POSTER

ABSTRACTS

AAHKS 25TH ANNIVERSARY
AMERICAN ASSOCIATION OF HIP AND KNEE SURGEONS

ANNUAL MEETING | 2015
NOV 5-8 2015 • SHERATON DALLAS HOTEL

NEW MEETING SITE IN 2016, HILTON ANATOLE, DALLAS, TX

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2. Characterization of the Acute Phase Response Following Total Joint Arthroplasty
Stephen M. Engstrom, MD, Nashville, TN
3. Myocardial Cobalt Levels Are Elevated After Joint Arthroplasty and Associated with Cardiac Pathology
Cody C. Wyles, BS, Rochester, MN
4. How Common is Trunnionosis in Metal-on-Polyethylene Total Hip Replacements?
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5. MRI Predicts Adverse Local Tissue Reaction Histologic Severity in Modular Neck Total Hip Arthroplasty
Brian T. Barlow, MD, New York, NY
6. Should We Think Twice about Psychiatric Disease in Total Hip Arthroplasty?
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7. The Prevalence of Neurocognitive Dysfunction in Total Joint Arthroplasty and Relation to Patient Reported Outcomes - *Stephen Yu, BS, New York, NY*
8. Long-term Outcome of Total Hip Arthroplasty in Patients with Cerebral Palsy: A Durable and Effective Means of Pain Relief and Functional Improvement *Cody C. Wyles, BS, Rochester, MN*
9. Minimum 13 year Multi-center Study of THR with Highly Cross-linked Polyethylene and Standard Diameter Femoral Heads - *Charles R. Bragdon, PhD, Boston, MA*
10. 5 year Clinical Performance of Highly Cross-Linked Polyethylene and Vitamin E Diffused Polyethylene using RSA - *Orhun Muratoglu, PhD, Boston, MA*
11. 5 year RSA Evaluation of Vitamin E diffused Highly Cross-Linked Polyethylene Wear and Stability of Femoral Stems - *Orhun Muratoglu, PhD, Boston, MA*
12. Wear and Oxidation of Retrieved, Long-Term, 1st Generation HXLPE Components in THA
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13. Cobalt chrome and oxidized zirconium on highly cross-linked polyethylene: Mid-term results *Edward M. Vasarhelyi, MD, MSc, FRCSC, London, Ontario*
14. Anatomic Hip Center Decreases 20-Year Acetabular Component Loosening in Cemented Crowe-II THAs
Chad D. Watts, MD, Rochester, MN
15. Total hip arthroplasty for osteoarthritis secondary to Legg-Calve-Perthes Disease: Is there an increased risk of complications?
Spencer Martin George, MD, Clayton, MO
16. Implant Survival and Outcomes after Total Hip Arthroplasty in Young Patients with Developmental Dysplasia of the Hip
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17. Does Radiographic Severity of Osteoarthritis Predict Patient-Reported Outcomes in Young Total Hip Arthroplasty Patients?
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18. Long-Term Results of Total Hip Arthroplasty with Shortening Subtrochanteric Osteotomy Performed in Crowe IV DDH - *Matthew P. Abdel, MD, Rochester, MN*
19. Primary Total Hip Arthroplasty in the Octogenarian Population - *Arthur L. Malkani, MD, Louisville, KY*
20. Primary Total Hip Arthroplasty Patients with Parkinson's have Increased Two-Year Dislocation and Revision Rates - *Karthikeyan E. Ponnusamy, MD, Baltimore, MD*
21. Effects of Pelvic Tilt and Stem Anteversion on Hip Range-of-Motion to Impingement
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22. Influence of Dual Mobility Design on Femoral Head Stability: Dynamic Dislocation Test Model
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23. Do Conversion Total Hip Arthroplasty Yield Comparable Results To Primary Total Hip Arthroplasty
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24. Biplanar Low-dose Radiography is Accurate for Measuring Total Hip Arthroplasty Position in Patients Postoperatively
David J. Mayman, MD, New York City, NY
25. Utilizing Robotics or Fluoroscopy in THA: Do New Techniques Improve Acetabulum Positioning in the Learning Curve?
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26. Same Day Total Hip Arthroplasty Performed at an Ambulatory Surgical Center: 90 day Complication Rate on 549 Patients - *Gregg R. Klein, MD, Livingston, NJ*
27. Accelerated Physical Therapy Rehabilitation Following Elective Primary Total Hip Arthroplasty Facilitates Early Discharge - *Azim A. Karim, MD, Houston, TX*
28. Comparison of Discharge Disposition between Physicians with and without Defined Post-acute Care Pathways - *Paul J. Duwelius, MD, Lake Oswego, OR*
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30. Health Related Quality of Life Measures Can Assess Clinical Improvements in Primary Total Hip Arthroplasty Patients - *Russell Cohen, MD, Tucson, AZ*
31. Mortality Following Periprosthetic Femur Fractures During and After Primary THA
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32. Early Proximal Periprosthetic Femoral Fractures in Total Hip Arthroplasty using a Direct Anterior Approach - *Marcel A. Bas, MD, New York, NY*
33. Fewer Complications and Revisions with Hemiarthroplasty compared to Total Hip Arthroplasty for Femoral Neck Fractures in the Medicare Population - *Scott Eskildsen, MD, Chapel Hill, NC*
34. Pre-Opioid Use: Is There an Association with Outcomes Following THA?
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35. Primary Tritanium Acetabular Components are Associated with a High Prevalence of Radiolucencies which Compromise Clinical Function at Short Term Follow-up
Alberto Carli, MD, MSc, FRCSC, New York, NY
36. Comparative Survival Analysis Of Porous Tantalum And Porous Titanium Cups In Total Hip Arthroplasty
Sumon Nandi, MD, Lima, OH
37. Evaluation of Applied Torques and Forces During Femoral Reaming for Hip Arthroplasty - Manual vs. Power Reaming
Michael R. Conti Mica, MD, Maywood, IL
38. Are Patient-Reported Outcomes Different after Direct Anterior Versus Posterior Approach to Total Hip Arthroplasty?
Michael S. Cremins, PhD, PA-C, Farmington, CT
39. The Effects of Elastic Moduli on Primary THA: A Clinical And Radiographic Follow-Up
Carlos Lavernia, MD, FACS, South Miami, FL
40. The impact of surgical approach on short-term patient outcomes in total hip Arthroplasty
Edward Vasarhelyi, MD, MSc, FRCSC, London, Ontario
41. Simultaneous Bilateral Versus Staged Bilateral Total Hip Arthroplasty: A Matched Survival Study
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42. Patient Reported Outcomes Following Simultaneous versus Staged Bilateral Total Hip Arthroplasty
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43. Perioperative Outcomes of Primary Total Hip Arthroplasty after Prior Lumbar Spinal Fusion
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44. Cementless Taper-Wedge Femoral Stems Are Ideal in Obese Patients Compared to Traditional Fit and Fill Stems - *R. Michael Meneghini, MD, Fishers, IN*
45. A Prospective, Randomized, Radiostereometric Analysis of Patients Undergoing Cementless THR
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46. The Effect of Total Hip Replacement on the Non-operated Lower Extremity Joints
Elie Ghanem, MD, Danville, PA
47. Does Hip Arthroscopy Affect The Outcomes Of a Subsequent Total Hip Arthroplasty?
Bryan Haughom, MD, Chicago, IL
48. "Dual Diagnosis" Triples Rates of Periprosthetic Infection and Revision after Primary Total Hip Arthroplasty - *Mitchell R. Klement, MD, Durham, NC*
49. Tranexamic Acid in Total Hip Arthroplasty: Do Drug Formulation and Dosage Determine Efficacy and Safety? - *Yale A. Fillingham, MD, Chicago, IL*
50. Oral and Intravenous Tranexamic Acid are Equivalent at Reducing Blood Loss Following Total Hip Arthroplasty - *Erdan Kayupov, MSE, Cleveland, OH*

PRIMARY KNEE

51. IV vs. Topical Tranexamic Acid in TKA: IV vs. Topical Tranexamic Acid in TKA:
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52. Randomized Prospective Trial Comparing the use of IV versus PO Acetaminophen with Total Joint Arthroplasty - *Richard L. Davis, MD, Columbus, OH*
53. Bilateral simultaneous versus staged total knee replacement: A comparison of complications and mortality. - *Dhiren S. Sheth, MD, Irvine, CA*
54. 10 Year Outcomes of UKA Versus TKA in Patients with Similar Pre-operative Function and Arthritis
Gavin Hart, MD, and John Masonis, MD, Charlotte, NC
55. Unicondylar Versus Total Knee Arthroplasty in Young Patients: Minimum 5 Year Follow-up
Jason H. Lee, MD, Chino, CA
56. To Uni Knee or Not Uni Knee...That is the Question: Does Preoperative Range of Motion Matter?
Nitin Goyal, MD, Alexandria, VA
57. Safety and Cost-Effectiveness of Outpatient Unicompartmental Knee Arthroplasty in the Ambulatory Surgery Center: A Matched Cohort Study
Marcus C. Ford, MD, Memphis, TN
58. How do Demographic, Surgical, Patient, and Cultural factors Affect Pain Control after Unicompartmental Knee Arthroplasty? A Multivariable Regression Analysis - *John W. Barrington, MD, Plano, TX*
59. Adoption of Haptic Robotic Technology Improves Component Positioning in Medial Unicondylar Knee Replacement - *Marcel A. Bas, MD, New York, NY*
60. Total Joint Replacement: A Granular Analysis Of Outcomes In The Economically Disadvantaged Patient
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61. Intra-Operative Synovitis Predicts Worse 2 Year Outcomes after Total Knee Arthroplasty for Osteoarthritis

Charles N. Cornell, MD (Hospital for Special Surgery)

62. How Do Previous Solid Organ Transplant Recipients Fare after Primary Total Knee Arthroplasty?
Mitchell R. Klement, MD, Durham, NC

63. What is the role of "Dual Diagnosis" in Primary Total Knee Arthroplasty?
Mitchell R. Klement, MD, Durham, NC

64. Outcomes after Total Knee Arthroplasty for Posttraumatic Arthritis
Thorsten Seyler, MD, PhD, Durham, NC

65. The Patient's Native Tibial Slope Is The Ideal Target In Cruciate-Retaining Total Knee Arthroplasty
Nicholas R. Arnold, BS, Washington, DC

66. Greater Medial Compartment Forces during TKA Associated with Improved Patient Satisfaction and Ability to Navigate Stairs
Cale A. Jacobs, PhD, Lexington, KY

67. Are We Putting too Much Pressure on our Total Knee Arthroplasties? - *Michael A. Mont, MD, Baltimore, MD*

68. Participation in Non-Recommended Sports After Total Knee Did Not Affect Long-Term Durability
Matthew P. Abdel, MD, Rochester, MN

69. Rapid Discharge Versus Traditional Pathways after Knee Replacement: Clinical and Patient Reported Outcomes - *Craig M. McAllister, MD, Kirkland, WA*

70. Readmission and Complication Rates Among Parkinson Patients Undergoing a Primary Total Knee Arthroplasty - *Mostafa H. El Dafrawy, Baltimore, MD*

71. Rapid discharge after total knee arthroplasty is safe in the Medicare population
Gregory G. Klingenstein, MD, Moorestown, NJ

72. Long-term Survival of the All-Poly Tibia in a Community Based Implant Registry
Thomas K. Comfort MD, Oak Park Heights, MN

73. Oxidized Zirconium vs. CoCr in Total Knee Arthroplasty: 3D Laser Scanning of Retrieved Polyethylene Inlays
Forrest L. Anderson, BA, New York, NY

74. Psychiatric Disorders Increase Complication Rate After Primary Total Knee Arthroplasty
Mitchell R. Klement, MD, Durham, NC

75. Effectiveness of Embedded Case Management in the Utilization of Post-Acute Care Service during Care Transitions
Coles L'Hommedieu, MD, St. Louis, MO

76. Prospective Trial of Liposomal Bupivicaine Periarticular Anesthetic Injection Compared to Femoral Nerve Block in TKR - *Carl T. Talmo, MD, Boston, MA*

77. Is There a Benefit for Liposomal Bupivacaine Compared to a Traditional peri-articular injection in TKA patients with a history of chronic opioid use
Ran Schwarzkopf, MD, MSc, Scarsdale, NY

78. Comparing Pain Relief between Exparel® Injection vs. On-Q Catheter as the Postsurgical Analgesia following Total Knee Arthroplasty (TKA): A Double Blinded, Randomized Controlled Trial
Eric B. Smith, MD, Media, PA

79. Liposomal Bupivacaine versus Femoral Nerve Block for Pain Control in Total Knee Arthroplasty
Stephen Yu, BS, Garden City, MI

80. Postoperative Pain Management After Primary Knee Arthroplasty: The Value Of Liposomal Bupivacaine
Scott M. Sporer, MD, Winfield, IL

81. Adductor Canal Blockade for Total Knee Arthroplasty: A Randomized, Double Blind Placebo Controlled Trial
Robert Dekker, MD, Chicago, IL

82. Peri-Articular Morphine Injection in Total Knee Arthroplasty - *Kentaro Iwakiri, MD, Ikoma, Nara, Japan*

83. The Role of Gender, Age, Race, and Ethnicity on Postoperative Pain after Primary Total Knee Arthroplasty - *John W. Barrington, MD, Plano, TX*

84. Comparison Between the Risk Falls After Total Knee Arthroplasty with Use of Femoral Nerve Block versus Adductor Canal Block
Nabil M Elkassabany MD, MSCE, Philadelphia, PA

85. Do Smart Tools Reduce the Need for Manipulation after Primary Total Knee Arthroplasty?
Adolph V. Lombardi, Jr., MD, FACS, New Albany, OH

86. Decreased Range of Motion Following Total Knee Arthroplasty is Predicted by the Tampa Scale of Kinesiophobia (TSK)
Matthew L. Brown, MD, Winston Salem, NC

87. Bariatric Surgery Does Not Improve Outcomes in Patients Undergoing Primary Total Knee Arthroplasty
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88. Lingering Risk: Bariatric Surgery Prior to Total Knee Arthroplasty - *Brian T. Nickel, MD, Durham, NC*

89. Pre-Opioid Use: Is There an Association with Outcomes Following TKA? - *Nicholas A. Bedard, MD, Iowa City, IA*

90. Distal Femur Rotational Alignment in Patient Specific Instrumentation: A CT-Based Evaluation
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91. Thick or Thin? Patellar Thickness: The Influence on Motion and Complications after Total Knee Arthroplasty
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92. Metal or Modularity: Why do Metal Backed Tibias

Have Inferior Outcomes to All-Polyethylene Tibial Components - *Cody C. Wyles, BS, Rochester, MN*

93. Femoral Bowing is Main Determinant of the Proper Alignment to Restore Mechanical Axis in Total Knee Arthoplasty - *Gregory W. Stocks, MD, Houston, TX*
94. Does Marital status affect Outcomes following Total Knee Arthroplasty (TKA)
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95. Questionnaires And Patient Oriented Outcomes In Primary Total Knee Arthroplasty Perception Or Reality
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96. The Effect of Total Knee Replacement on the Non-operated Lower Extremity Joints
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97. Cemented Versus Cementless Femoral Components in TKA: Long-term Follow-Up
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98. The Inadequacy of Short Knee Radiographs in Evaluating Coronal Alignment Following Total Knee Arthroplasty - *Andrew Park, MD, St. Louis, MO*
99. Effect of Tourniquet and Reperfusion on Lower Extremity Oxygenation during Total Knee Arthroplasty
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100. Can Systematic Medial Collateral Ligament Needle Puncturing lead to a Predictable and Safe Reduction in Medial Tension during Total Knee Arthroplasty?
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102. Aspirin is as Effective as and Safer Than Warfarin for Patients at Elevated Risk of Venous Thromboembolism Undergoing Total Joint Arthroplasty
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103. Low Dose Aspirin Is an Effective Chemoprophylaxis for Venous Thromboembolism Following Total Joint Arthroplasty: An Interim Analysis
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104. Efficacy of Venous Thromboembolism Prophylaxis in Total Joint Arthroplasty based on Risk Stratification: Should Potent Anticoagulation be used in Higher Risk Patients?
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105. Venous Thromboembolism Following Hip and Knee Arthroplasty: Is There A Difference in Risk For Primary Compared to Revision Surgery?
Michael A. Mont, MD, Baltimore, MD
106. Risk-Stratified VTE Prophylaxis following TJA: Aspirin and SPCDs versus Aggressive Chemoprophylaxis
Stephen Yu, MD, New York, NY
107. Use of a Risk Stratification Protocol for Thromboembolism Prophylaxis Following Hip Arthroplasty
Denis Nam, MD, MSc, St. Louis, MO
108. The Clinical Severity of PE Following Joint Replacement Is Unrelated to the Location of Emboli in the Pulmonary Vasculature
Alejandro Gonzalez Della Valle, MD, New York, NY
109. Propagation of Infrapopliteal Venous Thrombotic Events with Aspirin Treatment Following Total Knee Arthroplasty
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110. Is outpatient arthroplasty as safe as fast-track inpatient arthroplasty? A propensity score matched analysis - *Francis Lovecchio, BA, Chicago, IL*
111. Is Metal-On-Metal Total Hip Arthroplasty Associated with Neurotoxicity?
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112. Prevalence of Pseudotumor in Patients after Metal-on-Metal Hip Arthroplasty: A Single Surgeon's Large Case-Series - *Sean A. Sutphen, DO, Columbus, OH*
113. Cervical Myelopathy Doubles the Rate of Dislocation and Fracture After Total Hip Arthroplasty (THA)
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114. Decreased Cardiac Morbidity and Mortality in Higher Risk Populations Undergoing Elective Total Knee Arthroplasty Procedures Following Surgical Care Improvement Project Guidelines
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115. Which Adverse Events are Associated with Revision Versus Primary Total Joint Arthroplasty?
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116. The Effect of Smoking on Thirty-Day Postoperative Complications after Total Hip Arthroplasty: A Propensity Score Matched Analysis
Shawn Sahota, MD, Chicago, IL
117. The Interaction of Obesity and Diabetes in Determining Risk of Complication Following Total Joint Arthroplasty - *Linda I. Suleiman, MD, Chicago, IL*
118. Chronic Kidney Disease Linearly Predicts Outcomes After Elective Total Joint Arthroplasty
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119. Elixhauser Comorbidity Method Is More Accurate than the Charlson Index in Predicting 90-Day Mortality and Morbidity for Hip Fracture Patients
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120. Iliopsoas Impingement After Primary Total Hip

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122. A Multi-Center Randomized Clinical Trial of Articulating and Static Spacers for Periprosthetic Hip Infection - *Erdan Kayupov, MSE, Cleveland, OH*

123. Recurrent Periprosthetic Joint Infection after Irrigation and Debridement with Component Retention is Most Often Due to Identical Organisms
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124. Success of Debridement and Implant Retention in Periprosthetic Joint Infection – Does the Surgeon Matter?
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125. Risk of Re-infection Following Treatment of Infected Total Knee Arthroplasty
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126. Two-stage Debridement with Prosthesis Retention for Acute Periprosthetic Infections Following Knee Arthroplasty - *Matthew C. Niesen, MD, Middleton, WI*

127. Two-stage Debridement with Prosthesis Retention for Acute Periprosthetic Joint Infections Following Primary Hip or Knee Arthroplasty
Matthew C. Niesen, MD, Middleton, WI

128. Positive Cultures during Reimplantation Increase the Risk of Subsequent Failure in Two-Stage Exchange Arthroplasty - *Timothy L. Tan, MD, Philadelphia, PA*

129. The CRP Test May Not Detect PJIs Cause by Less-Virulent Organisms
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130. Alpha-Defensin is an Accurate Test for PJI
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131. The Utility of Repeated Joint Aspirations to Diagnose a Periprosthetic Joint Infection
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132. Patients with BMI ≥ 35 at Greater Risk of Wound Complications Requiring Reoperation after Direct Anterior THA
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133. Is Obesity Putting Anterior Approach Hips at Higher Risk of Infection?
William G. Hamilton, MD, Alexandria, VA

134. High Risk of Wound Complications Following Direct Anterior Total Hip Arthroplasty in Obese Patients
Chad D. Watts, MD, Rochester, MN

135. Preoperative Hip Injections Increase the Rate of Periprosthetic Infection After Total Hip Arthroplasty
William Schairer, MD, New York, NY

136. Does the Timing of Previous Intra-articular Steroid Injection Affect the Rate of Postoperative Infection after TKA?
Jourdan M. Cancienne, MD, Charlottesville, VA

137. The Risk of an Infection Associated with Intra-articular Injections Prior to Total Knee Arthroplasty
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138. Rate and Risk Factors for Periprosthetic Joint Infection after Same-Day and Staged Bilateral Total Hip Arthroplasty
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139. Implications of Hypoalbuminemia in Revision Total Joint Arthroplasty - *Daniel D. Bohl, MD, Chicago, IL*

140. No Advantage to Prolonged Antibiotic Therapy Following Total Hip Arthroplasty Irrigation and Debridement - *Sumon Nandi, MD, Lima, OH*

141. Administration of Vancomycin to Patients with a Reported Penicillin Allergy During Total Joint Arthroplasty Results in a Higher Rate of Infection with Gram Negative Organisms
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REVISION KNEE

142. Quantifying and Predicting Surgeon Work Effort for Primary and Revision Total Knee Arthroplasty
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143. Results of Contemporary Rotating Hinge Total Knee Arthroplasties - *Matthew P. Abdel, MD, Rochester, MN*

144. The Outcome of Semi-Constrained Rotating-Platform implants for Revision Total Knee Arthroplasty
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145. More Metal, More Problems - Length of Endoprosthetic Reconstruction in Revision Arthroplasty is Associated with Complications and Reoperations - *Jeffrey Barry, MD, San Francisco, CA*

146. Utility and Reliability of Fluorscopic Images in Determining Loosening in Total Knee Arthroplasty
Peter K. Sculco, MD, Rochester, MN

147. The Fate of Revision Total Knee Arthroplasty With Preoperative Abnormalities in Either Sedimentation Rate or C-Reactive Protein
Gwo-Chin Lee, MD, Horsham, PA

148. Stability of Novel Porous Metal Metaphyseal Tibial Cones Designed for Surgical Efficiency is Comparable to Traditional Cones
R. Michael Meneghini, MD, Fishers, IN

149. Mid-Term Results of Porous Tantalum Femoral Cones

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150. Effect of diaphyseal-engaging femoral and tibial stem length on mechanical alignment in revision total knee arthroplasty - *Rishi Balkissoon, MD, MPH, Chicago, IL*

151. Comparison of Articulating Spacer Techniques in Revision Total Knee Arthroplasty for Sepsis. A Metanalysis. - *George Guild, MD, Atlanta, GA*

REVISION HIP

152. Long-term Mortality following Revision Total Hip Arthroplasty (THA)
Hilal Maradit Kremers, MD, Rochester, MN

153. Modular Fluted Tapered Stems in Aseptic Revision Total Hip Arthroplasty
Matthew P. Abdel, MD, Rochester, MN

154. Tapered vs. Cylindrical Stem Fixation Stability in a Femoral Bone Loss Model
Robert D. Russell, MD, Dallas, TX

155. Assessment of Polyethylene Surface Damage on a Dual Mobility Acetabular System
Timothy M. Wright, PhD, New York, NY

156. XLPE Acetabular Liners Exhibit Damage after Short-Term Articulation with Scratched OXINIUM Femoral Heads
Alberto Carli, MD, MSc, FRCSC, New York, NY

157. The Fate of Serum Cobalt following Revision of a Recalled Dual Modularity Femoral Component
Jim Nevelos, PhD, Mahwah, NJ

158. Dual Mobility Cups: An Effective Prosthesis In Revision Total Hip Arthroplasties For Preventing Dislocations - *Michael A. Mont, MD, Baltimore, MD*

159. Dual Mobility Articulations For Patients at High Risk for Dislocation
Darren R. Plummer, MD, MBA, Indianapolis, IN

160. Reduced Instability in Revision Total Hip Arthroplasties with Dual Mobility Constructs
Molly A. Keegan, MD, Rochester, MN

161. Outcomes of Custom Tri-Flange Acetabular Components in Revision Total Hip Arthroplasty and Predictors of Failure
Brian T. Barlow, MD, New York, NY

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162. Here Today, Gone Tomorrow: An Examination of the Survivorship of Orthopaedic Devices Advertised in a Major Medical Journal
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163. Pre-Operative MRI as a Prognostic Factor for Outcomes of Core Decompression for Osteonecrosis of the Femoral Head
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164. Gender Differences In the Three Dimensional (3D) Pathomorphology of Femoroacetabular Impingement (FAI) - *James R. Ross, MD, Boca Raton, FL*

165. Pelvic Incidence Plays a Role in Pelvic Mobility & Acetabular Version in Patients with Femoroacetabular Impingement - *James R. Ross, MD, Boca Raton, FL*

166. Reoperation Rate after Primary Hip Arthroscopy for the treatment of chondrolabral pathology and FAI
Christopher L. Peters, MD, Salt Lake City, UT

167. Predictors of Clinical Outcomes After Hip Arthroscopy: A Prospective Analysis of 1038 Patients With Two-Year Follow-Up
Parth Lodhia, MD, FRCSC, Westmont, IL

168. Demographics and Early Functional Outcomes of Periacetabular Osteotomy for Symptomatic Mild Acetabular Dysplasia
Benjamin F. Ricciardi, MD, New York, NY

169. Three-dimensional CT Analysis Identifies Distinct Variations in Acetabular Morphology in the Dysplastic Hip - *John C. Clohisy, MD, St. Louis, MO*

170. Is Combined Surgical Hip Dislocation and Periacetabular Osteotomy a Safe Procedure for Complex Hip Deformities?
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171. Perioperative Factors and Their Effect on the Fibrinolytic System in Arthroplasty Patients
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172. Characterization of the Neuroanatomy of the Hip Joint to Optimize Periarticular Injection Techniques in Total Hip Arthroplasty
Matthew J. Simons, MD, Fresno, CA

173. Comparative Effectiveness of Viscosupplement and Corticosteroid Injections for Knee Osteoarthritis
James A. Keeney, MD, Columbia, MO

174. Efficacy of Intraarticular Corticosteroid Injections in Patients with Symptomatic Knee Osteoarthritis
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175. Noninvasive Hemoglobin Monitoring: A Rapid, Reliable, and Cost-effective Method Following Total Joint Replacement
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176. Enhanced Biocompatibility to Co-Cr Alloy by Surface Treatment with 3-D metal Printing
Young Wook Lim, MD, PhD, Seoul, Republic of Korea

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177. A CPT code for Conversion Knee Arthroplasty is Warranted - *Tyler M. Kreitz, MD, Philadelphia, PA*

178. Costs and Medicare Reimbursements for Conversion

and Primary Total Hip Arthroplasty
Thomas P. Vail, MD, San Francisco, CA

179. Non-Elective Joint Arthroplasty is Associated with Increased Length of Stay and Alternative Discharge Disposition - *Eric Greber, MD, Little Rock, AR*
180. How Much Do Patients Value Total Hip and Knee Arthroplasty? A Prospective, Multi-center Study
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181. Patients' Perception of Value in Bundled Payments for Total Joint Arthoplasty
Adam J. Schwartz, MD, MBA, Phoenix, AZ
182. Societal Cost Savings of Total Hip Arthroplasty: A Markov Analysis
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183. The Tortoise and the Hare Increase Complications During Total Joint Arthroplasty
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184. How will the Financial Impact of Major Medical Complications after TKA Change with Bundled Payments? - *Michael M. Kheir, BS, Philadelphia, PA*
185. Are Bundled Payments an Effective Payment Model in Revision Hip and Knee Arthroplasty?
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186. Appropriate Use Criteria And Local Carrier Determinations: Are We Hurting Our Total Joint Arthroplasty Patients?
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187. The Cost of Post-Hospital Acute Care of Total Joint Arthroplasty in a Bundled Payment System
Elie Ghanem, MD, Danville, PA
188. Does "6-Clicks" Day 1 Postoperative Mobility Score Predict Resource Use after Joint Replacement?
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189. Outpatient Total Joint Replacement: Is It Safe? Evaluation of Complications and Readmission Rates
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190. The Sticky Wicket of Length of Stay and Reimbursement Calculations
Susan Odum, PhD, Charlotte, NC
191. RAPT Score Predicts Inpatient Hospital Length of Stay Following Total Joint Arthroplasty
David Nicoloro, PT, MS, Newton, MA
192. Can We Predict Discharge Status After Total Joint Arthroplasty? A Simple Calculator to Predict Home Discharge - *Nicholas A. Bedard, MD, Iowa City, IA*
193. Short Stay Total Joint Replacement: Any Difference Between Day 0 and Day 1 Discharge?
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Lifetime Survivorship of 2000 Primary Charnley Total Hip Replacements: Mean Follow-up of 40 Years

Matthew P. Abdel, MD, Philip von Roth, MD, Daniel J. Berry, MD

Introduction: While numerous series have shown good long-term survival with the Charnley total hip arthroplasty (THA), there is a paucity of data on how implants perform during the entire lifetime of a patient. The purpose of the current study was to determine the 40-year results of the Charnley THA utilizing death as a competing risk.

Methods: We retrospectively reviewed 2000 consecutive cemented Charnley THAs between 1969 and 1971 at a single institution. A competing risk analysis was completed at 40 years with death as the competing risk. Patients were analyzed based upon age, gender, and diagnosis. Mean age at the index arthroplasty was 64 years. Mean follow-up was 40 years.

Results: The cumulative incidence of revision for any reason at 40 years, accounting for death as a competing risk, was 14%. When stratified by age in a multivariate model, patients less than 50 had a 35% incidence of revision for any reason (HR=3.6; $p<0.0001$), patients 50–59 years had a 20% incidence of revision for any reason (HR=2.1; $p<0.0001$), patients 60–69 had a 9% incidence of revision for any reason (reference), and patients $\geq$ 70 years had a 5% incidence of requiring revision for any reason (HR=0.96; $p=0.86$) during their lifetime. Men had a higher risk of revision for any reason (HR=2.1; $p=0.0001$), and this effect was most strong for younger age groups.

Conclusion: Almost all patients in this series were followed until death or revision; this allowed development of “rules of thumb” for lifetime likelihood of revision for Charnley THA: 1 in 3 for patients < 50 years, 1 in 5 for patients 50 to 59 years, 1 in 10 for patients 60 to 69 years, and 1 in

Characterization of the Acute Phase Response Following Total Joint Arthroplasty

Stephen M. Engstrom, MD, William Oelsner, BS, Thomas J. An, AB, Michael A. Benvenuti, BS, Richard A. Jacobson, BS, Xulei Liu MS, Gregory G. Polkowski, MD, MSC, Jonathan G. Schoenecker, MD, PhD

Introduction: The acute phase response (APR) is a systemic reaction to tissue trauma induced by locally-released cytokines essential for hemostasis and wound healing. The extent of tissue injury correlates with APR intensity, and excessive or prolonged APR leads to complications following surgery. No prior attempts have been made to quantify the intensity and duration of the APR following total joint arthroplasty (TJA) despite routine use of C-reactive protein (CRP) in screening for periprosthetic joint infection. The purpose of this study was to characterize the APR in healthy patients undergoing primary uncomplicated hip and knee arthroplasty.

Methods: Records of 108 consecutive patients undergoing TKA (n=70) and THA (n=38) by a single surgeon for primary osteoarthritis were evaluated. The APR was quantified using plasma values of CRP (mg/L) and fibrinogen (mg/dL) preoperatively, daily during hospitalization, and at two and six-weeks postoperatively.

Results: Mean CRP peaked at 135.8+/-56.1 on post-operative day 1.79+/-0.55 following THA and at 164.5+/-76.2 on day 2.5+/-2.2 following TKA. By two weeks post-operative, CRP approached baseline in both groups, with THA values being similar to pre-operative ($p=0.31$) and TKA values remaining slightly elevated ($p=0.04$). By six weeks, TKA values returned to baseline ($p=0.74$). Mean fibrinogen peaked at 589.94+/-137.63 on day 2.44+/-1.97 following TKA and at 563.54+/-111.34 on day 1.92+/-0.58 following THA. For both procedures, fibrinogen remained elevated at two weeks ($p<0.0001$), but returned to baseline by six weeks ($p=0.41$ (TKA), $p=0.63$ (THA)). The median peak CRP after TKA was significantly higher than THA ($p=0.002$).

