health prior to injury (74% with an EQ-5D score of 1.00). On average these patients lived in a household with 4.6 other individuals, with 2.72 school-aged children per household. The most common injury was femur fracture (76%) sustained in a traffic accident (77%). 30% of fractures were open injuries. 86% of subjects were available for 6-month follow-up (2 deaths, 8 lost to follow-up). 58% had been treated operatively. There were significant changes in average EQ-5D score (0.908 vs. 0.375, \( P < 0.05 \)), and the number of subjects with active employment (86% vs. 24%, \( P < 0.05 \)). 93% of school-aged children missed school during their parent’s injury, with an average of 2.7 months missed.

Conclusion: The vast majority of lower extremity fractures in Uganda affect working-age men involved in traffic accidents. These men are responsible for the financial security of several household dependents, including school-aged children. They rely on labor-intensive employment for their livelihood, but lack financial security factors such as formal terms of employment and external sources of income. This study demonstrates that orthopaedic injury has a significant impact on the earning potential of the individual, as well as the financial health of the family unit. The findings of this study corroborate concerns highlighted in the 2004 World Health Organization report on road traffic injury prevention, and warrant further investigation.
Knee Fusion Using the SIGN Nail for Internal Fixation: Experience in Soddo, Ethiopia
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2Soddo Christian Hospital, Soddo, Ethiopia

Background/Purpose: Knee fusion is an uncommon operative procedure, although a very useful procedure when other surgical procedures are contraindicated. Serious bacterial infections with bone destruction, advanced tuberculosis of the knee, polio with flexion contracture, and severe contractures from other causes are indications for knee fusion. Complicated two-part intramedullary nails are used in the developed world for knee fusion as well as plates and external fixators. The SIGN (Surgical Implant Generation Network) nail is a simple, stable, and inexpensive implant that can be used for knee fusion and is available in many institutions in the third world.

Methods: This was a retrospective study of all patients undergoing knee fusion with a SIGN nail at our institution. In all, 6 consecutive patients (3 males, 7 knees) with an average age of 30.5 years (range, 18-50 years) underwent a fusion by the described method at our institution. Diagnoses included tuberculosis of the knee in two patients, congenital knee dislocation in two knees (one patient), and two knees with end-stage bacterial septic arthritis, and one patient with severe gout and a 90° flexion contracture. A final radiograph demonstrating intact hardware and fusion in each patient was obtained as well as a physical examination. Our surgical technique utilized a straight anterior knee incision with bone cuts made perpendicular to the axis of the knee joint. Additional bone was removed to allow the knee to approach full extension. Care was taken to avoid removing too much bone as well as avoiding the natural bone compression from a tight joint. A posterior soft-tissue release was also used to avoid excessive shortening of the bone and resulting limb-length inequality. Knees were placed in 10° of flexion and neutral coronal alignment. An entrance point 12 cm above the joint line was made on the anterior medial aspect of the femur and carefully enlarged. The canals of the tibia and femur were reamed with hand reamers. The nail was inserted, locked distally, reverse-impacted, and proximally locked. Knee immobilizers were used when there was poor bone quality and/or fixation. Weight bearing as tolerated was immediately permitted.

Results: Two of 7 patients ambulated without an aid and all knees had clinical and radiographic evidence of fusion at an average 10.7 months follow-up (range, 8-14). All patients reported improved overall physical function. There were no infections, nerve injuries, or nonunions.

Conclusion: We found in our small series with short-term follow-up that the SIGN nail is a safe and effective device for internal fixation for the purpose of knee fusion.
Microcirculation of the Healthy Hindfoot. A Proband-Study from the Perspective of the Surgical Approach
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Background/Purpose: The choice of the optimal surgical technique of intra-articular calcaneal fractures represents a surgical challenge. Despite the establishment of minimally invasive techniques and possibilities of conservative treatment, surgical treatment using the extended lateral approach represents the gold standard. In combination with a plate osteosynthesis this leads to wound complications in up to 20% of cases impairing the outcome significantly. The literature suggests a multifactorial etiology, characterized by individual patient factors. The intact dermal microcirculation is essential for wound healing without complications. The aim of this study is to detect microcirculatory parameters of the soft tissue in a healthy volunteer collective to identify the optimal approach and factors predicting microcirculation.

Methods: 125 study participants (age, 30.7 years; 76 males, 49 females; BMI [body mass index] 22.3 kg/m²; blood pressure, 124/79 mm Hg; 32 smokers, 93 nonsmokers) were included in the study and underwent analysis of the soft-tissue microperfusion of the right hindfoot in supine position using the O2C (oxygen to see, laser-Doppler/ultrafast laser spectroscopy, LEA-Medizintechnik GmbH, Giessen, Germany). Using a standardized measurement plan, 10 measurement-points were laterally and medially recorded in a penetration depth of 2 mm and 8 mm each, analyzing the blood flow and the capillary venous O₂ saturation in the blood vessels up to 100 µm.

Results: Demographic and individual variables (gender, age, systolic and diastolic blood pressure, BMI, smoking pack-years) did not show a statistically relevant prediction of microcirculation. The comparison of the superficial (2 mm) and deep (8 mm) measurements showed significant differences in favor of the deep values (SO₂ 57% vs. 42% \( P < 0.001 \); flow 122 AU vs. 25 AU \( P < 0.001 \)). Both the analysis of the superficial (2 mm) and deep (8 mm) measurements and the statistical correlation analysis between SO₂ and blood flow values showed a close correlation \( P < 0.001 \). When comparing the medial approaches the McReynolds approach was found to have significantly higher values (SO₂ and flow, \( P < 0.001 \)) in both 2 mm and 8 mm depth, whereas the descending sustentaculum approach had the lowest values \( (P < 0.001) \). On lateral hindfoot the extended lateral approach showed significantly higher SO₂ values (2 mm and 8 mm) compared to the Palmer approach showing the lowest values \( (P < 0.001) \). Focusing on the blood flow, however, the Palmer approach provided the highest values \( (P < 0.001) \). The clinically critical tissue zone connecting the vertical and horizontal part of the extended lateral approach showed significantly superior microcirculatory values \( (P < 0.001) \) in comparison to surrounding area.

Conclusion: Soft-tissue measurements of the hindfoot microcirculation show significant regional differences. The McReynolds approach provides high parameters in microcirculatory criteria on the medial hindfoot. The extended lateral approach, gold standard in the treatment of calcaneal fractures, does not show lower microcirculatory values in healthy feet despite high infectious complication rates in fracture cases. Clear factors influencing the microcirculation could not be detected. The analysis of all results shows a relevant correlation of the values for blood flow and SO₂, as well as for the superficial and deep measurements. Microcirculatory measurements in patients with calcaneal fractures are mandatory.
Inhaled and Oral Corticosteroids in Chronic Lung Disease Patients with Ankle Fractures: Effect on Fracture and Wound Healing

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Background/Purpose: Inhaled corticosteroids are commonly prescribed for patients with chronic lung disease. Long-term use of these agents leads to decrease in bone mineral density. On the other hand, the use of oral corticosteroids can, in theory, have detrimental effect on bone leading to increased fracture risk, delayed fracture healing, as well as poor wound healing. We aimed through our retrospective comparative analysis to assess the effect of inhaled and oral corticosteroids on fracture healing in patients suffering from asthma and chronic obstructive pulmonary disease (COPD).

Methods: Out of 2436 patients, 88 patients met the inclusion criteria (closed ankle fracture, surgical fixation, and known to have asthma or COPD, being treated with corticosteroids). 21 patients were asthmatic and the rest (n = 67) suffered from COPD. Oral corticosteroids were used by 12 patients, 6 of whom suffered from COPD. The rest of the cohort (n = 76) used corticosteroid inhalers. An age- and sex-matched control group (n = 88) were randomly identified and confirmed not to suffer from chronic lung disease, hormonal disorders, or on any medication that may affect bone metabolism. Both groups were also matched to their Lauge-Hansen fracture classification and surgical fixation requirements. Primary outcome factors studied were time to fracture union and wound healing. Secondary outcome factors analyzed included duration of postoperative pain, bleeding, swelling, infection, delayed union and nonunion, neurovascular impairment, and compartment syndrome. All patients were followed up for a minimum period of 24 months.

Results: The mean age of the chronic lung disease group (46 males, 42 females) was 56 years. In the control group (49 males, 39 females), the mean age was 59 years. There was significant difference in time to fracture union between the oral corticosteroid group (mean, 14 weeks; range, 13-16) when compared to both inhaled corticosteroid group (mean, 10 weeks; range, 8-10) and control group (mean, 9 weeks; range, 8-11). Inhaled corticosteroids, regardless of the dose, were not associated with delayed union or nonunion as well as delayed or poor wound healing. Asthmatic and COPD patients on oral corticosteroids suffered from delayed union when compared to both inhaled corticosteroid patients (P <0.001) and the control group (P < 0.001). Assessment of secondary outcome factors revealed that the oral corticosteroid group had slight increase in time to wound healing, wound infections, and postoperative pain when compared to inhaled corticosteroid group (P = 0.012, 0.042, and 0.021) and the control group (P = 0.013, 0.023, and 0.021), respectively.

Conclusion: Inhaled corticosteroids for asthma and COPD could not be linked to any adverse event affecting fracture union and wound healing. Oral corticosteroids were associated with an increased time to fracture union, poor wound healing, postoperative pain (registered at 4 weeks), and surgical site infection.
Background/Purpose: Quantification of three-dimensional CT (Q3DCT) is a reliable and reproducible technique to quantify and characterize ankle fractures with a posterior malleolar fragment (www.traumaplatform.org). This technique could be useful to characterize posterior malleolar fragments associated with specific ankle fracture patterns. Fixation of posterior malleolar fractures of the ankle is subject of ongoing debate. Fracture fixation is recommended for fragments involving 25%-30% of articular surface. However, these measurements—and this recommendation—are based on plain lateral radiographs only. A reliable and reproducible method for measurements of fragment size and articular involvement of posterior malleolar fractures has not been described. The aim of this study is to assess the interobserver reliability of Q3DCT modeling for fragment size and articular involvement of posterior malleolar fractures. We hypothesize that Q3DCT modeling for posterior malleolar fractures has good to excellent reliability.

Methods: To evaluate interobserver reliability of Q3DCT modeling, we included a consecutive series of 43 patients with an ankle fracture involving the posterior malleolus and a complete radiographic documentation (radiographs and CT). Fractures of the tibial plafond (pilon type fractures) were excluded. These 43 patients were divided in 3 different types (Type I, II or III) as described by Haraguchi. Five patients of each type were randomly selected for an equal distribution of articular fragment sizes. 3D models were reconstructed by (1) creating a mask for every respective slice, (2) select the appropriate dots that separate fracture from tibial shaft, (3) connect masks of each respective slice, and (4) reconstruct a 3D mesh. After reconstruction of 3D models, (1) fragment volume, (2) articular surface of the posterior malleolar fracture fragment, (3) articular surface of intact tibia, and (4) articular surface of the medial malleolus were calculated by all three observers. A summary of this technique is shown on www.traumaplatform.org. The interobserver reliability of these measurements was calculated using the intraclass correlation coefficient (ICC), which can be interpreted as the kappa coefficient.

Results: Measurements of the volume of posterior malleolar fracture fragments ranged from 357 to 2904 mm$^3$ with an ICC of 1.00 (confidence interval [CI] 0.999-1.000). Measurements of the articular surface of the posterior malleolar fracture fragment ranged from 25 to 252 mm$^2$ with an ICC of 0.998 (CI 0.996-0.999); the articular surface of the intact tibia plafond ranged from 375 to 1124 mm$^2$ (ICC 0.998, CI 0.996-0.999); and the articular surface of the medial malleolus ranged from 79 to 149 mm$^2$ (ICC 0.978, CI 0.976-0.911). The categorical ratings for all ICCs were defined as almost perfect according to the system of Landis.

Conclusion: This study showed that our Q3DCT modeling technique is reliable and reproducible to reconstruct ankle fractures, in order to assess fracture characteristics of posterior malleolar fracture fragments. Future research will focus on the association between overall ankle fracture patterns according to Lauge-Hansen, and characterization of posterior malleolar fragment morphology. We hypothesize that supination-exorotation type fractures are associated with smaller (in volume and involved articular surface) “pull-off” fragments, while pronation-exorotation type ankle fractures are associated with larger (in volume and involved articular surface) “push-off” fragments. The clinical relevance might be that smaller “pull-off” type fractures benefit from positioning screws, while larger “push-off” type fractures require direct open reduction and internal fixation of the posterior malleolar fragment.
Treatment of Deltoid Ligament Injuries in Ankle Fracture: Should it Be Repaired or Not?
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**Background/Purpose:** 20 years ago, it was common for surgeons to repair the injured deltoid ligaments at the time of fibular osteosynthesis. Then, anatomic restoration of the fibular fracture and the medial clear space without direct surgical intervention of the injured deltoid ligaments grew common. However, it was supported mostly by case series reports. The controversy has never ended. This study compared the clinical outcomes in patients with repairing the injured deltoid ligaments and patients without direct surgical intervention after anatomic restoration of the fibular fracture and the medial clear space.

**Methods:** 71 patients were followed up for average 31 months, who were diagnosed as ankle fractures associated with deltoid ligament rupture and later dislocation of talus. Among them, 33 patients were treated by deltoid ligament repairing at the time of fibular (and posterior malleolus, sometimes) osteosynthesis; 38 patients accepted no direct surgical intervention to the deltoid ligaments after anatomic restoration of the fibular fracture and the medial clear space. All the patients were evaluated with stress views intraoperatively. The outcomes were evaluated with Philips and Schwartz clinical scoring system of ankle.

**Results:** All fractures were healed without pain. In the repairing group, the mean degree of plantar flexion was 50°, with 2.5° (range, 0°-10°) less than the normal side, the mean degree of dorsiflexion was 14.5°, with 7° (range, 0°-20°) less than the normal side. In the non-repairing group, the mean degree of plantar flexion was 48.8°, with 2.8° (range, 0°-10°) less than the normal side, the mean degree of dorsiflexion was 15.4°, with 6.6° (range, 0°-20°) less than the normal side. There were no degenerative changes in all ankles. The mean Philips and Schwartz score was 92.5 (range, 85-100) in the repairing group versus 93.4 (range, 85-100) in the non-repairing group. According to the intraoperative stress views, we found that repairing of injured deltoid ligaments can reduce the talus tilt under valgus and lateral rotational stress. However, no statistically significant intergroup differences were evident in terms of clinical outcomes.

**Conclusion:** This study did not support regularly exposing and repairing the injured deltoid ligaments, since both repairing and non-repairing achieved similar results. Repairing injured deltoid ligaments may be helpful to early talus stability postoperatively.
What is the Cell Composition and Characteristics of Fibrous Tissue Harvested from the Nonunion Site of Long Bone Atrophic Nonunions?