Conclusion: The APR induced in healthy patients following uncomplicated primary TJA is predictable and consistent, with resolution of CRP occurring earlier than fibrinogen. Furthermore, TKA induces a more robust APR than THA. Establishing baseline APR following TJA allows further research on which patient factors modulate the extent and intensity of the APR, and whether a dysregulated APR is predictive of postoperative complications.

Myocardial Cobalt Levels Are Elevated After Joint Arthroplasty and Associated with Cardiac Pathology

Cody C. Wyles, BS, Robert T. Trousdale, MD

Introduction: Orthopedic joint implants commonly contain elemental metal that may undergo wear-related release. Recently, cases of implant-associated myocardial injury have been reported; however, we are not aware of any study that has systematically measured myocardial metal levels or examined the relationship with arthroplasty.

Methods: Archives of our institution's total joint registry and autopsy registry were cross-queried for autopsies of individuals that underwent hip, knee or shoulder replacement with cobalt-chrome components (1990-2011). Eighty age- and sex-matched, non-arthroplasty controls were procured. Demography, implant type, and the presence of heart disease were abstracted from the medical record. Myocardial tissue samples were acid-digested using closed vessel microwave digestion, diluted with internal standards, and analyzed for cobalt (Co) and chromium (Cr) by inductively-coupled plasma mass spectroscopy. Wilcoxon rank-sum, chi-square tests, and Kruskal-Wallis tests were used to assess differences between cohorts.

Results: Ninety-four Co/Cr-on-polyethylene arthroplasty cases were included (mean age 77.4 years; 46.8% women). Baseline cardiac risk factors were statistically similar between groups. 77 (81.9%) cases had at least one hip replacement at the time of death. Significantly higher myocardial concentrations of Co were observed in individuals with arthroplasty compared to controls (median 0.105 vs. 0.077 μg/g, p=0.003). Median Co was 62% higher in hip patients that had undergone revision versus no revision (p=0.008). In general, the highest Co levels were observed in those with multiple replaced joints. Cardiomegaly and fibrosis were observed more frequently in the postmortem samples of patients with implants (p=0.002 and p=0.025, respectively).

Conclusion: This is the first study to our knowledge that quantifies metal levels in cardiac tissue in patients with and without joint replacement. The elevated Co levels, in concert with cardiomegaly and increased interstitial fibrosis found during autopsy in the arthroplasty cohort, are novel findings. Additional study is needed to more fully characterize the clinical implications of this association.

How Common is Trunnionosis in Metal-on-polyethylene Total Hip Replacements? ◊

Harry Hothi, BEng, MSc, PhD, Robert Whittaker, BSc, Jay Meswania, PhD, Rebecca McMillan BSc, Antti Eskelinen, MD, PhD, Daniel Kendoff, MD, PhD, Christian Lausmann, MD, Gordon Blunn, PhD, John Skinner FRCS, Alister Hart FRCSG (Orth), MD

Introduction: The incidence of trunnionosis in large diameter metal-on-metal (LDMOM) total hip replacements has been widely reported; less is known about taper junction damage in metal on polyethylene (MOP) hips. Retrieval studies comparing the extent of trunnionosis between MOM and MOP hips will help us understand the size of the clinical impact of taper damage in these hips.

Methods: This retrieval study compared 200 hips with 2 different bearing combinations; 100 with 36mm MOM bearings and 100 with 38mm MOP bearings.We used a well-published scoring classification method to grade the severity of corrosion at the head taper. We then used a roundness- measuring machine to quantify the volume of material loss from these junctions.Linear regression analysis was then performed to determine if there was a significant difference between taper corrosion and material loss between the two bearing types.

Results: We found that the head tapers of the MOM hips all had evidence of mild to severe corrosion whilst the MOP head tapers were substantially less damaged. The median (range) corrosion scores of the MOP and MOM head tapers were 2 (1-4) and 3 (2-4) respectively; this difference was significant ($p<0.001$). The median (range) rate of material lost from the MOP and MOM taper junctions were 0.09 mm3/year (0-1.15) and 0.24 mm3 (0-3.45) respectively; this difference was significant ($p<0.001$). Additionally, the MOP hips had been implanted for significantly longer than the MOM hips, with a median (range) time to revision of 208 months (1-324) and 75 months (12-128) respectively.

Conclusion: Our study was the first to use large numbers of retrieved hip implants to examine the affect of bearing type on the severity of trunnionosis. We found that MOM hips exhibited significantly greater taper damage with evidence of greater corrosion and volumetric material loss at the head taper junction.

◊ The FDA has not cleared the pharmaceuticals and/or medical devices listed here. MOPs

MRI Predicts Adverse Local Tissue Reaction Histologic Severity in Modular Neck Total Hip Arthroplasty

Brian T. Barlow, MD, John Boles, BS, Kara Fields, MS,
Alissa Burge, MD, Hollis Potter, MD, Geoffrey Westrich, MD

Introduction: The correlation between advanced imaging, serum metal ions, and histologic ALTR severity has not been previously reported for a modular neck femoral stem with an increased revision rate.

Methods: The retrospective cohort included 90 patients with 98 modular neck femoral stems from a single manufacturer revised between 2011-2014. Prior to revision, patients underwent MAVRIC (multiacquisition variable-resonance image combination) sequence MRI and serum cobalt and chromium ion levels were measured. The association between MRI characteristics, ALVAL histologic grade, and pre-revision serum metal ion levels was assessed with random forest analysis, Spearman rank correlation coefficients, and regression based on the generalized estimating equations (GEE).

Results: The mean age of the cohort was 65.9 (±8.9) years. 8.9% of patients had bilateral modular neck THA. The mean time to revision was 2.4 ± 0.9 years. The median (1st quartile, 3rd quartile) preoperative cobalt level was 6.7µg/L (4.8 µg/L, 10µg/L); the median preoperative chromium level was 1.3µg/L (0.5, 2.2µg/L). Using MRI, the median maximum synovial thickness was 6.5mm (4.1, 10mm) and the median volume of synovitis was 32,287.4mm3 (11,397, 80,340mm3). Using regression based on a GEE approach, the MRI ALTR grade predicted histologic ALVAL severity ($p<0.001$). Spearman rank correlation coefficients identified a strong correlation between maximum synovial thickness ($\rho=0.60$; 95% CI: 0.46-0.71) and synovitis volume ($\rho=0.56$; 95% CI: 0.41-0.68) with ALVAL histologic grade. The Spearman rank correlation coefficients failed to show a strong correlation between the pre-revision cobalt levels (µg/L) ($\rho=0.17$; 95% CI -0.02-0.35) or pre-revision chromium levels ($\rho=-0.06$; 95% CI -0.25-0.13) with ALVAL histologic grade. Random forest analysis demonstrated that maximum synovial thickness and synovitis volume were the most important MRI predictors of the histologic ALVAL score.

Conclusion: MRI characteristics were correlative with histologic severity in modular femoral neck stems, but serum metal ion levels did not correlate with histologic severity.

Should We Think Twice about Psychiatric Disease in Total Hip Arthroplasty?

Mitchell R. Klement, MD, Colin T. Penrose, BA, BS, Abiram Bala, MD, Daniel J. Blizzard, MD, MS, Samuel S. Wellman, MD, Michael P. Bolognesi, MD, Thorsten M. Seyler, MD, PhD

Introduction: Psychiatric disease is difficult to screen preoperatively and the incidence of mental health disorders in patients undergoing total hip arthroplasty (THA) may be as high as 16%. The purpose of this study is to evaluate the postoperative complication profile in patients with psychiatric disorders and we hypothesize they will be significantly increased compared to control.

Methods: A search of the entire Medicare database from 2005 to 2011 was performed using International Classification of Disease version 9 (ICD-9) codes to identify 86,976 patients who underwent THA with psychiatric disorders including bipolar (5,626), depression (82,557), and schizophrenia (3,776) without substance abuse disorders (SUD). A cohort of 590,689 primary THA patients without psychiatric disorder or SUD served as a control with minimum 2.5-year follow-up. Medical co-morbidities and post-operative complications at 30-day, 90-day, and overall time points were compared between the two cohorts.

Results: Patients with psychiatric disease were more likely to be younger (age <65 OR 4.51, $p < 0.001$), female (OR 2.02, $p < 0.001$), and more medically complex (significant increase in 28/28 Elixhauser medical comorbidities, $p < 0.001$). There was a significant increase ($p < 0.001$) in 13/14 (92.8%) recorded post-operative medical complications rates at the 90-day time point including suicide (OR 39.40), deep vein thrombosis (OR 1.31), pulmonary embolism (OR 1.48), and need for blood transfusion (OR 1.36). In addition, there was a statistically significant increase in periprosthetic infection (OR 2.26 $p < 0.001$), periprosthetic fracture (OR 2.09, $p < 0.001$), dislocation (OR 2.30, $p < 0.001$), and THA revision (OR 1.93, $p < 0.001$) at overall follow up.

Conclusion: Patients with psychiatric disorders who undergo elective primary THA have significantly increased medical and surgical complication rates in the global period and short term follow up. An ideal screening tool is yet to be determined and these patients need to be counseled accordingly.

The Prevalence of Neurocognitive Dysfunction in Total Joint Arthroplasty and Relation to Patient Reported Outcomes

Stephen Yu, MD, Emmanuel Edusei, BS, Kelsey Grossman, BS, Raj Karia, MPH, David Steiger, MD, James Slover, MD, MS

Introduction: Neurocognitive dysfunction (NCD) has been reported to be highly prevalent and often under-diagnosed in elderly patients presenting for surgery. The presence of NCD increasingly significant, and pre-operative neurocognitive impairment may affect functional outcome scores. We aimed to evaluate the relationship between pre-operative neurocognitive dysfunction and short-term patient reported outcome (PRO) scores.

Methods: Neurocognitive tests were administered to patients during their pre-surgical visit to evaluate their neurocognitive status. The Rey Auditory-Verbal Learning Test (RAVLT) was utilized to assess memory function and two grooved pegboard tests (dominant-hand, PEGD, and non-dominant hand, PEGN) were utilized to assess dexterity/coordination. The presence of NCD in patients was determined by comparing the performance of each test with age-matched normative means. Baseline PROs were collected 10-14 days prior to TJA, with a follow-up PRO 4-8 weeks post-operatively.

Results: 99 patients underwent neurocognitive testing and completed PRO measures. 53% (53/99) tested positive for NCD on at least one of the three tests. Baseline PRO scores were significantly lower in NCD patients [RAVLT: VAS Scores ($p=0.004$)]; [PEGD: VAS ($p=0.004$); EQ5D ($p<0.001$); HOOS/KOOS-SR ($p=0.010$), QOL ($p=0.048$)]; [PEGN: EQ5D ($p=0.050$)]. When measuring the difference in PRO score at follow-up versus baseline, the degree of improvement between normal and impaired patients was not statistically different, with the exception of NCD patients experiencing greater degrees of improvement by PEGD-EQ5D ($p=0.028$) and PEGN-VAS ($p=0.007$).

Conclusion: NCD is highly prevalent among the total joint arthroplasty population compared with age-matched norms. Patients with NCD demonstrated a more significant mental and physical debilitated state of health prior to surgery as measured by PRO. The degree of short-term improvement in NCD patients matched normal patients, but they started with functional deficits. Further studies are needed to identify neurocognitive dysfunction

Long-term Outcome of Total Hip Arthroplasty in Patients with Cerebral Palsy: A Durable and Effective Means of Pain Relief and Functional Improvement

Matthew T. Houdek, MD, Chad Watts, MD, **Cody C. Wyles, BS,**
Todd Milbrandt, MD, Michael J. Taunton, MD

Introduction: The spasticity that is a commonly observed in patients with cerebral palsy (CP) can lead to hip degeneration and pain. Total hip arthroplasty (THA) has been used to provide pain relief in patients with CP, however there is hesitation due to fears of dislocation and wear. The purpose of this study was to review the outcome of tTHA performed in patients with CP with a focus on need for revision and complications.

Methods: We reviewed the records of 41,349 patients undergoing a primary THA over a 43-year period. 35 (0.08%) THA's were performed in patients with CP. The cohort was 64% male, with a mean age and BMI of 52 and 25.3. All patients could walk prior to surgery. Harris Hip Scores (HSS) were calculated prior to surgery and at last follow-up. Mean follow-up was 7 years. CP patients were matched 1:2 to a group undergoing THA for OA over the same time period. Patients were the same gender, age, and had their surgery with-in 2-year of the same surgical year. Kaplan-Meier survival methods was used to estimate implant survival.

Results: The mean implant survival in patients with CP at 10-, and 20-year time points was 81%. There was no difference (HR 0.72, P=0.56) in implant survival compared to patients with a diagnosis of OA. There was no increased risk of dislocation in patients with CP (OR 0.31, P=0.41). Prior to surgery all patients had severe or moderate pain, this was significantly reduced (P <0.0001) postoperatively. The preoperative HSS was 37 and significantly improved (P=0.0001) to 77.

Conclusion: THA provides patients with CP significant pain relief and functional improvement. Patients with CP should expect similar outcome to those with a primary diagnosis of OA, and a diagnosis of CP should not discourage a surgeon from performing this procedure.

Minimum 13 year Multi-center Study of THR with Highly Cross-linked Polyethylene and Standard Diameter Femoral Heads

Charles R. Bragdon, PhD, Christopher J. Barr, BS, Christian S. Nielsen, MD, Daniel Berry, MD, Craig Della Valle, MD, Kevin Garvin, MD, Per-Erik Johanson, MD, PhD, John Clohisy, MD, Henrik Malchau, MD, PhD

Introduction: The first highly crosslinked and melted polyethylene acetabular component for use in total hip arthroplasty was implanted in 1998. Numerous publications have reported reduced wear rates and a reduction in particle induced peri-prosthetic osteolysis at short to mid-term follow-up. The purpose of this study was to re-assemble a previous multi-center patient cohort in order to evaluate the radiographic and wear analysis of patients receiving this form of highly crosslinked polyethylene articulating against 32mm femoral heads or less at a minimum of 13 years follow-up.

Methods: Inclusion criteria for patients was a primary THR with femoral heads 32mm or less and a minimum 13 year follow-up. 71 hips have been enrolled with an average follow-up of 13.7 years (13-16), 25 females (33%). Wear analysis was performed using the Martell Hip Analysis software. Radiographic grading was performed on the longest follow-up AP hip films. The extent of radiolucency in each zone greater than 0.5mm in thickness was recorded along with the presence of sclerotic lines and osteolysis.

Results: Wear analysis: Using the average of the slopes of the individual regression lines, the wear rate was 0.006±0.033mm/yr. Using the early to latest film method, the wear rate was 0.004±0.056mm/yr.Radiographic analysis: Acetabular side: the greatest incidence of radiolucency occurred in zone 1 at 21%; sclerotic lines had a less than 2% incidence in any of the 3 zones; there was no identified osteolysis. Femoral side: the incidence of radiolucencies was limited to zone 1, 2%; sclerotic lines were rare in any zone, maximum in zone 3, 4%; there was no identified osteolysis.

Conclusion: The wear of this form of irradiated and melted highly crosslinked polyethylene remained at levels lower than the detection limit of the software at minimum 13 year follow-up and there was no identified osteolysis.

5 year Clinical Performance of Highly Cross-linked Polyethylene and Vitamin E Diffused Polyethylene using RSA

Audrey K. Nebergall, Meridith E. Greene, PhD, Mogens Berg Laursen, MD, PhD, Poul Torben Nielsen, MD, PhD, **Orhun Muratoglu, PhD,** Anders Troelsen, MD, PhD, Henrik Malchau, MD, PhD

Introduction: Highly cross-linked polyethylene was developed to increase the survivorship of total hip arthroplasty by reducing osteolysis. Vitamin E diffused polyethylene was developed to decrease oxidation without compromising mechanical strength.The purpose of this randomized controlled trial was to evaluate wear differences of highly cross-linked polyethylene (HXLPE) and Vitamin E diffused HXLPE (VEPE) using radiostereometric analysis (RSA) and patient reported outcome measures (PROMs) 5 years after surgery.

Methods: 65 patients participated in a 5 year RSA, randomized controlled study. All patients received a porous titanium coated acetabular shell, an uncemeted femoral stem, a 32 mm femoral head, and were randomized for either a HXLPE or VEPE liner. Patients returned for follow-up immediately postoperatively, and at 6 weeks, 1, 3, and 5 years. Differences in head penetration within each liner group and between each group were determined over time ($p \leq 0.05$ for all).

Results: 60 patients returned at 3 years, and 34 at 5 years. The median±standard error (SE) superior head penetration for the HXLPE group was 0.02±0.04 at 3 years, and 0.08±0.07 at 5 years. The median±SE penetration for the VEPE group was -0.04±0.05 at 3 years, and -0.11±0.08 at 5 years. There were no significant differences after the initial settling period. The HXLPE group had significantly higher penetration than VEPE at 3 years ($p=0.029$) and 5 years ($p=0.001$). All PROMs improved from the preoperative interval to 5 years.

Conclusion: Both the HXLPE and VEPE liner groups showed low femoral head penetration at 5 years. The negative measurements are likely variations of measurements of 0 (measurement error) indicating negligible penetration at 5 years. All PROMs improved significantly from the preoperative to all postoperative intervals suggesting an excellent clinical outcome at the mid-term. Further monitoring into the long-term is necessary to determine if low penetration in both liner types remains over time.

5-year RSA Evaluation of Vitamin E diffused Highly Cross-linked Polyethylene Wear and Stability of Femoral Stems

Audrey K. Nebergall, Ola Rolfson, MD, PhD, Anders Troelsen, MD, PhD,
Orhun Muratoglu, PhD, Harry E. Rubash, MD, PhD,
Henrik Malchau, PhD, Meridith E. Greene, PhD

Introduction: In vitro studies showed that the anti-oxidative properties of vitamin E stabilize free radicals while retaining the mechanical strength of UHMWPE. The purpose was to evaluate vitamin E diffused polyethylene (VEPE) wear and stability of femoral components using RSA. Patient reported outcome measures (PROMs) were evaluated to determine the clinical outcome at 5 years.

Methods: 48 patients (52 hips), with osteoarthritis, participated in a 5 year RSA study. Each patient received a VEPE liner, a porous titanium coated shell, and an uncemented stem with a 32mm head. Tantalum beads were inserted into the VEPE and the femur to measure head wear and stem stability using RSA. RSA and PROM follow-up was obtained postoperatively, 6 months, 1, 2, 3, and 5 years after surgery. The Wilcoxon signed-ranks test determined if changes in penetration or migration were significant ($p \leq 0.05$).

Results: 47 hips were followed at 3 years, and 35 at 5 years. The median± standard error (SE) superior head penetration into the polyethylene was 0.05±0.01mm at 3 years and 0.06±0.01 mm at 5 years. There was no difference after 2 years. The median± SE distal stem migration was 0.06±0.21mm at 3 years, and 0.06±0.29mm at 5 years with no significant differences over time. All PROMs improved significantly from the preoperative to all other intervals ($p<0.001$ for all).

Conclusion: The VEPE liners showed low head penetration at 5 years. The early head penetration, probably due to creep, is lower relative to that reported for non-VEPE measured by RSA. While most stems were stable, the high standard error results from one stem that migrated 9.4mm by 6 months, which has since stabilized. This study documents the longest evaluation of in vivo wear performance of vitamin E stabilized UHMWPE. The low wear and the stability of the femoral stem shows promise for long-term survivorship.

Wear and Oxidation of Retrieved, Long-term, 1st Generation HXLPE Components in THA

Daniel W. MacDonald, Jaclyn T. Schachtner, Antonia F. Chen, MD, MBA, Gregg R. Klein, MD, Michael A. Mont, MD, Matthew J. Kraay, MD, Arthur Malkani, MD, Brian Hamlin, MD, Clare M. Rimnac, MD, Steven M. Kurtz, PhD

Introduction: Highly crosslinked polyethylene (HXLPE) was clinically introduced approximately 15 years ago to reduce polyethylene wear rates and subsequent osteolysis. Clinical and radiographic studies have demonstrated increased wear resistance, however concerns of rim oxidation and fatigue fracture remain. Although retrieval studies of these materials are available, the long-term behavior of these materials remains unclear.

Methods: 115 HXLPE acetabular liners (in vivo >5y) were collected and analyzed as part of a multi-institutional orthopaedic implant retrieval program. There were two material cohorts based on thermal processing (annealed (n=45) and remelted (n=70)). Each cohort was stratified into two more cohorts based on implantation time (5–10 years and >10 years). For each cohort, the predominant revision reasons were loosening, instability, and infection. For oxidation analysis, thin slices were taken from the superior/inferior axis and boiled in heptane for 6 hours to remove absorbed lipids. 3mm line profiles were taken perpendicular to the surface at each ROI. Oxidation indices were calculated according to ASTM 2102. Penetration was measured using a calibrated micrometer.

Results: The penetration rates for both cohorts were low and similar between the cohorts. Generally, the annealed liners had higher oxidation indices than the remelted components ($p<0.001$). For remelted components, the intermediate-term liners had higher oxidation indices than short-term liners ($p=0.001$). For annealed liners, both the long-term and intermediate-term liners had higher oxidation indices than the short-term liners ($p<0.008$).

Conclusion: The results of this study suggest that thermally treated HXLPEs have lower penetration rates than conventional polyethylene; however, the oxidation resistance was formulation dependent. Specifically, remelted components were more effective at preventing oxidation than annealed liners. Nevertheless, we were able to detect temporal oxidative changes of remelted liners. Future work is necessary to fully understand how these oxidative changes impact the clinical performance of these materials in their second decade of service.

Cobalt Chrome and Oxidized Zirconium on Highly Cross-linked Polyethylene: Mid-term Results

Stephen Petis, MD, **Edward M. Vasarhelyi, MD, MSc, FRCSC,**
Brent Lanting, MD, FRCSC, James Howard, MD, FRCSC,
Douglas Naudie, MD, FRCSC, Lyndsay Somerville, PhD, MS,
Richard McCalden, MD, FRCSC

Introduction: The choice of bearing articulation for total hip arthroplasty in younger patients is amenable to debate. The purpose of this study was to compare mid-term survivorship and clinical outcomes of cobalt chrome and oxidized zirconium on highly cross-linked polyethylene in a young patient cohort.

Methods: Six hundred and twenty-two patients between 2004 and 2012 with cobalt chrome or oxidized zirconium on highly cross-linked polyethylene followed prospectively were reviewed. Kaplan-Meier analysis was used to generate survivorship curves with 95% confidence intervals and to determine predicted cumulative survivorship at 5 years with all-cause and aseptic revisions as the endpoint. Patient-reported outcomes including the Harris hip score (HHS), Western Ontario and McMaster University Osteoarthritis Index (WOMAC), and Short-form 12 (SF-12) were compared.

Results: Mean follow-up was 8.2 (range: 2.0 – 10.6) years for cobalt chrome and 7.8 (range: 2.1 – 10.7) years for oxidized zirconium. Mean age was 54.9 (SD 10.6) for cobalt chrome and 54.8 (SD 10.7) for oxidized zirconium. Demographic variables including age (p=0.20), sex (p=1.0), and BMI (p-0.86) were similar between the groups. Implant survivorship was 96.0% for cobalt chrome (95%CI 94.9-97.1%) and 98.7% for oxidized zirconium (95%CI 98.0-99.4%) on highly cross-linked polyethylene for all cause revisions, and 97.2% for cobalt chrome (95%CI 96.2-98.2%) and 99.0% for oxidized zirconium (95%CI 98.4-99.6%) for aseptic revisions. An age, sex, and diagnosis-matched comparison of the HHS, WOMAC, and SF-12 scores demonstrated no statistically significant changes in clinical outcomes across the three groups.

Conclusion: Both bearing surface couples demonstrated excellent mid-term survivorship and outcomes in young patient cohorts. Future analyses on wear and costs are warranted to elicit differences between the groups at long-term follow-up.

Anatomic Hip Center Decreases 20-year Acetabular Component Loosening in Cemented Crowe-II THAs

Chad D. Watts, MD, Matthew P. Abdel, MD,
Arlen D. Hanssen, MD, Mark W. Pagnano, MD

Introduction: Optimal positioning of acetabular components in patients with hip dysplasia continues to be debated. In this study we sought to determine if long-term acetabular loosening and revision rates were correlated with initial cup position relative to 1) superior displacement ≥15mm from the approximate femoral head center (AFHC), 2) superior displacement ≥35mm from the interteardrop line (ITL), 3) presence within the true acetabular region (TAR), and 4) location within the four-zone system (1-inferomedial, 2-superomedial, 3-superolateral, and 4-inferolateral).

Methods: We reviewed 145 cemented THAs performed in patients with Crowe II dysplasia between 1969 and 1980. Hips were assessed for radiographic evidence of aseptic loosening, as well as revision for aseptic loosening. Given the long-term nature of this study, a competing-risk analysis was utilized to determine cumulative incidence of cup loosening and revision for aseptic loosening, with other-cause revision and death considered to be competing risks. At most recent follow-up, 44 hips were in patients alive and available for follow-up. Mean age at index arthroplasty was 51 years and mean follow-up was 26 years.

Results: Hips with an anatomic hip center had lower acetabular component loosening and aseptic revision rates. Radiographic loosening was less likely for hip centers placed within the TAR (p=0.01), <15mm superior to the AFHC (p=0.001), <35mm superior to the ITL (p=0.001), or located within zone 1 (p=0.0002). Cup revision for aseptic loosening was more likely for hip centers placed >35mm superior to the ITL, with a cumulative incidence of 26% vs 18% at 20-years (p=0.01).

Conclusion: An anatomic hip center lead to lower acetabular component loosening and revision rates following cemented THA done for Crowe II dysplasia. A noticeable divergence in survival was noted at long-term (20-year) follow-up, indicating the importance of accounting for death and other-cause revisions by including analysis with a competing-risk model in long-term investigations.

Total Hip Arthroplasty for Osteoarthritis Secondary to Legg-Calve-Perthes Disease: Is There an Increased Risk of Complications?

Spencer Martin George, MD, Gail Pashos, MT, ASCP,
Ryan M. Nunley, MD, John C. Clohisy, MD

Introduction: Residual deformity secondary to Legg-Calve-Perthes disease (LCPD) can predispose patients to early osteoarthritis (OA) of the hip necessitating primary total hip arthroplasty (THA). Previous case series have reported relatively high rates of major complications including intraoperative fractures (3-9%) and nerve palsies (3-6%). The purpose of this study was to use a validated complication grading scheme to perform a comprehensive analysis of complications associated with primary THA in patients with OA secondary to LCPD.

Methods: We reviewed 50 primary THAs (48 patients) with a documented history of childhood LCPD. All cases had a minimum two year follow-up. Preoperative and postoperative modified Harris Hip scores (mHHS) and UCLA scores were reviewed. A detailed analysis of all perioperative and postoperative complications was performed utilizing the modified Dindo-Clavien complication grading scheme. There were 30 males and 18 females. The mean age at time of surgery was 42+/- 16 years. The mean follow-up was 4.5+/- 3.4 years.

Results: There was one early major complication requiring reoperation (grade III) for instability secondary to cup malposition that was treated with revision. One patient required a psoas lengthening for psoas impingement refractory to conservative management. There were two grade II complications, which included a DVT and one UTI. The most common grade I complication was asymptomatic heterotopic ossification. The mean mHHS and UCLA score improved by 29.8+/- 22.5 ($p<0.0001$) and 1.9+/- 3.5 ($p=0.0002$) respectively. Patients were lengthened a mean of 1.4 +/- 0.9 cm ($p<0.0001$), with an average preoperative limb length discrepancy of 1.7 +/- 1.2 cm.

Conclusion: Secondary OA from childhood LCPD can pose technical challenges for primary THA; however, in this case series of fifty hips, the complication risk was acceptable and there were no nerve injuries or fractures, which have been previously reported in the literature. Additionally, patient-reported outcomes were favorable.

Implant Survival and Outcomes after Total Hip Arthroplasty in Young Patients with Developmental Dysplasia of the Hip

Ishaan Swarup, MD, Astrid C. Marshall, BA,
Yuo-yu Lee, MS, Mark P. Figgie, MD

Introduction: Developmental dysplasia of the hip (DDH) is a common cause of hip pain in young patients, and may require treatment with total hip arthroplasty (THA). This study evaluates implant survival and describes patient-reported outcomes after primary THA in DDH patients aged 35 or younger. We hypothesized that patients would have good implant survival and report favorable long-term outcomes after surgery.

A registry-based retrospective study with prospective follow-up was conducted at a major academic medical center. A chart review was performed to identify young THA patients with DDH, and follow-up surveys were conducted to determine implant survival and patient-reported outcomes. Kaplan-Meier survival analysis was performed to evaluate implant survival, and the hip disability and osteoarthritis outcome score (HOOS) was used to describe patient-reported outcomes.

Results: Patient data was reviewed for 87 patients with DDH that underwent a primary THA. Follow-up data was available for 61 patients (75 primary THAs), and the mean time to follow-up was 13 years (Range: 3 years – 25 years). The 10-year and 20-year implant survival was 87% (95% CI: 78%-94%) and 55% (95% CI: 37%-72%), respectively, and implant survival was significantly better in patients over the age of 25 at the time of surgery (p-value < 0.01). The mean HOOS scores were 83 for pain (SD: 20.29), 78 for symptoms (SD: 19.72), 83 for ADLs (SD: 20.89), and 74 for sports (SD: 25.92). Patients that were younger at the time of surgery or required custom implants reported worse HOOS-Symptom scores at follow-up (p-value = 0.02).

Conclusion: Overall, young patients with DDH have good outcomes after surgery. Patient factors and implant characteristics should be considered when predicting implant survival and outcomes after THA in young patients with DDH.

Does Radiographic Severity of Osteoarthritis Predict Patient-reported Outcomes in Young Total Hip Arthroplasty Patients?

Jeffrey B. Stambough, MD, Ao Xiong, MD, Geneva R. Baca, BA, John J. Callaghan, MD, John C. Clohisy, MD

Introduction: In a new healthcare economy, there is an emerging need to understand and quantify predictors of total hip arthroplasty (THA) outcomes. We investigated the association between preoperative radiographic disease (as measured quantitatively by joint space width (JSW)) and patient-reported function, activity, pain and quality of life after THA.

Methods: We retrospectively analyzed 146 patients (146 hips) ≤55 years of age with a diagnosis of osteoarthritis who underwent cementless THA between January 2009 and December 2010. The cohort consisted of 54% females (n=79) and 46% males (n=67), with a median age of 47 years and a median body mass index (BMI) of 27.5 kg/m2. Preoperative pelvic radiographs were measured by one author blinded to clinical outcomes to establish JSW, defined as the shortest distance between the femoral head margin and the superolateral weight-bearing portion of the acetabulum. The JSW value was treated as a continuous variable when applied to statistical modeling. The relationship between the JSW and the improvement of clinical outcome was examined via a general linear modeling approach with adjustments for patients' age, BMI, and gender.

Results: We identified an inverse relationship between preoperative JSW and improvements in functional, activity, pain and quality of life. We found that as JSW decreased by 1mm, the outcome measure improvements were as follows: modified Harris Hip Score: 6.3 ($p<0.001$, Figure 1); SF-12 physical: 2.1 ($p=0.027$); WOMAC-pain: 4.8 ($p=0.01$); and UCLA Activity: 0.44 ($p=0.02$). Minimal clinically important thresholds, when available, were surpassed in all cases when the JSW narrowed by 2mm or more.