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Background/Purpose: In a proportion of fractures, adequate stabilization is not sufficient to bring about union. Mesenchymal stromal cells (MSCs) are widely accepted as being key contributors to new bone formation following fracture and are often taken from bone marrow (BM) and used as components of autologous grafts. However, the local microenvironment of the nonunion site is poorly understood and the prevalence of MSCs at these sites is unknown. We examined material taken directly from the nonunion site in order to gain a better understanding of its cellular composition.

Methods: Patients undergoing long bone nonunion revision surgery were invited to participate (n = 8; 5 male, 3 female; mean age, 51 years; range, 22-72 years). The mean time from original fracture fixation to nonunion treatment was 14 months (range, 9-18 months). Following debridement, fibrous tissue removed from the fracture side was enzymatically digested into a single cell suspension. Flow cytometry was next used to quantify cell subsets whereas a colony forming unit fibroblast (CFU-F) assay was employed to detect MSCs. Adherent cells were also expanded in MSC culture conditions and their differentiation potential following exposure to osteogenic, adipogenic, and chondrogenic stimuli was compared to standard BM-derived MSCs. Osteogenesis was assessed by alkaline phosphatase activity and calcium accumulation, adipogenesis by oil red uptake, and chondrogenesis was measured by glycosaminoglycan (GAG) content of resulting pellets.

Results: A substantial percentage of enzymatically released cells (40%) expressed cell surface markers consistent with BM MSCs (CD90+CD73+CD45−/low); additionally 22% and 20% of cells expressed markers consistent with pericytes (CD45−CD34−CD146+) and endothelial cells (CD45−CD31+), respectively. Adherent cells from digested extracts readily formed CFU-F colonies morphologically identical to MSCs. Culture expanded cells were able to undergo trilineage differentiation and showed parity with BM MSCs with regards to calcium accumulation and GAG content.

Conclusion: Analysis of the cellular content of nonunion tissue suggests a bioactive environment, not only containing MSCs but also cells essential for blood vessel formation and maturation. The ability of enzymatically released cells to readily form CFU-F colonies in vitro and undergo trilineage differentiation confirms the presence of MSCs. The fact that the presence of these cells at the fracture site is not sufficient to induce full healing is intriguing; manipulation of the local microenvironment to maximize cell potential may reduce the need for revision surgery.
Predictors for Nonunion, Reoperation and Infection after Surgical Fixation of Patellar Fracture
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Purpose: The most common major complications following surgical fixation of patellar fractures are infection, nonunion, and reoperation. In this study, we sought to define the predisposing factors to the development of these complications.

Methods: Open reduction and internal fixation surgeries for patellar fractures that were performed in a single institution between 2006 and 2011 were retrospectively reviewed. Patient demographic data (age, gender, comorbidities), injury and fracture data (associated injuries, type of fracture, open or closed fracture), surgical data (type of surgery and interval between fracture occurrence and surgery), and major postoperative complications (infection, nonunion, symptomatic hardware, and revision surgery) were collected from the medical records and verified by a telephone survey. Correlation analysis identified the major variables influencing the development of these complications.

Results: The cohort of 188 patients had an average follow-up of 908 days. 13 patients (6.9%) developed infection, 3 (1.6%) had fracture nonunion, and 42 (22.3%) required a second operation. A history of CVA (cerebrovascular accident) correlated significantly with the development of infection (OR (odds ratio) = 6.18, CI (confidence interval): 1.1-35.6, \( P = 0.041 \)) and nonunion (OR = 14.9, CI: 1.2-188.1; \( P = 0.037 \)). A history of diabetes significantly increased the risk of a second operation (OR = 8.69, 95% CI: 1.8-41.9, \( P = 0.007 \)). Open fracture did not increase the risk of any of these complications.

Conclusion: A history of CVA and diabetes mellitus significantly increased the risk of complications following patellar fracture fixation. Patients with these comorbidities should be informed of their increased risk of these complications and be followed up more rigorously.
Multipotential Stromal Cell Abundance in Cellular Bone Allograft: Comparison with Fresh Age-Matched Iliac Crest Bone and Bone Marrow Aspirate

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Purpose: Autograft bone remains the “gold standard” for bone replacement following trauma, but it has known disadvantages associated with additional surgery. In contrast to traditional allografts totally devoid of cells, “viable” cellular bone allografts such as Osteocel (used clinically since 2005) are characterized by the selective removal of the immune cell component from the graft while preserving the osteogenic, non-immune cells. The purpose of this work was to enumerate and characterize multipotential stromal cells (MSCs) in a cellular bone allograft material, as it is used clinically, and compare with fresh age-matched iliac crest (IC) bone and bone marrow (BM) aspirate.

Methods: After IRB approval, BM aspirates (n = 16) and IC bone (n = 14) were collected from patients undergoing orthopaedic surgery and used as controls. Six Osteocel lots were used for whole genome array and 10 for other assays. MSC characterization used in vitro functional assays of differentiation and immunomodulation, confocal/scanning electron microscopy, and cell phenotyping. Native MSCs resident in Osteocel and control IC bone were enumerated by flow cytometry for the CD45−CD271+ phenotype following enzymatic extraction using collagenase.

Results: Cellular allograft material contained live osteocytes and proliferative bone-lining cells defined as MSCs by phenotypic, functional, and immunoregulation capacities. Without cultivation/expansion, the allograft displayed an “osteoinductive” molecular signature, with high-level expression of MSC- and osteoblast-specific transcripts such as osterix, osteocalcin, osteopontin, and alkaline phosphatase. The allograft material contained CD45 CD271+ MSCs that were also positive for CD73, CD90, and CD105 and similar in numbers to IC bone; however, their purity was over 100-fold higher due to the effective removal of hematopoietic cells, HLCs. In comparison to BM, MSC numbers enzymatically released from 1 g of cellular allograft were equivalent to ~45mL of BM aspirate.

Conclusion: Cellular bone allograft represents a unique non-immune material rich in MSCs and osteocytes. This osteoinductive graft therefore represents an attractive alternative to autograft bone or composite/synthetic grafts in orthopaedic trauma and broader orthopaedic settings.
The Free Vascularized Medial Femoral Condyle Corticocancellous Flap for Treatment of Challenging Upper Extremity Nonunions

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Background/Purpose: Numerous methods have been used to address fracture nonunions. Microsurgical techniques have evolved tissue management largely by applying free vascularized bone grafts.

Methods: In a retrospective study, we reviewed patients with upper limb nonunion who had undergone vascularized corticocancellous flap from the medial femoral condyle. Patient demographics, surgical technique, and outcome measurements were evaluated.

Results: 15 patients with nonunion of upper extremity underwent free vascularized corticocancellous flap reconstruction. Two patients were lost to follow-up. The other 13 patients healed in an average of 15 weeks (range, 8-22 weeks). Only one patient required additional surgery. On average 1.5 surgeries were performed prior to this last surgery. The length of bone defect ranged from 0.8-3 cm. Functional outcome measures such as Mayo, DASH (Disabilities of the Arm, Shoulder and Hand) and Constant Murley scores were all improved.

Conclusion: Free vascularized medial femoral condyle corticocancellous flap is a reliable option in tissue reconstruction over recalcitrant nonunions and small bone defects.
Long Bone Defects Managed with the Induced Membrane Technique: Treatment Protocol and Clinical Outcomes

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Purpose: This study was conducted to present our institutional experience in a cohort of patients with bone defects who were treated with the use of the induced membrane technique.

Methods: This prospective study was undertaken at a regional tertiary referral centre from January 2008-December 2012. Inclusion criteria were septic nonunion, acute fracture with bone loss, and chronic osteomyelitis treated with the induced membrane technique. Pathological fractures with bone loss were excluded. Data collection included patient demographics, pathology, previous surgical intervention, size of bone defect, time to union, and complications. The minimum follow-up was 12 months.

Results: 18 patients (15 males) with bone loss after debridement of a septic nonunion or an acute fracture met the inclusion criteria. The mean age was 50 years (range, 18-80). In 7 patients the above technique was applied following an acute fracture with bone defect while in the remaining 11 cases for management of septic nonunion. Anatomically, radius was involved in 6 patients, femur in 5 patients, tibia in 4 patients, metatarsal in 2 patients, and humerus was involved in 1 patient. All patient except one sustained grade 2 or 3 open fractures. One had chronic osteomyelitis following fracture fixation 20 years previously. The mean length of the bone defect was 5 cm (range, 2-12 cm). Two patients required additional soft-tissue coverage. In all patients both clinical and radiological healing was evident at an average of 8 months (range, 2-20 months). Functionally all of them were able to perform their daily living activities with upper limb injuries recovering to almost near normal range of motion. Two patients had 1-1.5 cm leg-length discrepancy. No evidence of reoccurrence was observed.

Conclusion: The induced membrane technique appears to be a good alternative for the management of large bone defects secondary to acute bone loss or as a result of chronic infected nonunions as seen in this series of patients. It should be considered in the surgeon's armamentarium as it is effective and is associated with a low incidence of complications.
Tibial Plateau Fractures: Will I Need a Knee Replacement?

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Purpose: Tibial plateau fractures are common intra-articular fractures. The principal long-term complication is posttraumatic osteoarthritis (PTOA) with the usual salvage procedure being total knee arthroplasty (TKA). Our aim was to define the incidence of PTOA requiring TKA following tibial plateau fractures and identify the risk factors.

Methods: We looked at all tibial plateau fractures in our catchment area between 1995 and 2008. There were 888 tibial plateau fractures. 23% were Schatzker I, 25% II, 14% III, 22% IV, 8% V, and 8% VI. To date, 25 have undergone TKA (2.8%). The mean time from fracture to arthroplasty was 27 months. 56% of the arthroplasty implants were primary, 28% complex tibial components, and 8% full revision arthroplasty.

Results: The mean age of patients at time of fracture was 56 years in the overall cohort and 65 in those requiring TKA; this was statistically significant ($P = 0.04$). 4% of females with tibial plateau fractures required TKA in comparison to 2% of males. The Schatzker I fractures were the least likely to require TKA at 1% with the most likely requiring arthroplasty surgery being type II at 6%. Only 1% of the patients treated nonoperatively later underwent TKA.

Conclusion: The overall incidence of TKA after tibial plateau fractures was 3%. For displaced fractures requiring internal fixation this rose to 4%. Risk factors were increasing age, split depression fractures, and female gender. Although tibial plateau fractures are commonly associated with degenerative radiographic changes, we concluded that the incidence of symptomatic osteoarthritis severe enough to require TKA is low.
Hormone Replacement Therapy in Proximal Humerus Fracture Patients: Effect on Fracture Severity and Fracture Healing

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Background/Purpose: The incidence of proximal humerus fractures is rising and they are mostly linked to osteoporosis in the elderly. In general, they result from low-energy trauma following a mechanical fall, and are more predominant in females. This retrospective comparative study examines the relationship between hormone replacement therapy (HRT) and severity of proximal humerus fracture among women >45 years as well as fracture healing.

Methods: Over a 5-year period, 2317 patients were treated with humerus fractures. The inclusion criteria included females of >45 years of age with good health status and no balance or mental health issues, not diabetic or suffering from neuromuscular weakness, not requiring a walking aid, and no history of falls or previous fractures. Fractures were classified as per the Neer classification system: one-part, two-part, three-part, or four-part fracture and their displacements (>1 cm or >45°). 822 patients met the inclusion criteria and mechanism of injury was a mechanical fall in 92% of the patients. 82 patients underwent surgical fixation and the rest were treated conservatively. The cohort (n = 822) was divided according to whether or not they received HRT. This was compared to the severity of the fracture and outcome of fracture and soft-tissue healing. All patients were followed up for a minimum period of 24 months.

Results:

<table>
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<tr>
<th></th>
<th>1-Part Fracture</th>
<th>2-Part Fracture</th>
<th>3-Part Fracture</th>
<th>4-Part Fracture</th>
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<tbody>
<tr>
<td>Never received HRT (n = 134)</td>
<td>5</td>
<td>28</td>
<td>28</td>
<td>73</td>
</tr>
<tr>
<td>Receiving HRT (n = 67)</td>
<td>6</td>
<td>20</td>
<td>36</td>
<td>5</td>
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<tr>
<td>Received HRT for &lt;3 years (n = 155)</td>
<td>15</td>
<td>68</td>
<td>43</td>
<td>29</td>
</tr>
<tr>
<td>Received HRT for ≥3 years (n = 466)</td>
<td>40</td>
<td>236</td>
<td>122</td>
<td>68</td>
</tr>
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</table>

Patients who never used HRT were more likely to sustain 4-part proximal humerus fracture with >1 cm displacement when compared to patients who are receiving HRT (P = 0.002) or have received HRT for <3 years (P = 0.003) or ≥3 years (P < 0.001). The surgical fixation group of patients who never received HRT (8 3-part and 39 4-part fractures) had an increased delay in fracture healing (mean 15 weeks [range, 12-15]) when compared to the surgical fixation group of patients receiving or who have received HRT (7 3-part and 28 4-part fractures) (mean 11 weeks [range, 9-12]), (P = 0.002). Further analysis revealed a significant correlation when it comes to postoperative delayed wound healing (P = 0.032), duration of postoperative pain (P = 0.03), and surgical site infections (P = 0.05). The conservatively managed group of patients who never received HRT (15 3-part and 67 4-part fractures) had an increase delay in fracture healing (mean 13 weeks [range, 9-15]) when compared to the conservatively managed group of patients receiving or who have received HRT (213 3-part and 109 4-part fractures) (mean 10 weeks [range, 8-12]; P = 0.021). Further analysis revealed a significant correlation when it comes to soft-tissue healing (P = 0.042) and duration of postoperative pain (P = 0.01).

Conclusion: Current and past use of HRT for more than 3 years appears to be associated with a reduced severity of fracture at the proximal humerus. Furthermore, these patients were less likely to suffer from delayed union and other soft-tissue problems.
Are Individuals with TNF-β NCO1 Polymorphism at a Higher Risk of Developing Postoperative Sepsis?

Rajeshwar N. Srivastava; Kavita Baghel; Saloni Raj;
KG Medical University, Lucknow, India

Background/Purpose: Postoperative sepsis remains a challenge for surgeons and clinicians as it is a significant cause of morbidity and mortality following major surgeries. Tumor necrosis factor (TNF) is believed to be a cytokine central to pathogenesis of sepsis and the TNF-β Ncol polymorphism has been found to be associated with increased mortality rate in severe sepsis. We therefore postulated that Ncol polymorphism may be associated with clinical findings and that despite comparable risk factors, postoperative sepsis develop in some patients but not in others. It has been postulated that genetic factors may have a role in etiopathogenesis of sepsis. The accurate identification of such risk factors may develop strategies to prevent these potentially devastating catastrophes. If specific diagnostic markers could be identified, surgeons may be able to predict which patient is prone to develop post operative sepsis.

Methods: The study group consisted of 153 patients undergoing major spinal surgeries. Blood samples were obtained for genomic DNA isolation. Genotyping of each patient for TNF-β polymorphism was performed by analyzing restriction fragments of an Ncol-digested DNA fragment obtained using polymerase chain reaction. All the patients were followed for 1 month following surgery for any evidence of sepsis as determined by guidelines from Bone et al.

Results: The overall allele frequency for TNF-β genotype was 0.32 for TNFB1 and 0.68 for TNFB2. In TNF-β genotype, homozygous recessive TNFB1 were 17 (11.1%), heterozygous TNFB1/TNFB2 were 63 (41.2%), and homozygous dominant TNFB2 were 73 (47.7%). 125 patients showed an uncomplicated postoperative recovery, while sepsis developed in 28 patients. Genotype distribution in patients with an uncomplicated clinical course was significantly different from that in patients with postoperative sepsis. Development of postoperative sepsis was significantly higher in patients homozygous for the allele TNFB2. When compared with patients carrying at least one TNFB1 allele, the TNFB2 homozygous genotype was associated with an odds ratio (OR) of 3.39 (P = 0.005; 95% confidence interval [CI] 1.4 to 8.3) for the development of severe sepsis. Compared with the heterozygous genotype, the OR for the homozygous TNFB2 genotype was 5.5 (P = 0.001; 95% CI 1.78 to 17.33). Although the small number of TNFB1 homozygous surgical patients makes their risk estimate less accurate, the data indicate that both homozygous genotypes possess a significantly increased susceptibility for the development of postoperative sepsis compared with the heterozygous genotype.

Conclusion: The Ncol polymorphism within the TNF-β gene influences the development of postoperative sepsis. This suggests a genetic determination of the individual inflammatory response, which significantly influences susceptibility to postoperative sepsis.
A Simple Technique for the Correction of Coxa Vara Deformity With the Use of a SIGN Intramedullary Locking Nail

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1Baptist Hospital Mutengene, Cameroon, West Africa;
2Cure International Children’s Hospital, Kijabe, Kenya

Background/Purpose: Coxa vara deformity has many causes but the treatment is essentially the same. This involves the use of a subtrochanteric osteotomy and fixation with a blade plate or screw and plate combination under real-time fluoroscopic or radiographic guidance. This equipment is expensive and not affordable in resource-limited hospitals in developing countries. The aim of this study is to demonstrate a safe, simple, effective, and affordable technique for the correction of coxa vara deformity using a SIGN (Surgical Implant Generation Network) intramedullary locking nail.

Methods: We operated seven consecutive patients presenting with coxa vara deformity using a subtrochanteric valgus osteotomy and stabilization with an intramedullary SIGN nail with image intensifier or intraoperative radiographs.

Results: All patient achieved correction of the deformity and had a neck-shaft angle >110°, and gain in leg length. One patient had a second surgery to improve on the neck-shaft angle and increase limb length. There were no complications.

Conclusion: An intramedullary locking nail can be used in the correction of coxa vara deformity to a desired angle without the need for expensive intraoperative image intensifier or radiographs. Long-term follow-up and a bigger sample size will be necessary to confirm the efficacy of this technique.
Guest Nation Symposium

2:02 pm - 3:20 pm

Fractures Around the Knee Joint

2:05 pm  Brazil – Distal Femoral Fractures: What to Do with the Difficult Multifragmented Fracture Patterns
Daniel Balbachevsky, MD

2:20 pm  US – Comminuted Patella Fractures: Is There an Ideal Method of Treatment?
Andrew H. Schmidt, MD

2:35 pm  Brazil – Posterior Shearing Tibial Plateau Fractures: My Preferred Method of Treatment
Paulo Barbosa, MD

2:50 pm  Brazil – Floating Knee Injuries: How Can We Optimize the Outcome?
João Antonio Matheus Guimarães, MD

3:05 pm  Discussion
Combined Basic Science Focus Forum and International Symposium

3:45 pm - 4:50 pm
Moderators:  Mohit Bhandari, MD, PhD
            Gerard P. Slobogean, MD, MPH, FRCSC

Global Clinical Research: Bigger Data-Bigger Problems

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

4:00 pm  NHS Database-What it Can and Cannot Do
          TBD

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

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

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

4:40 pm  Discussion
Paper Session IV: International Research Studies

4:50 pm

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

**Background/Purpose:** International evidence suggests that trauma care improves with organized trauma systems. In England, trauma care for the entire population (58.5 million) was reorganized in 2012 with the development of Trauma Networks. All hospitals in the country were designated as either Major Trauma Center (MTC; Level-1: n = 26) or Trauma Units (TU; Level-2), or Local Emergency Hospitals (LEH; Level-3). Prehospital care was also reorganized so that patients identified with major trauma were taken directly to the MTC if within 45 minutes travel time from accident. Other patients are taken to the nearest TU for resuscitation and expert triage before secondary transfer to the MTC. All Level-3 centres are bypassed. This paper reviews the early results.

**Methods:** From April 2008 until April 2014, data on 118,801 patients with an ISS >8 was prospectively collected by the national Trauma Audit and Research Network (TARN). The probability of survival was calculated using a model including ISS, age, blood pressure on arrival at hospital, and Glasgow Coma Scale (GCS). The odds ratio of survival (+95% confidence interval) was then calculated for each year and normalized to the year 2008-2009.

**Results:** From 2008 until 2011 there was a no significant change in the odds of surviving major trauma in England. However, following introduction of the Major Trauma Networks there was a significant ($P < 0.008$) 19% increase in the odds of survival during the first year of the new system and a further 17% increase in the odds of survival during the second year as the system matures so that the odds of survival for the population is now 1.36 compared to 2008. Process measures within the trauma system have shown significant increases in reception by an attending-led trauma team, more rapid intubation and CT scan, and increased use of tranexamic acid and massive transfusion protocols (all $P < 0.001$).

**Conclusion:** We believe this is the first attempt at an organized change in the system for major trauma care on a national level and covering a population of over 50 million. We have observed a significant improvement in the care process together with a significant improvement in the odds of surviving. This demonstrates that improvements seen in smaller state or regional trauma systems can be translated into a national trauma system with similar improvements for the whole population.
Increased Systemic Complications in Open Femoral Shaft Fractures Are Associated with the Degree of Soft-Tissue Injury Rather Than New Injury Severity Score (NISS) Values: A Nationwide Database Analysis

Christian D. Weber, MD¹; Rolf Lefering, PhD²; Thomas Dienstknecht, MD¹; Philipp Kobbe, MD, PhD¹; Richard M. Sellei, MD¹; Frank Hildebrand, MD, PhD¹; Hans-Christoph Pape, MD, PhD, FACS¹; Trauma Registry of the German Trauma Society;
¹RWTH Aachen University Medical Center, Department of Orthopedic Trauma, Aachen, Germany;
²Institute for Research in Operative Medicine (IFOM), University of Witten/Herdecke, Cologne-Merheim Medical Center, Cologne, Germany

Background/Purpose: In blunt high-energy trauma, the degree of soft-tissue injuries associated with femoral shaft fractures may vary. The objective of this study was to assess the impact of open versus closed soft-tissue injuries associated with femoral shaft fractures on major systemic complications and mortality after trauma.

Methods: In this prospective cohort study from a population-based trauma database, patients with femoral shaft fracture (AO/OTA-32) were divided into the following groups: closed femoral shaft fracture (CFSF) and open femoral shaft fracture (OFSF). Open soft-tissue injuries were classified according to the Tscherne classification. Data of demographic, injury, therapy, and outcome characteristics (e.g., multiple organ failure [MOF], sepsis, mortality, length of stay [LOS]) were collected and analyzed using SPSS.

Results: Data from 32,582 trauma victims were documented in a nationwide trauma registry between January 1, 2002 and December 31, 2013. Among 5761 trauma patients (NISS 30 ± 14 points), 4423 belonged to the CFSF group (77%) and 1338 belonged to the OFSF group (23%). Open fractures were separated into I° (334, 28.1%), II° (526, 44.3%), III° (309, 26%), and IV° (19, 1.6%). OFSF are associated with an increased risk for hemorrhagic shock (HS), higher resuscitation requirements, and increased in-hospital and intensive care LOS, but not with increased injury severity according to NISS, sepsis, or mortality. The prevalence of MOF, sepsis, and mortality increased with the degree of open soft-tissue injury.

Conclusion: Open femur fractures were not associated with higher injury severity scores (NISS), but with an increased risk for HS, higher resuscitation requirements, MOF, and increased length of stay (LOS). The incidence of sepsis and mortality increased with the degree of open soft-tissue injury. The treatment of OFSF seems to be more complex and time-consuming, but the risk for major clinical complications (e.g., sepsis, mortality) seems to be comparable for both groups.
Anatomic Region and the Risk of Adverse Events in Orthopaedic Trauma: An Analysis of 19,000 Patients
Cesar S. Molina, MD; Rachel V. Thakore, BS; Eduardo J. Burgos, MD; William T. Obremskey, MD, MPH, MMHC; Manish K. Sethi, MD; Vanderbilt University, Nashville, Tennessee, USA

Purpose: Little data exist exploring adverse events in orthopaedic trauma surgery. As our health-care system creates potential reimbursement implications for perioperative complications through readmission penalties, etc., it is increasingly important to turn our attention to this issue. Through the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database, we sought to compare adverse events in orthopaedic trauma procedures by anatomic region (upper extremity [UE], hip and pelvis [HP], and lower extremity [LE]) and to evaluate the impact of anatomic region on the overall rate of complications.

Methods: The ACS-NSQIP prospective database was used to identify a total of 91 CPT codes representing 19,028 orthopaedic trauma patients from 2005-2011. These patients were then divided into three anatomic regions: UE (n = 4925), HP (n = 5273), and LE (n = 8830). Perioperative minor and major complications were recorded and include wound dehiscence, superficial surgical site infection, pneumonia, urinary tract infection, death, deep wound infection, myocardial infarction, deep venous thrombosis, pulmonary embolism, peripheral nerve injury, sepsis, and septic shock. A comparison in perioperative complications between the three groups was performed using c² analysis. We used a multivariate analysis that controls for age, medical comorbidities, American Society of Anesthesiologists (ASA) status, operative time, baseline functional status, and anatomic region to evaluate risk factors for complications.

Results: A total of 19,028 orthopaedic trauma cases were divided into three anatomic regions: 25.9% (n = 4925) UE, 27.7% (n = 5273) HP, and 46.4% (n = 8830) LE. Table 1 shows the difference in age, ASA scores, and complication rates between the three groups. Statistically significant differences were identified when comparing demographics between HP and UE patients; these include the number of patients in each group over 65 years of age (85% vs. 32.2%), ASA >2 (78.9% vs. 32.4%), and diabetes (17.9% vs. 11.1%) (P = 0.01). No other variables were significantly different among the groups. After controlling for several important individual patient factors, hip and pelvis patients are nearly four times more likely to develop any perioperative complication than upper extremity patients (odds ratio [OR]: 3.79, 95% confidence interval [CI]: 3.01-4.79, P = 0.01). Also, patients in the LE group are three times more likely to develop any complication versus UE patients (OR: 2.82, 95% CI: 2.30-3.46, P = 0.01). The table shows the differences in patient age and ASA status as well as presents the overall complication rates:

Table 1. Patient Demographics/Characteristics and Rates of Complications

<table>
<thead>
<tr>
<th>Anatomic Region</th>
<th>Mean Age*</th>
<th>Mean ASA Score*</th>
<th>Complication Rate*</th>
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<tbody>
<tr>
<td>Upper extremity</td>
<td>55.4 ± 19.2</td>
<td>2.16 ± 0.77</td>
<td>3.0% (148)</td>
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<td>(n = 4925)</td>
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<tr>
<td>Hip/pelvis</td>
<td>79.3 ± 14.0</td>
<td>2.95 ± 0.67</td>
<td>19.0% (1002)</td>
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<tr>
<td>(n = 5273)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Lower extremity</td>
<td>70.2 ± 19.3</td>
<td>2.77 ± 0.77</td>
<td>14.2% (1251)</td>
</tr>
<tr>
<td>(n = 8830)</td>
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</table>

*P < 0.005

Conclusion: There is an alarming difference in complication rates among anatomic regions in orthopaedic trauma patients. Even after controlling for several variables, patients undergoing procedures to the LE are almost three times more likely to develop a complication than patients in the UE group. Those undergoing procedures to the HP are almost four times more likely to develop a complication than patients in the UE group. While some of these results are explained by age and ASA status, further studies are required to explain the impact that anatomic region has on the overall complication rate.
International Poster

Int’l Poster #1

Early Prediction of Tibial and Femoral Fracture Healing: Are We Reliable?
Emily Squyer, MD; Greg Dikos, MD; David Kaehr, MD; Dean Maar, MD; Renn Crichlow, MD;
Ortho Indy Trauma, St. Vincent’s Trauma Center, Indianapolis, Indiana, USA

Purpose: This study was undertaken to evaluate the ability of orthopaedic trauma subspecialists to predict early bony union in femoral and tibial shaft fractures in their own patient population.

<table>
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<tr>
<th>Predictions at 12 Weeks</th>
<th>Expert Review</th>
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<tr>
<td></td>
<td>Union (N)</td>
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<td>Treating surgeon</td>
<td>Predicted union</td>
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<td></td>
<td>Predicted nonunion</td>
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</table>

Methods: Eight orthopaedic trauma subspecialists (postgraduate year 8-26, mean 19.4 years) were asked to prospectively predict the probability of bony union on an aggregate of 48 femoral and tibial shaft fractures treated at a Level I trauma center at 6 and 12 weeks postoperatively. An additional fellowship-trained orthopaedic trauma surgeon (expert review) was blinded to the treating physician and adjudicated healing at 18 weeks utilizing clinical scenarios and final radiographs. The Squared-Error Skill Score (SESS) was utilized to determine the likelihood of accurate forecasting for union or nonunion. An SESS score of 0.5 is equivalent to forecasting the results of a coin toss.

Results: Nine patients were lost to follow-up, resulting in 39 fractures (81.25% retention) including 20 femoral and 19 tibial shaft fractures. 14 fractures were open (9 tibia); 15 (38.5%) were not yet united at final follow-up. SESS scores ranged from 0.25 to 0.77. The ability to predict union (sensitivity) was 1.000. The ability to predict nonunions (specificity) was 0.330 to 0.500. The probability that a predicted union was correct was 0.727. The probability that a predicted nonunion had failed to unite at final follow-up was 1.000. AO/OTA type A fracture pattern predictions were highly accurate. As body mass index increased, predictions strongly trended toward decreased accuracy ($P = 0.06$). Tobacco use, age, gender, associated injuries, open fractures, and surgeons’ years in clinical practice were not associated with accuracy of predictions.