Conclusion: Our results demonstrate that patients with less severe radiographic disease have less predictable clinical improvement in terms of function, pain relief and activity. These findings indicate that by quantifying anticipated gains based on baseline clinical scores, young patients with JSW > 1.5mm may have suboptimal THA outcomes

Long-term Results of Total Hip Arthroplasty with Shortening Subtrochanteric Osteotomy Performed in Crowe IV DDH

Matthew P. Abdel, MD, Matthieu Ollivier, MD, Aaron J. Krych, MD, Robert T. Trousdale, MD, Daniel J. Berry, MD

Introduction: Cementless total hip arthroplasty (THA) combined with a femoral shortening osteotomy for the treatment of Crowe IV dysplasia allows for anatomic socket placement while minimizing excessive limb lengthening and risk of traction injuries. However, long-term data on the technique is lacking. This study's goal was to determine the 10-year outcomes of THA with concomitant subtrochanteric osteotomy for Crowe IV dysplasia.

Methods: We retrospectively reviewed 28 consecutive primary cementless THAs performed in 24 patients suffering from Crowe IV dysplasia between 1992-2005. Clinical outcomes, survivorship, radiographs, and complications were evaluated. Mean age was 48 years, with a mean follow-up of 10 years.

Results: The mean HHS significantly improved from 43 preoperatively to 89 at 5 years postoperatively ($p<0.0001$). At 10 years, the mean HHS was similar at 87 ($p=0.4$). The mean preoperative limb-length discrepancy was 4.3 cm, and < 2 cm in all patients postoperatively, with 13 patients having discrepancy < 1 cm. At most recent follow-up, 5 patients were revised (2 femoral non-unions associated with loose femoral components at 1 and 3 years; 1 aseptic acetabular loosening at 1 year; 1 periprosthetic fracture at 1 year; and 1 disengaged liner at 6 years). 10-year survivorship free from revision for aseptic loosening was 89%, and 81% free from revision for any reason. 29% had an early complication, but no additional reoperations were noted after 6 years. There were 4 dislocations (3 occurred less than 1 year from surgery, and one occurred at 9.5 years postoperatively). There were no sciatic neurapraxic injuries.

Conclusion: In the longest series to date, cementless THA combined with a subtrochanteric shortening osteotomy in patients with a high hip dislocation secondary to dysplasia was associated with high rates of successful implant fixation and healing of the osteotomy, with a significant clinical improvement. The majority of complications occur early.

Primary Total Hip Arthroplasty in the Octogenarian Population

Arthur L. Malkani, MD, Kevin Ong, PhD, Doruk Baykal, PhD, Edmund Lau, MS, Theresa Mackin, BS, Gwo-Chin Lee, MD

Introduction: Number of primary THA being performed in our aging population has increased. There are greater challenges and risks in our elderly undergoing THA due to compromised bone and underlying health conditions. Purpose of this study was to identify trends, results and specific complications in the Octogenarian undergoing THA.

Methods: We used the 5% sample of Part A (inpatient) Medicare data (1998-2013). We exclude: patients with less than 12 months prior history, HMO cases, those not enrolled in both parts A and B, those <65 y.o., and non US residents. The octogenarian group was stratified from remaining age groups. A multivariate cox regression used to evaluate effect of patient/hospital factors on risk of revision/ arthrotomy, PJI, dislocation, VTE, and mortality. We evaluated patient factors (age, socioeconomic status, Charlson score, race, census region, gender, year of surgery, history of diabetes, ischemic heart disease, obesity), and hospital factors (bedsize, ownership, teaching status, location).

Results: There has been approximately 45% increase in primary THA's in the Octogenarian during the study period 1998 to 2013. Octogenarian group had a statistically higher incidence of co-morbidities: 33% have a Charlson score of 3 or higher, 49% with CAD or CHF whereas those 65 -70 years have a 19% incidence of Charlson score 3 or higher and 30% CAD or CHF. Octogenarian group had statistically greater incidence of dislocation, $p<.001$, VTE, $p<.001$, infection (PJI), $p<.027$, and mortality, $p<.001$ compared to the younger cohort, 65-79 years. The younger cohort had a higher revision incidence, $p<.001$ compared to the Octogenarian group at 10 years.

Conclusion: There has been a significant increase (45%) in primary THA in Octogenarians. They are at increased risk of complications: dislocation, VTE, infection, and mortality. Based on this study, optimization of co-morbid conditions is essential to minimize complications and readmission when considering THA in the Octogenarian.

Primary Total Hip Arthroplasty Patients with Parkinson's have Increased Two-year Dislocation and Revision Rates

Karthikeyan Ponnusamy, MD, Mostafa El Dafrawy, MD, Louis Okafor, MD, Clayton Alexander, MD, Zan Naseer, BS, Robert Skolasky, MD, Richard Skolasky, DSc, Paul Khanuja, MD

Introduction: Total hip arthroplasty (THA) rates are increasing and more patients with Parkinson's disease are being considered for THA. We hypothesized that altered muscular function would increase their dislocation and revision rates.

Methods: We conducted a retrospective cohort study of the 100% 2008 Medicare Provider Analysis and Review database, and identified primary THA patients by ICD9 codes and excluded fractures/ER admissions to select for elective cases. Patients with Parkinson's (866 patients) were compared to a control group without Parkinson's (142,437 patients). Descriptive statistics of demographics and outcomes (length of stay, readmission rates, and 2 year dislocation, revision, and mortality rates) were calculated. Multivariate logistic regression models to assess the association of Parkinson's with outcomes were constructed.

Results: Patients with Parkinson's disease undergoing THA are older (76.1 vs. 73.1 years, $p<0.0001$) and more likely to be white (94.7% vs. 91.4%, $p<0.0001$). Parkinson's patients have longer (3.8 vs. 3.7 days, $p<0.0001$) hospital stays. They have no difference in mortality at 30-days (0.4% vs. 0.4%, $p=0.6878$) and 2-years (2.8% vs. 2.3%, $p=0.3079$). However, patients with Parkinson's disease had more complications at 30-days (3.5% vs. 2.3%, $p=0.0259$), which were mostly due to greater surgical complications (3.0% vs. 1.8%, $p=0.0096$). They had greater readmissions at 30-days (8.8% vs. 6.7%, $p=0.0145$). Parkinson's patients had significantly greater 2-year dislocation (2.5% vs. 1.3%, $p=0.0025$) and revision rates (5.1% vs. 3.1%, $p=0.0010$). Parkinson's status is an independent risk factor for 60-day readmission (OR: 1.3, 95% CI: 1.1 to 1.6). It was the largest risk factor for 2-year dislocations (OR: 2.1, 95% CI: 1.4 to 3.2) and 2-year revisions (OR: 1.8, 95% CI: 1.3 to 2.5).

Conclusion: After primary THA, patients with Parkinson's disease are at a higher risk for complications and readmissions in the short-term. At 2-years, Parkinson's disease is the largest risk factor for dislocations and revisions.

Effects of Pelvic Tilt and Stem Anteversion on Hip Range-of-motion to Impingement

Michael A. Mont, MD, Thomas McCarthy, MS,
Vincent Alipit, MS, Jim Nevelos, PhD

Introduction: Femoral stem impingement can damage an acetabular liner, create polyethylene wear, and potentially lead to dislocation. To avoid component-to-component impingement, many surgeons aim to align acetabular cups based on the "Safe Zone" proposed by Lewinnek. These recommendations assume a: (1) neutral pelvic tilt angle of the patient; and (2) femoral stem-neck anteversion angle that is inconsequential to impingement. The purpose of this study was to determine the effect of alterations of these angles on hip range-of-motion (ROM) to impingement.

Methods: Ten healthy subjects were instrumented and asked to perform six motions commonly associated with hip dislocation, including picking up an object, squatting, and low-chair rising. Femur-to-pelvis relative motions were recorded for flexion/extension, abduction/adduction, and internal/external rotation. A previously reported validated hip ROM three-dimensional simulator was utilized. Acetabular cup orientations for abduction and anteversion combinations were chosen. The software was then used to compute minimum clearances or impingement between the components for any hip position. Graphs for acetabular cup abduction vs. anteversion were generated using a tapered wedge stem with a 132º neck angle and a 36 mm femoral head for a range of pelvic tilt and stem version angles.

Results: We found that the "Safe Zone" varies considerably depending on the combination of variables and is dramatically affected by both pelvic tilt and stem version angles. In all cases except the best case scenario, the non-impingement area is much smaller than the Lewinnek safe zone.

Conclusion: The acetabular target for impingement-avoidance motion is much smaller than previously believed and identifies the need account for both pelvic tilt and stem version. This may explain why approximately 70% of dislocations have been reported to be found even when cups were placed within the safe zone. This study supports the need for better planning and intraoperative execution for placement of the acetabular component.

Influence of Dual Mobility Design on Femoral Head Stability: Dynamic Dislocation Test Model

David Ferguson, MD, Laura Scholl, MS, Joseph Mummert, MS, Gregg Schmidig, MS, Carlos Higuera, MD

Introduction: Dislocation is a major concern following total hip arthroplasty (THA). Past literature suggests the distance of femoral head travel is a predictive factor of dislocation where the smaller the travel distance, the greater chance of dislocation. The purpose of this study was to use a dynamic test model to evaluate the potential for femoral head dislocation comparing a dual mobility design with metal on metal and hemispherical component designs.

Methods: Dynamic dislocation distance of three commonly used implant designs was evaluated using a mechanical test model performed on a materials testing system (MTS Systems Corp., Eden Prairie, MN) that defined acetabular component inclination and anteversion angles as well as pelvic tilt. The three test groups included a hemispherical shell with a modular polyethylene liner and 32mm head, a metal on metal hip resurfacing cup design with a 40mm CoCr head, and a dual mobility design with a 42mm outside diameter articulating liner and an inner 28mm articulating head. All test groups were oriented at inclination angles of 30 , 45 , and 60 , anteversion angles of 0 , 15 , and 30 , and pelvic tilt angles of 5 (represent standing) and 26 (represent chair rise). Statistical analysis was performed using ANOVA and Tukey post-hoc tests at 95% confidence level.

Results: The dual mobility bearing increased dynamic dislocation distance when compared to the other designs for all inclination, anteversion and pelvic tilt angles tested. This increase was significant ($p<0.05$) with the exception of 60° inclination/0° anteversion where distance was not significantly larger. For 26° pelvic tilt, dislocation distance increased with greater anteversion and decreased with larger inclination.

Conclusion: Clinical results have shown that dual mobility designs may reduce dislocation. These data support those findings and suggest that using a dual mobility implant potentially improves hip stability compared to other implant designs by increasing the dynamic dislocation distance.

Do Conversion Total Hip Arthroplasty Yield Comparable Results to Primary Total Hip Arthroplasty

Ran Schwarzkopf, MD, MSc, David J Wright, BS, Garwin Chin, BS

Introduction: The incidence of conversion THA from previous failed hip surgeries is increasing. The Center for Medicare & Medicaid Services (CMS) currently bundles conversion THA with primary THA, in spite of studies showing clinical differences between the two. We sought to determine differences in postoperative outcome and hospital resources usage that could help the CMS to better classify conversion THA procedures. Our hypothesis is that conversion THA will have decreased perioperative outcomes and increased utilization of hospital resources compared to primary THA

Methods: Fifty-one consecutive conversion THA and 105 matched primary THA patients were included in this study. We controlled for age, gender, BMI, ASA, Charlson score, and smoking. Outcomes for conversion THA and primary THA including; length of stay, operative time, use of revision type implants, were compared using regression, chi-square, and ANOVA analysis.

Results: Conversion THA and Primary THA were determined to be significantly different ($P<0.05$) in hospital length of stay (LOS), operative time, likelihood of requiring revision type femoral component, and likelihood of requiring revision type acetabular component. When compared against primary THA (average 2.53 days), conversion THA (average 3.59 days) had approximately one day longer LOS ($p<0.01$), 35 minutes longer operative time ($p=0.022$). For conversion THA, the odds are 591% higher ($p<0.001$) for requiring revision type femoral component and 1313% higher ($p<0.001$) for requiring revision type acetabular component. Measures for postoperative complications, readmission, and patient reported outcomes were not found to be significantly different between the two cohorts.

Conclusion: Based on greater LOS, operative time, and likelihood of revision type femoral and acetabular components, conversion THA use more hospital resources than primary THA. In order to help prevent a financial disincentive to care for these complex surgical patients, there has to be a reclassification of conversion THA, as they do not fit together with primary THA.

Biplanar Low-dose Radiography is Accurate for Measuring Total Hip Arthroplasty Position in Patients Postoperatively

Christina I Esposito, PhD, Theodore T. Miller, MD, Joseph Lipman, MS, Douglas E. Padgett, MD, Seth A. Jerabek, MD, **David J. Mayman, MD**

Introduction: Implant position plays a major role in the mechanical stability of a total hip arthroplasty (THA). Computed tomography (CT) scanning is the gold standard modality for measuring postoperative THA alignment. However, radiation remains a health concern and CT exposes patients to more radiation than conventional x-rays. The purpose of this prospective study was to test the accuracy of a new low-dose biplanar radiography system for measuring THA position.

Methods: Twenty patients undergoing unilateral THA consented to this prospective IRB-approved study. CT scans and biplanar radiographs were taken of the same patients 6 weeks post-operatively. Two blinded observers measured cup inclination, cup anteversion and femoral anteversion in CT and radiography images using computer-aided design softwares. Reproducibility was analyzed by the Bland-Altman method, and interobserver reliability was calculated using the Cronbach's alpha ( ) coefficient of reliability.The Bland-Altman analysis of test-retest reliability indicated that the 95% limits of agreement between the CT and biplanar radiography measurements, which ranged from -2° to 5° for acetabular inclination, from -6° to 3° for acetabular anteversion, and from -11° to 1° for femoral anteversion.

Results: The average absolute difference between CT and radiography measurements were 3° ± 2° for acetabular inclination, 2°± 2° degrees for acetabular anteversion and 4° ± 3° femoral anteversion. Interobserver agreement was good for acetabular inclination (Cronbach's = 0.55), acetabular anteversion (Cronbach's = 0.76) and femoral components (Cronbach's = 0.98) using biplanar radiography.Biplanar radiography can accurately and reliably measure acetabular component position, while exposing patients to ten times less radiation than a CT scan.

Conclusion: The error was slightly higher when measuring femoral anteversion but this error is favorable to the increased radiation dose of CT.

Utilizing Robotics or Fluoroscopy in THA: Do New Techniques Improve Acetabulum Positioning in the Learning Curve?

Eli Kamara, MD, Jonathon Robinson, MD, Marcel Aguilar Bas, MD, Jose A. Rodriguez, MD, Matthew Hepinstall, MD

Introduction: Acetabulum positioning affects dislocation rates, component impingement, bearing surface wear rates, and need for revision surgery. Our aim was to assess whether adopting robotic or fluoroscopic techniques improves acetabulum positioning compared to manual THA during the learning curve.

Methods: Three types of THAs were compared in this retrospective cohort: 1) THAs done by a posterior surgeon learning the anterior approach with fluoroscopy (fluoroscopic anterior, FA) 2) Robotic assisted THAs done by a surgeon learning robotic assisted surgery (robotic posterior, RP) and 3) THAs done by a posterior surgeon out of fellowship prior to adoption of robotic techniques (manual posterior, MP). The first 100 consecutive THAs performed in each of these categories were analyzed. Radiographic measurements were done by two blinded observers. The percentage of hips that were in the safe zone of Lewinnek (inclination, 30°–50°; anteversion, 5°–25°) was calculated. Relative risk and absolute risk reduction were calculated. Variances (square of the SDs) were used to define the variability of the outcome measure.

Results: 68% of MP THAs were within the safe zone. There was no change with FA THAs (68%), while RP THAs were more often in the safe zone (87%). This difference was statistically significant, associated with a relative risk reduction of 61% (RR 0.39 [0.22-0.70], p<.01, ARR 20%, NNT 5). Compared to FA THAs, RP THAs were associated with a relative risk reduction of 59% (RR 0.41 [0.22-0.73], p<.01, ARR 19%, NNT 5). Variances were lower for acetabulum inclination and anteversion in RP THAs (17.6 and 17.8 respectively) as compared with the MP THAs (27.2 and 37.7 respectively). These differences were statistically significant (P<.01).

Conclusion: Adoption of robotic techniques during the learning curve can significantly improve acetabulum positioning and precision compared to manual THA. While fluoroscopy has been shown to be beneficial, a significant learning curve exists.

Same Day Total Hip Arthroplasty Performed at an Ambulatory Surgical Center: 90 day Complication Rate on 549 Patients

Gregg R. Klein, MD, Harlan B. Levine, MD,
Jason Posner, BA, Mark A. Hartzband, MD

Introduction: Ambulatory Total hip arthroplasty (THA) offers benefits to the patient, insurer and overall healthcare system. However, the safety of outpatient TJA has not been qualified.

Methods: Between 2008 and 2014, 549 patients underwent mini-posterior THA under lidocaine spinal at an ambulatory surgical center and were enrolled in an institutionalized registry. Standardized pain management, DVT and therapy protocols were employed. Indications for ambulatory THA included patient age, comorbidiites and the patient's motivation for rapid recovery. All patients were discharged from the center on the day of surgery.

Results: 549 THA were identified. The average age was 54.4 years (range 27-73). There were 376 males and 173 females. The average ASA score was 1.6. 3/549 (0.5%) patients required same day hospital admission: one for pain control, one for an acetabular component migration, and one for acute polyarthralgia exacerbation. 10 patients required subsequent hospitalization for hematoma or delayed wound healing at an average of 15.7 days (range 8-28); 5 occurred in the first 100 patients. There were 5 infections identified on average POD 35 (range 22-56).6 hips dislocated between days 0 and 77 (average 15). There were 3 patients with VTE: 1 popliteal and 2 below knee superficial vein

Conclusion: Outpatient THA at an ambulatory surgical center is safe and effective when performed on the appropriately indicated patient. Only three patients required hospitalization; one for diffuse inflammatory exasperation, one for pain control, and one for implant/technique failure. There were no medical/surgical events that put the patients at risk by having surgery performed on an outpatient basis. There was a higher rate of hematoma/delayed wound healing noted in the first 100 patients. We feel that this was related to aggressive anticoagulation combined with rapid patient mobilization. By adjusting the DVT prophylaxis protocol the complication rate was significantly decreased from 5 % to 1.1 % in the next 449 patients. Same day discharge THA in an ambulatory surgical center is safe and reproducible.

Accelerated Physical Therapy Rehabilitation Following Elective Primary Total Hip Arthroplasty Facilitates Early Discharge

Azim A. Karim, MD, Luis Puilido, MD, Stephen Incavo, MD

Introduction: Accelerated physical therapy protocols are a potential mechanism to achieve early mobilization and safe discharge from the hospital following elective primary total hip arthroplasty (THA). The purpose of the current study was to determine if physical therapy (PT) initiated the same day following unilateral, primary total hip arthroplasty (THA) lead to a reduction in the length of hospital stay compared to unilateral primary THA patients starting PT on postoperative day 1.

Methods: This study compared 62 patients who received physical therapy on the same day of surgery (Day 0 PT group) following elective, unilateral THA, versus 50 patients who received physical therapy starting the day after surgery (Non-Day 0 PT group). Power analysis indicated that minimum sample size of 23 subjects in each group would be required to attain a statistically significant difference using non-parametric, Mann-Whitney test.

Results: The difference in the mean length of hospital stay was not statistically significant (2.26 days ± .11 vs. 2.50 days ± .15, p=0.270). Sixteen (16) percent of the patients in the Day 0 PT group were able to meet physical therapy discharge goals and be discharged by postoperative day 1 compared to six (6) percent in patients the non-Day 0 PT group (p=0.041, Fischer's exact test). On post-operative day 1, the mean gait distance of the patients receiving accelerated physical therapy was significantly higher than the patients who did not (162.4 ± 12.9 feet vs. 118 ± 11.7 feet, p=0.019).

Conclusion: A greater percentage of patients in the Day 0 PT group were discharged on postoperative day one and facilitate achievement of physical therapy goals which potentially justifies the use of accelerated PT. The study results provide useful information for providers managing patients in postoperative patient care and resource allocation.

Comparison of Discharge Disposition between Physicians with and without Defined Post-acute Care Pathways

Michael Burns, MD, **Paul J. Duwelius, MD,** Jim Gera, MBA,
Coles L'Hommedieu, MD, Jerry Rupp, PhD,
John Tessier, MD, Jeffrey Salin

Introduction: Our objective was to compare orthopedic groups with and without defined post-acute care pathways and the effect on service utilization and cost for Medicare patients in the Bundled Payment for Care Improvement program.

Methods: Cross-sectional study. Setting: Subjects from Medicare Model 2 Bundled Payment for Care Improvement episode claims data. Participants: 81,389 DRG 470 Medicare fee-for-service patients from 68 orthopedic groups across the US.Main Outcome Measures: Elective hip and knee arthroplasty episode and post-acute care costs; utilization rates (frequency and length of time) for inpatient rehabilitation facility, skilled nursing facility, home health and readmission.

Results: Orthopedic physicians with defined post-acute care pathways showed consistent decreases in cost and utilization as compared to physicians without defined post-acute care pathways. Elective hip arthroplasty per episode cost differential was $2,683 (13%) per episode between physicians with care pathways ($18,677) and those without ($21,360) (p=.013). Elective knee arthroplasty per episode cost difference was $2,141 (10%) per episode between physicians with care pathways ($18,748) and those without ($20,888) (p=.24). Incident rates of utilization for post-acute care services displayed significant differences between physicians with and without post-acute care pathways. Physicians with defined post-acute pathways demonstrated utilization reductions ranging from 7% to 79% with incident rate reductions ranging from 44% to 79%.

Conclusion: The results suggest discharge disposition is effected by orthopedic physicians with defined post-acute care pathways. The findings show significant cost and utilization reductions for physicians with defined post-acute care pathways.

Does Increased Coefficient of Friction Increase Initial Stability at the Acetabular Interface?

Ashton H. Goldman, MD, Lucas Armstrong, MD, John R. Owen, MS, Jennifer R. Wayne, PhD, William A. Jiranek, MD

Introduction: Short term studies of "Highly porous metal" acetabular components (HPMAC) have suggested a decreased rate of aseptic loosening compared to registry data. One proposed advantage of rougher HPMAC is an increased coefficient of friction which intuitively should improve initial stability. The null hypothesis is that a standard porous coated acetabular cup would show no difference in initial stability as compared to a HPMAC when subjected to a bending moment. Secondly, would bone mineral density (BMD) be a significant variable under these test conditions.

Methods: Ten matched hemipelvises were prepared using standard surgical technique for a 1 mm press-fit implantation of a Depuy Porocoat™ component (Coeffiecient of Friction: 0.8, Pore Size: 250 microns) with a Depuy Gription™ component (Coefficient of Friction:1.2, Pore Size: 300 microns) implanted into its paired mate. BMD data was also obtained from the femoral necks available for associated specimen. We assessed interface stability using a custom made device outfitted with three linear variable differential transformers attached to the hemipelvis. A cantilever bending moment was applied to each cup, and the force required to move each component was measured.

Results: There was no difference in the mean bending moment required to produce 150 microns of motion between the Gription™ (24.6±14.0 N-m) cups versus Porocoat™ (25±10.2 N-m)($p>0.84$). There was also no difference in the peak bending moment between the two types of cups ($p>0.92$). No correlation between BMD and bending moment at 150 microns of displacement could be identified for Porocoat™ ($p > 0.34$) or Gription™ ($p > 0.68$).

Conclusion: The coefficient of friction provided by HPMAC did not provide better resistance to migration under bending load when compared to a standard porous component. Clinically, the increased surface roughness may not provide as much improved initial stability as might be hypothesized when compared to a standard porous implant

Health Related Quality of Life Measures Can Assess Clinical Improvements in Primary Total Hip Arthroplasty Patients

Russell G. Cohen, MD, Paul G. Perona, MD,
Alice Cruz, BS, Danielle Campbell, MS

Introduction: Functional and patient satisfaction scores provide representations of a patient's wellbeing following total hip arthroplasty (THA). Additionally, economic analyses measuring health related quality of life (HRQoL) can help determine the effect of treatment for a patient's current state, such as the EuroQol 5D (EQ-5D). The purpose of this study was to determine whether the EQ-5D correlates with other assessments, providing a comprehensive patient evaluation.

Methods: In US based, non-randomized, post-marketing, multicenter studies, 201 patients received a primary cementless dual mobility THA. The Harris Hip Score (HHS), Short Form 12 Physical Component Score (SF12), Lower Extremity Activity Score (LEAS), and EQ-5D was collected preoperatively and at six weeks and one year postoperative. The EQ-5D Time Trade-Off (TTO) was evaluated against the HHS and SF12 using Pearson's coefficient. Effect size was analyzed according to Cohen's criteria for index responsiveness.

Results: Patients were diagnosed with osteoarthritis (94%) and additional cardiovascular (67%) and musculoskeletal (49%) comorbidities. Clinical outcomes displayed increasing trends through early follow-up. The HHS increased significantly ($p < 0.0001$) from an average preoperative score of 54.2 to 79.9 and 94.5 at 6 weeks and 1 year. Clinically significant improvements were seen at 1 year in SF12 (+18.3), LEAS (+3.1), and EQ-5D (+17.1). Effect size was large ($d = 1.105$) for TTO improvement from preoperative to 6 weeks. The TTO was highly correlated ($r > 0.5$) with the HHS and SF12 at 6 weeks postoperative.

Conclusion: The EQ-5D is effective in health state prediction for primary THA patients. Strong correlations between HRQoL analyses and clinical outcomes during early follow-up show decreases in pain and increases in function after THA have a direct impact on patient quality of life. Further use of the EQ-5D can provide the ability to calculate quality of life adjusted years to perform cost analyses of joint replacement.

Mortality Following Periprosthetic Femur Fractures During and After Primary THA

Matthew P. Abdel, MD, Hilal Maradit Kremers, MD, MSC,
Jeanine E. Ransom, BS, David G. Lewallen, MD, Daniel J. Berry, MD

Introduction: Although an increased risk for death after geriatric hip fractures is well established, there is limited information on mortality rates after periprosthetic fractures. We determined mortality rates following intraoperative and postoperative periprosthetic fractures during and after primary total hip arthroplasty (THA).

Methods: This was a retrospective cohort study of 32,678 primary THAs performed at a large academic medical center between 1969 and 2011. Patients were followed up at regular intervals until death, revision surgery or last clinical follow-up. A total of 646 intraoperative and 832 postoperative periprosthetic femur fractures were identified. Mortality rates were evaluated using a person-years approach. Standardized mortality ratios (SMR) were calculated using the United States life tables. The risk of death associated with intraoperative and postoperative periprosthetic femur fractures was examined using multivariable Cox proportional hazards regression models adjusting for age, sex, calendar year, surgical diagnosis. Postoperative femur fractures were modeled as a time-dependent covariate.

Results: Mean age was 64 years and 48% were male. THA patients with periprosthetic femur fractures were significantly younger, had a higher proportion of female patients, and had higher proportion of surgical indications other than degenerative arthritis ($p<0.001$). The risk of death among patients with intraoperative periprosthetic fractures was similar to the general population with an SMR of 0.89 (95% CI 0.76, 1.05). In Cox regression analyses, intraoperative fractures were not associated with a higher risk of death (HR: 0.95, 95% CI: 0.81, 1.12), but postoperative fractures were associated with a significantly higher risk of death (HR: 1.25, 95% CI: 1.13, 1.38). Findings were similar when the cohort was limited to patients with osteoarthritis.

Conclusion: Although intraoperative periprosthetic femur fractures during primary THA do not increase mortality, the risk of death is elevated by 25% for patients with postoperative periprosthetic femur fractures.

Early Proximal Periprosthetic Femoral Fractures in Total Hip Arthroplasty Using a Direct Anterior Approach

Marcel A. Bas, MD, Cameron K. Yau, MD, FRCSC, Kenneth H. Jahng, MD, Herbert J. Cooper, MD, Jose A. Rodriguez, MD

Introduction: The risk factors for early periprosthetic fracture using a direct anterior approach for total hip is not well studied. The purpose of this study was to determine what patient-specific risk factors contribute to early femoral fracture.

Methods: We retrospectively reviewed a cohort of 916 consecutive primary non-cemented DAA total hip arthroplasties. Patients were subgrouped according to age (greater than or equal to 70 or less than 70), BMI (greater than or equal to 25 or less than 25), sex, and preoperative diagnosis. Odds-Ratios were obtained to compare all significant risk factors. Canal fill, stem angle and bone morphology were assessed using a 3-to-1 comparison method and Student's T-test statistical evaluation.

Results: Early periprosthetic fracture occurred at a rate of 1.41%. Patients aged 70 or older demonstrated increased fracture risk (OR: 2.49, P=0.03). Patients who were both age 70 or older and had a BMI less than 25 were at compound risk of fracture (OR: 4.44, P<0.0001). Femoral neck fractures upon presentation also demonstrated increased fracture risk (OR: 10.86, P = 0.003).

Conclusion: Patients who present at an age greater than or equal to 70 are at significantly increased risk of developing an early periprosthetic fracture. There is a compounding risk associated with age over 70 and low BMI. Mechanical factors such as implant canal fill, implant femoral stem alignment, and proximal bone morphology were not found to contribute to fracture risk. Increased fracture risk also occurs in the setting of total hip for treatment of femoral neck fractures.

Fewer Complications and Revisions with Hemiarthroplasty Compared to Total Hip Arthroplasty for Femoral Neck Fracturesin the Medicare Population

Scott M. Eskildsen, MD, Rutledge C. Clement, MD, MBA,
Ganesh V. Kamath, MD, Daniel J. Del Gaizo, MD

Introduction: The optimal treatment of patients with displaced intracapsular femoral neck fractures remains controversial. We utilized a national database of Medicare patients to determine if there was any difference in complications and reoperation rate of patients undergoing total hip arthroplasty (THA) or hemiarthroplasty (HA) for femoral neck fractures.

Methods: This study utilized the PearlDiver Patient Records Database, a national for-fee database of Medicare patient procedure and diagnosis records from 2005-2012. International Classification of Diseases, 9th Revision (ICD-9) procedure and diagnosis codes were used to identify patients that underwent THA or HA for a diagnosis of femoral neck fracture. Outcome procedures and diagnoses including revision, dislocation, infection, venous thromboembolism and myocardial infarction that occurred during the study time period were also identified. Odds Ratio (OR) and 95% confidence intervals (CI) were calculated and chi-square test were performed for statistical significance ($p<0.05$).

Results: We identified 275,439 patients with displaced femoral neck fractures that underwent HA and 26,017 patients that underwent THA, respectively. Patients undergoing HA had significantly lower rates ($p<0.0001$) of revision 2.48% vs. 3.85% (OR=1.58 95% CI [1.48-1.68]), dislocation 1.76% vs. 3.39% (1.95 [1.82-2.10]), infection 3.44% vs. 4.87% (1.44 [1.36-1.53]), and venous thromboembolism 4.04% vs. 4.54% (1.13 [1.06-1.20]) compared to THA. These differences were maintained when controlling for age, sex, region as well as follow-up periods of one year and two years. There was no significant difference in the number of myocardial infarctions between patients undergoing THA and HA ($p=0.252$).

Conclusion: Patients that underwent THA for femoral neck fractures had a higher rate of complications and increased rates of revision than those who underwent HA. Further study is needed to determine if there is significant functional advantage in THA over HA to outweigh the potential increase in complications and revision.

Pre-opioid Use: Is There an Association with Outcomes Following THA?

John Callaghan, MD, **Nicholas Bedard, MD,** Andrew Pugely, MD,
Christopher Martin, MD, Kyle Duchman, MD,
Robert Westermann, MD, Yubo Gao, PhD

Introduction: The United States is in the midst of an opioid epidemic. An unknown percentage of the THA population are on chronic opioids prior to THA. The purpose of this study was to evaluate opioid use after THA comparing pre-operative opioid users (OU) and non-opioid users (NOU); and to evaluate comorbidities and 90-day complication rates between these cohorts.

Methods: The Humana Inc. dataset was reviewed from 2007-2014 for patients undergoing primary THA. Patients, comorbidities and 90-day outcomes were identified using ICD-9/CPT codes and prescription opioid use was measured by monthly prescription fill rates. An OU user was defined as opioid prescription within 3 months prior to THA and NOU was defined as no history of prior opioid use. Patient demographics, comorbidities and 90-day outcomes were identified and compared between OU and NOU using standard statistical techniques.