Conclusion: Orthopaedic trauma subspecialists at 12 weeks postoperatively can predict bony union with excellent sensitivity and a high negative predictive value, but lower specificity and positive predictive values. These data can help objectify our own prognostic accuracy and decision-making process to determine if and when further surgical intervention should be taken. In our findings, progressing with interventions to promote healing of fractures not yet united at 12 weeks would have a low risk of including patients with healed fractures (false negatives).
International Poster

Int’l Poster #2

Long-Term Follow-up of Patella Fractures in the Elderly
Eleanor Davidson, MB, CHB; Andrew Duckworth, MSc, MRCSEd; Timothy White, MD, FRCS;
Orthopaedic Trauma Unit, Royal Infirmary of Edinburgh, Edinburgh, United Kingdom

Purpose: Patella fractures account for 1% of all skeletal fractures with tension band wiring the most common management option. Geriatric fractures are becoming an increasing medical problem and research suggests that all fractures in the elderly should be treated expeditiously to allow mobilization. Our aim was to define the long-term outcome of patella fractures in the geriatric population.

Methods: Using a prospective database from September 1995 to May 2010 we looked at all patella fractures in patients over 60 years old and patient-related outcome measures (PROMs) were recorded in the form of the EuroQol 5D (EQ 5D) and the Oxford Knee Score. The mean follow-up time was 9 years with a minimum follow-up of 2 years.

Results: There were 141 patients, 51% of whom were deceased at the time of follow-up. We managed to follow up 87% of the remaining patients. The mean age was 73 and 71% were females. The majority sustained their injuries by simple falls. 96% underwent primary union. 25% required removal of hardware for discomfort. 15% of the cohort were working at the time of injury with 55% having to stop working. 46% of the patients played regular sports and 48% of these were able to continue. PROMs suggested no significant difference with gender, mild problems in the knee, and no change from the UK mean in general health scores. Complications and removal of hardware did not statistically alter the outcome measures.

Conclusion: In this, the largest series of elderly patella fractures in the literature with long-term PROMs data, we found a satisfactory long-term outcome. A third of the patients required hardware removal and half of the patients who were working or playing sports at the time of injury subsequently stopped. These data allow us to better inform our patients of prognosis after patella fractures.
Subtrochanteric Femoral Fractures Treated With Intramedullary Fixation: Our Institutional Experience
Michalis Panteli, MD; Jonathan Lamb, MBBS; Peter Giannoudis, MD, FRCS;
Academic Unit of Trauma and Orthopaedics, University of Leeds, Leeds, United Kingdom

Background/Purpose: Subtrochanteric femoral fractures account for 10%-34% of all hip fractures. Because of the unique biomechanical features of the subtrochanteric region and the high concentration of stresses, their treatment is very challenging. Intramedullary fixation is favored over internal fixation due to the better load sharing and less bending forces across the fracture site and implant. However, a high rate of complications may arise, with nonunion reported as high as 20%. Our aim was to evaluate the characteristics and the outcome of subtrochanteric fractures admitted to our institution, with a special report to the development of complications.

Methods: This is a case series of patients treated in our institution for subtrochanteric femoral fractures, between January 2007 and July 2012. The fractures were classified according to AO/OTA and Seinsheimer classification. The following parameters were collected and evaluated: (1) patient demographics, (2) mechanism of injury, (3) type of operation, (4) time to radiographic union, and (5) complications. The patients were followed up until clinical and radiographic union were evident. Nonunion was defined as the absence of radiographic progression of healing 6 months post-surgery or hardware failure more than 5 months post-surgery. Patients with follow-up less than 1 year and patients with pathological fractures were excluded.

Results: Over this 5-year period, 211 (71 males [33.6%]) consecutive patients met the inclusion criteria and formed the study group with a mean age of 71.3 years (SD 18.7 years). 176 patients progressed to uneventful healing within a mean of 6 months (range, 4-8 months). 35 patients (16.6%) developed nonunion (septic nonunion in one patient), with 23 patients having associated implant failures. All of the patients with nonunions underwent further operations until fracture union was achieved. Another eight patients had breakage of the distal locking screws (dynamization) although union was otherwise uncomplicated. Two patients sustained periprosthetic fractures, one of which was iatrogenic (nail penetrated anterior cortex of distal femur), while the other resulted following a mechanical fall. Seven patients developed implant-related sepsis (intramedullary) and after union underwent removal of the implant, debridement of the canal, and intravenous antibiotics. In five patients the insertion of cement spacer was deemed necessary. Recognized predisposing factors to nonunion included malalignment, poor bone stock, and infection.

Conclusion: Subtrochanteric fracture treatment can be very challenging for the treating physician and is associated with a high incidence of complications. Initial management should aim for satisfactory reduction, especially avoiding varus malalignment and distraction. In case of aseptic nonunion, a single-stage procedure should be carried out, ensuring that the biological and mechanical environments are optimized.
Factors Affecting Overall Mortality After Hip Fractures
Yechiell Gellman, MD, MSc; Josh E. Shroeder, MD; Amal Khoury, MD; Rami Mosheiff, MD; Meir Liebergall, MD; Yoram A. Weil, MD; Hadassah Hebrew University Hospital, Jerusalem, Israel

Background/Purpose: Hip fractures are a common geriatric condition, and are associated with increased age-adjusted mortality. Numerous factors have been mentioned in relation with mortality but the exact correlation still remains unknown. Timing from admission to treatment, effect of anticoagulant treatment, and associated comorbidities remain major prognostic issues. The aim of this study was to investigate the prognostic factors affecting early and late mortality in the geriatric population with hip fractures.

Methods: A retrospective analysis of 521 surgically treated geriatric hip fractures between the years 2008 and 2011 was performed. Patients sustaining high-energy trauma, patients younger than 65, and pathological or periprosthetic fractures were excluded. The following data were reviewed: patient demographics, fracture type, time to surgery, prescribed medication, comorbidities, and mortality. Prescribed medications were used both as an independent factor and as an indication for the severity of preexisting medical condition. Statistical analysis was performed using \( \chi^2 \) and analysis of variance.

Results: Average patients' age was 81.2 years (range, 65-102) and the male-to-female ratio was 1:2.6. The mean time from admission to surgery was 45 hours (range, 1-745). Femoral neck fractures occurred in 36.8% of the patients, intertrochanteric fractures occurred in 53.2%, and subtrochanteric fractures in 10%. Common comorbidities included in our analysis were hypertension (61%), cardiovascular conditions (41.3%), diabetes mellitus (26.1%), renal failure (12.7%), and chronic obstructive pulmonary disease (8.4%). Prescribed medications included statins, aspirin, steroids, bisphosphonates, anticoagulants, diuretics, and antiglycemic medications. 1.5% of our patients underwent regular hemodialysis. Overall mortality rates were 3.3% at 1 month, 7.5% at 3 months, 10.6% at 6 months, 15.9% at 1 year. Increased age, number of comorbidities, and delay to surgery were significantly associated with increased early and late mortality (\( P < 0.05 \)). Delay from admission to surgery was associated with a higher mortality rate, with 25% mortality at 1 year when time to surgery was ≥96 hours. Differences in mortality rates, as assessed by delay to surgery, were noted mainly in the first month postoperatively and the trend continued throughout all the follow-up period (\( P < 0.05 \)). Cardiovascular condition, renal failure, and hypertension were associated with increased mortality (\( P < 0.05 \)). Patients receiving steroids, diuretics, and nitrates were in a higher risk of mortality (\( P < 0.05 \)), while intake of aspirin increased mortality rates only in late mortality. Of note, while intake of anticoagulants was associated in delayed surgery (\( P < 0.05 \)) there was no significant increase in mortality in correlation with this factor alone. Bisphosphonate treatment was associated with a lower mortality rate (\( P =0.05 \)).

Conclusion: Geriatric hip fractures continue to elude physicians by substantially increasing mortality in the geriatric population. In our analysis, we found several demographic and medical factors associated with increased mortality rate following geriatric hip fractures. Specific medical conditions such as cardiovascular disease, renal disease, and hypertension were associated with increased mortality. Delaying surgery was also found to play a substantial role in increased mortality. Future prospective studies are required to further substantiate our findings.
Background/Purpose: Tibial plateau fractures are complex injuries and often technically demanding if treated with open reduction and internal fixation. Recent discussion focused on the significance of posterior articular fragments in bicondylar injuries. In bicondylar tibial plateau fractures about one-quarter to three-quarters of cases demonstrate a posteromedial fragment. Fixation of posteromedial fragments is challenging, and fracture morphology should guide surgical approach and fixation techniques. Morphologic features of the posteromedial fragment might result in a suboptimal relationship to fixed-angle locking screws to the relatively large posteromedial fragment. The purpose of this study is to characterize posteromedial fractures of the tibial plateau using the “Cole” fracture mapping technique. Morphologic features, including posteromedial fragment fracture angle orientation and articular surface area, were analyzed in complex tibial plateau fractures. We hypothesized that posteromedial fractures occur in a continuous spectrum—from large fragments that could be secured via a lateral approach, to potentially unsecured fragments with lateral to medial fixed-angle screws.

Methods: Out of a consecutive series of 127 tibial plateau fractures, we included 47 patients with Schatzker type IV, V, and VI tibial plateau fractures with a posteromedial fragment. A posteromedial fragment was defined as a fragment inside the posterior or posteromedial column with a fracture angle <90°. The analysis was descriptive. For additional quantification, fracture angles were measured using a regression line through individual posteromedial fragment fracture line coordinates. Posteromedial fragment articular surface areas were translated into individual matrices for statistical analysis.

Results: 47/63 tibial plateau fractures from our inaugural tibial plateau fracture mapping study included a posteromedial fragment (75%). 9/15 type IV fractures involved the posterior column (60%), 20/26 type V (77%), and 18/22 type VI (82%) had a posteromedial fragment. Posteromedial fragment fracture angles were on average 52° for type IV, 39° for type V, and 46° for type VI. There was no statistically significant difference between Schatzker type IV, V, and VI tibial plateau fractures (P = 0.38).

Conclusion: The majority of complex tibial plateau fractures in this consecutive series included a fracture of the posterior column. These so-called posterior-shear fragments were not included in Schatzker’s original classification, and our understanding of posteromedial fractures and treatment strategies continues to evolve. Knowledge of constant patterns in tibial plateau fractures and morphologic features of the posterior fragments should improve our understanding of the relationship of fixed-angle locking screws and posteromedial fractures. Posteromedial fragment fracture angles help guide preoperative planning to prevent potentially unsecured fragments with lateral to medial fixed-angle screws.
Electromagnetic Navigation: A New Technique for Minimally Invasive Iliosacral Screw Placement?
Miguel Pishnamaz, MD; Hong Na; Max Janssen; Christoph Wilkmann, Dipl Ing; Prof. Thomas Schmitz-Rode; Hans-Christoph Pape, MD
1University of Aachen Medical Center, Aachen, Germany; 2Institute of Applied Medical Engineering, Helmholtz Institute of RWTH Aachen University, Aachen, Germany

Purpose: Electromagnetic tracking is a new technique that allows for real-time navigation without radiation. The aim of this study was to prove the feasibility of this technique in the posterior pelvic ring and to compare the results with established image-guided procedures.

Methods: Pelvic specimens were used for all tests. Denis type I or Denis type II sacral fractures were induced prior to the experiment. The pelvic specimen (Sawbone) was then embedded in a gel matrix to disable visual control. Four different test series were performed: Group OCT, optical navigation using preoperative CT scans; Group O3D, optical navigation using intraoperative 3-D fluoroscopy; Group Fluoro, conventional 2-D fluoroscopy; and Group EMT, electromagnetic navigation combined with a preoperative Dyna-CT scan. Screw placement accuracy was analyzed by standardized postoperative CT scan for every specimen. The time of procedure as well as the time of intraoperative radiation exposure for the surgeon was documented. For statistical analysis, we used SPSS (Version 20, Chicago, IL), Mann-Whitney U-test. Statistical significance was set at $P < 0.05$.

Results: 160 iliosacral screws were placed. A significantly higher number of optimal screw placements were achieved in Group EMT (36/40) when compared to Group Fluoro (30/40; $P < 0.05$) and Group OCT (31/40; $P < 0.05$). These results were comparable to group O3D (37/40; not significant). Equally the time of operative procedure was comparable between Group EMT and Group O3D (EMT 7.62 min vs. O3D 7.98 min; not significant). Those results were significantly shorter compared to Group Fluoro (10.69 min; $P < 0.001$) and Group OCT (13.3 min; $P < 0.001$). No intraoperative radiographic imaging was required in Group EMT because of real-time navigation. In Group O3D significantly less additional intraoperative fluoroscopy time was required when compared with Group OCT. (O3D 1.25 sec vs. OCT 15.4 sec; $P < 0.001$). Worst results were seen in Group Fluoro (42.6 sec vs. OCT 15.4 sec; $P < 0.001$).

Conclusion: Electromagnetic-guided iliosacral screw placement is a safe procedure and associated with good accuracy of screw placement, shorter operative time, and little intraoperative radiation exposure.
Factors Influencing the Accuracy of Percutaneous Iliosacral Screw Positioning: A Cohort Study
Miguel Pishnamaz, MD; Thomas Dienstknecht, MD; Barbara Hoppe; Christina Garving, MD; Philipp Kobbe, MD, PhD; Hans-Christoph Pape, MD; University of Aachen Medical Center, Aachen, Germany

Purpose: The accuracy of percutaneous iliosacral screw placement can be difficult in certain clinical scenarios. The aim of this study was to identify parameters associated with screw misplacement.

Methods: This was a single-center cohort study conducted at a Level I trauma center. Inclusion criteria were unstable pelvic injury and percutaneous placed transiliac screws. Exclusion criteria were screw implantation after open reduction and other stabilizations of the posterior pelvic ring. Fractures were classified regarding the Tile and the Denis classifications. Analyzed parameters were age, gender, body mass index (BMI), type of pelvic or sacral fracture, number of screws, ISS or NISS (New ISS) scores. Furthermore, length of operative procedure and complications were documented. Screw placement accuracy was graded as follows: grade 0, no perforation (optimal); grade 1, perforation <2 mm (suboptimal); grade 2, perforation from 2-4 mm (poor); grade 3, >4 mm perforation (failed) using postoperative CT scans. For statistical analysis, we used SPSS (Version 20, Chicago, IL), Mann-Whitney U-test. Statistical significance was set at \( P < 0.05 \).

Results: Between March 2007 and March 2013, 102 patients (53 women) and 130 screw placements were examined. Mean age of 48.5 years (SEM [standard error] 2.12) could be included. The ISS and the NISS was 18.9 (SEM 0.98) (ISS) and 22.3 (SEM 1.02) (NISS). No major complications occurred. Overall, 86.9% (113) of all screws were placed in an optimal or suboptimal fashion (<2 mm perforation). Consequently the malposition rate was 13.1% (17 screws). None of the analyzed factors (age, gender, BMI, type of pelvic or sacral fracture, number of screws, ISS or NISS) was associated with a significant reduced accuracy of screw positioning.

Conclusion: Even if we found a high rate of screw misplacement, none of our analyzed parameters alone diminished the accuracy of screw positioning. We conclude that percutaneous iliosacral screw positioning is a difficult procedure and its success depends on multiple factors. All of our investigated parameters should be considered as possible interference factors regarding the accuracy of screw positioning.
Virtual Transsacral Implant Positioning Is Critical in S1 Whereas in S2 a Transsacral Corridor Always Is Present

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²AO Research Institute Davos, Davos, Switzerland;
³Department of Orthopedics & Joint Reconstructive Surgery, Toyama Municipal Hospital, Toyama, Japan

Purpose: Transsacral implants are used increasingly, especially in treating sacral insufficiency fractures. However, a considerable number of individuals offer only limited safe space in the upper sacrum to place transsacral implants. The goal of this study was to quantify the possible number and location of transsacral implant positioning in Europeans and Japanese.

Methods: We studied a total of 156 CT scans of intact pelves from 92 European (48 females, 44 males; mean age 61.5 years, SD ±11.2) and 64 Japanese adults (29 females, 35 males; mean age 74.3 years, SD ±13.6). Only sacra with 5 segments fused were included. Semi-automated segmentation was performed to compute surface models of the pelvis. In the semitransparent lateral view virtual transsacral implants (transsection 7.3 mm) with or without a safety zone (transsection 12 mm) were placed. Nominal data were compared by the Fisher exact test.

Results: 36% of the sacra allowed virtual positioning of two transsacral implants on level S1 with a safety zone (males significantly more often, P = 0.01) whereas in 49% no implant surrounded by a safety zone could be placed. Ignoring the safety zone, in 22% positioning of a transsacral implant alone was not possible without perforation of cortical bone in S1. On level S2, 22% of individuals did not offer enough space for implant positioning with a safety zone but in all pelves transsacral implant alone was possible to position. Transsacral implants perforated cortical bone cranially in S1 at the level of the sacral ala, at the level of the sacroiliac (SI) joint or in the iliac fossa. The sacra without transsacral corridor in S1 all offered enough space for positioning of conventional SI screws.

Conclusion: Transsacral implant positioning is highly dependent on the individual anatomy. This ranged in S1 from two transsacral implants surrounded by a safety zone to the impossibility of transsacral implant positioning, but transsacral implants in S2 and conventional SI screws in S1 were possible in all individuals.
A New Definition of Polytrauma: Results From an International Consensus Process and a Database Analysis
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Purpose: The nomenclature for multiply injured patients with high mortality rates is variable and there is a lack of a uniform definition of the term “polytrauma”. A consensus process was therefore initiated by a panel of international experts with the goal of providing a new definition for the polytraumatized patient that is supported by patient data.

Methods: 1. Expert panel: Multiple meetings and consensus discussions (members: European Society for Trauma and Emergency Surgery [ESTES], American Association for the Surgery of Trauma [AAST], German Trauma Society [DGU], British Trauma Society [BTS]). 2. Literature review: Original articles prior to May 8, 2012. 3. A priori assumptions by the expert panel: “The basis for a new definition should include the Injury Severity Score (ISS) based on the abbreviated injury scale (AIS);” “A patient classified as polytraumatized should have a mortality rate of about 30%, twice above the established mortality of ISS >15.” 4. Database-derived resources: Deductive calculation of parameters based on a trauma registry (TraumaRegister DGU) with the following inclusion criteria: multiple injuries, need for intensive care therapy.

Results: 28,211 patients documented in the trauma registry met the inclusion criteria. The mean age of the study cohort was 42.9 ± 20.2 years (72% males, 28% females). The mean ISS was 30.5 ± 12.2 with an overall mortality rate of 18.7% (n = 5277), and an incidence of 3% penetrating injuries (n = 886). Five independent physiological variables were identified and their individual cut-off values were calculated based on a set mortality rate of 30% (hypotension, systemic blood pressure £ 90 mm Hg), level of consciousness (Glasgow coma scale [GCS] £ 8), acidosis (base excess ≤ –6.0), coagulopathy (international normalized ratio [INR] ≥ 1.4/partial thromboplastin time [PTT] ≥ 40 sec), and age (> 70 years).

Conclusion: The expert panel consensus-derived and database-supported definition of “polytrauma” implies the following parameters: significant injuries ≥3 points in ≥2 different anatomic regions in conjunction with ≥1 additional variable from five physiological parameters. We anticipate further validation of the definition in future international studies.
**International Poster**

**Int’l Poster #10**

**Predicting Multiple Organ Failure Following Major Trauma: Clinical Variable Models in the First 48 hours After Injury**

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*2Kadoorie Centre for Critical Care Research, University of Oxford, Oxford, United Kingdom;*  
*3Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom*

**Purpose:** The primary purpose was to determine combinations of clinical variables indicative of risk of multiple organ failure (MOF) at a range of times up to 48 hours after injury. The secondary purpose was to assess population and predictive variable differences seen with differing definitions of post-trauma MOF, as given by the Denver Postinjury MOF Score, Sequential Organ Failure Assessment (SOFA), and Marshall Multiple Organ Dysfunction Score.

**Methods:** A trauma database for adult polytrauma patients requiring ICU admission was compiled at a Level I trauma center. This combined clinical data from national trauma and ICU databases, with hourly local recording of patient parameters. Potential candidate predictors of MOF were determined by literature review and questionnaire analysis of trauma clinicians. The primary outcome measure was defined as MOF or no-MOF by each of the Denver, SOFA, and Marshall scores. Secondary outcomes of mortality, ICU, and hospital length of stay were recorded. Prediction models of MOF were developed using logistic regression at 2, 4, 6, 12, 24, and 48 hours postinjury. Analysis of best-fit models across time was used to identify common variable sets for each of the Denver, SOFA, and Marshall MOF definitions. Re-application of these to the population at all time points allowed assessment of prediction trajectory. Models were internally validated using bootstrapping.

**Results:** 517 trauma patients were identified, with a median ISS of 25 and an overall mortality of 14.9%. 491 patients survived more than 48 hours to be at risk of MOF development. MOF incidence depended on the scoring system used, ranging from 21% (Denver score) to 68% (SOFA score). MOF definition impacted on timing of MOF onset and duration. All definitions of MOF were associated with mortality, and length of hospital and ICU stay. Patients who developed MOF were admitted to ICU later than those who did not. Differences were seen in the variables predictive of Denver, SOFA, and Marshall MOF. Age, head injury, abdominal injury, maximum heart rate, and vasopressor use were strongly predictive of all MOF definitions. Denver MOF models showed high specificity and low sensitivity. SOFA and Marshall MOF models had higher sensitivity, but lower specificity. Overall percentage accuracy in classification (PAC) ranged from 69.0% (SOFA 4 hours postinjury) to 88.7% (Denver 12 hours postinjury). Common variable sets showed improved prediction as post-injury time increased, with maximum receiver operating characteristic area under the curve values of 0.856 (Denver), 0.848 (SOFA), and 0.827 (Marshall).

**Conclusions:** Post-trauma MOF can be predicted early after injury using combinations of clinical variables. Differences were seen in the predictive variables identified compared to previous studies. Alterations in MOF definition change the pattern, incidence, and predictive variables, emphasizing the need for uniformity to allow study comparison. External validation would allow development of an MOF prediction score to target interventions in the early stages following injury.
International Poster

Int'l Poster #11

Treatment of Exposed Fractures of the Tibia: A Comparative Study Between Biplane External Fixator and Locked Intramedullary Nail
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Faculdade de Medicina ABC, São Paulo, Brazil

Purpose: Our objective was to evaluate prospectively a group of patients with exposed fracture of tibial shaft conducted with biplane external fixator or with locked intramedullary reamed nail.

Methods: In this randomized prospective study, 68 patients were subjected to two types of widely used surgical treatments: biplane external fixator or locked intramedullary reamed nail. Later the postoperative complications (infections, malunion, and nonunion) were evaluated along with the consolidation and alignment and the life quality by the Short Form 36 (SF-36) protocol in the 12 months after surgery.

Results: On those patients randomized to the locked intramedullary reamed nail, the consolidations occurred 84.6% of the time and with biplane external fixator, the consolidation occurred 90.3% of the time. The nail group had two cases of infection, two cases of nonunion, and three cases of malunion. In the case of the patients treated with biplane external fixator, there were three cases of nonunion, five cases of malunion, and no infections. The quality of life was statistically equal with both methods.

Conclusion: The treatment with the biplane external fixator, compared to the locked intramedullary nail, yielded a similar index of life quality.
Effect of Chronic Heavy Smoking on Proximal Humerus Fracture Healing

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Academic Unit of Trauma and Orthopaedic Surgery, School of Medicine, University of Leeds, Leeds, United Kingdom

Background/Purpose: Proximal humerus is a common site of fracture in the elderly and usually linked to bone fragility. Cigarette smoking is associated with increased risk of osteomyelitis and delayed union/nonunion in long bone fractures. In this retrospective comparative study, we analyzed the effect of chronic heavy smoking on closed proximal humerus fracture and overall outcomes.

Methods: Over a 5-year period, 1752 patients were treated for proximal humerus fractures in our institution. Chronic heavy smoking was defined as daily smoking of greater than 20 cigarettes per day for over 20 years. 118 met the inclusion criteria. An age- and sex-matched control group (n = 118) (non-smokers, closed fractures) were randomly selected for comparison purposes. Fractures were classified as per the Neer classification system. Patient demographics, preexisting comorbidities, medication, mechanism of injury, and clinical details including surgical procedures were collected. Primary outcome factors studied were time to fracture union and wound healing. Secondary outcome factors studied were postoperative complications (pain, bleeding, swelling, infection, compartment syndrome, and neurovascular impairment) and incidence of delayed union and nonunion. Both cohorts were followed up for a minimum period of 24 months.

Results: The mean age of the heavy smokers group (31 males, 87 females) was 57 years. In the control group (45 males, 73 females), the mean age was 46 years. Other associated injuries between the groups included hip and distal radius fractures. Both cohorts were matched to the type of fractures: two-part, three-part, or four-part fracture and their displacements (>1 cm or >45°). For the chronic heavy smokers group, 14 patients required surgical fixation. The rest were treated conservatively. For the control group, 10 patients required surgery and the rest were treated conservatively. None of the patients in either cohort suffered from diabetes mellitus. For the conservatively treated cohort, chronic heavy smokers were more likely to suffer from delayed fracture healing (mean 11 weeks [range, 10-15]) when compared to the control group (mean 9 weeks [range, 7-10]; P = 0.004). Other significant differences were identified when comparing soft-tissue healing (P = 0.021) and postoperative pain (at 4 weeks) (P = 0.08). For the surgically treated cohort, chronic heavy smokers showed a statistically significant delay in fracture healing (mean 14 weeks [range, 12-19]) when compared to the control group (P < 0.001). Further analysis revealed a significant correlation between chronic smoking and postoperative delayed wound healing (P = 0.005), duration of postoperative pain (P < 0.001), and surgical site infections (P = 0.002).

Conclusion: Chronic heavy smokers with proximal humerus fractures are likely to suffer from delayed fracture union when compared to non-smokers. Patients with this injury requiring surgical fixation were reported to suffer from poor wound healing, postoperative pain, and deep surgical infection. Orthopaedic surgeons need to encourage their patients to enter into smoking cessation programs.
Decision-Making in Displaced Fractures of the Proximal Humerus: Fracture- or Surgeon-Based?
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1Department for Trauma and Reconstructive Surgery, University of Aachen Medical Center, Aachen, Germany;
2Hand and Upper Extremity Service, Department of Orthopaedic Surgery, Massachusetts General Hospital, Boston, Massachusetts, USA;
3Department of Orthopaedic Surgery, Academic Medical Center Amsterdam, Amsterdam, The Netherlands

Purpose: This study was undertaken to analyze the factors that influence surgeon decision-making in the treatment of complex proximal humerus fractures that might be considered for an arthroplasty.

Methods: A total of 217 surgeons evaluated 10 case vignettes on patients with fractures of the proximal humerus. In addition to radiographs, we provided patient age, sex, trauma mechanism, activity level (sedentary to vigorously active), and physical status (normal healthy to moribund). Observers were asked to (1) choose open reduction and internal fixation or hemiarthroplasty (closed question, one option) and (2) briefly describe the factors that led to their decision (open-ended question). We assessed interobserver reliability using the Fleiss generalized kappa and analyzed factors that influenced decision-making according to treatment choice.

Results: Internal fixation was the preferred treatment in the majority of cases. The overall multirater agreement was fair ($\kappa = 0.30$) with a 75% proportion of agreement. When asked to describe the factors that influenced decision-making, surgeons favoring internal fixation described patient-based factors in 52%, fracture morphology in 51%, surgeon factors in 42%, and bone quality in 11%. In contrast, fracture morphology was the most common factor (67%) described by surgeons considering replacement. Patient age, sex, activity level, physical status, and the presence of angular displacement were significant predictors for the recommendation of internal fixation.

Conclusion: Internal fixation is the treatment of choice even in complex fractures of the proximal humerus. Decision-making is not only influenced by the type of fracture, but also by patient- and surgeon-related factors.
Purpose: Floating knee injuries are common fracture pattern in high-energy trauma in which there is fracture of ipsilateral femur and tibia. This study was designed to evaluate the effectiveness of SIGN (Surgical Implant Generation Network) nails in treating floating knee injuries.

Methods: There were 14 patients in whom nailing was done after they had sustained floating knee injuries. The average age of patients was 26.3 years (range: 20-50 years). There were 13 male patients and 1 female patient. All nails were passed using standard technique with hand reaming and without using bone graft or image intensifier. The patients were followed for a minimum of 9 months. Patients were evaluated by Karlström and Olerud functional score.

Results: The patients were evaluated for infection, radiographic parameters, range of movements, time to weight bearing (partial and complete), and complications or revision surgery (if needed). One patient developed surgical site infection. Two revision surgeries were done. All patients had greater than 90° flexion at the knee joint and were full weight bearing at final follow-up.

Conclusion: SIGN nails are effective in treating floating knee injuries. In our study, Type I injuries had similar results as IIb injuries. Better functional outcomes were seen in this study. Patients with distal tibia fractures were associated with poor functional outcomes.
International Poster

Int’l Poster #15

Anchor Suture Fixation of Distal Pole Fractures of the Patella: 27 Cases and Comparison to Partial Patellectomy
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Purpose: Fractured distal pole of the patella is often too small or comminuted for fixation with traditional techniques. Partial patellectomy (PP) and reattachment of the patellar ligament with transosseous suturing is commonly performed in these cases. An anchor suturing (AS) technique has recently been reported as an alternative to PP in such fractures and allows for bone-to-bone interface and possibly superior fracture healing than bone-to-tendon interface with PP. We present our experience with AS and compare it to PP.

Methods: Between August 2006 and October 2011, 60 patients with distal pole patellar fracture underwent either AS (n = 27) or PP (n = 33). We retrospectively gathered their demographic data and information on fracture type, fixation technique, operation time, and postoperative complications. A telephone survey was performed to grade functional outcomes with standard questionnaires (the Short Form 12 [SF-12] for quality of life, the Kujala score for patellofemoral function, and a visual analog scale [VAS] pain score).