Results: 43,243 patients underwent THA; 23,089 (53.4%) patients did not use opioids prior to surgery, while 20,154 (46.6%) were taking opioids prior to surgery. Post-op, NOU had a lower number of opioid scripts filled per patient at discharge than OU (0.50 vs 0.95 scripts/patient, $p<0.05$). Monthly opioid script fill rates were lower for NOU at all time points ($p<0.05$). OU had more medical comorbidities (higher Charlson Comorbidity Index; more obesity, smokers, diabetes, CHF, CAD, CKD, COPD and CLD; $p <0.0001$). Ninety-day complications including respiratory failure, AKI, pneumonia and SSI were higher among OU ($P<0.0001$ for all).

Conclusion: Forty-seven percent of THA patients took opioids pre-op. OU had prolonged opioid use after surgery with more comorbidities and higher rates of post-operative complications. OU did decrease their monthly prescription fill rates compared to pre-operative values, but at one year rates still remained higher than NOU (0.23 vs 0.02 scripts/patient). These results support the importance of minimizing opioid use prior to and in the peri-operative THA period.

Primary Tritanium Acetabular Components are Associated with a High Prevalence of Radiolucencies which Compromise Clinical Function at Short Term Follow-up

Alberto Carli, MD, MSc, FRCSC, Lucian Warth, MD, Bryan Nestor, MD

Introduction: Cementless fixation is the preferred method for acetabular reconstruction in total hip arthroplasty (THA). Despite promising long-term results among several designs, concerns regarding the high modulus of elasticity, low friction and low volumetric porosity of contemporary cementless cups have spurred the introduction of novel porous surfaces designed to improve osseointegration. Although several novel surfaces have been introduced into clinical use, little literature regarding their clinical and radiographic performance exists. This study investigates the performance of one such novel surface, Tritanium.

Methods: We prospectively evaluated 121 consecutive THAs performed in 94 patients by a single surgeon using the Tritanium Primary Acetabular Component (Stryker, Mahwah, NJ). 109 hips (90.1%) had adequate follow-up for analysis. Parameters recorded included implant survivorship, Harris Hip Scores, WOMAC and SF-12. Radiographs at the 6-week, 1 year and most recent visit were evaluated by two blinded observers for implant position, evidence of radiolucency, sclerosis and component migration.

Results: At an average of 3.88+1.71 years, survivorship for aseptic loosening was 98.1%. At one year postoperatively, 35.5% of hips demonstrated radiolucencies and sclerotic changes in two or more DeLee zones, with half (17.3%) involving all three zones. These proportions increased (37.2% and 18.4% respectively) on radiographs two years postoperatively. Hips with radiolucencies in three zones exhibited significantly lower Harris Hip Scores at two years compared to non-radiolucent hips (p=0.016). Age, gender, BMI, preoperative function and cup position did not differ between patients. Bone-implant gaps on six-week radiographs were not correlated with later presence of radiolucencies.

Conclusion: We found that over one third of hips implanted with a Tritanium coated primary shell exhibit radiographic signs of fibrous ingrowth that increase in prevalence over time and lead to poorer clinical function. We advocate that patients that have received this implant be followed closely for evidence of clinical deterioration and component loosening.

Comparative Survival Analysis of Porous Tantalum and Porous Titanium Cups in Total Hip Arthroplasty

Sumon Nandi, MD

Introduction: Porous metal acetabular components were developed to achieve enhanced initial stability and osseointegration in total hip arthroplasty (THA). Porous tantalum (PoTa) acetabular components are well-studied, but less is known about porous titanium (PoTi). Our aim was to perform a comparative survival analysis between PoTi and PoTa components.

Methods: THA performed using a single manufacturer PoTi (n=1,511) or PoTa (n=151) acetabular component with minimum 2-year followup were analyzed. Paprosky classification of acetabular defect, periacetabular radiolucencies, date of revision, and reason for revision were recorded. One-sided Cochran-Armitage Trend Test was performed to evaluate relationship between acetabular defect, primary versus revision THA, and acetabular component type. Cox proportional hazards regression analysis was performed to test effect of acetabular component type on revision surgery. Power to detect difference in revision rate greater than 18% between groups was >0.80.

Results: With failure defined as revision for any reason, survival of the PoTi acetabular component was 97.7% in primary THA and 93.4% in revision THA. Survival of the PoTa component was 92.0% in primary THA and 95.1% in revision THA.There was no difference in likelihood of revision between PoTi and PoTa components. After adjusting for severity of acetabular defect, PoTi components were less likely to require revision than PoTa in primary THA (HR=0.081, 95%CI 0.007-0.940). With failure defined as revision for aseptic loosening, only PoTi components failed. There was no difference in periacetabular radiolucencies between PoTi and PoTa (p=0.2444).

Conclusion: Our data suggest it may be beneficial to use PoTi acetabular components over PoTa in primary THA. In revision THA, we did not observe a difference in outcome between PoTi and PoTa. PoTi, but not PoTa, failed due to aseptic loosening in revision THA. Consideration should be given to use of PoTa in patients with metabolic bone disease or pelvic irradiation.

Evaluation of Applied Torques and Forces during Femoral Reaming for Hip Arthroplasty – Manual vs. Power Reaming

Michael R. Conti Mica, MD, Robert Havey, MSC, Ryan Sullivan, MD, Craig J. McAsey, MD, Saeed Khayatzadeh, BS, Gerard Carandang, MS, Leonard Voronov, MD, PhD, Avinash Patwardhan, PhD, Karen Wu, MD

Introduction: Intraoperative fracture of the femur during hip arthroplasty is a serious complication. There is paucity in the literature regarding the biomechanics of femoral reaming despite the fact that fracture may take place during this process. The purpose of this study was to measure and compare the forces and torque created by manual and power reaming of the femoral diaphysis for a distally fitting hip prosthesis. Our hypothesis was that manual reaming would result in higher off-axis force and torque.

Methods: The femurs of thirty-two, matched pair, human cadaveric limbs were reamed with conical diaphyseal reamers. For each matched pair, one femur was reamed manually and the contralateral side was prepared using a power reamer. Pairs were mounted together in a novel apparatus affixed to a 6-component force platform. The 3-D orientation and location of the force vector was defined relative to the femur at each instant in time using an optoelectronic motion capture system. Femurs were radiographed at the end of the experiment to evaluate for the presence of fracture or cortical perforation.

Results: The average maximum axial force and off-axis force were significantly greater for manual compared to power reaming (341±50 N vs. 271±74 N, $p<0.001$ and 62±25 N vs. 41±12 N, $p=0.008$, respectively). The average maximum torque was higher and trended towards significance for manual reaming compared to power reaming (13±7 Nm vs 9±3 Nm, $p=0.066$). No fractures or cortical perforations were observed.

Conclusion: Manual reaming of the femur for hip arthroplasty produced significantly higher axial and off-axis forces. A trend towards greater maximum torque was observed during manual reaming. These increased forces and torque imparted by manual reaming to the femur could increase the risk of intraoperative fracture.

Are Patient-reported Outcomes Different after Direct Anterior Vs. Posterior Approach to Total Hip Arthroplasty?

Michael S. Cremins, PhD, PA-C, John C. Grady-Benson, MD, Steven F. Schutzer, MD,Smitha Vellanky, MSC, Gina Panek, BS

Introduction: Two popular choices for surgical approach during total hip arthroplasty (THA) are direct anterior and posterolateral. Numerous studies have been conducted comparing these approaches with equivocal results. Some variables studied include length of stay, narcotic consumption, physical therapy needs, and adverse events. However, to our knowledge, there have been no comparative studies using intermediate-term patient-reported outcomes measures (PRO). This study compares the difference in Hip Disability and Osteoarthritis Outcomes Scores (HOOS) between direct anterior and posterolateral approaches.

Methods: Unilateral, primary THA patients from 2 surgeons exclusively performing direct anterior approaches were case-matched with THA patients from 2 additional surgeons exclusively performing posterolateral approaches at a dedicated joint replacement institute. All patients answered long form HOOS questionnaires preoperatively and at 6 months postoperatively. Subscores (Pain, Other Symptoms, Function in Daily Living, Function in Sports & Recreation, and Hip-related Quality of Life) were then calculated. Preoperative HOOS, postoperative HOOS and the differences in subscores were compared between the two groups. Normally distributed scores were assessed with paired sample T-Tests while Wilcoxon Signed Rank Tests were used to assess differences in scores not normally distributed.

Results: A total of 274 patients (137 matched pairs) were included between June 2012 and August 2014. Average age was 65 and average BMI was 28. No significant differences at the $p<0.05$ level were observed in preoperative, postoperative, or difference in HOOS subscores between the direct anterior and posterolateral approach patient groups.

Conclusion: The plethora of information available to patients via the internet and other avenues has created significant confusion regarding THA surgical approaches. In this study, the surgical approach had no bearing on 6 month postoperative PRO when comparing the two studied approaches. Furthermore, surgeons that exclusively perform one surgical approach can achieve equivalent PRO results.

The Effects of Elastic Moduli on Primary THA: A Clinical and Radiographic Follow-up

Carlos J. Lavernia, MD, FACS, Michelle D'Apuzzo, MD,
Jesus M. Villa, MD, Carlos M. Naranjo, MD

Introduction: Factors such as larger stem size, stem designs, and material composition have been associated with thigh pain. We wanted to assess the effects of material composition on thigh pain, patient oriented/clinical outcomes, and key radiographic signs of fixation/instability.

Methods: 222 cementless primary THAs (Trilock, DePuy) performed in 192 patients by a single surgeon were prospectively studied. All patients received identically shaped tapered cementless stems. Two types of stem alloy were utilized: CoCr-Mo (n=82) and Ti-6Al-4V (n=140). Outcomes studied included postoperative thigh pain (pain diagram, present yes or no), pain intensity/frequency visual-analogue-scale (VAS; range, 0-10), QWB-7, SF-36, hip-Harris score, and WOMAC. The presence of spot welds and pedestals on the latest radiographs were also noted. Comparisons between groups were made controlling for race (MANCOVA). Mean follow-up: 7.8 years (range, 2-17 years). Alpha was set at 0.05.

Results: Thigh pain was not different between the groups [CoCr-Mo (4%) Vs. Ti-6Al-4V (10%)] (p=0.2). The level of pain was very low in both groups. Globally both groups obtained significant pain relief however, CoCr-Mo stems had a higher mean pain intensity when compared to Ti-6Al-4V stems (2.59 vs. 0.94, respectively; p=0.001). The QWB-7 (0.567 vs 0.601; p=0.038), hip-Harris (75 vs. 85; p=0.001), and WOMAC-total scores (18 vs. 9; p=0.002) were also worse in the CoCr group. Spot welds were observed in 29% of CoCr-Mo stems and 45% of Ti-6Al-4V stems (p=0.2). Pedestals were evident in 14% of CoCr-Mo stems and 12% of Ti-6Al-4V stems (p=1.0).

Conclusion: The results of our study suggest that, regardless of the stem alloy composition with this tapered stem design thigh pain was not prevalent or significant with this particular design. However, we found better patient oriented outcomes in the stems made up of titanium alloy. Radiographic parameters were also better in the titanium group.

The Impact of Surgical Approach on Short-term Patient Outcomes in Total Hip Arthroplasty

Stephen Petis, MD, James Howard, MD, FRCSC, Brent Lanting, MD, FRCSC, Lyndsay Somerville, PhD, MS, **Edward Vasarhelyi, MD, FRCSC**

Introduction: The impact of surgical approach on clinical outcomes following total hip arthroplasty (THA) has been under scrutiny over the past decade. Few studies have used validated clinical outcome measures, and to our knowledge, none of the studies have standardized the implants used at the time of the index procedure. The purpose of this study was to determine the impact of the anterior, posterior, and lateral approach for THA on validated clinical outcome measures as well as complication rates.

Methods: We recruited 118 patients undergoing a THA using either an anterior, posterior, or lateral approach. Each patient received standardized implants at the time of the operation. A single surgeon performed each approach. Each patient completed a WOMAC, Harris hip score (HHS), SF-12, EQ-5D, and Timed Up-and-go (TUG) test pre-operatively, 6-weeks and 3-months following THA. We recorded postoperative complications for each approach.

Results: The three groups were similar with respect to age (p=0.79), sex (p=0.97), BMI (p=0.54), and diagnosis (p=0.42). At 6-weeks, the anterior group had higher WOMAC function scores compared to the lateral group (p=0.036). The posterior group achieved higher HHS functional scores at 6-weeks compared to the lateral group (p=0.037). Significantly more patients were performing “Usual Activities” at 6-weeks in the anterior versus lateral or posterior cohort as rated on the EQ-5D (p=0.017). There were no statistical differences at 3-months for any outcome score, and no group differences between the pre- and postoperative TUG times. There were more nerve palsies in the anterior group (p=0.001), however, no group differences were noted in the number of dislocations, peri-prosthetic infections or dislocations, or wound complications.

Conclusion: Both the anterior and posterior approaches had higher functional component scores compared to the lateral approach at 6-weeks post-operatively. There was a higher complication rate of lateral femoral cutaneous nerve sensory deficits in the anterior group. Future research should correlate surgical approach and functional analyses such as gait analysis to explain functional differences between the groups.

Simultaneous Bilateral Vs. Staged Bilateral Total Hip Arthroplasty: A Matched Survival Study

Matthew T. Houdek, MD, Chad D. Watts, MD, Cody C. Wyles, BS, Rafael J. Sierra, MD, Robert T. Trousdale, MD, Michael J. Taunton, MD, **Daniel R. Whiting, MD**

Introduction: There continues to be debate regarding the role of simultaneous versus staged bilateral total hip arthroplasty (THA) for patients with end-stage bilateral osteoarthritis. Previous studies have shown that simultaneous bilateral THA is associated with short-term systemic complications, but there is limited data comparing implant survival.

Methods: Using our institution's joint registry, we identified 124 consecutive patients (248 hips) who underwent simultaneous bilateral THA. Patients were 43% female, with a mean age 52 years and BMI of 27.5 kg/m2. These patients were matched 1:1 based on gender, age, and year of surgery (±3 yrs) to a cohort of patients undergoing a staged bilateral THA. In the staged group, there was less than one year between procedures. Mean follow-up was 5-years for each group. Kaplan-Meier implant survival outcomes were assessed in addition to postoperative complications and short term mortality (30- and 90-day) between groups.

Results: There was no difference (HR 0.76, P=0.51) in the overall 5-, 10-, 20-year revision free survival in patients undergoing a single- or staged bilateral THA (95% v. 91%), (84% v. 85%), (84% v. 73%). The risk of reoperation (HR 0.79, P=0.54), postoperative infection (HR 0.98, P=0.98), and postoperative complications (HR 0.97, P=0.89) was also similar. There were no differences in 30-day (0% vs. 0.8%, p=1.0), 90-day (0.8% vs. 0.8%, p=1.0) or overall (HR 0.81, P=0.41) mortality. Likewise, there was a similar rate of complications including periprosthetic fracture (3.2% v. 4.4%, P=0.80), dislocation (2.4% vs. 1.6%, p=0.74), and DVT (1.6% vs. 0.8%, P=0.68).

Conclusion: Previous studies have shown increased rates of perioperative systemic complications following simultaneous bilateral total hip arthroplasty. In our experience, simultaneous bilateral THA is a safe procedure with similar survival and complication risk compared to staged bilateral THA and for certain patients, offers an excellent means to deal with concomitant bilateral coxarthrosis.

Patient Reported Outcomes Following Simultaneous vs. Staged Bilateral Total Hip Arthroplasty

Long-Co Nguyen, BS, **Kevin J. Bozic, MD, MBA**

Introduction: Although simultaneous bilateral THA has been shown to be associated with a higher risk of perioperative morbidity and mortality in older patients with a higher burden of baseline comorbid disease, the impact of simultaneous bilateral THA on pain and functional outcomes when compared with staged bilateral THA are unclear. The objective of this study was to compare patient-reported outcomes (PROs) following simultaneous vs. staged bilateral THA.

Methods: SF12v2, WOMAC, and UCLA Activity Scores were measured preoperatively and at 6 and 12 months postoperatively in 159 patients who underwent staged bilateral THA and 43 patients who underwent simultaneous bilateral THA between 2002 and 2014 at a single institution. Change in PROs at 6 and 12 months were compared for each group utilizing student's t-test and multivariable analysis, controlling for age, sex, and American Society of Anesthesiologists (ASA) classification.

Results: There were no significant pre-operative differences between the groups in regard to age, gender, body mass index, or grading of ASA. At 6 months postoperatively, patients who received simultaneous bilateral THA had a statistically significant higher change from their baseline UCLA activity score 1.73 vs 0.77 (p-value = 0.01) compared to the patients who received a staged procedure. At 12 months patients in the simultaneous group had significantly higher changes in the UCLA activity score and SF12v2 Physical Component Score, 2.25 vs 1.62 (p-value = 0.03) and 16.88 vs 11.83 (p-value < 0.01), respectively. There was no difference in SF12v2 Mental Component Score at either 6 months (p-value = 0.37) or 12 months (p-value = 0.88).

Conclusion: Patients who undergo simultaneous bilateral THA have improved activity and physical function when compared with patients who undergo staged bilateral THA. Simultaneous bilateral THA is a valid option for younger patients with bilateral hip disease who have a low burden of comorbid disease.

Perioperative Outcomes of Primary Total Hip Arthroplasty after Prior Lumbar Spinal Fusion

Jeffrey J. Barry, MD, David C. Sing, BS,
Thomas P. Vail, MD, Erik N. Hansen, MD

Introduction: Coexistence of degenerative hip disease and spinal stenosis, coined "hip-spine syndrome" by Fogel, may affect up to 18% of patients undergoing primary total hip arthroplasty (THA). The limited research to date suggests spinal pathology portends less pain relief and worse outcomes after THA. We hypothesize that primary THA patients with preexisting lumbar spinal fusion (LSF) experience worse perioperative outcomes.

Methods: Retrospective case-control study. All primary THA patients at one institution who had undergone prior LSF, deemed spine arthrodesis - hip arthroplasty (SAHA), were identified and matched to a control group of primary THA patients without LSF. Perioperative outcomes (<90 days) were compared including complications, readmissions, reoperations, anesthesia type, pain scores, narcotic usage, hospital length of stay (LOS), disposition, and walking distance.

Results: From 2012-2014, 35 SAHA patients were identified. Compared to 70 matched controls, patients were similar in age, sex, ASA score, BMI and Charlson comorbidity scores. SAHA patients had higher rates of complications (31.4% vs 8.6%, p=0.007), reoperation (14.3% vs. 2.9%, p=0.040), and general anesthesia (54.3% vs. 5.7%, p=0.0001). Bivariate analysis demonstrated prior LSF to predict reoperation (OR 5.67, p=0.045) and complications (OR 4.89, p=0.005). With the numbers available for study, dislocations (2.8% vs. 0%), infections (8.6% vs. 0%), readmissions, post-operative walking distance, hospital LOS, and disposition only trended to favor patients without LSF (p>0.05). In comparing THA to SAHA patients with <3 or 3+ levels fused, longer fusions resulted in higher early VAS pain scores (1.2 vs. 2.9 vs. 4.2, p<0.001) and increased post-operative narcotic consumption (mean-morphine-equivalents 44.3 vs.46.9 vs. 169.4, p=0.001).

Conclusion: Patients with preexisting LSF experience worse perioperative outcomes after primary THA including higher rates of complications and reoperation. Lower rates of neuraxial anesthesia, decreased functional mobility, higher narcotic

Cementless Taper-wedge Femoral Stems Are Ideal in Obese Patients Compared to Traditional Fit and Fill Stems

Tanner W. Grant, BS, Mary Ziemba-Davis, BA,
Luke R. Lovro, BS, **R. Michael Meneghini, MD**

Introduction: Cementless femoral component stability and resistance to subsidence is critical for osseointegration and clinical success in total hip arthroplasty (THA). Obesity continues to increase at alarming rates worldwide and poses a significant challenge to the arthroplasty surgeon. The purpose of this study was to assess the subsidence and clinical stability of two different modern cementless femoral component designs.

Methods: A retrospective cohort study of 129 consecutive cementless THAs was performed. Traditional fit-and-fill stems were implanted in the first 64 hips with the remaining 65 receiving morphometric tapered-wedge stems. Preoperative bone morphology was radiographically assessed by the canal-flare index. Subsidence, canal fill, and the sagittal alignment of stems were measured digitally on the immediate and 1-month postoperative radiographs. Statistical analysis was performed to assess differences between the two stem design types with $p < 0.05$ as significant.

Results: Age, height, weight, BMI, and radiographic canal flare index were similar between groups. There was significantly less median subsidence in the tapered wedge design (0.15mm) versus the fit and fill design (0.65mm)($p<0.0001$). Subsidence significantly increased as BMI increased in the fit and fill stems, a finding not observed in the tapered wedge design ($p=0.01$). Subsidence was not influenced by patient age in either group. Radiographic canal fill was greater in the tapered wedge design compared to the fit and fill design ($p<0.0001$).

Conclusion: An anatomically designed morphometric taper wedge femoral stem demonstrated greater axial stability than a traditional fit-and-fill stem. In addition, radiographic subsidence is correlated with increasing BMI in the fit-and-fill design, while the tapered wedge design is resistant to increasing patient weight. The resistance to subsidence, irrespective of BMI, is likely due to the inherent axial stability of a tapered wedge design and appears to be the optimal stem design for obese patients.

A Prospective, Randomized, Radiostereometric Analysis of Patients Undergoing Cementless THR

David C. Ayers, MD, Patricia D. Franklin, MD, MBA, MPH,
Henrik Malchau, MD, PhD, Charles Bragdon, PhD

Introduction: This study compared, at a minimum of five years, and up to ten years following surgery, the micromotion of tantalum and titanium acetabular cups and femoral head penetration in highly cross-linked polyethylene liners and conventional (ultra-high molecular weight polyethylene) liners in active patients who had undergone total hip replacement, using Radiostereometric analysis (RSA).

Methods: This IRB-approved prospective, randomized, blinded study involved 46 patients randomized twice and placed into 1 of 4 cohorts: Patients received either a cementless cup with a titanium mesh surface or a tantalum trabecular surface and either a highly crosslinked polyethylene liner or an ultra-high molecular weight polyethylene liner. All patients received a M-L Taper femoral stem, modified for RSA use. RSA examinations and SF-36 (Physical Component and Mental Component), WOMAC, UCLA activity, and Harris hip scores were obtained preoperatively, postoperatively, at six months, and annually thereafter.

Results: All patients had significant improvement ($p < 0.05$) in SF-36 Physical Component, WOMAC, UCLA activity, and Harris hip scores postoperatively. On RSA examination, highly cross-linked polyethylene liners showed significantly less median femoral head penetration at 5 years ($p < 0.05$). Steady-state wear rates from one year to five years were 0.04 mm per year for ultra-high molecular weight polyethylene liners and 0.004 mm per year for highly cross-linked polyethylene liners. At the 5-year follow-up, median migration (and standard error) was 0.05 ± 0.20 mm proximally for titanium cups and 0.21 ± 0.05 mm for tantalum cups. Femoral stem subsidence was minimal and measured 0.05 ±0.05 mm.

Conclusion: In this cementless THR cohort, radiostereometric analysis showed significantly less femoral head penetration in the highly cross-linked polyethylene liners compared with that in the conventional ultra-high molecular weight polyethylene liners.

The Effect of Total Hip Replacement on the Non-operated Lower Extremity Joints

Kristi Collins, PA-C, Thomas R. Bowen, MD, Edgardo Parrilla, BA, BS, Patricia Franklin, MD, MBA, MPH, Celeste Lemay, MPH, **Elie Ghanem, MD**

Introduction: The degree of pain in the contralateral and ipsilateral hip and knee joints affects outcome after total hip arthroplasty (THA). It is not known whether pain in the non-operated joints improves or deteriorates after THA. The objective of this study was to assess the effect of THA on short-term pain relief of the remaining non-operated joints.

Methods: We identified 2,136 patients using a national cohort from 22 states (2011-2015) who underwent a unilateral THA and completed a preoperative and 6 month postoperative KOOS/HOOS pain score evaluation. Approximately 17% and 57% of the population reported no pain prior to THA in their ipsilateral and contralateral knees respectively, while only 54% noted that their contralateral hip was pain free. The change in improvement between the mild, moderate, and severe groups was compared using Chi-squared analysis.

Results: Patients with severe preoperative pain in their contralateral hip reported improvement in 83% of the time compared to 43% who noted mild preoperative pain ($p<0.001$). Approximately 85% to 88% of the patients who complained of moderate or severe ipsilateral knee pain, reported improvement at 6 months compared to 61% with mild preoperative pain ($p<0.001$). Similar results were observed for the contralateral knee after their THA ($p<0.001$). Approximately 14% who did not report any pain preoperatively in their contralateral hip developed worsening pain after surgery. Similarly, asymptomatic patients noted worsening pain in their ipsilateral and contralateral knees in 16% and 14% of the time respectively.

Conclusion: Patients who undergo THA achieve pain improvement in their non-operated hip or knees in addition to the pain relief they obtain from their operated hip. Those patients who report moderate to severe pain levels are more likely to experience improvement. It is possible that these patients are able to unload the remaining non-operated joints at 6 months and rely more on their THA.

Does Hip Arthroscopy Affect the Outcomes of a Subsequent Total Hip Arthroplasty?

Bryan D. Haughom, MD, Darren Plummer, MD, MBA, Michael D. Hellman, MD, Shane Nho, MD, Aaron Rosenberg, MD, Craig Della Valle, MD

Introduction: Hip arthroscopy is one of the fastest growing fields of orthopaedic surgery with some patients ultimately requiring total hip arthroplasty (THA) following the procedure. As the number of hip arthroscopies performed continues to grow, determining the impact of prior arthroscopy on subsequent THA is important to understand. The purpose of this investigation was to determine the impact of prior hip arthroscopy on the outcomes of a subsequent THA.

Methods: A retrospective review of a high-volume orthopaedic surgery practices' billing database yielded 28 hips that had undergone hip arthroscopy and subsequent THA. An age, sex, and BMI matched cohort of THA (without prior arthroscopy) was used for comparison (n=56). All patients in both cohorts had a minimum of two-year follow up (average 4.0±1.7 vs. 3.5±1.1 years; p = 0.11). Rates of complication and revision, as well as Harris Hip Scores (HHS) were compared using Fisher's exact and t-tests, respectively (<0.05). An a priori analysis indicated 20 patients were needed per group to detect a difference of 10 HHS points (power: 85%).

Results: The average age (53.6±9.6 vs. 52.2±10.3 years, p=0.55), BMI (28.3±6.4 vs. 28.6±3.7 kg/m2, p=0.81), and gender composition did not differ between groups (50% female in both groups) suggesting adequate matching. There were three complications (dislocation, deep infection, symptomatic leg length discrepancy) in the arthroscopy group, compared to two (deep infection and taper corrosion) in the control group (p=0.3); three revisions were required in each group (p=0.3). There was no difference in the mean postoperative HHS (92.1±12.8 vs. 90.15±6.8, p=0.20).

Conclusions: With the number of patients available for study, prior hip arthroscopy does not appear to have an impact on the functional outcomes of a subsequent THA.

"Dual Diagnosis" Triples Rates of Periprosthetic Infection and Revision after Primary Total Hip Arthroplasty

Mitchell R. Klement, MD, Colin T. Penrose, BA, BS,
Abiram Bala, BA, David E. Attarian, MD, FACS,
Richard C. Mather, MD, MBA, Samuel S. Wellman, MD,
Michael P. Bolognesi, MD, Thorsten M. Seyler, MD, PhD

Introduction: The co-occurrence of a mental illness and a substance abuse disorder (SUD) is common and has been referred to as "dual diagnosis." These disorders have been linked to inferior outcomes. The purpose of this study is to evaluate "dual diagnosis" as a comorbidity and how it impacts clinical outcomes. We hypothesize these patients will have increased surgical complications after primary total hip arthroplasty (THA).

Methods: A search of the Medicare database from 2005 to 2012 was performed using International Classification of Disease version 9 (ICD-9) codes to identify 86,976 patients who underwent THA with psychiatric disorders and alcohol (5,528), opiods (2,826), sedatives (892), cocaine (1,170), and cannabis (962) abuse/dependense. A cohort of 590,698 patients served as a control with 2 year minimum follow up. Medical co-morbidities and post-operative complications at 30-day, 90-day, and overall time points were compared between the two cohorts.

Results: Patients with "dual diagnosis" were more likely to be younger (age <65, OR 36.63, $p < 0.001$), with no gender preference (Male, OR 1.02, $p = 0.547$), and more medically complex (significant increase in 28/29 Elixhauster comorbidities, $p < 0.05$). There was a significant increase ($p < 0.001$) in 7/14 (50%) of recorded post-operative medical complications rates at the 90-day time point including acute renal failure (OR 1.78), postoperative anemia (OR 1.31), blood transfusion rate, and incidence of suicide (OR 296.08). In addition, there was a statistically significant increase overall in periprosthetic infection (OR 4.75, $p < 0.001$), periprosthetic fracture (OR 2.82, $p < 0.001$), dislocation (5.53, $p < 0.001$), and need for THA revision (OR 4.42, $p < 0.001$).

Conclusion: Patients with "dual diagnosis" have substantially increased medical and surgical complication rates in the global period and at short-term follow up. These patients must be carefully selected and need to be counseled accordingly regarding the increased complication rates before proceeding with THA.

Tranexamic Acid in Total Hip Arthroplasty: Do Drug Formulation and Dosage Determine Efficacy and Safety?

Yale A. Fillingham, MD, Jonathon Riboh, MD, Brandon J. Erickson, MD, Gregory L. Cvetanovich, MD, Craig J. Della Valle, MD

Introduction: The growing body of randomized controlled trials (RCT) on tranexamic acid (TXA) has demonstrated efficacy of intravenous (IV), topical, and oral TXA compared to placebo in postoperative blood management, but there is scarce data comparing drug formulations. The purpose of this network meta-analysis (NMA) was to provide quantitative synthesis of the entire body of RCTs on TXA in total hip arthroplasty (THA).

Methods: We searched Medline, Cochrane and EMBASE databases for all RCT performed before April 2015 on TXA in primary THA. Patients were stratified into low dose IV (LDIV, ≤20 mg/kg), high dose IV (HDIV, >20 mg/kg), topical and oral TXA groups. We then applied Bayesian NMA, which combines both direct and indirect evidence to allow pairwise comparisons of all treatment groups. Dichotomous outcomes were compared using odds ratios and continuous outcomes using mean differences.

Results: 19 RCT, including 1,388 patients, were eligible. Topical and IV TXA formulations were statistically superior to placebo in terms of blood loss and risk of transfusion. HDIV TXA offered significantly lower blood loss than LDIV and oral TXA while all other comparisons demonstrated no difference. No difference was observed between TXA formulations with regards to risk of transfusion or thromboembolic events.

Conclusion: TXA formulation and dosage have a direct effect on blood loss with HDIV TXA providing superior results compared to LDIV and oral TXA. However, these differences did not translate into clinically relevant lower rates of transfusion. No TXA formulation portended a higher risk of thromboembolic event. We believe the observed difference between HDIV and oral TXA is an artifact of inadequate dosing. Thus, all IV and topical TXA formulations are equivalent in terms of efficacy and safety, suggesting use of the lowest cost formulation to provide significant savings to the healthcare system.

Oral and Intravenous Tranexamic Acid are Equivalent at Reducing Blood Loss Following Total Hip Arthroplasty

Erdan Kayupov, MSE, Yale A. Fillingham, MD, Darren Plummer, MD, Mario Moric, MS, Tad Gerlinger, MD, Craig J. Della Valle, MD

Introduction: Tranexamic acid (TXA) is an antifibrinolytic that has been shown to reduce blood loss and the need for transfusions when administered intravenously (IV) in total hip arthroplasty (THA). An oral formulation of the medication is available, at a fraction of the cost of the IV preparation. The purpose of this randomized controlled trial was to determine if oral administration is equivalent in terms of minimizing blood loss in primary THA.

Methods: In this double-blinded, placebo-controlled trial, 64 patients undergoing primary THA were randomized to receive 1.95g TXA orally two hours preoperatively, or a 1g TXA IV bolus in the OR prior to incision. The primary outcome was reduction of hemoglobin. Power analysis determined 28 patients were required in each group with a ± 1.0g/dL hemoglobin equivalence margin between groups with an alpha of 0.05 and a power 80%. Equivalence analysis was performed with two-one sided t-tests (TOST) where a p-value of <0.05 indicates equivalence between treatments.

Results: 28 Patients received IV TXA, 30 received oral and 6 were excluded for protocol deviations. Patient demographics were similar between groups suggesting successful randomization. The mean reduction of hemoglobin between oral and IV groups were similar (3.82g/dL vs. 3.64g/dL; p=0.007, equivalence). Similarly, mean total blood loss was equivalent between oral and IV administration (1375ml vs. 1342ml; p=0.038, equivalence). Two patients in the oral group and one in the IV group were transfused, and none experienced a thromboembolic event.

Conclusion: Oral TXA provides equivalent reductions in blood loss in the setting of primary THA, at a cost of $14 compared to $47 to $108 depending on the IV formulation selected. With over 300,000 primary THA performed in the United States annually, a switch to oral TXA would yield total cost savings of $10 to $28 million per year for our health care system.

IV vs. Topical Tranexamic Acid in TKA: IV vs. Topical Tranexamic Acid in TKA

Matthew P. Abdel, MD, Michael J. Taunton, MD, Rafael J. Sierra, MD, Robert T. Trousdale, MD, Mark W. Pagnano, MD, Friedrich Boettner, MD, Edwin P. Su, MD, Steven B. Haas, MD, Mark P. Figgie, MD, David J. Mayman, MD

Introduction: Antifibrinolytics such as tranexamic acid (TA) reduce postoperative bleeding and the need for transfusion after total knee arthroplasty (TKA). Most literature has focused on IV TA and less data is available on the efficacy of topical TA. We designed this multi-center randomized clinical trial to specifically assess the efficacy of topical TA compared to IV TA as measured by total blood loss, drain output, and transfusion rates.

Methods: 600 unilateral primary TKAs performed for osteoarthritis were randomized to 2 groups: 1) 1 g of IV TA upon incision and 1 g at closure or 2) 3 g of TA diluted in 75 mL normal saline and applied locally after cementation. Age, sex, BMI, ASA score, preoperative hemoglobin, and co-morbidities were similar between groups. Univariate, multivariate regression, and multiple logistic regression analyses were performed.

Results: Patients receiving topical TA had significantly more blood loss compared to those receiving IV TA (409 mL vs. 306 mL; $p = 0.007$). Drain output was similar between the topical and IV TA groups (400 mL vs. 409 mL; $p = 0.8$). There was no significant difference in transfusion rates between the topical and IV groups (1.4% vs. 0.84%; $p = 0.99$).

Conclusion: Both topical and IV TA were effective in minimizing total blood loss, drain output, and transfusion rates after TKA. Patients who received topical TA had slightly greater blood loss (100 mL), but this did not result in a significant increase in transfusions. As part of a contemporary blood management strategy, the use of either topical or IV TA was associated with transfusion rates less than 2% in this randomized trial.

Randomized Prospective Trial Comparing the use of IV vs. PO Acetaminophen with Total Joint Arthroplasty

Joel R. Politi, MD, **Richard L. Davis, MD,** Alexis Matrka, BS

Introduction: Multimodal pain management has had a significant effect on improving total joint replacement recovery and satisfaction. There is literature supporting that IV Acetaminophen reduces postoperative pain and narcotic use in the total joint population, however, there are no studies comparing the effectiveness of the IV versus the PO form.

Methods: 120 patients undergoing hip and knee replacement surgery performed by one surgeon were prospectively randomized into two groups. Group 1 (63pts) received IV and Group 2 (57pts) received PO acetaminophen. Each group received 1g preoperatively and then every 6 hours for 24 hours. Total narcotic use and visual analog scale (VAS) scores were collected every 4 hours on patients.

Results: The 24 hour average VAS scores in Group 1 was 3.00 and in Group 2 it was 3.40. This trended toward but did not show significance (p=0.06). None of the 4 hour intervals were significantly different except the first interval, where there was significance (p=0.03). The 24 hour average hydromorphone equivalents given were not different (3.71 vs. 3.48) at 24 hours (p=0.75), or at any of the individual four hour intervals.

Conclusion: The use of IV Acetaminophen may have a limited role when given intraoperatively to reduce the initial pain after surgery, but following that, provides no additional benefit in reducing pain or narcotic use when compared to the much less expensive PO form.

Bilateral Simultaneous vs. Staged Total Knee Replacement: A Comparison of Complications and Mortality

Dhiren S. Sheth, MD, Guy Cafri, PhD, MStat,
Elizabeth W. Paxton, MA, Robert S. Namba, MD

Introduction: Comparison of complications and mortality between bilateral simultaneous TKR (BSimTKR) and bilateral staged TKR performed within one-year (BStgTKR) is hampered by differences in the baseline characteristics of the patients, surgeon preference and hospital characteristics. The purpose of this study was to compare the complications and mortality between BSimTKR and BStgTKR while adjusting for these differences.

Methods: We compared patients undergoing BSimTKR to BStgTKR in an integrated healthcare system total joint registry. Groups were weighed according to their propensity scores. For outcomes related to revision and infection the sample included 11118 patients (4/17/2001 – 12/28/2012) and for outcomes of death, acute myocardial infarction, stroke, and venous thromboembolism a subsample of 7991 patients was selected (11/16/2004 – 12/28/2012) due to availability of extensive comorbidity information.

Results: Overall death and complications in both groups were rare. The complication rates for BSimTKR and BStgTKR were comparable: Aseptic revision (1.17% vs 0.9), septic revision/deep infection (0.8% vs. 0.7%), death (0.28% vs 0.1%) and adverse events (2.49% vs 1.97%). In the final analytical models there was no difference in any of the outcomes between the two groups (see tables)Time to Revision or Deep Surgical Site Infection (SSI), reference group BStgTKROutcome HR LB UB pSeptic Revision or Deep SSI 1.09 0.69 1.73 0.700Aseptic Revision 1.20 0.86 1.69 0.285Any revision or Deep SSI 1.21 0.93 1.56 0.157Effect for Death and Other complications within 90 days, ref group BstgTKROutcome Exp (estimate) LB UB pVTE 1.07 0.68 1.69 0.756Death 2.14 0.62 9.40 0.205AMI 1.73 0.69 4.33 0.244Stroke 0.99 0.42 2.32 0.973Any Death or Complication 1.29 0.88 1.89 0.189

Conclusion: After adjusting for patients, surgeon and hospital characteristics, we found no evidence of increased risk of revision, infection, death, or complications in bilateral simultaneous versus staged TKR.

10 Year Outcomes of UKA vs. TKA in Patients with Similar Pre-operative Function and Arthritis

John L. Masonis, MD, Gavin Hart, MD, Walter B. Beaver, MD

Introduction: The debate of UKA versus TKA continues. Pre-operative guidelines exist for determining which patients are candidates for UKA, but preoperative evaluation is not always sensitive to degenerative changes in the other compartments of the knee or ACL integrity. We report the 10 year mean survivorship and function of UKA versus TKA when intra-operative procedure selection was implemented in a cohort of patients with similar pre-operative knee function and radiographic level of arthritis.

Methods: We reviewed clinical outcomes of all patients consented for UKA versus TKA at our institution from 1/6/2003 – 2/13/2006 by a single surgeon. Procedure selection was determined intra-operatively based on inspection of the lateral compartment, the patellofemoral compartment, and the ACL. Patient reported outcome measures included WOMAC, KOOS, incidence of subsequent surgery, implant survivorship at latest follow up, and reason for revision surgery.

Results: Follow-up was available for 174 patients (67% of the original eligible study population). Mean follow-up for the study population was 119 months (range 86 - 142 months). UKA was associated with a significantly higher re-operation rate (16.5%) versus TKA (6.9%). UKA re-operation occurred at a mean of 33.2 months. The most common UKA failure modes were aseptic loosening (53%) and progression of adjacent compartment arthritis (23%). No UKA patients were revised for infection. The most common TKA failure modes were infection and aseptic loosening. No significant differences were demonstrated between TKA and UKA with respect to WOMAC and KOOS scores at a mean of 9.3 years (range 7 – 12).

Conclusion: When using a selective intra-operative algorithm for deciding between UKA and TKA, we found no difference in KOOS/WOMAC scores at 9.3 years. Survivorship was lower in UKA (84%) versus TKA (93%).

Unicondylar vs. Total Knee Arthroplasty in Young Patients: Minimum 5 Year Follow-up

Jason H. Lee, MD, Steven Barnett, MD, Jay Patel, MD, Nader Nassif, MD, Akil P. Simon, MD, Katie Salmond, BS, Dominic J. Peters, MD, Robert Gorab, MD

Introduction: Total knee arthroplasty (TKA) in the young patient population has been avoided due to concerns of early failure and need for early revision. Alternatively, many use the unicompartmental (UKA) as a bridging procedure. The purpose of this retrospective study was to evaluate the mid to long-term results of UKA versus gap-balanced rotating platform (RP) TKA in younger, more active patients.

Methods: The study group consisted of all patients less than 60 years old with minimum 5 year follow up who underwent either gap balanced TKA (91 Knees, 68 patients) or UKA (59 knees, 48 patients). Knee Society scores, modified Tegner scores, and range of motion were collected on all patients preoperatively and postoperatively. Serial radiographic review evaluated component fixation and alignment as well as degenerative disease progression in native compartments. Kaplan-Meier survivorship analysis was evaluated.

Results: All patients had significant improvement in Knee Society and modified Tegner scores, as well as range of motion ($p<0.05$). Adverse events were significantly higher in the UKA cohort (16.44% vs 5.49%, $p<0.05$). Revisions for all causes were greater in the UKA cohort (13.7% vs 3.3%, $p<0.05$). Postoperative Tegner scores were lower in the UKA group (2.91 vs 3.18), although not statistically significant. The UKA cohort had eight revisions: four for aseptic loosening and four for degenerative progression in unresurfaced compartments. The TKA cohort had three revisions: one each for arthrofibrosis, painful unresurfaced patella, and aseptic loosening. Kaplan-Meier analysis demonstrated a 10-year survivorship of 96.7% for RP TKA and 86.3% for UKA.

Conclusion: Young patients who underwent either UKA or gap-balanced RP TKA showed no significant differences in pain relief and function, however, there were significantly lower adverse events, revisions for all causes and aseptic loosening in the gap-balanced RP TKA cohort.

To Uni Knee or Not Uni Knee … That is the Question: Does Preoperative Range of Motion Matter?

Nitin Goyal, MD, Kevin B. Fricka, MD, Deborah Ammeen, BS, William G. Hamilton, MD, Gerard A. Engh, MD

Introduction: Classical indications for unicondylar knee arthroplasty (UKA) exclude 90-95% of patients with arthritic knees. Preoperative indications include flexion >90° and flexion contractures <5°. Many surgeons have broadened their indications without any evidence-based data regarding pre- and postoperative motion. In this study, we examined patients with limited preoperative motion and evaluated the motion achieved after UKA and total knee arthroplasty (TKA).

Methods: From our institutional database, we identified patients with preoperative flexion contractures of 10°-20° and those with preoperative flexion of 75°-100°. For these cases, we extracted age, BMI, preoperative extension/flexion and postoperative extension/flexion data for all patients with existing minimum 2-year follow-up.

Results: In patients with flexion contractures from 10°-20°, UKA patients improved slightly less (10.3° ±4.2°) than TKA patients (12.6° ±5.0°)($p<0.001$). However, the overall postoperative arc of motion was statistically different between UKA patients (120°±9.9°) and TKA patients(112°±15.2°)($p<0.001$). In patients with restricted flexion (between 75°-100°), UKA patients improved their overall flexion by 27.9°±10.5°, while TKA patients improved an average 16.1°±15.6°($p=0.039$). The postoperative arc of motion was an average of 12° greater in UKA patients(116° ±9°) compared to TKA patients(104° ±19°) ($p=0.05$).

Conclusion: Our data demonstrates that in patients with limited flexion preoperatively, UKA patients had greater improvement of flexion at the latest follow-up. This is in contrast with the traditionally held belief that TKA may allow for greater improvement in flexion in stiff patients. Additionally, in patients with preoperative flexion contractures, UKA is able to restore extension albeit, less than with TKA. However, patients with a preoperative flexion contracture who undergo a UKA maintain significantly more flexion than TKA patients. Therefore, patients with flexion contractures should be counseled that although a TKA may result in a comparatively greater improvement in extension, there will likely be a concomitant loss of flexion that is more than with UKA.

Safety and Cost-effectiveness of Outpatient Unicompartmental Knee Arthroplasty in the Ambulatory Surgery Center: A Matched Cohort Study

Marcus C. Ford, MD, Jordan D. Walters, MD,
Ryan P. Mulligan, MD, Gregory D. Dabov, MD,
William M. Mihalko, MD, PhD, Anthony M. Mascioli, MD

Introduction: Unicompartmental knee arthroplasty (UKA) has an established track record for pain relief and improved function. Historically, UKA was performed in the inpatient hospital setting. However, with renewed emphasis on safety and cost effectiveness, many surgeons are performing arthroplasty procedures in the ambulatory surgery center (ASC). We proposed to compare a matched cohort of outpatient ASC UKA's with those performed in the inpatient hospital setting to evaluate episode-of-care complications. We also proposed to investigate our ASC UKA total facility charges.

Methods: Sixty-seven patients underwent UKA at a freestanding ASC. An age and co-morbidities-matched cohort included 48 patients undergoing UKA in the inpatient setting. Ninety day episode-of-care measures included complications, hospital (re)admissions, and reoperations. Total facility charges were evaluated for all ASC patients. Statistical differences ($p<0.05$) between the ASC and inpatient groups were determined by two-tailed t-tests.

Results: The ASC and hospital cohorts revealed no statistically significant differences with respect to age (58.8 vs. 59.4), sex, BMI (34.3 vs. 32.9), and preoperative ASA scores (1.94 vs. 2.08). Two minor complications were noted in the ASC group. No major complications were noted and no patients required hospital admission. In the hospital cohort there were four major complications: one deep venous thrombosis (DVT), one pulmonary embolus (PE), one acute postoperative infection, and one postoperative periprosthetic fracture. All four of the hospital cohort patients with complications required readmission, while two of the patients required reoperation. The average total charge for all ASC patients was $29,475.14.

Conclusion: These results demonstrate that outpatient UKA in the ASC is a safe and reasonable alternative to UKA in the traditional inpatient hospital setting. Additionally, the average total charge for UKA in the ASC compares favorably to reported inpatient UKA total charges. Despite our favorable short-term results, further investigation is required to address long-term safety and cost-effectiveness.

How do Demographic, Surgical, Patient, and Cultural Factors Affect Pain Control after Unicompartmental Knee Arthroplasty? A Multivariable Regression Analysis

John W. Barrington, MD, Scott Lovald, PhD, Kevin Ong, PhD, Heather Watson, PhD, Roger Emerson, MD

Introduction: Patient characteristics, such as age, gender, race, and ethnicity, may play a role in pain related outcomes after UKA. The purpose of this study was to examine the effect of patient and treatment characteristics on measured postoperative pain after UKA using standardized postoperative pain control protocols.

Methods: The study sample included 442 consecutive UKA cases performed between December 2011 and August 2013. The primary outcome measures were the average Visual Analog Scale (VAS) pain score and the percent of VAS pain scores during hospitalization that were 0, i.e., “no pain”. Multivariable regression analyses were implemented to investigate associations between patient demographics, or analgesic group and average pain scores. For the analgesic groups, the ”PAI” group received injections of a cocktail including Marcaine, ketorolac, and morphine, the ”LBUP” group received injections of liposomal bupivacaine as part of a multi-modal analgesic protocol.

Results: Postoperative pain was higher in females, younger patients, patients with a higher BMI, and those in the PAI group. The regression analysis demonstrated that average VAS pain scores were affected by patient age ($p<0.001$), gender ($p=0.003$), race ($p<0.001$), BMI ($p=0.020$), surgeon administering the treatment ($p=0.002$), and analgesic protocol ($p=0.007$). Ethnicity was not significant in the model ($p=0.474$). The patient group treated with liposomal bupivacaine injection technique had significantly lower average VAS pain scores by 0.33 if adjusted for all other factors in the model ($p=0.007$).

Conclusion: This multivariate regression analysis study showed that in patients undergoing UKA, postoperative pain was lower in males, older patients, patients with lower BMI, and those treated with liposomal bupivacaine. Awareness of these factors may assist in developing patient-specific multimodal postoperative pain and education protocols that reduce opioid reliance and related adverse events.

Adoption of Haptic Robotic Technology Improves Component Positioning in Medial Unicondylar Knee Replacement

Marcel A. Bas, MD, Eli Kamara, MD, Matthew S. Hepinstall, MD, Aruna M. Seneviratne, MD, Michael M. Alexiades, MD

Introduction: Robotic surgery aims to improve alignment in Unicondylar Knee Arthroplasty (UKA). We examined whether introduction of robotic technology improved alignment outcomes at our institution.

Methods: Retrospective review of medial UKA surgeries performed between 2007 and 2014 by 3 surgeons who switched from manual to robotic techniques in 2012. Lateral UKRs were excluded. Short limb pre and postoperative radiographs were reviewed. Radiographic measurements (AP tibiofemoral angle (TFA), femur AP, tibia AP, femur lateral, tibial slope) were performed by 2 independent observers. Mean alignment was compared using t-Tests. Variability of implant positioning was assessed using Levene's Test. Odds-Ratios was performed for risk of malpositioning for AP TFA, femur AP, tibia AP, and tibial slope.

Results: 45 manual and 103 robotic UKAs were identified. No significant difference in preoperative alignment was found. Significant differences in mean postoperative alignment for robotic vs manual was seen in femur AP [valgus 2.9° vs 5.1°; p=0.002], tibia AP [varus 2.1° vs 4.25°; p<0.001), and femur lateral (flexion 7° vs 2° p<0.001). No significant difference for mean AP TFA, tibial slope, or average limb deformity correction was seen. Odds Ratios showed a non-significant decrease in AP TFA overcorrection risk [OR: 0.48 (p=0.211); >6° valgus postoperatively], but significantly decreased risk of tibial coronal misalignment [OR: 0.41 (p=0.004); >3° valgus or varus] and decreased risk of excessive slope [OR: 0.31 (p=0.013) >7°]. Robotic UKA decreased variability of implant positioning for femur AP (p=0.001), tibia AP (p<0.001), femur lateral (p<0.001), and tibial slope (p=0.019).

Conclusion: Robotic UKA improved alignment precision for both femoral and tibial components in both the coronal and sagittal planes, resulting in fewer outliers for femur AP, tibia AP and tibia slope measurements.

Total Joint Replacement: A Granular Analysis of Outcomes in the Economically Disadvantaged Patient

Carlos J. Lavernia, MD, FACS, Michelle D'Apuzzo, MD,
Jesus M. Villa, MD, Jose C. Alcerro, MD

Introduction: It has been reported that poor patients experience more serious complications and use more resources after surgery than higher income patients. Our objective was to study detailed patient oriented outcomes in this cohort of patients in a low income population.

Methods: 3,298 consecutive Total Joint Replacement surgeries performed in 2,543 subjects by a single surgeon were prospectively studied. Demographic characteristics, Visual Analogue Scale, QWB-7, SF-36, WOMAC, Harris Hip, hip Postel D'Aubigne; HSS Knee Score; Knee Society Knee Score and Knee Society Function Score were recorded before and after surgery. A low income group was identified based on Medicaid eligibility. Socio-demographic data was compared. Preoperative and postoperative outcomes were compared controlling for baseline differences (MANCOVA). $p<0.05$ was considered significant.

Results: There was a significant difference between groups for most socio-demographic data. Mean age in the low income group (LIG) was 58.5 years vs. the high income group with 69.1 years ($p\leq0.001$). There were more African-American [LIG 20% vs. high income group 7.8% ($p\leq0.001$)], more single [LIG 21.6% vs. high income group 12.1% ($p\leq0.001$)], less college level educated [LIG 22.3% vs. high income group 43.7% ($p\leq0.001$)], more with disabled status, [LIG 51.3% vs. high income group 15.2% ($p\leq0.001$)]. Regarding outcomes, preoperatively, the LIG reported significantly worse scores for QWB-7, SF-36, and all WOMAC scores (all $p<0.05$). Postoperatively (mean follow-up 5.34 years), the differences remained significant for QWB-7, some SF-36 scores, and WOMAC stiffness (all $p<0.05$).

Conclusions: When compared to the higher income bracket, low income patients are mostly single, disabled, and have a higher proportion of African-Americans and Hispanics. Low income patients consistently had worse scores and lower quality of life before and after surgery.

Intra-operative Synovitis Predicts Worse 2 Year Outcomes after Total Knee Arthroplasty for Osteoarthritis

Shivi Duggal, BS, Kelly R. McHugh, BA, Xian Wu, MPH, Geoffrey H. Westrich, MD, Thomas P. Sculco, MD, Steven Goldring, MD, John A. Carrino, MD, Edward F. DiCarlo, MD, **Charles N. Cornell, MD,** Lisa A. Mandl, MD, MPH

Introduction: Total knee arthroplasty (TKA) is the most common elective orthopedic procedure in America. However, significant number of patients continue to have poor outcomes making it important to identify modifiable risk factors to optimize patients' outcomes. Therefore, we investigated the association between preoperative synovial inflammation and 2-year outcomes post-TKA for knee osteoarthritis (KOA).

Methods: 33 KOA patients with poor pain (WOMAC<60;100=best) 2-years post-TKA were identified from a single institution. All were <80 years old and underwent primary unilateral TKA by one of three surgeons. Patients were matched 2:1 on surgeon and surgery date with little pain at 2-years, (WOMAC>70), TKA cases. All patients provided pre-operative and 2-year-post-operative self-report/ demographic data (gender, age, ethnicity, education, WOMAC scores, SF-36, Euroqol.) Two blinded evaluators graded preoperative radiographs for varus/valgus (degrees) and Kellgren & Lawrence score(K&L;). Intra-operative synovial tissue slides were graded for degree of inflammation according to validated Krenn Criteria. Radiographs (13%) and pathology slides(6%) were read twice to assess intra-rater reliability. Surgeons' and inpatient charts provided prosthesis information, index knee's previous surgical history, incidence of post-operative steroid injection and manipulation. Univariate analyses and a multivariate linear regression were performed to evaluate whether pre-operative inflammation was an independent predictor of pain, function or stiffness 2-years post-TKA.

Results: In 99 patients evaluated, average age was 67(+/-7.9), 65% were women and 91% were white. In the multivariate linear regression controlling for multiple confounders, patients with high Krenn scores (>3) had more pain(WOMAC 65.01 vs 76.14;p-value=0.03) and worse function(WOMAC 70.2 vs. 81.1;p-value=0.01) 2-years post-TKA. Krenn score(KS) and 2-year WOMAC stiffness had no association(p-value=0.14). Also, patients injected with steroids post-TKA were more likely to have worse 2-year WOMAC pain(p-value=0.0495). Weighted Kappa for K&L;(evaluator 1=0.75;evaluator 2=0.5), and KS(0.42) indicated good intra-reliability. Pearson correlation coefficients indicated excellent intra-reliability for Varus(evaluator 1=0.90;evaluator 2=0.57)/Valgus (evaluator 1=0.98;evaluator 2=0.98). Inter-reliability analysis was fair for K&L;(Kappa=0.5) and excellent for Varus (kappa=0.85)/ Valgus (Kappa=0.94.)

Conclusion: Synovial inflammation at time of surgery predicts worse WOMAC pain and function 2-years post-TKA in osteoarthritic patients. This is a potentially modifiable risk factor which could be a target for future interventional trials.

How Do Previous Solid Organ Transplant Recipients Fareafter Primary Total Knee Arthroplasty?

Mitchell R. Klement, MD, Abiram Bala, BA,
Colin T. Penrose, BA, BS, Samuel S. Wellman, MD,
Michael P. Bolognesi, MD, Thorsten M. Seyler, MD, PhD

Introduction: Total knee arthroplasty (TKA) has been proven to increase knee outcome scores after solid organ transplantation (SOT) but many authors are concerned about a higher complication rate. The purpose of this study is to evaluate the complication profile of TKA after previous SOT and we hypothesize medical and surgical complications will be significantly increased.

Methods: A search of the entire Medicare database from 2005 to 2011 was performed using International Classification of Disease version 9 (ICD-9) codes to identify 3,339 patients who underwent TKA with one or more solid organ transplants including kidney (2,321), liver (772), lung (129), heart (412), and pancreas (167). A cohort of 1,685,295 patients who underwent elective primary TKA without prior SOT served as a control with minimum 2-year follow-up. Medical co-morbidities and post-operative complications at 30-day, 90-day, and overall time points were compared between the two cohorts.

Results: Patients with any SOT were younger (age <65, OR 6.58, $p < 0.001$), male (OR 1.88, $p < 0.001$), and medically complex (significant increase in 28/29 Elixhauser comorbidities, $p < 0.05$). There was a significant increase ($p < 0.05$) in 11/13 (84.6%) recorded post-operative medical complications rates at 90 days including acute renal failure (OR 5.52), sepsis (OR 3.97), postoperative anemia (OR 1.22), and blood transfusion rate (1.42). There was a significant increase overall in periprosthetic infection (OR 2.11, $p < 0.001$), periprosthetic fracture (OR 1.78, $p < 0.001$), and TKA revision (1.36, $p < 0.001$). When analyzed by individual organ, periprosthetic infection and need for revision were not significant in lung ($p = 0.395$, p=507) and pancreas ($p = 0.795$, $p = 0.94$) transplants.

Conclusion: The results of this study demonstrate that patients with previous SOT who undergo elective primary TKA have more co-morbidities and represent an at-risk population with higher post-operative complication rates. Yet, complication profiles by individual organ varied significantly.

What is the role of "Dual Diagnosis" in Primary Total Knee Arthroplasty?

Mitchell R. Klement, MD, Brian T. Nickel, MD,
Colin T. Penrose, BA, BS, Daniel J. Blizzard, MD, MS, Abiram Bala, BA,
Michael P. Bolognesi, MD, Thorsten M. Seyler, MD, PhD

Introduction: The co-occurrence of a mental illness and a substance abuse disorder (SUD) is common and has been referred to as "dual diagnosis." These disorders have been linked to decreased patient satisfaction. The purpose of this study is to evaluate "dual diagnosis" as a comorbidity and how it impacts clinical outcomes. We hypothesize these patients will have increased surgical complications after primary total knee arthroplasty (TKA).

Methods: A search of the entire Medicare database from 2005 to 2012 was performed using International Classification of Disease version 9 (ICD-9) codes to identify 392,350 patients who underwent TKA with one or more psychiatric disorders and sedatives (1,569), opiods (3,824), street drugs (1,908), alcohol (6,622), and smoking (52,138) abuse/dependence. A cohort of 1,066,479 patients who underwent elective primary TKA without "dual diagnosis" served as a control with minimum 2-year follow up. Medical co-morbidities and post-operative complications at 30-day, 90-day, 1-year, 2-years, and overall were compared between the two cohorts.

Results: Patients with "dual diagnosis" were more likely to be younger (age <65, $p < 0.001$), female ($p < 0.001$), and more medically complex (significant increase in Charlson Comorbidity Index, $p < 0.001$). There was a significant increase ($p < 0.05$) in 10/13 (76.9%) recorded post-operative medical complications rates at the 90-day time point including acute renal failure, pulmonary embolism, sepsis, respiratory failure, and heart failure. In addition, there was a statistically significant increase in periprosthetic infection ($p < 0.001$), periprosthetic fracture ($p < 0.001$), TKA revision ($p < 0.001$), patellar complications ($p < 0.001$), and extensor mechanism rupture ($p < 0.001$).

Conclusion: Patients with "dual diagnosis" who undergo elective primary TKA exhibit significantly increased medical and surgical complication rates in the global period and at short-term follow up. These patients must be carefully selected and need to be counseled accordingly regarding the increased complication rates before proceeding with TKA.

Outcomes after Total Knee Arthroplasty for Posttraumatic Arthritis

Abiram Bala, Colin T. Penrose, BA, BS, **T**
horsten M. Seyler, MD, PhD, Richard C. Mather III, MD, MBA,
Samuel S. Wellman, MD, Michael P. Bolognesi, MD

Introduction: Total Knee Arthroplasty (TKA) remains an important treatment modality for posttraumatic arthritis (PTA). Although outcomes after TKA for PTA have been studied, these have been with small cohorts at single institutions. The purpose of this study was to evaluate the impact of PTA versus primary osteoarthritis (OA) on postoperative outcomes after TKA in large cohorts of patients.

Methods: We retrospectively queried the entire Medicare database from 2005 to 2012. International Classification of Diseases, 9th revision (ICD-9) and Current Procedural Terminology (CPT) codes were used to identify the procedure, associated arthritis diagnoses, and postoperative complications. Patients with index TKA performed in 2005 to 2010 were selected to guarantee minimum 2-years follow-up. Odds ratios (OR), confidence intervals, and p-values were calculated. Demographics and comorbidities were collected.

Results: 3,509 patients had PTA as the indication for TKA. 257,611 patients with TKAs for primary OA served as control. The average Charlson Comorbidity Index for both groups was 5. PTA patients were younger, and had a higher prevalence of only 5/30 Elixhauser comorbidities. PTA patients had higher overall rates of periprosthetic infection (OR 1.69, $p < 0.001$), cellulitis/seroma (OR 1.20, $p < 0.001$), knee wound complications (OR 1.46, $p < 0.001$), TKA revision (OR 1.23, $p = 0.01$), and arthrotomy/I&D; (OR 1.55, $p < 0.001$). There were no statistically significant differences in blood transfusion rates, death, bleeding complications, prosthetic dislocation, broken prosthetic joints, periprosthetic fracture, osteolysis + polywear, vascular/neuro injury, and extensor mechanism rupture.

Conclusion: This study represents, to our knowledge, TKA outcomes in the largest cohort of PTA patients to date. Our findings indicate these patients are at higher risk for many, but not all, postoperative surgical complications despite being as healthy as patients receiving TKA for primary OA. Orthopaedic surgeons should be aware of the higher risk of these specific complications.

The Patient's Native Tibial Slope is the Ideal Target in Cruciate-retaining Total Knee Arthroplasty

Nicholas R. Arnold, BS, Marshall K. Ishmael, BS, Luke R. Lovro, BS, Mary Ziemba-Davis, BA, R. Michael Meneghini, MD

Introduction: Increased attention is being paid to component alignment in total knee arthroplasty (TKA). The majority of focus has been on the coronal plane and subsequently less is understood about TKA alignment in the sagittal plane, particularly with respect to tibial slope. The purpose of this study is to evaluate the effect of tibial component slope on patient outcomes after cruciate retaining TKA.

Methods: A retrospective review of 260 consecutive primary TKAs was performed. All procedures were performed with identical surgical technique, identical implants and similar perioperative protocols. All TKAs were a cruciate-retaining (CR) design. Digital radiographic evaluation was performed specifically measuring native tibial and the implanted tibial component slope. Clinical outcome measures (UCLA Score, new Knee Society Score) were obtained preoperatively, 4-weeks, 4-months and annually thereafter. Statistical analysis correlated tibial component slope with clinical outcomes and $p<0.05$ considered significant.

Results: The cohort consisted of 195 females (63.5%) and 95 males (36.5%) with a mean age of 65 and a mean BMI of 34. TKAs with tibial implant slope that more closely approximate native slope are associated with greater absolute KSS satisfaction and function scores ($p=0.002$, $p=0.001$) and greater improvement in KSS satisfaction and function scores ($p=0.014$, $p = 0.059$) compared to those that substantially deviate from native slope. Similarly, greater improvement in patient UCLA activity scores was positively correlated with a closer approximation of the native tibial slope ($r = 0.2$; $p = 0.04$).