Results: AS had a nonsignificant advantage over PP in terms of residual pain and functional outcomes (VAS: 2 vs. 2.9, \( P = 0.243 \) and Kujala score: 74.3 vs. 69, \( P = 0.351 \), respectively). Complications included one case of nonunion in the AS group and 3 cases of infection in each group. Operation time was significantly shorter for AS compared to PP (68.5 vs. 79.1 minutes, \( P = 0.03 \)).

Conclusion: AS showed a nonsignificant advantage over PP for function and pain after distal pole patellar fractures and a significant advantage for operative time. We recommend this simply executed and safe technique as a viable option for fixation of this specific fracture pattern.

<table>
<thead>
<tr>
<th>Table 1. Comparisons of anchor suturing (AS) to partial Patellectomy operative techniques for distal pole patellar fractures.</th>
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</thead>
<tbody>
<tr>
<td><strong>Characteristic</strong></td>
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<td>Age (years)</td>
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<tr>
<td>Range</td>
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<tr>
<td>Median</td>
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<td>Mean (SD)</td>
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<td>Sex</td>
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<tr>
<td>Female</td>
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<tr>
<td>Male</td>
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<tr>
<td>Follow-up (months)</td>
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<td>Mean (SD)</td>
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<tr>
<td>VAS scores</td>
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<td>Range</td>
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<td>Median</td>
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<td>Mean (SD)</td>
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<td>SF-12</td>
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<td>PCS score</td>
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<td>Median</td>
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<td>Mean (SD)</td>
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<td>MCS score</td>
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<td>Median</td>
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<tr>
<td>Mean (SD)</td>
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<tr>
<td>Kujala patellofemoral scores</td>
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<tr>
<td>Median</td>
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<td>Mean (SD)</td>
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Table 2. Postoperative complications by surgical technique.

<table>
<thead>
<tr>
<th>Technique</th>
<th>n</th>
<th>Infection ( \eta ) (%)</th>
<th>Nonunion ( \eta ) (%)</th>
<th>Reoperation ( \eta ) (%)</th>
<th>Mean time to reoperation (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS</td>
<td>27</td>
<td>3 (11.1%)</td>
<td>1 (3.7%)</td>
<td>3 (11.1%)</td>
<td>60.3</td>
</tr>
<tr>
<td>PP</td>
<td>33</td>
<td>3 (9.1%)</td>
<td>--</td>
<td>3 (9.1%)</td>
<td>118</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>6 (10%)</td>
<td>1 (1.7%)</td>
<td>6 (10%)</td>
<td></td>
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</tbody>
</table>

PCS = Physical Component Summary, MCS = Mental Component Summary
Elastic Stable Intramedullary Nailing in Pediatric and Adolescent Forearm Fractures: Analysis of 210 Patients
Marcel Dudda, MD; Christiane Kruppa, MD; Pamela Bunge, MD; Thomas A. Schildhauer, MD;
Department of Surgery, University Hospital Bergmannsheil, Ruhr-University of Bochum, Bochum, Germany

Purpose: Forearm fractures are the most common fractures of children and adolescents (incidence of 23%). In case of instability, unacceptable angular deformation, open fracture, or combination injuries like Monteggia or Monteggia-equivalent injuries an operative treatment should be considered. In the last decade elastic stable intramedullary nailing (ESIN) has been established as state-of-the-art treatment. We analyzed the cases of forearm fractures to verify the success rate and outcome.

Methods: All patients treated with ESIN in the period of 2000 to 2012 of an age of up to 17 years were determined. Evaluation of treatment procedure, complications and problems, as well as final results after consolidation and ESIN removal was performed. Postoperative clinical and radiological controls were performed in 168 cases (80%).

Results: There were 210 ESINs implanted for forearm fractures in the observation period. 151/59 boys/girls with a mean age at trauma of 9.7 ± 3.4 years were included and analyzed retrospectively. 127 fractures (60%) occurred on the left side, 83 (40%) on the right, and one child had bilateral fractures. Mean time to consolidation and nail removal was 16.7 weeks (range, 13-70 weeks; median 12.4 weeks). No further consultation due to disorders was registered in these patients. Reosteosynthesis was necessary in three (2.3%) patients. One (0.8%) patient suffered an ipsilateral forearm fracture 4 month after nail removal with an ESIN redo after an adequate trauma. One wound infection on the radial side after surgery occurred.

Conclusion: ESIN can be considered as first choice treatment in forearm fracture in children and adolescents, if operative treatment is necessary. ESIN is minimally invasive, reliable, and easy to use. It has few complications and high acceptance of the patient and gives the opportunity for early postoperative exercise.
Systematic Review of Complications of Percutaneous Iliosacral Screw Fixation of Traumatic Pelvic Fractures

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Background/Purpose: Percutaneous iliosacral screws are commonly used for the fixation of traumatic pelvic fractures. Misplacement of an iliosacral screw by as little as 4° could cause damage to vital neurovascular structures. This review considers the incidence of common complications of iliosacral screw placement in traumatic pelvic fractures.

Methods: A literature search on MEDLINE, Embase, and Google Scholar was performed to identify articles related to percutaneous iliosacral screw fixation and subsequent complications. The search employed the following terms: iliosacral joint OR sacroiliac joint AND bone screw AND complication. Other papers were sourced through the detailed review of the bibliographies of those initially identified. Only studies that reported on more than 20 cases of iliosacral screw placement were included in this review. All articles published in languages other than English were excluded from this review.

Results: 14 articles with a total of 1169 iliosacral screws inserted fit the inclusion criteria and were used to compile this systematic review. Number of iliosacral screws inserted ranged from 29 to 244. The overall rate of screw loosening was reported as 1.1% (13/1169), screw misplacement 1% (12/1169), nerve root injury 0.86% (10/1169), wound infection 1.22%, and nonunion 1.1%. The overall risk of any complication occurring in this review was 4.6% (54/1169).

Conclusion: Percutaneous iliosacral screw fixation of the posterior pelvic ring is a relatively safe procedure with a total complication rate of less than 5%. This systematic review provides an incidence of the common complications of percutaneous iliosacral screw fixation. This information can be extremely useful in the process of gaining informed consent from patients and for local governance processes.
Proximal Third Tibia Fractures: Do We Really Need Retropatellar Nailing?
Alexander N. Chelnokov, MD; Dmitry A. Bekreev, MD;
Orthopaedic Trauma, Ural Scientific Research Institute of Traumatology, Ekaterinburg, Russia

Background/Purpose: Proximal third fractures of the tibia can be difficult to nail using conventional technique. Common problems include valgus malalignment, antecurvature and posterior shift of the distal fragment. Methods of avoiding these pitfalls have been suggested, including semi-extended knee, retropatellar approach, and provisional plating but use of the fixator-assisted technique seems to be underestimated. The aim of our study was to refine the technique of closed interlocking nailing in fractures of the proximal tibia introducing fixator-assisted technique.

Methods: 97 closed interlocking nailings were performed in 91 patients in 55/97 proximal tibia fractures (20 open) and 42/97 nonunions after other treatment modalities. All nailings were performed using a flat radiolucent table, in conventional knee flexion in all but one case of preexisting knee stiffness in extension. Reduction was obtained and maintained by a pre-assembled distractor consisted of two half-rings connected with three telescopic rods. Spatial control over the proximal fragment was gained by two Kirschner wires (K-wires) inserted in coronal plane. Frame application required 10-15 minutes. Transmedullary (Poller) K-wires were used for additional control of nail passage.

Results: Healing was reached in all cases, in 8/97 of them after secondary procedures in open and/or high-energy injuries with low healing potential. Malunions that required surgical correction occurred in 2/97 cases and were caused by loss of fixation by two locking screws of conventional type nails.

Conclusion: The simple and reproducible fixator-assisted technique provides low invasive nail insertion in knee flexion as if it is a midshaft fracture. It renders unnecessary the retropatellar approach, semi-extended position, extended incision, use of reduction clamps, or provisional buttress plating.
Background/Purpose: The incidence of proximal humerus fractures is rising and they are mostly linked to osteoporosis in the elderly. In general, they result from low-energy trauma following a mechanical fall, and are more predominant in females. We investigated the relationship between body mass index (BMI) and proximal humerus fracture in postmenopausal females.

Methods: Over a 5-year period, 1752 patients were treated for proximal humerus fractures. The inclusion criteria included females >45 years of age with good health status and no balance or mental health issues, not diabetic or suffering from neuromuscular weakness, not requiring a walking aid, and no history of falls or previous fractures. 822 patients met the inclusion criteria and mechanism of injury was a mechanical fall in 92% of the cohort. Patients were classified according to their BMI into 4 categories: (1) underweight, (2) normal weight, (3) overweight, and (4) obesity. Fractures were classified as per the Neer classification system: one-part, two-part, three-part, or four-part fracture and their displacements (>1 cm or >45°). 82 patients underwent surgical fixation and the rest were treated conservatively. All patients were followed for a minimum period of 24 months.

Results:

<table>
<thead>
<tr>
<th></th>
<th>1-Part Fracture</th>
<th>2-Part Fracture</th>
<th>3-Part Fracture</th>
<th>4-Part Fracture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight (n = 6)</td>
<td>6</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Normal weight (n = 156)</td>
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<td>Obesity (n = 108)</td>
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<td>31</td>
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Overweight and obese patients are more likely to sustain 4-part proximal humerus fracture with >1 cm displacement when compared to normal weight ($P < 0.001$) and underweight ($P < 0.001$) patients.

The surgical fixation group (15 3-part and 67 4-part fracture) had an increase delay in fracture healing (mean 14 weeks [range, 12-15]) when compared with the conservatively managed group (150 3-part and 102 4-part fracture), $P < 0.021$. Further analysis of the surgical cohort revealed a significant correlation when it comes to postoperative delayed wound healing ($P = 0.002$), duration of postoperative pain ($P = 0.002$), and surgical site infections ($P = 0.005$), when compared to the conservatively managed (Neer classification-matched) group.

Conclusion: The current evidence linking BMI and proximal humerus fracture in postmenopausal females confirms that the severity of the fracture is increased in overweight and obese patients. Furthermore, surgical fixation in 3-part and 4-part fractures in postmenopausal women tends to be associated with a slight delay in fracture union and increase wound healing problems.
Background/Purpose: According to the American Academy of Orthopaedic Surgeons (AAOS), more than 193,000 total hip replacements are performed each year in the United States. Femoral fractures are not common, but occur in 0.1% to 6% of all patients who have a total hip arthroplasty. Therefore, approximately 10,000 periprosthetic femur fractures need treatment annually. The majority (75%) of periprosthetic fractures following total hip arthroplasty occur at the tip of the stem (Vancouver type B1, Cooke type III). Most recently, the introduction of periprosthetic plates that allow for angling of the screws around the implant shaft proximally have been introduced. The purpose of this study was to test these plates biomechanically for stability and compare several different screw constructs in an effort to identify the most desirable construct.

Methods: 15 large adult synthetic left femora (4th Generation Composite Femur; Sawbones) were used. Each femur was implanted with a cementless hip prosthesis and osteotomized 45° to the shaft axis at the level of the implant tip to simulate a periprosthetic fracture, Vancouver type B1, OTA 32A2. A gap of 5 mm was created and fracture fixation was performed using a 12-hole periprosthetic proximal femur plate (NCB; Zimmer). Bone samples were randomly assigned to one of the following groups: (1) proximal six 4-mm bicortical locked screws full contact, distal three 4-mm screws bicortical; (2) proximal 3 cerclages (Cable Assembly Cerclage, 1.8 mm), distal three 4-mm screws bicortical; and (3) proximal cerclage (1+1 NCB Locking Plate Cable Button)/four unicortical 5-mm screws, distal three 4-mm screws bicortical. Testing was performed using an axial-torsional universal testing machine in three different loading modalities (axial compression to 500 N, lateral bending to 250 N, torsion to 200 N). After testing the samples for stiffness in all three modalities, cyclic loading was performed in axial compression with a maximum load of 500 N at 3 Hz for 10,000 cycles. After cyclic loading, the femurs were again tested in all three modalities. The specimens were finally loaded to failure in torsional loading. The failed samples were visually inspected for mode of failure.

Results: None of the constructs failed during cyclic testing. No significant differences in stiffness were found in axial loading before and after the cyclic loading between the 3 groups. Flexural stiffness after cyclic loading was higher in group 1 (5.4 N/mm) compared to group 2 (4.5 N/mm) (P < 0.01). Torsional stiffness for cable-only constructs (13.1 N/mm) was significantly lower compared with group 1 (17.2 N/mm) and 2 (15.7 N/mm) (P = 0.01, P = 0.03, respectively). Load to failure was comparable in group 1 and 3 (806 N and 818 N, respectively) but significantly lower in group 2 (606 N, P = 0.03). Differences were found in the type of failure. Constructs in group 1 failed in fracturing the trochanter region and loosening of the hip stem. One construct in group 1 fractured along two screw holes. In group 3 displacement of the fractures occurred. Load to failure resulted in rupture of the proximal cables.

Conclusion: Modern periprosthetic plates offer a wide variety of fixation techniques. All fixation methods provided stable fixation for axial loading. Differences were noted for flexion and torsion. Where bicortical screw fixation is not achievable, cable fixation is recommended. Additional unicortical screws increase torsional stiffness for cable fixation.
International Poster

Int'l Poster #21

Guesstimation of Posterior Malleolar Fractures on Plain Lateral Radiographs
Diederik T. Meijer, MSc; Job N. Doornberg, MD, PhD; Wouter H. Mallee, MD, Gino Kerkhoffs, MD, PhD; C. Niek van Dijk, MD, PhD; Sjoerd A. Stufkens, MD;
Academic Medical Center, Amsterdam, The Netherlands

Background/Purpose: Accurate assessment of the size of posterior malleolar fragments in ankle fractures is essential, as this is the leading argument for internal fixation. The purpose of this study, is to establish the diagnostic value of plain lateral radiographs with quantitative 3-dimensional CT (Q3DCT) as a reference standard, using a large web-based collaborative of experienced orthopaedic foot and ankle and trauma surgeons.

Methods: We used Q3DCT modeling techniques to determine articular involvement of posterior malleolar fractures, as a percentage of the tibial plafond, to establish a reference standard. 100 observers were assigned to review 31 AP and lateral radiographs of trimalleolar ankle fractures, in order to measure the size of the posterior malleolar fragment and answer two questions. (1) What is the involved articular surface of the posterior malleolar fracture as a percentage of the tibial plafond? (2) When you decide on operative treatment of this ankle fracture, would you fix the posterior malleolar fracture?

Results: Overall, the average posterior malleolar fragment involved 13.5% of the articular surface, as found on Q3DCT. The average posterior malleolar fragment, as measured by 100 observers, was found to be 24.4% (SD 10.0). This difference of 10.9% (95% confidence interval [CI] 7.8-14.0) is statistically significant (with $P < 0.001$) and can be read as a factor 1.8 overestimation of the fracture fragment. Agreement between observers showed an intraclass correlation coefficient (ICC) of 0.61. However, the smallest detectable change (SDC) was 28.1%, which is about equal to the observed fragment size on plain lateral radiographs. Furthermore, agreement on operative treatment yes or no showed a kappa value of 0.54. Marked differences were seen when the pathoanatomy of the fractures is taken into account. The large posterolateral fragments (Haraguchi type 1) lead to better agreement between observers than the smaller fragments (Haraguchi type 3) and posteromedial involvement (Haraguchi type 2). Also posteromedial fragments were less likely to be treated operatively.

Conclusion: There is an overestimation of posterior malleolar fragment size on plain lateral radiographs. This is most marked for smaller fragments. Posteromedial involvement is least overestimated. The observers showed a preference to fixate the Haraguchi type 1 fractures, with respect to the Haraguchi type 2 fractures. Undertreatment of these posteromedial fragments in trimalleolar ankle fractures may predispose to poor outcomes. Future investigations should take this into account. One could argue whether observers agree with each other, on both fragment size and operative fixation of posterior fragments. The ICC of 0.61 on fragment size reflects a borderline substantial agreement. The kappa value of 0.54 on operative treatment reflects only a moderate agreement. Q3DCT modeling could provide surgeons with more accurate information about true fragment size, thus improving interobserver agreement. The pathoanatomy of posterior malleolar fractures is of major importance in judgment of lateral radiographs.
Options of Fixator-Assisted Internal Fixation in Periprosthetic Femoral Shaft Fractures
Alexander N. Chelnokov, MD1; Igor M. Piven1; Igor L. Shlykov, PhD, ScD1; Konstantin I. Piastopulo1; Leonid N. Solomin, MD, PhD2; Alexey Semenisty, MD, PhD3;
1Ural Scientific Research Institute of Traumatology and Orthopaedics, Ekaterinburg, Russia; 2Vreden Russian Research Institute of Traumatology and Orthopedics, St. Petersburg, Russia; 3City Hospital N13, Moscow, Russia

Purpose: Gaining of proper length and alignment in periprosthetic femoral fractures, nonunions, and deformations may be challenging. Fixator-assisted technique can be helpful but its use in different periprosthetic fracture patterns has not yet been defined. The aim of our study was to define optimal implementation of fixator-assisted internal fixation in femoral periprosthetic fractures about hip arthroplasty stems.

Methods: Fixator-assisted internal fixation was used in the treatment of 47 femoral periprosthetic fractures: Vancouver B1, 16 cases (5 cemented); Vancouver B2, 11 (2 cemented); B3, 13 (3 cemented); and C, 7 (4 cemented). Mostly locked intramedullary nails with connection to the stem were used for definitive stabilization (45/47). Locked plates (2/47) were used in interprosthetic fractures only. Simplified Ilizarov frames were used to gain alignment and length acutely in 39 cases or gradually (5-14 days) in 8 cases. Immediate postoperative evaluation included radiological check of length and alignment of the femur, and also position of the stem if it was previously displaced in Vancouver B2-B3 fractures.

Results: Frame application allowed restoration of length and alignment of the segment in all 23 cases of stable stems (B1 and C). In loose stems (B2 and B3, 24/47), not only fixation (8/24) was performed but also reduction of displaced stems (16/24), correction of preexisting deformity (3/24), and acute femoral lengthening up to 3 cm (6/24). Three frame types were defined depending on two factors: injury type according to Vancouver classification, and position of the stem tip inside or outside medullary canal. Frame type 1 (Vancouver B1 and C type) is secured to the proximal and distal aspects of the femur. In type 2 (Vancouver B2-B3, stem tip outside the distal fragment), the frame is secured to the iliac wing and the distal femur. Frame type 3 (B2-B3 with the stem tip inside the medullary cavity) consists of one arc secured to the distal femur, with connection to an insertion handle of the intramedullary nail.

Conclusion: Fixator-assisted internal fixation provides easy control of length and alignment including reduction of displaced stem and lengthening of the femur in periprosthetic fractures. Position of the stem tip inside or outside the medullary cavity and Vancouver classification appear to be key factors defining optimal frame configuration.
International Poster

Int’l Poster #23

Treatment of Extra-Articular Open Tibial Fractures
Hyung Keun Song, MD;
Department of Orthopaedic Surgery, Ajou University School of Medicine, Suwon, Korea

Purpose: This study was conducted to evaluate treatment outcomes for patients with high-energy extra-articular open tibial fractures.

Methods: The study included 82 adult patients available for follow-up for over 1 year after surgery. Of the 82 patients, 59 were male and 23 were female, average age was 44 years (range, 18-86 years), and the mean follow-up was 14.5 months. The AO/OTA fracture classification, Gustilo-Anderson open wound classification, presence of initial nerve injury, surgical technique, soft-tissue reconstruction technique, union time, radiological features, and complications at the last follow-up were examined. According to the AO/OTA fracture classification, there were 26 type 41A cases, 34 type 42 cases, and 22 type 43A cases. In accordance with the Gustilo-Anderson classification system, there were 31 type I cases, 19 type II cases, 4 type IIIa cases, and 27 type IIIb cases. Initial nerve injury was confirmed in 19 cases.

Results: Definitive fixation from injury averaged 6.73 days (range, 0-16 days). For soft-tissue reconstruction, 50 cases of primary closure with debridement were performed, as well as 5 cases of split-thickness skin graft, 10 cases of perforator based rotational flaps, and 17 cases of free flaps. Complications were observed in 29 cases (35.4%). Of these, 5 cases involved superficial infection, 3 cases displayed deep infection, and 7 cases of primary suture site skin necrosis, 4 cases of partial flap necrosis, 7 cases of malalignment, 2 cases of joint stiffness, and 1 case of hardware breakage were observed. 30 additional surgical operations (36.6%) were performed during the treatment including 1 case of plate augmentation due to instability after intramedullary nailing, 8 cases of bone graft, 1 case of plate change owing to metal breakage, 3 cases of deep infection, 2 cases of release for joint stiffness, 11 cases of additional skin graft for necrosis of the primary closure or flap site, and 4 cases of dynamization. Average bone union time was 20.4 weeks (range, 13-63 weeks) and the lower extremity functional scale was 70.93 (range, 36-79). Results of a multiple linear regression analysis indicated that defect size ($P = 0.002$) and the occurrence of complications ($P < 0.0001$) were factors found to influence clinical results.

Conclusion: In the treatment of open tibial fractures, good clinical results can be expected provided that complications are prevented through proper reduction, firm fixation, early soft-tissue reconstruction, and early rehabilitation.
Background/Purpose: The neurological recovery following spinal cord injury (SCI) remains obscure. It has long been believed that intrinsic repair is restricted after SCI because neurogenesis rarely occurs in the central nervous system. As a result of unpredictable results following available methods of SCI treatment, the stem cell transplantation is becoming a promising therapeutic option. Due to the ethical, logistics, and the economy involved in embryonic stem cells, the use of autologous bone marrow–derived mononuclear cells (MNCs) in SCI patients has been investigated. We designed this study to improve the conventional treatment modalities by augmenting with MNCs, which have property to bear stem and progenitor cells of various fate with a goal to repair a damaged tissue that has lost the property to heal itself.

Methods: The aim of the study was correlation of infused mononuclear cell concentration to neurological recovery scales of SCI. Eligible patients for this phase 2, open-label trial were acute complete injuries between T3-L1 spine. The three arms of the study group were Group 1, decompression and posterior instrumentation; Group 2, decompression, posterior instrumentation, and MNC infusion; and Group 3, nonsurgical treatment as control. Follow-up was done at 6 monthly intervals for 2 years. To go through the safest way for the bone marrow aspiration, centrifugation, and infusion, we used a non–touch closed system by transfusion blood bags. The MNCs were counted by automated cell counter and the counts were correlated with recovery of SCI patients using ASIA (American Spinal Injury Association) Impairment Scales.

Results: A total of 92 patients were included in the study and 80 patients followed up to 2 years. The recovery was higher in Group 2 at 6 monthly follow-ups. The motor score increased to 5.14 at 1 year, to 4.95 at 2 years from admission (3.90 ± 8.84) in Group 1. However, in Group 2, this was in increasing order and there was no change in Group 3 (P > 0.05). The sensory score increased to 163.43, 166.29, and 169.33 from 159.43 at admission in Group 1. Similar observations were found in Groups 2 and 3 (P > 0.05). The purity and yield of MNCs were almost the same as some other studies showing the best result of MNC count in purified bone marrow. But our result become more significant than other studies in which they used different procedures of MNC isolation that required MNC retrieval at least washing by saline or even more while our procedure consists of an aseptic closed system of purification that also does not require any retrieval process.

Conclusion: This study promises the efficacy of autologous mononuclear bone marrow cells in the regeneration of neurons and a sound ground to continue this study with a large sample size.
Disclosure Listing - Alphabetical

Acharya, Mehool R. ................................................................. Paper #2; Int'l Poster #17
Agarwal, Abhishek ................................................................. Int'l Poster #24
Agrahari, Ashok ................................................................. Int'l Poster #24
Anderson, Duane ................................................................. Paper #13
Anderson, Lucas ................................................................. Paper #13
Andruszkow, Hagen ............................................................. Papers #8, 14
Aslam-Pervez, Nayef ............................................................ Paper #4
Baboolal, Thomas G. ............................................................ Paper #20
Baghel, N. Kavita ................................................................. Paper #25
Balbachevsky, Daniel ............................................................ Symposium Faculty
Balogh, Zsolt J. ................................................................. (8-INJURY, Journal of Trauma, British Journal of Surgery; Critical Care Medicine, World Journal Surgery, Critical Care; 9-AAOS, Orthopaedic Trauma Association)
Barbosa, Paulo ................................................................. Symposium Faculty
Bekreev, Dmitry A. ............................................................... Int'l Poster #18
Bhandari, Mohit ................................................................. Moderator, Symposium Faculty
Blachut, Piotr A. ................................................................. Paper #12
Böhle, Franziska ................................................................. Paper #8
Born, Christopher T. ............................................................ Moderator
Bouillon, Bertil ................................................................. (2-DePuy, A Johnson & Johnson Company; 9-German Trauma Society (DGU), German Society for Orthopedics and Trauma (DGOU))
Boxall, Sally A. ................................................................. (6-Nuvasive)
Brandão, Fernando ............................................................ Paper #7
Bunge, Pamela ................................................................. Int'l Poster #16
Burgers, Travis A. ................................................................. Int'l Poster #20
Burgos, Eduardo J. ............................................................... OTA BSFF Paper #24
Butcher, Nerida ................................................................. Int'l Poster #9
Carow, John Bennet ............................................................. Paper #14
Cestari, Rafael da Costa Pereira ........................................... Int'l Poster #11
Challa, Abebe ................................................................. Paper #13
Chandra, Tulika ................................................................. Int'l Poster #24
Chelnokov, Alexander N. .................................................. Int'l Posters #18, 22
Coats, Timothy ................................................................. OTA BSFF Paper #22
Crichlow, Renn ................................................................. (2-Stryker, Synthes; 8-Journal of Orthopaedics and Traumatology; Journal of Trauma; Orthopedics)
Cuthbert, Richard J. ............................................................. Papers #18, 20
Danmou, Xing ................................................................. Paper #21
Davidson, Eleanor ............................................................. (5-AO UK)
Disclosure Listing - Alphabetical

Haller, Justin .................................................. (n) .......................................................... Paper #13
Hammouche, Salah ............................................. (n) .......................................................... Paper #6
Harmer, Luke .................................................... (n) .......................................................... Paper #11
Harwood, Paul J. .................................................. (2-Pfizer; DePuy, A Johnson & Johnson Company; Smith & Nephew). Paper #22
Hildebrand, Frank ................................................ (8-Wolters Kluwer Health - Lippincott Williams & Wilkins, shock (Journal)) Papers #8, 14; OTA BSFF Paper #23
Hoffmann, Martin F. ............................................. (n) .......................................................... Int'l Poster #20
Holt, Catherine ................................................. (5-Arthrex, Inc; Orthox) ....................................... Paper #6
Hoppe, Barbara ................................................... (n) .......................................................... Int'l Poster #7
Horst, Kemens .................................................... (n) .......................................................... Papers #8, 14
Hossain, Fahad .................................................... (n) .......................................................... Paper #4
Hutchings, Lynn ................................................... (n) .......................................................... Int'l Poster #10
Janssen, Max ...................................................... (n) .......................................................... Int'l Poster #6
Jerjes, Waseem .................................................... (n) .......................................................... Papers #15, 24; Int'l Posters #12, 19
Jiang, Xie-yuan ..................................................... (n) .......................................................... Paper #17
Jones, Clifford B. .................................................. (8-Journal of Bone and Joint Surgery - American; Journal of Orthopaedics and Traumatology; 9-AOA Own the Bone Board, Mid American Orthopaedic Association Membership Committee, OTA Membership Chairman, OTA Health Policy Committee, Michigan Orthopaedic Society PAC Secretary) Int'l Poster #20
Jones, Elena ....................................................... (2-Miltenyi Biotec GmbH; 5-Neoaxis) ......................... Papers #18, 20
Josten, Christoph ................................................. (2-Synthes, Medtronic; 3B-Zimmer; 7-Springer) .............. Int'l Poster #9
Kadar, Assaf ....................................................... (3A,4-Teva Pharmaceutical Industries LTD) .................. Paper #19; Int'l Poster #15
Kaehr, David ...................................................... (n) .......................................................... Int'l Poster #1
Kamer, Lukas ...................................................... (n) .......................................................... Int'l Poster #8
Keating, John F. ................................................... (n) .......................................................... Paper #23
Kelly, Michael .................................................... (2-Synthes) ................................................ Paper #2
Kerkhoffs, Gino ................................................... (3B-Advance Medical; 5-Biomet; 9-ESSKA) .................. Paper #16; Int'l Poster #21
Khoury, Amal .................................................... (n) .......................................................... Paper #1; Int'l Poster #4
Kloen, Peter ...................................................... (n) .......................................................... Paper #16; Int'l Poster #5
Knobe, Matthias ................................................... (n) .......................................................... Papers #8, 14; Int'l Poster #13
Kobbe, Philipp .................................................... (n) .......................................................... OTA BSFF Paper #23; Int'l Poster #7
Kojima, Koki ....................................................... (9-AO Trauma Education Commission; Brazilian Orthopaedic Trauma Society) ................. Paper #87
Kruppa, Christiane ............................................... (n) .......................................................... Int'l Poster #16
Lage, André Valente ............................................. (n) .......................................................... Int'l Poster #11
Lamb, Jonathan .................................................... (n) .......................................................... Int'l Poster #3
Lampropoulos, Tasos ............................................ (n) .......................................................... Paper #5
Lecky, Fiona ...................................................... (n) .......................................................... OTA BSFF Paper #22
Leenen, Luke ..................................................... (n) .......................................................... Int'l Poster #9
Lefering, Rolf ..................................................... (8-Springer; (Europ. J. Trauma Emerg. Med.)) ..................... OTA BSFF Paper 23; Int'l Poster #9
Leonhardt, Marcos ............................................... (n) .......................................................... Paper #7
Disclosure Listing - Alphabetical