Conclusion: Multiple patient-reported outcome measures were optimized with larger absolute scores and greater improvement from pre-operative values in patients whose tibial component more closely approximated their native proximal tibial inclination. Surgeons should target the native tibial slope in cruciate-retaining TKA to optimize patient function and outcomes.

Greater Medial Compartment Forces during TKA Associated with Improved Patient Satisfaction and Ability to Navigate Stairs Greater Medial Compartment Forces during TKA Associated with Improved Patient Satisfaction and Ability to Navigate Stairs

Cale A. Jacobs, PhD, Christian P. Christensen, MD

Introduction: The purpose of this study was to determine if patient satisfaction, subjective outcomes, and functional force testing differed between those with symmetric or asymmetric intraoperative mediolateral (ML) compressive forces. We hypothesized that a greater proportion of those with well-balanced TKAs would be satisfied.

Methods: To date, 50/65 TKAs have completed postoperative testing. At the conclusion of each case, a commercially-available instrumented trial tibial liner was used to measure compressive force differences between the medial and lateral compartments with the knee at 0°, 20°, and 90° of flexion. Patients then completed the Knee Society Score Function and Pain subcomponents, SANE, LEFS, EQ-5D, and patient satisfaction questionnaires, and also performed instrumented sit-to-stand and stair descent maneuvers. A ROC curve was used to determine if a threshold of ML force asymmetries was associated with a greater likelihood of satisfaction. Pre- and postoperative outcomes and functional force measures were compared between patients with ML force asymmetries above and below the calculated threshold using independent t-tests or ANOVAs as appropriate.

Results: Surprisingly, lower ML asymmetries in extension were associated with a greater risk of being dissatisfied. Of the 50 TKAs, 6/23 (26%) with ML force asymmetries < 10 lbf were dissatisfied with their procedures compared to 0/27 with ML asymmetries > 10 lbf (p=.01). Those with asymmetries > 10 lbf had significantly greater gains in EQ-5D scores (p=.05) and Pain Scores (p=.03), and greater pain relief when navigating stairs (p=.006). Those with asymmetries > 10 lbf also had significantly superior impact forces when descending stairs (p=.05).

Conclusion: Recreating greater forces in the medial compartment like that of the native knee may yield improved patient-reported outcomes and increased patient satisfaction. The current results further suggest that recreating greater medial compartment forces may have the greatest affect on high flexion activities such as navigating stairs.

Are We Putting too Much Pressure on our Total Knee Arthroplasties?

Michael A. Mont, MD, Jeffrey J. Cherian, DO, Randa K. Elmallah, MD, Anil Bhave PT

Introduction: Post-TKA dissatisfaction occurs in 20% of patients, and soft-tissue balancing plays a role. Balancing techniques are based on surgeon subjective judgment. Newer technologies have allowed evidence-based decisions for intra-operative soft-tissue balancing throughout knee ROM. We evaluated the compartment pressures at static positions and throughout ROM, number of soft tissue releases, and rotation with the use of sensor technology versus the 30-year surgeon experience.

Methods: We compared a prospective pilot series of patients receiving sensor-guided TKAs for soft-tissue balance to standard gap-balancing techniques. Each cohort had similar mean ages (64 versus 66 years) and BMI's (32 versus 34 kg/m2). Before cementing final implants, sensor tibial insert trials were utilized with the gap-balancing cohort with the surgeon blinded to data. In the sensor cohort, the surgeon was unblinded, and performed ligamentous releases to balance compartments throughout the ROM based on sensor data. Pressure measurements were taken in both compartments at 10, 45, and 90°.

Results: The sensor cohort, after soft-tissue balancing, demonstrated lower medial compartment loading at 10 (22.8 vs. 79.3 lb; p=0.0108), 45 (23.1 vs. 77.2 lbs; p=0.0035), and 90°(20.4 vs. 55.4 lbs; p=0.0326). The sensor cohort demonstrated lower lateral compartment loading at 10 (17.2 vs. 27.6 lbs; p=0.39), 45 (13.3 vs. 31.3 lbs; p=0.15) and 90° (16.1 vs. 28.4 lbs; p=0.21). The sensor cohort had lower pressures (8.1 versus 63.2 lbs; p=0.0018) between medial and lateral compartments throughout ROM. There were a mean of 2 soft-tissue releases in the sensor cohort that were not performed in the gap-balanced knees. In the gapped-balanced cohort, the tibial tray was positioned at a mean of 9° of external rotation, whereas, the sensor guided cohort had 6 knee place in internal rotation at a mean of 3° and 4 knees in external rotation at a mean 3°.

Conclusion: Patients with gap balancing may result in uneven pressures, potentially leading to dissatisfaction. Sensor-balanced TKAs provide objective feedback to perform appropriate releases to improve knee balancing and rotational alignment.

Participation in Non-recommended Sports after Total Knee Did Not Affect Long-term Durability

Matthew P. Abdel, MD, Mitchell R. Obey, BS,
Sebastien Parrattee, MD, PhD, Diane L. Dahm, MD,
Michael J. Stuart, MD, Daniel J. Berry, MD, Mark W. Pagnano, MD

Introduction: Recent studies report some sports participation after TKA is not uncommon, but the long-term effect on prosthesis durability of non-recommended sports (according to the Knee Society [KS] definition) is unknown. This study compared TKA mechanical failure rates in patients involved in non-recommended sports with matched patients involved in moderate activities.

Methods: From 1630 primary contemporary posterior-stabilized (PS) TKAs of one design, 178 patients were identified by self-completed questionnaire as participating in non-recommended sports. This sport group was matched by age, gender, BMI, and surgical year to patients not practicing in non-recommended sports (i.e. the control group). The sports group was 79% male with a mean age of 66 years and a mean BMI of 30 kg/m2. The control group included 337 patients (79% males, mean age of 68 years, mean BMI 30 kg/m2). Clinical and radiologic evaluation was performed using KS clinical and roentgenographic scores, and multivariable analysis was performed using a Cox model. Median follow-up was 14 years.

Results: At most recent follow-up, the median KS Knee scores were similar between the sport and control groups (96 vs. 95, respectively; p=0.46). However, the median KS function score was significantly better in the sport group (90 vs. 80, respectively; p<0.001). The revision rate for mechanical failure (i.e. aseptic loosening or wear) at 10 years was significantly lower in the sport group compared to the control group (8% vs. 24%, respectively; HR=0.60; p=0.003). In the multivariable model, the sport group did not have an increased risk of mechanical failure compared to the control group (HR = 0.67; p=0.02).

Conclusion: At a median of 14 years, patients participating in non-recommended sports had a significantly higher median KS function scores and substantially lower revision rates for mechanical failure. Further investigation is needed into the etiology of this interesting survivorship difference.

Rapid Discharge vs. Traditional Pathways after Knee Replacement: Clinical and Patient Reported Outcomes

Craig M. McAllister, MD, Ira H. Kirschenbaum, MD,
Jeff D. Stepanian, PA-C, Geoff G. Burks, BS

Introduction: Rapid discharge after knee replacement offers significant improvements. These improvements must be balanced against safety concerns. This study compares the outcomes of a traditional care pathway versus a rapid discharge pathway after knee replacement.

Methods: 169 total knee arthroplasties were performed. 89 knees were done using traditional methods. All patients attended a standardized joint camp and were admitted to the hospital. They followed a 3 day pathway with PT, social services, labs, and other services. Pain management included parenteral narcotics, oral narcotics, and NSAIDs.Eighty (80) knees were using rapid discharge methods. Patients attended a novel "swiftpath" joint camp. Patient selection scores were used to assign patients to a hospital admission (n=20), 23 hour stay (n=18) or same-day discharge (n=42). MIS-navigated surgical methods, periarticular injections and multimodal pain management were utilized. A cyber-secure patient reported outcome system was used to report daily pain, weekly rehabilitation, and patient satisfaction.

Results: The average LOS was shorter for the rapid discharge patients (3.8 versus 0.46 days, $p > 0.05$). Rapid discharge patients had less pain, better early range of motion ($p<0.05$), and a lower manipulation rate ($p <0.5$). The traditional group required more narcotics and reported a higher VAS (3.8 vs 2.5, $p <0.05$). There was no difference peri-operative complications or readmissions. Patient satisfaction was 8.0 for pain control and 9.8 for being likely to refer a family member. 93% of patients felt that their knee replacement met their expectations by 12 weeks.

Conclusion: A significant proportion of patients having knee replacement do not require hospital admission. Patients can be safely and predictably discharged early after knee replacement are as likely to be happy with their pain control and functional result as patients who are admitted.

Readmission and Complication Rates among Parkinson Patients Undergoing a Primary Total Knee Arthroplasty

Mostafa H. El Dafrawy, MD, Louis Okafor, MD,
Clayton Alexander, MD, Zan Naseer, BS,
Karthikeyan Ponnusamy, MD, MS, Robert Skolasky, MD,
Richard Skolasky, Sc.D, Paul Khanuja, MD

Introduction: Total knee arthroplasty (TKA) rates are increasing with more patients with Parkinson's disease under consideration for surgery. We hypothesized that muscular dysfunction would increase readmissions and complications.

Methods: We conducted a retrospective cohort study of the 100% 2008 Medicare Provider Analysis and Review database, and identified primary TKA patients by ICD9 codes and excluded fractures/ER admissions to select for elective cases. Patients with Parkinson's (2,549 patients) were compared to a control group without Parkinson's (337,164 patients). Descriptive statistics of demographics, readmissions (up to 60 days), complications at 30 days, mortality (up to 2 years), and revision at 2 years were calculated. Multivariate logistic regression models were constructed to assess the association of Parkinson's with 60-day readmissions and 2-year mortality and revisions.

Results: Parkinson's patients undergoing a TKA are older (74.3 yrs vs. 72.7 yrs, $p=0.0011$). Parkinson's patients have longer (3.7 vs. 3.5 days, $p<0.0001$) and costlier ($44,059 vs. $42,824, $p=0.0062$) hospitalizations. Mortality rates were not significantly different for Parkinson's patients at earlier time points but was higher at 2-years (2.9% vs. 1.4%, $p<0.0001$). Parkinson's patients had greater overall complication rates at 30-days (2.1% vs. 1.4% $p=0.0033$) and readmissions at 60-days (12.0% vs. 8.3%, $p<0.0001$). They had no significant difference in 2-year revision rates (2.8% vs. 2.4% $p=0.2368$). Parkinson's status is the third most important independent risk factor for 60-day readmission (OR: 1.5, 95% CI: 1.3 to 1.7) after congestive heart failure and diabetes with complications. It was the fourth most important factor for 2-year mortality (OR: 1.9, 95% CI: 1.5 to 2.4), but not a risk factor for 2-year revision (OR: 1.3, 95% CI: 1.0 to 1.6).

Conclusion: Primary TKA patients with Parkinson's are at greater risk for complications and readmissions in the first couple months after discharge and should be followed closely after discharge to avoid these issues.

Rapid Discharge after Total Knee Arthroplasty is Safe in the Medicare Population

Gregory G. Klingenstein, MD, Manny D. Porat, MD, Rajesh K. Jain, MD, Jeremy J. Reid, MD, Robert Post, MD, Scott D. Schoifet, MD

Introduction: Early discharge after total joint arthroplasty has started to gain acceptance in select academic centers. The purpose of this study was to compare the risk of readmission of Medicare patients discharged one day after total knee arthroplasty (TKA), versus those discharged two or three days after surgery. Our hypothesis was that patients with length of stay (LOS) of one day would not have a higher risk of readmission in a community setting.

Methods: A hospital impatient database was queried for all unilateral, primary total knee replacements performed on patients 65 years or older from January 1, 2013 to December 31, 2014. 1117 patients discharged the day after TKA (reduced LOS) were compared with 947 patients discharged POD #2 or 3 (traditional LOS). All cases were performed at a community-based joint replacement center with rapid recovery protocols. Discharge timing and disposition were based on established functional benchmarks judged by physical therapy. The main outcome measure was all-cause 30-day readmissions. Multivariate logistic regression was used to calculate odds ratio for all cause 30-day readmission for reduced versus traditional LOS while controlling for age, gender, race, diabetes mellitus, ASA score (less than 3 versus 3 or greater), discharge disposition (home versus rehab).

Results: The 30 day readmission rate for the reduced LOS group was 1.2%, as compared to 3.4% readmission rate for the traditional LOS group (p=.001). In the regression model, the traditional LOS group had an increased risk of readmission (odds ratio 2.10, 95% CI 1.02-4.35, p=0.045) when controlling for confounding factors.

Conclusion: Medicare patients can be discharged safely the day after total knee arthroplasty with no increased risk of 30-day readmission in a community medical center.

Long-term Survival of the All-poly Tibia in a Community Based Implant Registry

Thomas K. Comfort, MD, Terence J. Gioe, MD, Susan C. Mehle, BS

Introduction: The continuing increase in rates of TKA in the USA and economic burdens of revision-TKA have made the revision-free performance of various TKA designs more important. We followed the performance of both metal-backed tibial (MBT) and all-poly tibial component (APT) designs over a 22 year period.

Methods: Between 9/1/1991 and 5/31/2014, 1126 TKAs utilizing an APT component were implanted by 15 surgeons in four hospitals associated with our community registry and 12,923 TKAs MBT were implanted by 67 surgeons. The mean age was 76 in APT and 66 in MBT. In APT, 70.4% were female vs. 63.7 % in the MBT group. Patients included in the study had a primary diagnosis of OA and bilateral surgeries were excluded.

Results: Eighty-nine revisions were performed; eleven of those in APT. Kaplan-Meier survival analysis revealed 2.3% cumulative revision in APT and 5.4% cumulative revision at 22.7 years. Cox regression shows APT has a 51.9% decrease in the risk of revision after adjustment for other explanatory variables (p=0.019).

Conclusion: This review of our results with TKA designs featuring APT vs. MBT demonstrated superior revision-free performance at both intermediate and long-term follow-up in our community based joint registry. We had previously demonstrated superior performance at intermediate term follow-up (1). These results were additionally demonstrated at lower age groups where “high demand” had been addressed with higher cost implants with no increase in revision rate for mechanical instability or loosening in the APT group. Economic burdens are also addressed through lower initial implant cost and lower revision rates in all age groups. We feel this evaluation supports the increased use of APT in all age groups. REFERENCES1 Gioe TJ, Sinner P, Mehle S, Ma W, Killeen KK. Excellent survival of all-polyethylene tibial components in a community joint registry. Clin Orthop Relat Res. 2007 Nov;464:88-92.

Oxidized Zirconium vs. CoCr in Total Knee Arthroplasty: 3D Laser Scanning of Retrieved Polyethylene Inlays

Forrest L. Anderson, BA, Chelsea N. Koch, Marcella E. Elpers, Timothy M. Wright, PhD, Steven S. Haas, MD, Thomas J. Heyse, MD

Introduction: Total knee arthroplasty (TKA) traditionally consists of cobalt-chromium alloy (CoCr) femoral components articulating with polyethylene (PE) tibial inserts. Oxidized zirconium (OxZr) was introduced as an alternative femoral bearing surface with the intent of reducing PE wear. This study investigates via matched comparison of retrieved PE inlays, if OxZr femoral components cause less PE volume loss as compared with conventional CoCr femoral components.

Methods: Twenty retrieved PE inserts that articulated with OxZr femoral components were identified and matched with retrieved CoCr articulations for age at index TKA, body mass index, length of implantation, and revision diagnosis. Dimensional deviations to the articular surfaces of the retrieved inserts were estimated by direct comparison to pristine inserts of the same size and design using a desktop 3D laser scanner to be merged into solid polygon models. The volume difference between retrieved and pristine articular surfaces was calculated and differences analyzed using the Mann-Whitney-U-test.

Results: The overall PE volumetric deviation was 121.7 ± 87.4 mm3 in the OxZr group and 170.1 ± 95.5 mm3 in the CoCr group ($p = 0.033$). Volumetric deviation in the OxZr group was also lower when analyzing medial (72.5 ± 66.7 mm3 vs. 92.3 ± 59.8 mm3) and lateral (49.2 ± 35.7 mm3 vs. 78.7 ± 60.7 mm3) compartments separately in comparison with the CoCr group but differences failed statistical significance.

Conclusion: The results corroborate earlier findings originating mainly from in vitro testing and visual retrieval analysis as PE volume loss was lower with OxZr femoral components in paired comparison with CoCr conventional femoral components. Since both OxZr and CoCr constitute hard surfaces that would be expected to creep and deform into the PE equally, the differences in volume loss may indeed reflect differences in the in vivo wear experienced by these inserts. Summary Sentence: The use of OxZr femoral components in TKA leads to less PE volumetric deviation in comparison with conventional CoCr components.

Psychiatric Disorders Increase Complication Rate after Primary Total Knee Arthroplasty

Mitchell R. Klement, MD, Brian T. Nickel, MD,
Colin T. Penrose, BA, BS, Abiram Bala, BA, Samuel S. Wellman, MD,
Michael P. Bolognesi, MD, Thorsten M. Seyler, MD, PhD

Introduction: Psychiatric disease is difficult to screen preoperatively and the incidence of mental health disorders in patients undergoing total knee arthroplasty (TKA) may be as high as 16%. The purpose of this study is to evaluate the postoperative complication profile in patients with psychiatric disorders and we hypothesize they will be significantly increased compared to control.

Methods: A search of the entire Medicare database from 2005 to 2011 was performed using International Classification of Disease version 9 (ICD-9) codes to identify 196,840 patients who underwent TKA with psychiatric disorders including bipolar disorder (20,972), depression (187,448), and schizophrenia (7,607) without substance abuse disorders (SUD). A cohort of 1,271,464 patients without psychiatric disorders or SUD served as a control with minimum 2.5-year follow-up. Medical comorbidities and post-operative complications at 30-day, 90-day, and overall were compared between the two cohorts.

Results: Patients with any psychiatric disease were more likely to be younger (age <65 OR 5.5, $p < 0.001$), female (OR 2.61, $p < 0.001$), and more medically complex (significant increase in 28/28 Elixhauser medical comorbidities, $p < 0.05$). There was a significant increase ($p < 0.001$) in 11/14 (78.5%) recorded post-operative medical complications rates at 90-days including suicide (OR 72.38), DVT (OR 1.28), PE (OR 1.31), acute renal failure (OR 1.57), and need for blood transfusion (OR 1.17). There was a statistically significant increase in periprosthetic infection (OR 2.17 $p < 0.001$), periprosthetic fracture (OR 2.40, $p < 0.001$), revision (OR 2.06, $p < 0.001$), and extensor mechanism rupture (OR 2.41, $p < 0.001$) at 90 day and overall time points.

Conclusion: Patients with psychiatric disorders have significantly increased medical and surgical complication rates in the global period and short term follow up after TKA. An ideal screening tool is yet to be determined and these patients need to be counseled appropriately regarding the increased complication rates before proceeding with TKA.

Effectiveness of Embedded Case Management in the Utilization of Post-acute Care Service during Care Transitions

Michael Burns, MD, **Coles L'Hommedieu, MD,** John Tessier, MD,
Jerry Rupp, PhD, Jim Gera, MBA

Introduction: Our objective was to compare post-acute care utilization and cost associated with a defined episode of care for Medicare patients in the Bundled Payment Care Improvement, utilizing embedded case management during the transition of care.

Methods: Comparative Descriptive Setting: Subjects from Medicare Bundled Payment for Care Improvement episode claims data. Participants: 128 Medicare fee-for-service (FFS) patients from CY 2013 without embedded case management and 140 Medicare FFS patients from CY 2014 utilizing embedded case management services during the post-acute continuum of care. Outcome Measures: Elective hip and knee arthroplasty post-acute care costs; utilization rates (frequency and length of time) for inpatient rehabilitation facility, skilled nursing facility, home health/physical therapy and readmission.

Results: Embedded Case Management resulted in noticeable differences in post-acute care service utilization, cost and readmission rates between embedded (CY 2014) and non-embedded (CY 2013). The average episode cost ($20,575.00 in 2013 and $19,521.47 in 2014), post-acute utilization of Acute Rehab (incident rate 2.3% in 2013, 0.7% in 2014 and length of services 13.3% in 2013 and 11.0% in 2014), skilled nursing facility utilization (incident rate of 20.3% in 2013 and 12.1% in 2014), and readmission (incident rate of 9.4% in 2013 and 7.9% in 2014) support the effectiveness of embedded case management during the transitions of care. Average length of services for skilled nursing facilities (18.2 days in 2013 and 24.6 in 2014) and Home Health Care (incidence rate of 96.1%, LOS 21.9 days in 2013 and incidence rate of 94.3, LOS 22.6 in 2014) were not impacted by case management services.

Conclusion: Embedded Case Management resulted in a decreased incidence of post-acute facility admissions, decrease readmissions, and reduction of the average cost of episode. Length of services provided in a skilled nursing facility once admission occurred and Home Health Care incidence and length of services were not impacted by case management services supporting the need for network and treatment protocol development in the post-acute phase.

Prospective Trial of Liposomal Bupivicaine Periarticular Anesthetic Injection Compared to Femoral Nerve Block in TKR

Carl T. Talmo, MD, Mohammed Hassan, MD, Suzanne Kent, Amanda Fredette, BA, Daniel Ward, MD, James Bono, MD, Gary Schneider, MD, David Mattingly, MD

Introduction: Femoral nerve block provides excellent pain relief following TKR, however, risks associated with motor blockade include weakness, delayed participation in therapy and nerve injury. Liposomal bupivacaine is a potentially longer acting depot preparation of anesthetic that may last up to 72 hours when used in peiarticular injection during TKR.

Methods: We performed a prospective, randomized, blinded study comparing periarticular injection with liposomal bupivacaine to femoral nerve block in TKR. 300 patients were randomized to receive either an ultrasound-guided femoral nerve block combined with intraoperative posterior capsular injection of 0.25% bupivacaine (control group) or a circumferential periarticular injection with liposomal bupivicaine (266mg) and 0.25% bupivacaine along with a placebo (saline) femoral nerve block (study group). Patients were evaluated with visual analogue scores (VAS) for pain, ROM, ability to perform straight leg raise, and walking distance, preoperatively, 12, 24, 36 and 48 hours postoperatively and 6 weeks and 3 months postoperatively. Knee society scores and SF-12 scores were also recorded preoperatively, at 6 weeks and 3 months after TKR.

Results: At 12 hours postoperatively, there were significantly lower VAS pain scores in the femoral nerve block group (mean 3.24 versus 3.87; $p<0.02$), and ROM was higher in the femoral nerve group (84.54 degrees versus 78 degrees; $p<0.001$). The patients receiving periarticular injection were more likely to perform a straight leg raise 12 hours after the surgery 73% versus 50% ($p<0.0003$). These differences remained statistically significant at 24 hours for VAS (4.16 versus 4.73) and ROM (87.35 and 81.98), but not for straight leg raise. At 36 and 48 hours, there were no differences between the groups for any of the study variables. At the 6 weeks and 3 months after TKR, there were no differences.

Conclusion: While femoral nerve block provided slightly better pain scores in the first 24 hours after TKR, use of liposomal bupivacaine periarticular injection is a reasonable alternative which avoids the additional weakness and other risks associated with femoral nerve block procedures.

Is There a Benefit for Liposomal Bupivacaine Compared to a Traditional Peri-articular Injection in TKA Patients with a History of Chronic Opioid Use

Ran Schwarzkopf, MD, MSc, Khanh-Van Le, BS,
Joseph Rinehart, MD, Vanessa Schultz, BS

Introduction: Modern multi-modal pain control protocols for total knee arthroplasty (TKA) patients have become commonplace among arthroplasty services around the country. Appropriate post-surgical pain management facilitates recovery and increases patients' satisfaction. The aim of this study was to compare liposomal bupivacaine (LB) to a traditional peri-articular injection (PAI) as part of a multi-modal pain control protocol for TKA for patients with a history of chronic opioid usage.

Methods: 38 patients undergoing primary TKA with a history of chronic opioid use were randomized to receive either (1) liposomal bupivacaine (20cc LB, 60cc saline, and 20cc 0.25% Marcaine) or, (2) our standard PAI (49.25cc 0.5% Ropivacaine, 0.8cc 100mg/ml Clonidine, 1cc 30mg/ml Toradol, 0.5cc 1mg/ml Epinepherine, and 48cc saline). Chronic opioid use was determined if patients consumed 30mg of morphine equivalent dose a day in the past 3 months prior to surgery. Patients were treated with the same multi-modal pain management protocol. Visual analog scale (VAS) scores were recorded every day, as well as time to first opioid use.

Results: There was a statistically significant difference between the groups in time to first opioid use in the recovery room ($p=0.047$) with the LB group being shorter. In POD 1 there were significantly higher VAS scores in the LB group ($p=0.03$), but no significant difference was found in reported VAS scores between the two groups on POD 2 and 3.

Conclusion: In order to optimize pain control among TKA patients with a history of chronic opioid usage, we sought to compare if LP will provide superior pain control compared to a traditional PAI as part of a multi-modal pain control protocol. LB PAI provided inferior pain control during the immediate post-operative period in the recovery room and POD-1 but had equivocal pain control results during POD 2, and 3 after TKA compared to a traditional PAI. Cost and ease of preparation should come into consideration when deciding which PAI to use as part of a multi-modal pain control protocol.

Comparing Pain Relief between Exparel® Injection vs. On-Q Catheter as the Postsurgical Analgesia following Total Knee Arthroplasty (TKA): A Double Blinded, Randomized Controlled Trial

Eric B. Smith, MD, Greg Kazarian, BA, Hind Sawan, BS, Joanne Y. Lee, BS, Mitchell G. Maltenfort, PhD, Jess H. Lonner, MD, Robert Good, MD, Peter F. Sharkey, MD

Introduction: A prospective, randomized double-blind study was conducted to compare peri-articular injections and intra-articular infusion as the postoperative analegesia following TKA.

Methods: Patients were randomized into two groups: one group received an intra-articular pain pump infusing bupivacaine via a continuous pump (PUMP), and the second received peri-articular liposomal bupivacaine injections with an inactivated pain pump filled with saline (INJ). Pain relief (current, minimum, maximum), in-hospital narcotic usage, complications, ambulatory function, as well as patient satisfaction were recorded on postoperative days 0 through 7, and at 2 and 6 weeks. A linear mixed model was used to analyze the longitudinal effects of age, BMI, and randomization on pain and narcotic use. 150 patients were enrolled and randomized to the 2 groups.

Results: The PUMP group showed comparatively better or equivalent levels of current, minimal, and maximal pain on a 1-10 visual analog scale (VAS) on all postoperative days. These differences were statistically significant in the analyses of minimal and maximal pain. There was no statistically significant difference in narcotic consumption between groups on postoperative days 0-3. There were no differences between groups with regard to the use of ambulatory assistive devices. No differences were found in overall satisfaction. There were no PUMP related complications during the study period. In this study, the cost of the PUMP was $225 per patient. For the INJ group, the cost per patient was $310.As compared to the INJ group, the PUMP group showed better pain relief from a statistical standpoint. However, the 0.5 point VAS pain difference in favor of the PUMP group did not have a clinical impact. All other measures showed statistical equivalence.

Conclusion: The choice of intra-articular infusion versus peri-articular injections should not be made based on efficacy, but rather on other factors, such as cost and convenience.

Liposomal Bupivacaine vs. Femoral Nerve Block for Pain Control in Total Knee Arthroplasty

Stephen Yu, MD, Alessandra Szulc MA, Sharon Walton, MD, Joseph Bosco, MD, Richard Iorio, MD

Introduction: Perioperative pain management following total knee arthroplasty (TKA) is under increased scrutiny. Although pain management affects rehabilitation, length of stay and functional outcome, an optimized pain management protocol has yet to be standardized. Femoral nerve blocks (FNB) are commonly used as an adjunct to TKA pain management strategies; however, reliance on techniques that affect motor function can negatively affect patient outcome by delaying rehabilitation and introducing fall risk. Liposomal Bupivacaine (LB) has been recently introduced as a long-acting analgesic agent that is administered intraoperatively, providing analgesic properties for up to 72 hours postoperatively without affecting motor function.

Methods: We compared functional and pain management outcomes in 583 primary TKA patients, who received a FNB as an adjunct to the standard TKA pain management protocol, to 527 primary TKA patients, who received an intra-operative injection of LB and did not receive FNB. All other pain management parameters were identical.

Results: Pain scores were statistically similar for the majority of time points measured, however LB patients demonstrated a significant decrease in total narcotic use ($p=0.004$), specifically within the first 48–72 hours ($p<0.001$) of in-patient hospitalization. Physical therapy milestones were significantly achieved to both a faster and a greater degree ($p<0.001$), along with a significant reduction in fall rate ($p=0.03$) in the LB-administered cohort. Anesthesia operating room time was significantly increased for the FNB cohort ($p<0.001$), while operation time was statistically similar ($p=0.735$). In the LB cohort, length of stay decreased by 0.26 days ($p<0.001$), discharge disposition to home significantly improved, ($p=0.032$) and re-admission rates were lower ($p=0.041$). Direct costs were not statistically different for the two cohorts ($p=0.486$).

Conclusion: Liposomal Bupivacaine is a valuable adjunct to our TKA pain management protocol, as we strive to achieve improved patient outcomes, reductions in length of stay and enhanced quality of TKA care.

Postoperative Pain Management after Primary Knee Arthroplasty: The Value of Liposomal Bupivacaine

Scott M. Sporer, MD, Thea J. Rogers, MPH

Introduction: Numerous multimodal pain protocols have been drafted to improve long-acting postoperative analgesia. The purpose of this study was to compare the post-operative pain scores, time to ambulation and overall narcotic usage between patients who received either a femoral nerve block utilizing bupivacaine versus a periarticular extended-release liposomal bupivacaine injection in patients undergoing primary total knee arthroplasty (TKA).

Methods: 597 primary TKAs performed between September 2012 and August 2014 were retrospectively reviewed. Preoperatively all patients received celecoxib, oxycontin, and topical scopolamine. Intraoperatively, patients either received a single dose bupivacaine femoral nerve block along with 30 ml 0.25% Marcaine periarticular injection (Group A) or 60 ml periarticular injection alone (20 ml liposomal bupivacaine, 30 ml 0.25% Marcaine, 10 ml saline) (Group B). Postoperatively, all patients received celocoxib, oxycodone and were provided narcotics as needed. All patients received the identical preoperative and postoperative scheduled analgesia among both groups. The postoperative pain scores, narcotic usage and time to ambulation were collected from the electronic medical record.

Results: 325 patients were in Group A, while 272 were in Group B. There was no difference in sex, race or BMI between groups. Group B demonstrated a decreased need for breakthrough pain medication (16.9% vs. 36.3% $p<0.001$), decreased pain scores 12 hours postoperatively (3.2 vs. 3.6 $p=0.003$) and an earlier time to ambulation ($p= 0.017$). No difference in hospital length of stay or pain score at 24 hours postoperatively were seen.

Conclusion: Liposomal bupivacaine resulted in a decreased need for breakthrough pain medication, improved pain scores at 12 hours postoperatively and an earlier time to ambulation compared to a combined femoral nerve block and periarticular Maracine injection. Liposomal bupivacaine should be considered as one modality to improve postoperative analgesia following primary total knee arthroplasty.

Adductor Canal Blockade for Total Knee Arthroplasty: A Randomized, Double Blind Placebo Controlled Trial

David W. Manning, MD, Mark C. Kendall, MD,
Robert G. Dekker II, MD, Matthew D. Beal, MD,
Antoun M. Nader, MD

Introduction: The adductor canal contains sensory nerves distal to femoral nerve motor branching and blockade in TKA has been described. However, randomized control trials evaluating the opioid sparing benefits and effect on hospital length of stay following TKA are lacking. This study was designed to assess outcomes following adductor canal block compared to a sham after TKA.