Li, Ting ................................................. (n) ................................................................. Paper #17
Lichte, Philipp ........................................ (7-Springer Verlag) .............................................. Int’l Poster #9
Liebergall, Meir ....................................... (8-Journal of Orthopedic Trauma) ...................... Paper #1; Int’l Poster #4
Lofty, Ahmed ......................................... (n) ................................................................. Paper #18
Maar, Dean ........................................... (1-Stryker) ............................................................ Int’l Poster #1
Mailu, Jeff .............................................. (n) ................................................................. Paper #11
Mailee, Wouter H. ................................... (n) ................................................................. Int’l Poster #21
Mangrus, Lukas ....................................... (n) ................................................................. Paper #16
Marciniak, Jan L. ...................................... (n) ................................................................. Paper #4
Marzi, Ingo ............................................. (n) ................................................................. Int’l Poster #9
Matityahu, Amir M. .................................. (2-DePuy-Synthes, A Johnson & Johnson Company; 4-Anthom Orthopaedics, LLC, Anthom Orthopaedics VAN, LLC, PDP Holdings, LLC; 5-Stryker and DePuy-Synthes) Program Committee, Moderator; Panelist
Meijer, Diederik T. ...................................(n) ................................................................. Paper #16; Int’l Poster #21
Mellema, Jos J. ......................................... (n) ................................................................. Paper #16; Int’l Poster #5
Molenaars, Rik J........................................ (n) ................................................................. Int’l Poster #5
Molina, Cesar S. ...................................... (n) ................................................................. OTA BSFF Paper #24
Moran, Christopher G. ............................. (2-Smith & Nephew, DePuy-Synthes; 8-International Editorial Board, Injury; 9-British Orthopaedic Association) Panelist; Paper #6; OTA BSFF Paper #22
Morshed, Saam ....................................... (3B-Microbion Corporation; 5-Stryker; Synthes) Symposium Faculty
Moseley, Timothy A. ................................ (3A,4-Nuvasive) ....................................................... Paper #20
Mosheiff, Ramli ....................................... (n) ................................................................. Paper #1; Int’l Poster #4
Mugarura, Rodney .................................. (n) ................................................................. Paper #12
Mussa, Mohamed A. ................................ (n) ................................................................. Paper #4
Na, Hong .............................................. (n) ................................................................. Int’l Poster #6
Ndasi, Henry .......................................... (n) ................................................................. Paper #26
Neuhaus, P. Valentin ............................... (6-Gottfried und Julia Bangerter -Rhyner-Stiftung Foundation) Int’l Poster #13
Nguku, Levis .......................................... (n) ................................................................. Paper #26
Noser, Hansrudi ..................................... (n) ................................................................. Int’l Poster #8
O’Hara, Nathan ....................................... (n) ................................................................. Paper #12
Obremisky, William T. ............................. (9-Orthopaedic Trauma Association; Southeastern Fracture Consortium) OTA BSFF Paper #24
Oliver, William M. .................................. (n) ................................................................. Paper #23
Panteli, Michalis ..................................... (n) ................................................................. Paper #5; Int’l Poster #3
Peitzman, Andrew .................................. (n) ................................................................. Int’l Poster #9
Plastopulo Konstantin I. ........................... (n) ................................................................. Int’l Poster #22
Pishnamaz, Miguel .................................. (n) ................................................................. Int’l Posters #6, 7
Piven Igor M. ......................................... (n) ................................................................. Int’l Poster #22
Pohl, Pedro ........................................... (n) ................................................................. Int’l Poster #11
Potter, Jeffrey M. .................................... (n) ................................................................. Paper #12
Raj, Saloni ............................................. (n) ................................................................. Paper #25; Int’l Poster #24

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<tr>
<td>Rehman, Saqib</td>
<td>(2-Synthes; 3B-Eli Lilly, Guidant Global; 7-Jaypee Medical Publishing; 8-Orthopedic Clinics of North America; 9-Pennsylvania Orthopaedic Society-Board of Directors, Orthopaedic Trauma Association-Committee member)</td>
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<td>Schmidt, Andrew H.</td>
<td>(3B-Acumed, LLC, Bone Support AB, Medtronic; St. Jude Medical; 3C-Twin Star Medical; 3C, 4-Conventus Orthopaedics; 4-Epiphany, Epiphany, International Spine and Orthopaedic Institute; 4,5-Twin Star Medical; 7-Thieme, Inc.; 8-Journal of Orthopaedic Trauma, Journal of Knee Surgery; 9-Orthopaedic Trauma Association)</td>
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Disclosure Listing - Alphabetical

Song, Hyung Keun .................................................. (n) .................................................. Int'l Poster #23
Squier, Emily .................................................. (n) .................................................. Int'l Poster #1
Srivastava, Rajeshwar N. .................................................. (n) .................................................. Paper #25; Int'l Poster #24
Stahel, Philip F. .................................................. (5,6-Stryker; 8-Orthopedics, Wolters Kluwer Health - Lippincott Williams & Wilkins, Springer, SLACK Incorporated) .................................................. Int'l Poster #9
Steinberg, Ely L. .................................................. (n) .................................................. Paper #19; Int'l Poster #15
Steller, Ernst P. .................................................. (n) .................................................. Paper #16
Stephens, Trina V. .................................................. (n) .................................................. Paper #12
Stulikens, Sjoerd A. .................................................. (n) .................................................. Paper #16; Int'l Poster #21
Sun, Xu .................................................. (n) .................................................. Paper #17
Tan, Hiang Boon .................................................. (n) .................................................. Paper #18
Thakore, Rachel V. .................................................. (n) .................................................. OTA BSFF Paper #24
Tomaszewski, Pawel K. .................................................. (n) .................................................. Paper #3
Tosounidis, Theodoros .................................................. (n) .................................................. Paper #10
van der Meent, Henk .................................................. (3A-Orthopedic Technology Nijmegen) .................................................. Paper #3
van Dijk, C. Niek .................................................. (3B-Smith & Nephew; 5-Biomet, GlaxoSmithKline; Stryker; 8-Knee Surgery, Sports Traumatology, Arthroscopy, Journal Sports Medicine, Arthroscopy, Rehabilitation Therapy and Technology (SMARTT); 9-International Society of Arthroscopy, Knee Surgery, and Orthopaedic Sports Medicine, European Society of Sports Traumatology, Knee Surgery and Arthroscopy (ESSKA), Nordic Orthopaedic Federation (NOF)) .................................................. Int'l Poster #21
Van Vugt, Arie B. .................................................. (3B-Stryker) .................................................. Paper #9
Verdonschot, Nico J.J. .................................................. (5-DePuy, A Johnson & Johnson Company) .................................................. Paper #3
Wagner, Daniel .................................................. (n) .................................................. Int'l Poster #8
Wang, Manyi .................................................. (n) .................................................. Paper #17
Watkinson, Peter .................................................. (n) .................................................. Paper #17
Weber, Christian D. .................................................. (n) .................................................. OTA BSFF Paper #23
Wei, Feng .................................................. (n) .................................................. Paper #21
Weil, Yoram A. .................................................. (n) .................................................. Paper #1; Int'l Poster #4
West, Robert M. .................................................. (n) .................................................. Paper #9
White, Timothy O. .................................................. (3B,5,6-Acumed, LLC; 3C-Smith & Nephew) .................................................. Paper #23; Int'l Poster #2
Wilkman, Christoph .................................................. (n) .................................................. Int'l Poster #6
Willett, Keith .................................................. (1-Zimmer) .................................................. OTA BSFF Paper #22; Int'l Poster #10
Woodford, Maralyn .................................................. (n) .................................................. OTA BSFF Paper #22
Wusheng, Kan .................................................. (n) .................................................. Paper #21
Yan, Chen .................................................. (n) .................................................. Paper #21
Yang, Ming-hui .................................................. (n) .................................................. Paper #17
Yeomans, Daniel .................................................. (n) .................................................. Int'l Poster #17
Young, Duncan .................................................. (9-Intensive Care National Audit and Research Centre (ICNARC)) .................................................. Int'l Poster #10
Zirkle Jr, Lewis G. .................................................. (3C-SIGN; 8-Orthoprenour; 9-Orthopaedic Trauma Association-International Committee) .................................................. Moderator; Int'l Poster #14
Accreditation – CME Information

This 30th Annual Meeting of the Orthopaedic Trauma Association has been planned and implemented in accordance with the Essential Areas and policies of the Accreditation Council for Continuing Medical Education through the joint sponsorship of the American Academy of Orthopaedic Surgeons and the Orthopaedic Trauma Association. The American Academy of Orthopaedic Surgeons is accredited by the ACCME to provide continuing medical education for physicians.

The American Academy of Orthopaedic Surgeons designates this live activity for a maximum of 7.5 AMA PRA Category 1 Credits™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

FDA Statement

Some drugs or medical devices demonstrated at this 30th Annual Meeting may not have been cleared by the FDA or have been cleared by the FDA for specific purposes only. The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or medical device he or she wishes to use in clinical practice.

Academy policy provides that “off label” uses of a drug or medical device may be described in the Academy’s CME activities so long as the “off label” use of the drug or medical device is also specifically disclosed (i.e., it must be disclosed that the FDA has not cleared the drug or device for the described purpose). Any drug or medical device is being used “off label” if the described use is not set forth on the product’s approval label.

- Indicates those faculty presentations in which the FDA has not cleared the drug and/or medical device for the use described (i.e., the drug or medical device is being discussed for an “off label” use).

Disclaimer

The material presented at the 30th Annual Meeting has been made available by the Orthopaedic Trauma Association for educational purposes only. The material is not intended to represent the only, nor necessarily best, method or procedure appropriate for the medical situations discussed, but rather is intended to present an approach, view, statement or opinion of the faculty which may be helpful to others who face similar situations.

The Orthopaedic Trauma Association disclaims any and all liability for injury or other damages resulting to any individual attending the Annual Meeting and for all claims which may arise out of the use of the techniques demonstrated therein by such individuals, whether these claims shall be asserted by physician or any other person.

Disclosure

The names of authors presenting the papers at the 30th Annual Meeting are printed in **boldface**.

As an accredited provider of continuing medical education CME, the Academy and OTA are required by the Accreditation Council for Continuing Medical Education (ACCME) to obtain and share with participants of an OTA CME activity any potential conflicts of interest by faculty, program developers and CME planners.

The ACCME Standards of Commercial Support, Standard 2 states the requirements:

2.1 The provider must be able to show that everyone who is in a position to control the content of an education activity has disclosed all relevant financial relationships with any commercial interest to the provider.

2.2 An individual who refuses to disclose relevant financial relationship will be disqualified from being a planning committee member, a teacher, or an author of CME, and cannot have control of, or responsibility for the development, management, presentation or evaluation of the CME activity.

The AAOS disclosure policy requires that faculty submit all financial relationships occurring within the past 12 months that create a potential conflict.

Each participant in the Annual Meeting has been asked to disclose if he or she has received something of value from a commercial company or institution, which relates directly or indirectly to the subject of their presentations.
Authors who completed their financial disclosures have identified the options to disclose as follows:

n. Respondent answered ‘No’ to all items indicating no conflicts;
1. Royalties from a company or supplier;
2. Speakers bureau/paid presentations for a company or supplier;
3A. Paid employee for a company or supplier;
3B. Paid consultant for a company or supplier;
3C. Unpaid consultant for a company or supplier;
4. Stock or stock options in a company or supplier;
5. Research support from a company or supplier as a PI;
6. Other financial or material support from a company or supplier;
7. Royalties, financial or material support from publishers;
8. Medical/orthopaedic publications editorial/governing board;
9. Board member/committee appointments for a society.

An indication of the participant’s disclosure appears after his/her name in the alphabetical listing along with the commercial company or institution that provided the support.

The Academy and OTA do not view the existence of these disclosed interests or commitments as necessarily implying bias or decreasing the value of the author’s participation in the meeting.

△ Indicates presentation was funded by a grant from the Orthopaedic Trauma Association.

**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.

Cameras or video cameras may not be used in any portion of the meeting.
Residents - Apply Online Today for OTA Candidate Membership!

Candidate Member Requirements

1. Currently participate in an American or Canadian Board approved Orthopaedic Surgery residency training program or currently participate in an officially recognized fellowship training program in musculoskeletal trauma management.

2. Be a citizen of or practice in the United States or Canada.

3. Maintain a full and unrestricted license to practice medicine in the United States or Canada or give evidence of full time medical service in the federal government which does not require licensure.

4. Be active members of their hospital staff and fulfill the on-call requirements of their hospital in accord with their hospital rules/regulations/bylaws.

5. Maintain the highest professional, moral, and ethical standards.

6. Be sponsored by one Active or Research member of the OTA or the Program Chair or Fellowship Director at the applicant’s institution. Contact the OTA office for a list of qualified sponsors.

7. Agree to comply with the dues, fees, and assessment requirements established by the Board of Directors of the Orthopaedic Trauma Association.

Benefits of OTA Membership

- **Professional Development** – The OTA annual meeting offers an array of specific trauma related educational sessions, case presentations, and hands-on workshops with an opportunity for candid discussions and consultations.

- **Networking Opportunities** – Through the OTA newsletter, the website, the annual meeting and specialty day contact other traumatologists and participate in multi-center research opportunities and start-up funds for research grants.

- **Member Discounts** – Meeting registration and subscription to Journal of Orthopaedic Trauma Research – Access to the Trauma Registry Database issued to members only to track patient outcomes and to participate in multi-center research studies.
The Orthopaedic Trauma Association gratefully acknowledges 2013 Research and Education Donors. The continued success and increased impact of the Orthopaedic Trauma Association’s research and education effort is dependent upon foundation and industry support. The OTA expresses sincere appreciation to these contributors for their generous financial support.

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OTA Calendar of Upcoming Events

OTA Residents Advanced Trauma Techniques Course
January 9 - 10, 2015  Houston, Texas

Annual Meeting Abstract Application Deadline
February 4, 2015
Abstracts must be submitted on-line at: http://www.ota.org

OTA Member Research Grants Pre-Proposal Deadline
February 16, 2015

15th Annual AAOS/OTA Joint Trauma Update Course
February 19 - 21, 2015

OTA Specialty Day Meeting
March 28, 2015  Las Vegas, Nevada

OTA Spring Resident Comprehensive Fracture Course
April 15 - 18, 2015  Lombard, Illinois (Chicago)

OTA Fellows Course (Registration limited to current trauma fellows.)
April 24, 2015  Boston, Massachusetts

OTA Membership Application Deadlines
May 1, 2015 and November 1, 2015
www.ota.org

OTA 31st Annual Meeting & Pre-Meeting Events
October 7 - 10, 2015  San Diego, California

For Details of All OTA Events:
Phone: (847) 698-1631
Fax: (847) 823-0536
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OTA website: www.ota.org