Methods: Following IRB approval, written informed consent was obtained by patients (>18 y/o) undergoing elective TKA under spinal anesthesia. All patients received intraoperative local infiltration analgesia. Subjects were randomized into Group 1 (USG-adductor canal blockade with 10 mL 25% bupivacaine) or Group 2 (USG-sham blockade with 10 mL normal saline). Blocks were placed pre-operatively. Patients received scheduled and prn oral and IV analgesia for breakthrough pain. Research personnel blinded to group allocation recorded pain scores and opioid consumption every six hours until discharge. Pain burden defined as the area under the numeric score for pain for the first 48 hours was calculated using the trapezoidal method. Morphine equivalents were compared between groups using the Kruskal–Wallis test.

Results: 33 (24 F/9 M) subjects were studied. Area under the curve pain scores at rest were decreased in group I (106 score·h ±74 score·h) compared to group 2 (163 score·h ±67score·h, P=0.03). Postoperative opioid consumption was reduced in group I 202 mEq (172-250) vs 260 mEq (175-360, P=0.15. There was no difference in length of stay (Group 1 2 (2 to 3), Group 2 2 (2 to 3), P=0.26). There were no adverse events and no in-hospital falls.

Conclusions: Adductor canal blockade reduces pain and opioid requirement after TKA. However, adductor canal blockade did not appear to reduce analgesic requirements or shorten hospital stay. Adductor canal blockade is a safe and effective pain management adjunct for patients undergoing TKA.

Peri-articular Morphine Injection in Total Knee Arthroplasty

Kentaro Iwakiri, MD, PhD, Akio Kobayashi, MD, PhD

Introduction: Peri-articular local anesthetic injections reduce postoperative pain in total knee arthroplasty (TKA) patients and assist recovery. It is inconclusive whether the intraoperative injection of peri-articular morphine is beneficial and morphine often causes nausea, an adverse effect. The aim of this study was to determine if the addition of high-dose or low-dose morphine to peri-articular injections improves postoperative pain, range of motion (ROM), swelling, and the prevalence of nausea.

Methods: A prospective double-blinded controlled trial was undertaken to assess the efficacy of adding morphine to intraoperative, peri-articular local anesthesia in TKA. Ninety six patients were divided into 3 groups. The control group (n = 43) received an intraoperative, peri-articular injection of a local anesthetic (ropivacaine), epinephrine, ketoprofen and methylpredonisolone sodium without morphine. In addition, the low-dose morphine group (n = 27) received 0.1 mg/kg of morphine and the high-dose morphine group (n = 26) received 10 mg of morphine. Primary outcome measures included the visual analog pain score (VAS), ROM, nausea numerical rating scale (NRS), the number of patients with vomiting, the total dose of antiemetic drug, and thigh swelling. Secondary outcomes were evaluated using the WOMAC and adverse outcomes.

Results: There was a statistically significant difference between the 3 groups only in the nausea NRS 3 to 24 hours postoperatively ($p<0.05$). There were no statistically significant differences in the other primary and secondary outcome measures between the 3 groups.

Conclusion: The opioids of multimodal peri-articular injections in TKA often lead to nausea as an adverse effect, reported in 25–56% of cases. Our study used 2 different doses of morphine and showed a significant difference only in the nausea NRS postoperatively. Nausea, the most frequent adverse effect of morphine, could be managed by eliminating-morphine in the multimodal peri-articular injection, without loss of pain relief efficacy.

The Role of Gender, Age, Race, and Ethnicity on Postoperative Pain after Primary Total Knee Arthroplasty

John Barrington, MD, Scott Lovald, PhD, Kevin Ong, PhD, Heather Watson, PhD, Roger Emerson, MD

Introduction: Despite the success of large joint arthroplasty, pain control after total joint arthroplasty can be severe and difficult to manage. Patient characteristics, such as age, gender, race, and ethnicity, may play a role in pain related outcomes after total knee arthroplasty (TKA). The purpose of this study was to examine the effect of patient and treatment characteristics on measured postoperative pain after TKA using standardized postoperative pain control protocols.

Methods: The study sample included 665 consecutive TKA cases performed between December 2011 and August 2013. The primary outcome measures were the average Visual Analog Scale (VAS) pain score and the percent of VAS pain scores during hospitalization that were 0, i.e., "no pain". Multivariable regression analyses were implemented to investigate associations between patient demographics and average pain scores. Variables in the regression analysis included race, ethnicity, BMI, gender, LOS, surgeon and patient age at surgery. Cases were performed using well-established multi-modal analgesia with periarticular standard and liposomal bupivacaine injection.

Results: Postoperative pain was higher in females ($p<0.001$), younger patients ($p<0.001$), and patients with a longer hospital stay ($p<0.001$). Race, ethnicity, and patient BMI were not significantly associated with postoperative pain ($p>0.205$). Surgeon 1 ($n=310$) had the lowest average pain scores and highest surgical volume ($p<0.001$). The percent of patients reporting a VAS score of 0 was also affected by patient age ($p<0.001$), gender ($p=0.028$), and length of stay ($p<0.001$), with the same trends as reported for the average VAS score.

Conclusion: This multivariate regression analysis study showed that in patients undergoing TKA, postoperative pain was higher in females and younger patients. Awareness of these factors may assist in developing patient-specific multimodal postoperative pain and education protocols that reduce opioid reliance and related adverse events.

Comparison Between the Risk Falls after Total Knee Arthroplasty with Use of Femoral Nerve Block vs. Adductor Canal Block

Nabil Elkassabany, MD, MSCE, Sean Antosh, MD, Charles L. Nelson, MD, Craig L. Israelite, MD, Christopher Hughes, PT, Jiabin Liu, MD, PhD

Introduction: Femoral nerve block (FNB) is effective for postoperative analgesia after TKA. However, FNB reduces quadriceps strength, which may increase the risk of falling. Adductor canal block (ACB) is an alternative with predominately sensory blockade. This study aims to measure the risk of falls, quadriceps strength, time to up and go (TUG) and ambulation distance following TKA with FNB versus ACB.

Methods: Sixty-two primary TKA patients were enrolled into a double-blind, prospective study and randomized to receive either ACB or FNB with continuous infusion, stopped POD#1. Patients were assessed for risk of falling (tinetti score <19). Quadriceps strength and TUG were assessed at 24H and 48H. The quality of postoperative analgesia and recovery were assessed with the APSPOQ-R(24H) and QOR-9 questionnaires (24H, 48H and one week).

Results: There was no difference in fall risk at 24H (P=0.7) or 48H (P=0.06). The average ambulation distance was similar at 24H and 48H (P=0.08, P=0.5), there was no difference in TUG at 24H or 48H (P=0.7, P=0.9). There was significant improvement in quadriceps strength at 24H in the ACB group (P=0.001), however no difference was found at 48H (P=1). There was no difference in QOR-9 for 24H, 48H and one week (P=0.9, P=0.2, P=0.5).

Conclusion: A proposed advantage of ACB compared with a FNB is improved quadriceps strength and decreased fall risk. However, whether improved quadriceps strength translates into lower fall risk is not known. This study showed significant improvement in quadriceps strength at 24H with ACB. However, we noted no reduction in fall risk or difference in average ambulation distance at 24H or 48H. Factors other than quadriceps muscle strength may contribute to patients' falls. Overall, FNB and ACB were comparable in terms of pain scores, fall risk, ambulation distance, and recovery after primary TKA.

Do Smart Tools Reduce the Need for Manipulation after Primary Total Knee Arthroplasty?

Adolph V. Lombardi, Jr., MD, FACS,
Keith R. Berend, MD, Joanne B. Adams, BFA, CMI

Introduction: Smart tools, that is, computerized pressure sensing trial inserts, have been developed to assist the surgeon with ligamentous balancing when performing primary total knee arthroplasty (TKA). Some early studies have reported improved clinical outcomes with the use of these tools. It is perceived that the use of smart tools would improve ligamentous balancing and consequently result in a reduced need for manipulation after primary TKA. The purpose of this study was to retrospectively review the early results of a single experienced surgeon's use of smart tools in primary TKA to determine if frequency of manipulation is decreased.

Methods: We identified patients who underwent 655 primary cemented cruciate-retaining (CR) TKA by a single experienced surgeon at a musculoskeletal specialty hospital between April 2013 and December 2014. Smart trial sensor inserts were used in 343 randomly selected cases performed during the study period while no such assistance was used in 312 TKA. The groups were similar in terms of gender distribution, height, weight, and body mass index. Mean age was slightly older (68 versus 70 years) in the sensor assisted group.

Results: Manipulation under anesthesia is indicated in patients having less than 90° ROM by six weeks after primary TKA, with no progression or regression in ROM. Manipulation under anesthesia was required in 13 patients in each group, out of 343 (3.8%) sensor-assisted TKA versus 312 (4.2%) non-assisted TKA, which was not substantially different (p=NS).

Conclusion: In the hands of an experienced high-volume joint replacement surgeon, the use of smart trial sensor inserts did not substantially reduce the need for manipulation under anesthesia after primary CR-TKA, indicating that ligamentous balancing was similar between study and control groups.

Decreased Range of Motion Following Total Knee Arthroplasty is Predicted by the Tampa Scale of Kinesiophobia (TSK)

Matthew L. Brown, MD, Johannes F. Plate, MD, PhD, Sarah Von Thaer, MD, Beth P. Smith, PhD, Thorsten M. Seyler, MD, PhD, Jason E. Lang, MD

Introduction: The Tampa Scale of Kinesiophobia (TSK) assesses the relationship between patients' fear of movement and outcomes of orthopaedic surgery. The purpose of this study was to determine whether TSK scores correlated with ROM after primary TKA if showing patients a clinical intraoperative photograph of their TKA in maximal passive flexion could increase ROM.

Methods: The TSK, short-form McGill Pain Score (MPS), and the short-form Geriatric Depression Scale (GDS) were obtained from patients prior to TKA. Patients were randomized into two groups; one group was shown an intraoperative photograph with their knee in full flexion after components were inserted and displayed in their room during the hospital stay, the other group served as controls. Active and passive knee ROM were with goniometer before TKA and daily during the hospital stay. Statistical analysis with a linear mixed model were performed to assess the influence of demographics, TSK, MPS, GDS and viewing the photographs on ROM with alpha 0.05.

Results: Seventy-nine patients were studied; 30 patients (38%) used psychiatric medications at baseline (38%). Mean age was 64.3±9.1 and body mass index was 32.1±x6.6 kg/m2. Mean opioid usage was 169.0±127.7 morphine equivalent units. Sixty patients were randomized; 31 patients were shown the photograph, 29 served as controls. There were no differences in patient demographics or medical comorbidities between study groups. TSK and both active flexion ($p<0.01$) and passive flexion ($p<0.001$) were correlated. Photograph intervention did not have an influence on knee ROM after surgery ($p>0.05$).

Conclusion: The findings of study show that the TSK van be used identify patients at risk for decreased ROM following TKA who may benefit from specific therapeutically interventions. However, showing the patient a photograph of their potential full knee flexion does not influence postoperative ROM. The optimal intervention to cost-effectively maximize ROM following TKA remains unclear.

Bariatric Surgery Does Not Improve Outcomes in Patients Undergoing Primary Total Knee Arthroplasty

J. Ryan Martin, MD, Chad Watts, MD, Michael Taunton, MD

Introduction: Limited information is currently available on patients that undergo bariatric surgery prior to total knee arthroplasty (TKA). The purpose of this study was to compare the results of patients who underwent bariatric surgery prior to TKA with two separate matched cohorts; one cohort matched with higher pre-bariatric BMI and a second matched with lower pre-TKA BMI.

Methods: Utilizing our joint registry between 1998-2012 we identified a cohort of 91 TKAs that were performed following bariatric surgery (bariatric cohort). One cohort was matched 1:1 with higher pre-bariatric BMI (high BMI group), and the other was matched 1:2 based on lower pre-TKA BMI (low BMI group). Aside from BMI, groups were also matched using sex, age (±4 years), and date of TKA (±4 years). Hazard ratios and 1- and 5-year Kaplan-Meier survival rates were determined for overall complication, reoperation, revision, and prosthetic joint infection rates.

Results: In the bariatric cohort, mean pre-bariatric BMI was 51.1 kg/m2, which improved to 37.3 kg/m2 at the time of TKA. Correspondingly, mean BMI was 51.2 kg/m2 in the high BMI group and 37.2 kg/m2 in the low BMI group. Patients in the bariatric cohort had a higher risk of, and worse survival free of, reoperation (HR 2.6, p=0.02) compared to the high BMI group. Furthermore, the bariatric group had higher risk of, and worse survival free of reoperation (HR 2.4, p=0.2) and revision (HR 2.2, p=0.04) compared to the low BMI group.

Conclusion: Patients undergoing bariatric surgery had a significant decrease in BMI; however, the risks of reoperation and revision do not necessarily decrease accordingly. Furthermore, their reoperation rate may be higher than even patients with similarly high pre-bariatric BMI. More analysis is needed prior to recommending bariatric surgery as a method of optimization prior to TKA.

Lingering Risk: Bariatric Surgery Prior to Total Knee Arthroplasty

Brian T. Nickel, MD, Mitchell R. Klement, MD,
Colin Penrose, BS, Cynthia L. Green, PhD, Abiram Bala, BA,
Michael P. Bolognesi, MD, Thorsten M. Seyler, MD, PhD

Introduction: Risk versus reward must be considered in obese patients seeking total knee arthroplasty (TKA). Intuitively, if bariatric surgery reduces BMI by 15 points on average it would be an excellent option to reduce risk, but previous studies with cohorts <100 have shown modest to no improvement in outcomes after bariatric surgery leaving the orthopaedist with no clear recommendation. The purpose of this study is to determine the risk associated with bariatric surgery prior to TKA.

Methods: A claim-based review of the entire Medicare database was performed and ICD-9 codes were used to identify patients who underwent TKA for osteoarthritis with the following specifics to obtain three separate patient groups. Those who underwent bariatric surgery prior to TKA (Group I) and two control groups that did not undergo bariatric surgery but had either a BMI >40 (Group II, bariatric patient control) or <25 (Group III, non-obese patient control). 30-day, 90-day, 1 year, 2 year, and overall complication incidence were calculated. Odds ratios (OR) were calculated using chi squared and fisher exact tests.

Results: Cohort sizes were: Group I 5,918; Group II 26,616; Group III 6,480. The highest preoperative OR I:II and I:III ($p<0.05$) include: age <65, liver and pulmonary disease, peptic ulcers, substance abuse, and psychiatric conditions. Overall 2 year major complication rates are reported below ($p<0.05$): Complication: Group I/Group II/Group III/OR I:II/OR I:IIIInfection: 5.80%/4.83%/1.98%/1.21/3.05 Revision: 7.38%/4.83%/2.52%/1.57/3.09 Manipulation: 3.13%/1.61%/2.39%/1.98/1.32 Extensor Rupture: 2.11%/1.42%/0.66%/1.49/3.23 Osteolysis: 0.44%/0.28%/0.39%/1.56/1.14 Death: 0.91%/0.36%/0.23%/2.57/3.97 Neurovascular Injury: 1.00%/0.88%/0.74%/1.07/1.28

Conclusion: The results of this study demonstrate that bariatric surgery prior to TKA does not decrease surgical complications; in fact, it may increase complications possibly due to malnourishment following rapid weight loss prior to surgery, medical/psychiatric comorbidities, and/or age. While bariatric surgery is an excellent option for patients seeking to correct metabolic syndromes and decrease BMI, these benefits may not secondarily improve TKA outcomes.

Pre-opioid Use: Is There an Association with Outcomes Following TKA?

John Callaghan, MD, **Nicholas Bedard, MD,**
Andrew Pugely, MD, Christopher Martin, MD,
Kyle Duchman, MD, Robert Westermann, MD, Yubo Gao, PhD

Introduction: Fifteen-percent of patients are not satisfied following primary TKA. An unknown percentage of the TKA population are on chronic opioids prior to TKA. The purpose of this study was to evaluate opioid use after TKA comparing pre-operative opioid users (OU) and non-opioid users (NOU) and to evaluate comorbidities and 90-day complication rates between these cohorts.

Methods: The Humana Inc. administrative claims dataset was reviewed from 2007-2014 for patients undergoing primary TKA. Patients, comorbidities and 90-day outcomes were identified using ICD-9/CPT codes and prescription opioid use was measured by monthly prescription fill rates. An OU user was defined as opioid prescription within 3 months prior to TKA and NOU was defined as no history of prior opioid use. Patient demographics, comorbidities and 90-day outcomes were identified and compared between OU and NOU using standard statistical techniques.

Results: 84,685 patients underwent TKA; 49,617 (58.6%) patients did not use opioids prior to surgery, while 35,068 (41.4%) were taking opioids prior to surgery. Post-op, NOU had a lower number of opioid scripts filled per patient at discharge than OU (0.6 vs. 1.2 scripts/patient, $p<0.05$). Monthly opioid script fill rates were lower for NOU at all time points ($p<0.05$). OU had more medical comorbidities (higher Charlson Comorbidity Index, and more obesity, smokers, diabetes, CHF, CKD, COPD and CLD; $p <0.0001$). Ninety-day complications including respiratory failure, AKI, pneumonia and SSI were higher among OU ($P<0.0001$ for all).

Conclusions: Forty-one-percent of TKA patients took opioids pre-op. OU had prolonged opioid use after surgery with more comorbidities and higher rates of post-operative complications. OU did decrease their monthly prescription fill rates compared to pre-operative values, but at one year rates still remained higher than NOU (0.28 vs. 0.03 scripts/patient). These results support the importance of minimizing opioid use prior to and in the peri-operative TKA period.

Distal Femur Rotational Alignment in Patient Specific Instrumentation: A CT-based Evaluation

David W. Fitz, MD, Alysen L. Demzik, BS, David W. Manning, MD

Introduction: Posterior condylar referencing, a common method for determining femoral axial orientation during total knee arthroplasty (TKA) surgery relies upon an assumed consistent relationship between the posterior condylar line (PCL) and the transepicondylar axis (TEA) of 3°. In this study we aim to examine the PCL-TEA relationship, identify frequency and magnitude of outliers and assess interaction with other anthropometric measurements.

Methods: 1558 CT scans for pre-surgical creation of custom instrumentation and 91 CT scans of non-diseased cadaveric knees were analyzed. Spearman correlation coefficient and multiple linear regression were performed to assess interaction between PCL-TEA relation and other anthropometric measurements (hip-knee angle, tibial axis, tibial slope, tibial varus/valgus, distal femoral angle, femoral flexion, gender and age. Sub-group analysis was performed of PCL-TEA outliers (>3°±1°).

Results: The mean (SD) difference between the PCL and TEA in the pathologic knees was 2.95 (0.82) and in 92.1% the PCL-TEA relationship was within 3° ±1°. The mean (SD) difference between the PCL and TEA in the non-diseased knees was 3.04 (0.90) and in 92.3% the PCL-TEA relationship was within 3° ±1°. The PCL-TEA relationship was no different between groups ($p>0.05$). There was no significant interaction with age or gender and PCL-TEA relationship. There was a significant direct correlation ($P=0.233$) between PCL-TEA relationship and the posterior slope of the tibia.

Conclusion: In the majority of knees the PCL-TEA relationship is within 3° and supports the routine use of posterior condylar referencing instrumentation. However, increased tibial slope is associated with outlier PCL-TEA relationship and surgeons should consider alternative techniques to establish femoral axial rotation in these cases.

Thick or Thin? Patellar Thickness: The Influence on Motion and Complications after Total Knee Arthroplasty

William G. Hamilton, MD, Debbie Ammeen, BS, Nitin Goyal, MD, Kevin B. Fricka, MD, C. Anderson Engh, Jr., MD, Nancy L. Parks, MS, Gerard A. Engh, MD

Introduction: Little data exists on the influence of patellar thickness on the postoperative outcome after TKA. This study examines patellar thickness change in primary TKA.

Methods: 6329 TKAs from a single institution were reviewed retrospectively. Patellar thickness was measured with a caliper prior to making the patellar cut and again with the final patellar component in place. These measurements, patient demographics, preoperative motion, implant design (fixed/mobile-bearing) and type (PS/CR) and data from follow-up evaluations(including complications) were recorded in an institutional database. Comprehensive analysis was performed to determine if the composite patellar thickness or the change in thickness influenced postoperative motion, revisions or complications including those involving the patella and extensor mechanism.

Results: Of 6329 knees, 1774 knees had a composite patellar thickness equal to their original patellar thickness, 2792 were thicker and 1763 were thinner after TKA. There was no association between the composite patellar thickness and motion, patellar complications or complications specifically involving the extensor mechanism. Regardless of how much the patella was thickened or thinned, there was no clear association between this change in thickness and postoperative motion ($r=-0.048$) or extensor complications ($p=0.71$). For patients whose patella was made thinner by more than 2-mm following surgery, the final ROM and the increase in ROM was 116° and 9° respectively, which was no different than the ROM of those patients whose patella was made thicker by 2-mm or more. Patellar thickness was not associated with subsequent revision (patellar or any component of the TKA). There was no association between the presence of an extensor mechanism complication (33 knees) and the preop, postop patellar thickness or implant design. There was a difference between extensor complications and the implant type: CR (7%) PS (2%) $p=0.001$.

Conclusion: Thickness of the patellar composite or the change in thickness after TKA was not associated with motion, revision or extensor mechanism complications.

Metal or Modularity: Why do Metal Backed Tibias Have Inferior Outcomes to All-polyethylene Tibial Components

Matthew T. Houdek, MD, Eric R. Wagner, MD, **Cody C. Wyles, BS,**
Joseph Cass, MD, Robert T. Trousdale, MD, Michael J. Taunton, MD

Introduction: Modular, metal backed tibial components are a mainstay of standard North-American total knee practice. Other designs include all-polyethylene, and monoblock metal backed tibial components. Prior studies have shown superior outcomes in the all polyethylene tibial components versus metal backed components. The purpose of this study is to compare the outcomes of all-polyethylene, monoblock metal backed and modular metal backed components with a focus on revision, reoperation, infection and complications.

Methods: Using an institutional total joint registry database we reviewed the medical records of 32,354 patients undergoing a primary total knee arthroplasty over a 43-year period (1970-2013). Of these 20,952 (65%) were metal-backed 7,657 (24%) were monoblock metal, and 3,715 (11%) were all-polyethylene. Patients in the metal-backed modular and monoblock group were significantly younger than the all-polyethylene group. Likewise the mean BMI and the percent of male patients and those with a primary diagnosis of osteoarthritis were similar. The mean follow-up over this period was 9 years (up to 40 years).

Results: The mean survival for all primary total knee arthroplasties at the 5, 10, 20 and 30 year time points were 95%, 88%, 72% and 58%, respectively. All-polyethylene tibial components were found to have a significantly improved survivorship ($p<0.0001$), with 5, 10, 20 and 30 year survival of 98%, 96%, 91% and 83% when compared to the survival of modular metal-backed components 95%, 90%, 73%, 64% and monoblock metal-backed components 92%, 84%, 68%, 53%. All-polyethylene tibial components had a significantly lower rate of infection, tibial osteolysis, tibial component loosening, tibial component wear, and periprosthetic fracture.

Conclusion: All-polyethylene tibial components have significantly improved survival and reduced complications when compared to metal backed tibial components, regardless of modularity. This study further highlights the potential superiority of all-polyethylene tibial components compared to their metal backed counterparts.

Femoral Bowing is Main Determinant of the Proper Alignment to Restore Mechanical Axis in Total Knee Arthoplasty

Romy Megahed, BS, **Gregory Stocks, MD,**
Sabir Ismaily, BS, Philip C. Noble, PhD

Introduction: The proper angle at which the surgeon should cut the distal femur (Valgus Cut Angle, VCA) in a successful knee replacement surgery cannot be easily determined. We sought to determine the incidence of femoral bowing and its influence on VCA.

Methods: 102 long-leg radiographs (51 inches) were obtained from scheduled total knee arthroplasties. All radiographs were prepared with the feet placed in identical rotation and the patellae pointing forward. The following anatomic variables were measured on each radiograph using published methods: the neck shaft angle (NSA); the femur's length; the length of the femoral shaft; the medial head offset; the medial-lateral bow of the distal femur; the hip-knee axis angle; the mechanical axis deviation of the extremity at the knee; the medio-lateral bow of the tibia, and the valgus cut angle required to restore the mechanical axis to the center of the knee during surgery (VCA). Bivariate plots were constructed using the measurements: femoral bowing, femoral offset, and femur's length. A linear regression was then performed yielding Pearson's coefficient.

Results: A histogram of femoral bowing was constructed from all cases to view the frequency (Figure 2). The plot of offset and VCA yielded an R2 of 0.02544 ($p = 0.11$) demonstrating insignificant correlation. The plot of femoral length and VCA yielded an R2 of 0.1294 ($p = 0.0002$) showing significant correlation. Lastly, the plot of femoral bowing and VCA yielded an R2 of 0.59136 ($p < 0.00001$) showing statistical correlation (Figure 3). Multivariate analysis revealed that femoral bowing was the best predictor of VCA: VCA = 5.46-0.363 femoral bowing (°) + 0.106 Femoral offset (mm) - 0.010 femoral length (mm).

Conclusion: Our work demonstrates that femoral bowing has a potent effect on VCA. The multivariate regression indicated that femoral bowing had the highest effect on VCA followed by offset and femoral length. The other variables measured did not influence the VCA. Surgeons should consider measuring long alignment radiographs before performing a total knee arthroplasty.

Does Marital status affect Outcomes following Total Knee Arthroplasty (TKA)

Luke A. Townsend, BS, Ryan C. Roubion, BS,
Devin Bourgeois, BS, Grant Pollock, BS,
Claudia Leonardi, PhD, Rabun Fox, MD, **Vinod Dasa, MD**

Introduction: Marital status in fields of medicine such as oncology has been found to have a positive influence on outcomes.

Methods: A retrospective chart review of 249 consecutive patients who underwent primary TKA for knee osteoarthritis was performed. All surgeries were performed by a single surgeon at a single institution. Outcome measures included the Oxford and WOMAC scores. Patients were categorized as either married or unmarried. Patient reported outcomes were measured over time, pre-operative and post-operative (approximately 10, 30, 90 and 180 days post-operation) and analyzed using the MIXED procedure of SAS. Scores collected pre- and post-operative were analyzed as repeated measures including marital status, day and their interaction, age, gender, BMI, length of stay and pre-operative score in the model. The unmarried group consisted of 81.6% female, average 61.6 years of age, 33.8 kg/m2 BMI, and 1.8 days hospital length of stay. The married group consisted of 50.8% female, average 67.7 years of age, 34.0 kg/m2 BMI, and 1.5 days hospital length of stay.

Results: Pre-operative, no significant difference was observed on WOMAC score while OXFORD scores were significantly higher for married vs. unmarried patients. The pre-operative OXFORD scores for unmarried and married were: 15.0 and 18.4 for overall score ($P < 0.014$), 5.5 and 6.8 for pain score ($P < 0.029$), and 9.5 and 11.6 for function score ($P < 0.016$), respectively. Post-operative, the WOMAC score was 62.9 for married and 54.4 for unmarried ($P < 0.0008$). The patients in the married group had higher pre-operative patient reported outcome scores than the unmarried group, and this difference continued post-operative.

Conclusion: Social support and marital status may have a positive impact on outcomes following primary TKA. Further research of social support is warranted. Risk adjustment for marital status may thus be important in future pay for performance formulas.

Patellar Thickness & Range Of Motion In Primary Total Knee Arthroplasty

Carlos J. Lavernia, MD, Jose C. Alcerro, MD, Jesus M. Villa, MD

Introduction: Patellar thickness before to after TKA surgery has been deemed to be an important outcome determinant after total knee arthroplasty (TKA). Overstuffing can result in a reduction in postoperative knee flexion or pain and making the patella too thin can result in a fracture. Our objective was to study the effects of the change in patellar thickness on postoperative range of motion and patient oriented outcomes after TKA.

Methods: 200 consecutive patients undergoing primary TKA were studied. Patellar thickness was measured intraoperatively before and after patellar resection. Each patient was assessed preoperatively and at minimum 2 year's follow-up for passive and active ROM. Difference in Knee Active Flexion (KAF), Knee Passive Flexion (KPF), Knee Active Extension (KAE), and Knee Passive Extension (KPE) were compared using ANOVA. A Pearson Product moment (r) was also calculated to assess the relationship between levels of preoperative patellar thickness
with the ROM. Independent t-tests were used to assess for differences in the KAF and KPF.

Results: There was no significant difference based on preoperative patellar thickness for each of the ROM assessments. Results were similar at mean follow-up of 2.53 years for all postoperative patellar thickness. Patellar thickness was poorly correlated to ROM preoperatively (r range, 0.001-0.11; p-value range, 0.22-0.41) and postoperatively (r range, 0.07-0.09; p-value range, 0.47-0.69). Mean patellar thickness before resection was 22 mm, mean patellar thickness after resection (bone stock + insert) was 22.4 mm. Postoperative KAF and KPF along with postoperative patellar thickness did not differ amongst those individuals who had <110° or >110° of KPF before the procedure.

Conclusion: Maintaining a patellar resection between ± 3.5 mm of its initial patellar thickness provides satisfactory results and does not affect postoperative range of motion,outcome or fracture rate after primary TKA.

The Effect of Total Knee Replacement on the Non-operated Lower Extremity Joints

Kristi Collins, PA-C, David Kolessar, MD, James Gotoff, BA,
Patricia Franklin, MD, MBA, MPH, Celeste Lemay, MPH, **Elie Ghanem, MD**

Introduction: Recent studies have indicated that the presence of contralateral and ipsilateral hip and knee disease influences outcomes of TKA. However, the natural history of the remaining non-operated joints with regards to pain improvement or deterioration after TKA is lacking. The objective of this study was to assess the effect of TKA on short-term pain relief of the remaining non-operated joints.

Methods: We identified 2,968 patients in a national cohort from 24 states (2011-2015) who underwent a unilateral TKA and completed a preoperative and 6-month postoperative KOOS/HOOS pain score evaluation. Approximately 50% and 61% of the population reported no pain prior to TKA in their ipsilateral and contralateral hips respectively, while only 14% noted that their contralateral knee was pain free. The change in improvement between the mild, moderate, and severe groups was compared using Chi-squared analysis.

Results: 73% of patients with severe preoperative pain in their contralateral knee reported improvement compared to 33% who noted mild preoperative pain ($p<0.001$). Approximately 78% of the patients who complained of moderate or severe ipsilateral hip pain, reported improvement at 6 months compared to 55% with mild preoperative pain ($p<0.001$). Similar results were observed for the contralateral hip after their TKA ($p<0.001$). Approximately 20% of the patients who did not report any pain preoperatively in their contralateral knee developed worsening pain after surgery. Similarly, asymptomatic patients noted worsening pain in their ipsilateral and contralateral hips in 11% and 12% of the time respectively.

Conclusion: Patients who undergo TKA can be expected to achieve pain relief in their non-operated hip and knee joints. Those patients who report moderate to severe pain levels are more likely to experience improvement. Patients may be able to unload the remaining non-operated joints at 6 months and rely more on their TKA. Progression of OA in non-operative joints was also noted.

Cemented vs. Cementless Femoral Components in TKA: Long-term Follow-Up

John B. Meding, MD, Tatsuya Sueyoshi, MD, PhD, Merrill A. Ritter, MD, E. Michael Keating, MD, Ken E. Davis, MS

Introduction: Because of the long-term success of cemented TKA and the failures in the early generation of cementless TKA (including metal-backed patellae), primary TKA without cement is less popular. The purpose of this study was to compare the long-term survivorship of femoral component fixation using these two techniques. We hypothesized that femoral component fixation without cement has better survivorship than fixation with cement.

Methods: Between 1983 and 1991, 1800 cruciate-retaining AGC (Biomet, Warsaw, IN) TKAs were implanted in 1425 patients. 299 TKAs used a cementless femoral component (201 with a cemented tibia and 98 with cementless tibia). The other 1561 TKAs were all cemented. The diagnosis was OA in 89% and RA in 8%. 60% of patients were female. There were no significant differences in the gender ratio, BMI and diagnoses between the two cohorts although the cementless cohort was statistically younger (average age: 67 years versus 70 years). Average follow-up was 19 years and 21 years in the cementless and cemented cohorts, respectively. Kaplan-Meier survival was defined as loosening with or without revision.

Results: There were 7 revision TKAs (2.3%) in the cementless femoral group (2 for instability and 5 for tibial component loosening). There were 20 revision TKAs (1.3%) in the cemented femoral group (5 for instability, 4 for tibial component loosening, and another 5 for femoral component loosening). In addition, 15 cemented femoral components were judged to be loose radiographically. There were no loose cementless femoral components. The 10, 15, 20, and 23- year survivorship of the cemented femur was 99.8%, 99.6%, 99.2%, and 96.8%, respectively. The 23-year cementless femoral component survival was 100%.

Conclusion: We found excellent long-term survivorship of this cementless femoral component when compared to its cemented counterpart. This study supports the routine use of cementless femoral component fixation in primary TKA.

The Inadequacy of Short Knee Radiographs in Evaluating Coronal Alignment Following Total Knee Arthroplasty

Andrew Park, MD, Jeffrey B. Stambough, MD,
Ryan M. Nunley, MD, Robert L. Barrack, MD, Denis Nam, MD

Introduction: Prior studies have associated coronal alignment after total knee arthroplasty (TKA) with survivorship and functional outcomes. However, some studies measured the femorotibial angle (FTA) on a short knee film, while others measured the hip-knee-ankle angle (HKA) on a full-length radiograph. This study's purpose was to determine if the FTA as measured on short knee radiographs can accurately predict the HKA alignment as measured on full-length radiographs following TKA.

Methods: Two orthopaedic surgeons independently measured the FTA, HKA, medial proximal tibial angle (MPTA), and lateral distal femoral angle (LDFA) in 262 patients who had both short and full-length standing radiographs before and/or after primary TKA. Overall coronal alignment was considered neutral if the FTA was between [2.4°-7.2°] on short knee x-rays or if the HKA was between [-3° to 3°] on full-length films.

Results: Preoperatively, 13.9% (26/187) of knees had a neutral FTA on short knee x-rays, but 50% (13/26) of those knees were in varus or valgus alignment on full-length films. Postoperatively, 51.4% (106/206) of TKAs had an FTA in the neutral range on short knee x-rays, but 27.4% (29/106) of those TKAs were in varus or valgus alignment on full-length films. When classified as varus, valgus, or neutral based on the short and full-length images, 13.9% (26/187) of patients had discordant classifications preoperatively (e.g. categorized as valgus by FTA but neutral by HKA) and 33.0% (68/206) had discordant classifications postoperatively. Interobserver correlations for all measurements were good to excellent (r = [0.86-0.99]).

Conclusion: A significant proportion of patients were misclassified as varus, valgus, or neutral based on the FTA when compared to the HKA. These results demonstrate the limitations of interpreting clinical outcomes based on measurements from short knee x-rays and support the use of full-length radiographs as the standard imaging modality for assessing coronal alignment following TKA.

Effect of Tourniquet and Reperfusion on Lower Extremity Oxygenation during Total Knee Arthroplasty

Ran Schwarzkopf, MD, MSc, Behnam Sharareh, BS, Goutham Ganesan, PhD, Tom O'Sullivan, PhD, George Philipopoulos, BS, Ryan Mayer, BS, Bruce Tromberg, PhD

Introduction: Tourniquet use during knee arthroplasty has had the reported benefits of reduced intraoperative blood-loss, cleaner surgical fields and reductions in operative time; however, some studies have associated prolonged tourniquet use with increased complication rates, longer post-operative recovery and decreased range-of-motion. The goal of this study is to describe the dynamics of oxygen saturation (StO2) during intra-operative tourniquet application utilizing diffuse optical spectroscopy (DOS), a non-invasive optical method.

Methods: Twenty-six patients undergoing total knee arthroplasties (TKAs), 20-primary TKAs and 6-revision TKAs had the DOS sensor placed distal to the tourniquet to record somatic oxygen saturation prior to tourniquet inflation to 250mmHg until after the completion of the case. DOS is a spectroscopy system that non-invasively quantifies hemoglobin content and oxygenation in real time. The primary DOS outcomes analyzed were StO2 and its kinetics during onset and release of tourniquet.

Results: The mean tourniquet time was 81.1±3.9 minutes, with longer times used in revisions. The average baseline StO2 prior to tourniquet inflation was 72.1%±2.3%, and mean minimum ischemic StO2 was 8.09%±2.4%. Mean StO2 following reperfusion was 78.7%±1.8%, which was significantly higher than baseline StO2 ($p=0.0002$). As the baseline StO2 increased, the rate of deoxygenation increased ($p=0.002$) and the rate of hyperemia decreased ($p=0.0002$). Using a two-phase linear fit, the mean time until steady state was 22.3±2.8 minutes. The longer it took to reach the minimum ischemic StO2, the less hyperemia was seen ($p=0.025$).

Conclusion: DOS is capable of monitoring tissue StO2 intra-operatively, providing real-time information on hemoglobin content and StO2. This study showed significantly higher mean StO2 over baseline after tourniquet release. This hyperemic response was significantly slower in patients with higher baseline StO2 and there was less response the longer it took to reach the minimum ischemic StO2. In addition, there was a significantly faster rate of deoxygenation in patients with higher baseline StO2. These kinematic parameters might better characterize patient's physiologic response during ischemia, and help establish ideal tourniquet time limits for TKA.

Can Systematic Medial Collateral Ligament Needle Puncturing Lead to a Predictable and Safe Reduction in Medial Tension during Total Knee Arthroplasty?

Thomas A. Herschmiller, MD, Gregory Cunn, MD,
Taylor Murtaugh, BS, Thomas Gardner, MCE, **Jeffrey A. Geller, MD**

Introduction: Traditional medial soft tissue release in total knee arthroplasty can be unpredictable. This study examines whether sequential needle puncturing of the medial collateral ligament (MCL) is safe, effective and reproducible.

Methods: Total knee prostheses were implanted in 10 cadaveric specimens by a single surgeon. Five sets of 5 punctures of the MCL were performed with an 18-gauge needle, followed by 5 transverse perforations with an 11-blade. A consistent valgus force was applied after each. Medial pressure and gap distance under tension were measured and compared by Pearson's correlation. Pressure measurements were analyzed by a repeated measures two-way ANOVA and a Tukey multiple comparisons test to determine significant decreases. Specimens were dissected and an anatomic study of the MCL performed.

Results: The pressure sensor correlated more closely with systematic tissue release ($R>0.5$ for % change from baseline) than did measurements of gap increase under tension. All knees had ≤5mm of medial opening with up to 25 needle punctures. 2 knees had >5mm of medial opening in flexion after blade perforation. The mean pressure decreases in 90 degrees flexion, mid-flexion and extension were 11.2, 9.4 and 9.9 psi respectively after 5 needle punctures and 8.1, 11.5 and 9.6 psi between 5 and 15. The first 2 sets of needle punctures and final 5 blade perforations led to significant ($p<0.05$) medial pressure reduction in the majority of iterations.

Conclusion: Needle puncture of the MCL leads to a significant and reliable decrease in medial tension over the first 15, with diminishing effect up to 25 punctures. This method may be employed when up to approximately 20 psi reduction in medial pressure is desired. Blade perforation after needle puncture should be approached with caution.

Routine Work-up of Patients with Postoperative Pyrexia following Total Joint Arthroplasty is Not Necessary

Je-Hyun Yoo, MD, PhD, Camilo Restrepo, MD,
Antonia F. Chen, MD, MBA, Javad Parvizi, MD, FRCS

Introduction: Postoperative fever following total joint arthroplasty (TJA) is common. The purpose of this study was to determine which patients with postoperative fever could potentially benefit from routine fever work up after TJA.

Methods: We retrospectively reviewed 25,558 consecutive primary or revision TJA patients at our institution between 6/2001-6/2013. Postoperative fever was defined as any recorded body temperature ≥100.4°F in the early postoperative period during their hospitals stay. Medical records were reviewed to identify patient demographics, the type of procedure, characteristics of patients with fever, and febrile complications. The costs of routine workups such as chest x-ray (CXR), urinalysis (UA), urine culture (UC), and blood culture (BC) were also determined.

Results: Postoperative fever occurred in 46% (11,875/25,558) of patients undergoing TJA. 11,589 separate routine workups were performed in 90.5% of patients with postoperative fever, of which only 2.4% were positive. UA had the highest positive rate for 38.7% patients while UC was positive in 9.5% patients. BC was positive in 7.0% patients, and CXR was positive in only 0.2% patients. Febrile complications occurred in 4.5% of patients and the rate of infectious complications was 2.0%. Fever workups were more likely to be positive when the first postoperative fever occurred after postoperative day (POD) 3, temperature spikes >102°F, multiple spikes, and patients undergoing revision TJA ($p<0.01$). These features were independent predictors of febrile complications on multivariate logistic regression analysis ($p<0.0001$). The total direct charge for 11,319 negative workups in patients with postoperative fever was $4,636,976.80, with CXR costing $4,613,182.00.

Conclusion: Routine workup of patients with postoperative fever following TJA is not warranted. Patients with higher temperatures (>102°F), fever occurring after POD 3, those with multiple fever spikes, and those with fever developing after revision TJA should be investigated. CXR has an extremely low yield and it should not routinely be ordered.

Aspirin is as Effective as and Safer than Warfarin for Patients at Elevated Risk of Venous Thromboembolism Undergoing Total Joint Arthroplasty

Ronald Huang, MD, Javad Parvizi, MD, FRCS,
William Hozack, MD, Matthew Austin, MD

Introduction: There is continued controversy regarding the most optimal venous thromboembolism (VTE) prophylaxis, in general and for patients at higher risk, in particular. Aspirin (ASA) is an effective modality for venous thromboembolism (VTE) prophylaxis after total joint arthroplasty (TJA). The purpose of this study was to compare the efficacy of ASA to warfarin in patients with higher risk of VTE.

Methods: This retrospective study examined a total of 30,270 patients who received either ASA or warfarin for VTE prophylaxis following primary and revision TJA. Based on our previously developed risk stratification model patients were classified into different risk categories for VTE. 22,751 patients were considered "lower risk" (4102 received ASA, 18,649 received warfarin) while the remaining 7,519 patients were "higher risk" patients (796 received ASA, 6,723 received warfarin). The incidence of VTE and other complications within 90 days were recorded.

Results: The average age and BMI were similar for patients receiving warfarin and ASA. Patients receiving warfarin had a higher mean Charlson Comorbidity Index (CCI) compared to ASA patients ($p<0.0001$). The incidence of VTE, in ascending order was: 0.2% for lower risk-ASA, 0.6% for higher risk-ASA, 1.8% for lower risk-warfarin, and 3.2% for higher risk-warfarin group ($p<0.0001$ for comparisons between ASA and warfarin groups). The incidence of periprosthetic joint infection (PJI) was higher for both the lower and the higher risk patients receiving warfarin ($p<0.0001$). The 90-day mortality was significantly higher in patients receiving warfarin ($p=0.0008$). In the multivariate analysis, warfarin was an independent risk factor for VTE and acute PJI in both the lower and the higher risk VTE patients ($p<0.0001$).

Conclusion: Our study demonstrates that ASA is more effective and safer than warfarin for VTE prophylaxis following total joint arthroplasty, even in patients at higher risk of VTE.

Low Dose Aspirin Is an Effective Chemoprophylaxis for Venous Thromboembolism following Total Joint Arthroplasty: An Interim Analysis

Javad Parvizi, MD, FRCS, **Ronald Huang, MD,**
Camilo Restrepo, MD, Antonia Chen, MD, MBA,
Matthew Austin, MD, William Hozack, MD, Jess Lonner, MD

Introduction: Aspirin (ASA) is accepted as effective prophylaxis for prevention of venous thromboembolism (VTE) following total joint arthroplasty (TJA). However, the optimal dose of ASA for VTE prophylaxis following TJA is unknown. The purpose of this study was to evaluate whether a lower dose of ASA (81 mg BID) was as effective as 325mg BID for prevention of VTE after TJA.

Methods: In this study, we analyzed 4,320 primary TJA cases performed between July 2013 and March 2015. 2,984 patients received ASA 325mg BID for 4 weeks while 1,336 patients received ASA 81mg BID for 4 weeks postoperatively. Ages were similar between groups. There were no significant differences in gender, BMI, or Charlson Comorbidity Index. Complications within 90 days including symptomatic VTE, gastrointestinal (GI) complications, acute infection, and death were recorded. Statistical analyses were performed using chi-squared and t-tests to compare the ASA 81mg and 325mg groups.

Results: There was no significant difference in the incidence of VTE between the groups; 0.3% in the ASA 325mg group (six DVTs, three PEs) and 0.15% in the ASA 81mg group (one DVT, one PE) (p=0.56). GI bleeding or upper GI ulceration incidence was 0.4% in the ASA 325mg group and 0.3% in the ASA 81mg group (p=0.81). Acute infection occurred in 0.5% in the ASA 325mg group and 0.2% in the ASA 81mg group (p=0.29). Finally, the 90-day mortality rate was 0.1% in the ASA 325mg group and 0.1% in the ASA 81mg group (p=0.80).

Conclusion: This study demonstrates that ASA 81mg BID is as effective for VTE prophylaxis following TJA as ASA 325mg BID. This is not surprising, as evidence demonstrates that lower dose aspirin has better antiplatelet aggregation properties. Evaluation of the safety and efficacy of the lower dose of ASA as a prophylactic agent continues in our prospective study.

Efficacy of Venous Thromboembolism Prophylaxis in Total Joint Arthroplasty Based on Risk Stratification: Should Potent Anticoagulation be used in Higher Risk Patients?

Timothy L. Tan, MD, Mitchel Maltenforr, PhD, Antonia F. Chen, MD, MBA, Alisina Shahi, MD, Carlos A. Higuera, MD, Marcelo Siqueira, MD, Erik N. Hansen, MD, David Sing, BS, Javad Parvizi, MD, FRCS

Introduction: Based on current guidelines from the American Academy of Orthopaedic Surgeons (AAOS),a number of prophylactic modalities for prevention of venous thromboembolism (VTE) in total joint arthroplasty (TJA) may be used. It is a common practice that more potent prophylactic agents are used for patients at higher risk of VTE. However, there are no studies that have investigated the efficacy of potent anticoagulation in higher risk individuals.

Methods: A retrospective multi-institutional study of 63,526 primary and revision TJAs (32,673 knees, 30,853 hips) from 2000 to 2014 was performed. Patients with unavailable VTE prophylaxis information or those not receiving prophylaxis were excluded. Identified medications were classified as aspirin, potent anticoagulation (low molecular weight heparin, oral and intravenous Factor Xa inhibitors), or warfarin. Information pertinent to the objective of this study including patient demographics, comorbidities, and surgical variables were collected and a VTE risk score was calculated based on 25 variables. Treatment outcomes assessed included 90 day rate of symptomatic VTE and periprosthetic joint infection (PJI).

Results: In lower risk patients (lowest 50% of VTE risk scores), the incidence of VTE using aspirin, warfarin, and potent anticoagulations were 0.17%, 0.78%, and 1.92%, respectively. In the higher risk patients (80th percentile or higher), the incidence of VTE using aspirin, warfarin and potent anticoagulations were 1.58%, 11.67%, and 3.48%, respectively. The incidence of PJI was statistically higher in patients receiving warfarin compared to the other modes of anticoagulation ($p<0.0001$, for both comparisons). Patients receiving aspirin had the lowest rate of PJI throughout all risk groups.

Conclusion: The results of this multi-institutional study demonstrate that potent anticoagulation in higher risk patients does not necessarily result in a reduction in symptomatic VTE. Aspirin administered to the higher risk patients seems to be as effective as potent anticoagulation and more effective than warfarin.

Venous Thromboembolism Following Hip and Knee Arthroplasty: Is There A Difference in Risk For Primary Compared to Revision Surgery?

Matthew R. Boylan, BS, Bhaveen H. Kapadia, MD, Paul W. Perdue, MD, Aditya V. Maheshwari, MD, **Michael A. Mont, MD**

Introduction: Venous thromboembolic events (VTE) remain a feared complication following lower extremity total joint arthroplasty. The annual incidence has been reported to be 2–3 cases per 1,000. Although the incidence and risk factors of VTE following primary total hip (THA) and knee (TKA) arthroplasty have been well described, there is a paucity of reports on revision total hip and knee arthroplasty. Therefore we compared the incidence of VTE within 90 days postoperatively for primary versus revision hip and knee arthroplasty.

Methods: The New York Department of Health Statewide Planning and Research Cooperative System (SPARCS) was used to identify all patients who underwent primary and revision THA and TKA between 2003 and 2012. We used an encrypted patient identifier to track patients for 90 days postoperatively. Patients admitted with VTE were identified using ICD-9 diagnosis codes for deep venous thrombosis and pulmonary embolism. Patients who had a history of pulmonary embolism at the time of surgery were excluded.

Results: The study cohort consisted of 343,387 patients who underwent THA or TKA, among which 331,672 were primary and 11,715 were revision cases. The incidence of VTE within 90 days was 1.75% for primary (N=5,794) and 1.45% (N=170) for revision cases. After controlling for the confounding effects of age, gender, race, and comorbidities, revisions were at 22% decreased risk of VTE (OR=0.78; 95% CI=0.66-0.92; p=0.003). Upon stratification by anatomical location, risk of VTE was decreased for revision compared to primary TKA (OR=0.69; 95% CI=0.55-0.88; p=0.002), and had no difference for revision compared to primary THA (OR=0.96; 95% CI=0.76-1.20; p=0.693).

Conclusion: Revision arthroplasty may involve greater intraoperative joint injury, longer operative time, and longer recovery time compared to primary arthroplasty, however, our data suggests that these potential exposures do not affect overall risk of postoperative VTE.

Risk-stratified VTE Prophylaxis following TJA: Aspirin and SPCDs vs. Aggressive Chemoprophylaxis

James P. Doran, MD, **Stephen Yu, MD,** Khalid I Odeh, BA, Alessandra Szulc, MA, Hamadi Murphy, MS, Daniel Smith, MD, Joseph A. Bosco, MD, Richard Iorio, MD

Introduction: Venous thromboembolism (VTE) is a major concern following total joint arthroplasty (TJA). Traditionally, aggressive anticoagulation agents, such as enoxaparin, warfarin, and rivaroxaban, have been the standard of care in the prevention of VTE disease. Unfortunately, these agents are associated with increased post-operative complications, such as bleeding, infection, wound complications, and need for readmission and/or reoperation.

Methods: A retrospective review was performed on 2611 TJA procedures among two cohorts. Cohort 1 consisted of 6 consecutive months of patients receiving standard aggressive chemoprophylaxis agents. Cohort 2 consisted of 6 consecutive months of patients treated based on a new risk-stratification protocol. A screening questionnaire for four VTE risk factors: history of VTE; active cancer treatment; current smoker; morbid obesity [BMI>40] was utilized to determine prophylaxis. Patients with zero risk factors received aspirin with sequential pneumatic compression devices (SPCDs), while patients with one or more risk factors received aggressive agents. VTE events, infections, hematomas, readmissions, and reoperations were recorded.

Results: 1203 TJA procedures in Cohort 1 were compared to 1408 procedures in Cohort 2. The risk-stratified protocol cohort (Cohort 2) had a lower incidence of VTE, readmission rate, and adverse event rate compared to the all-aggressive prophylaxis cohort (Cohort 1). Subgroup analysis within Cohort 2 also showed patients receiving aspirin/SPCDs with no risk factors for VTE had a lower incidence of VTEs and adverse events than the risk-matched aggressive prophylaxis subgroup. A statistically significant reduction in costs ($p<0.001$) was experienced with the use of aspirin/SPCDs compared to aggressive anticoagulation agents within Cohort 2.

Conclusions: A risk-stratified, post-operative VTE chemoprophylaxis protocol that avoids aggressive anticoagulation in TJA patients with standard VTE risk reduces post-operative complications, while maintaining low incidence of DVT/PEs. By improving outcomes and reducing cost, we increased the value of care provided to our TJA patients.

Use of a Risk Stratification Protocol for Thromboembolism Prophylaxis Following Hip Arthroplasty

Denis Nam, MD, MSc, Ryan M. Nunley, MD, Staci R. Johnson, MEd, James A. Keeney, MD, John C. Clohisy, MD, Robert L. Barrack, MD

Introduction: Venous thromboembolic events (VTE) remain a significant concern following total hip arthroplasty (THA), but the optimal prophylactic regimen is unclear. Patients may unnecessarily receive excessive anticoagulation and risk further perioperative morbidity when prescribed potent anticoagulants. This study's purpose was to present the use of a risk stratification protocol in selecting VTE prophylaxis for patients undergoing hip arthroplasty.

Methods: This was a prospective, IRB-approved study of patients undergoing primary THA, revision THA, and surface replacement arthroplasty (SRA) at a single institution. Patients were considered "high" risk if they met any of the following criteria: history of DVT, active cancer, hypercoagulable state, family history of VTE, or prolonged immobility at the surgeon's discretion. High risk patients received warfarin therapy for 4 weeks postoperatively targeting an INR between 1.8 and 2.2. All other patients were considered routine risk and received mobile pneumatic compression devices (MCDs) for 10 days and aspirin (325mg twice daily) for 6 weeks. Any symptomatic VTE event, readmission, wound, bleeding, or medical complication within 6 months postoperatively was recorded. Chi-square and independent t-tests were used to compare the two cohorts ($p<0.05$ = significant).

Results: From 2010 to 2014, 1859 patients were enrolled (1402 routine risk- 75.4%, 457 high risk- 24.6%). The incidence of VTE was 0.5% in the routine risk cohort versus 0.5% in the high risk cohort within 6 weeks postoperatively ($p=1.00$). Routine risk cohort patients had a lower incidence of major bleeding complications (0.5% versus 2.0%, $p=0.006$), wound complications (0.2% versus 1.2%, $p=0.01$), incisional drainage greater than 7 days (4.7% versus 11.1%, $p<0.0001$), and readmission within 6 months (10.0% versus 14.1%, $p=0.02$) versus the high risk cohort.

Conclusion: Use of a risk stratification protocol allowed the avoidance of more aggressive anticoagulation in 75% of patients undergoing hip arthroplasty while achieving a low incidence of symptomatic VTE.

The Clinical Severity of PE Following Joint Replacement is Unrelated to the Location of Emboli in the Pulmonary Vasculature

Alejandro Gonzalez Della Valle, MD, Alvaro Blanes Perez, MD, Yuo-yu Lee, BS, Gabrielle Konin, MD, Yoshimi Endo, MD, Gregory Saboeiro, MD, Nigel Sharrock, MD, Eduardo Salvati, MD

Introduction: Computed tomography pulmonary angiography (CTPA) has become standard of care for the diagnosis of pulmonary embolism (PE) following joint replacement. We studied if a relationship exists between the location of the emboli within the pulmonary vasculature and the symptoms and clinical severity at the time of diagnosis.

Methods: All 269 patients who developed a CTPA-proved, in-hospital PE following THA or TKA in our institution between 2005 and 2012 were studied. The clinical severity of the PE was calculated utilizing the Pulmonary Embolism Clinical Severity Index (PECSI), that classifies patients in 5 classes (Class 5: most severe). PE were classified based on the most proximal location of the emboli (central, segmental or subsegmental); and in unilateral or bilateral involvement. Patients were followed for a year. The association between PESI, and emboli location were examined using cross tabulation and Chi-square tests. There were 62 central, 139 segmental, and 68 subsegmental PE patients; and 180 unilateral and 89 bilateral PEs.

Results: There was no association between the location of the emboli and the PECSI ($p=0.32$). Patients with bilateral or unilateral PE had similar PECSI ($p=0.78$). Two patients died during the first year. One had a Class 5, segmental PE after TKA and died 11 months postoperatively due to an autopsy-proven E. Coli sepsis. The second patient developed a Class 1, segmental PE after THA. She was anticoagulated, developed an intracranial bleed, and died 8 months after surgery.

Conclusion: The PECSI, a well-recognized, validated predictor of mortality after PE was similar in patients with central, segmental or subsegmental PE; and in patients with unilateral of bilateral lung involvement. The one-year mortality rate of patients with postoperative PE is very low and death can be caused by anticoagulation and conditions that are unrelated to the severity of the clinical findings at the time of diagnosis.

Propagation of Infrapopliteal Venous Thrombotic Events with Aspirin Treatment Following Total Knee Arthroplasty

Bertrand W. Parcells, MD, Mark A. Hartzband, MD,
Harlan B. Levine, MD, Gregg R. Klein, MD

Introduction: There is no consensus for treating infrapopliteal venous thrombotic events (VTE) following total knee arthroplasty (TKA). The risk of VTE propagation and symptom progression must be balanced with the known risk of bleeding complications associated with anticoagulation therapy.

Methods: From 2006 to 2009, 2184 patients underwent primary and revision TKA, and received postoperative VTE prophylaxis with coumadin or LMWH for 14 days. We retrospectively examined the incidence of VTE propagation as diagnosed by duplex ultrasound (DUS) and symptom progression. Patients with infrapopliteal VTE were transitioned to ASA therapy, which was continued for three months.

Results: The overall incidence of infrapopliteal VTE was 7.6% (167/2184). Follow up DUS was performed in 57.9% (78/133) of patients with infrapopliteal VTE, within three months of surgery, which demonstrated 1.3% propagation to popliteal VTE (1/78). There was no further propagation, nor symptom progression with aspirin therapy. Venous recanalization occured in 73.1% (57/78) of cases. The 43.1% (55/133) of patients that were not rescanned were followed clinically and remained asymptomatic.

Conclusion: Infrapopliteal VTEs are effectively treated with aspirin, showing low risk for propagation or worsening symptoms in patients following primary or revision TKA.

Is Outpatient Arthroplasty as Safe as Fast-track Inpatient Arthroplasty? A Propensity Score Matched Analysis

Francis C. Lovecchio, BA, Shawn Sahota, MD, Hasham Alvi, MD, Matthew Beal, MD, David W. Manning, MD

Introduction: Currently, "fast-track" (≤2 days length of stay) total knee and total hip arthroplasties are being utilized by select institutions to optimize the value of arthroplasty. Outpatient TKA/THA could lead to further value enhancement. Patient selection criteria for outpatient and fast-track inpatient protocol are similar, yet perioperative outcomes may differ. The purpose of our study is to compare 30-day rates of post-discharge complications, reoperation, and readmission between fast-track inpatient and outpatient lower extremity arthroplasty.

Methods: All patients undergoing total hip or knee arthroplasty between 2011-2013 were selected from the National Surgical Quality Improvement Program (NSQIP) database. Exclusion criteria were hospital length of stay ≥3 days, bilateral procedures, and surgical indication other than osteoarthritis. To eliminate differences in demographics, comorbid diseases, and operative factors, a propensity score was used to match fast-track inpatients to outpatients. Logistic regression was used to generate propensity score adjusted odds ratios for outcomes of interest.

Results: A total of 24,292 patients from the NSQIP database met inclusion criteria. After using a propensity-score algorithm to eliminate selection bias, outpatients had higher rates of post-discharge medical complications (6.3% vs. 1.1%, $p<0.001$) and reoperation (2.2% vs. 0.5%, $p=0.002$). Blood transfusions and deep venous thrombosis (DVT) were increased in the outpatient cohort (4.1% vs. 0.1%, $p<0.001$ and 1.4% vs. 0.4%, $p=0.024$, respectively). Adjusted ORs showed that outpatients were almost five times as likely to have a post-discharge medical complication (OR 4.8, 95% CI 3.2-7.1), and over twice as likely to have a reoperation (OR 2.4, 95% CI 1.3-4.5). Readmissions were not increased in the outpatient cohort (2.4% vs. 2.0%, $p=0.589$).

Conclusions: Though outpatient arthroplasty does not lead to a higher rate of readmission compared to fast-track inpatient arthroplasty, outpatients experience higher rates of complications and reoperations. Outpatient arthroplasty requires improvements before being considered a routine alternative to fast track arthroplasty.

Is Metal-on-metal Total Hip Arthroplasty Associated with Neurotoxicity?

Abiram Bala, Colin T. Penrose, BA, BS, **Thorsten M. Seyler, MD, PhD,** Timothy R. Randell, MD, Samuel S. Wellman, MD, Michael P. Bolognesi, MD

Introduction: Isolated case reports in the literature describe systemic neurologic side effects associated with Metal-On-Metal (MOM) bearing surfaces, sometimes attributed to direct nerve damage from cobalt ions, yet the incidence of these effects have not been evaluated beyond individual cases. The purpose of this study was to compare new diagnoses of these side effects described in isolated cases in large patient cohorts of MOM versus Metal-On-Polyethylene (MOP).

Methods: We queried the entire Medicare database from 2005 to 2012. THA and bearing surface were determined using International Classification of Diseases, 9th revision (ICD-9) procedure codes. Patients with primary THA in 2005 – 2007 were selected for 5-year follow-up. Using ICD-9 codes, we identified new diagnoses of previously reported neurologic side effects: peripheral neuropathy, sensorineural hearing loss, visual impairment, paresthesias, tinnitus, and vertigo. Comorbidities and demographics were collected. Odds ratios, confidence intervals, and p-values were calculated.

Results: 29,483 MOM THAs and 54,470 MOP THAs were identified. The average Charlson Comorbidity Index was 5 for both groups. MOP patients were slightly older, and had statistically higher prevalence of 11/30 Elixhauser-measure comorbidities ($p<0.05$). There was no statistically significant difference in new diagnoses of peripheral neuropathy, visual impairment, or paresthesias between the two groups over 5 years. At 3-5 years postop, the MOM group had statistically significant ($p<0.05$) lower rates of sensorineural hearing loss, tinnitus, and vertigo.

Conclusion: This study represents, to our knowledge, the first longitudinal analysis of systemic neurotoxicity after THA in a large cohort of patients. The differences in hearing loss, tinnitus, and vertigo may be due to the older and slightly sicker MOP cohort. The results of our study suggest that on the large scale, neurologic side effects previously described do not occur as a common attributable complication. Rather, these cases may be due to individual patient hypersensitivity to metal ions.

Prevalence of Pseudotumor in Patients after Metal-on-metal Hip Arthroplasty: A Single Surgeon's Large Case-series

Sean A. Sutphen, DO, Lewis H. MacLaughlin, MD, Adam Madsen, DO, Jackie Russell, RN, Michael A. McShane, MD

Introduction: Metal-on-metal (MoM) total hip arthroplasty (THA) was felt to be the resolution for failures related to wear in total hip replacement while offering a large head size and enhanced stability. However, there has been much concern that surrounds the issues of implant design-related failures, failure of ingrowth, and pseudotumor formation after metal-on-metal THA. Pseudotumors causing severe symptoms have been found to be locally destructive, requiring revision surgery in a high number of patients. In a recent meta-analysis of the prevalence of asymptomatic pseudotumors in metal-on-metal arthroplasty and resurfacing, the prevalence of pseudotumors ranged from 0% to 6.5%. The purpose of this study is to quantify the prevalence of pseudotumors in patients with well-functioning and painful metal-on-metal total hip arthroplasty, to characterize the pseudotumors with the use of MARS-MRI, and to assess the relationship between pseudotumors and metal ions.

Methods: We retrospectively reviewed 102 single surgeon patients that underwent metal-on-metal total hip arthroplasty with a mean follow-up of 60 months using MARS-MRI with serum cobalt and chromium measurements.

Results: The results showed 68.6% developed pseudotumors with 60.9% of the asymptomatic group developing pseudotumors. The symptomatic group had a higher proportion of patients with elevated serum cobalt levels (P=0.035). There was no difference found with elevated metal ions and prevalence of pseudotumors, but elevated cobalt levels were associated with larger pseudotumor size (P=0.001).

Conclusion: The available evidence indicated that most patients that develop pseudotumors are asymptomatic, and that elevated serum cobalt levels may be associated with symptoms and pseudotumor size. Our findings demonstrate that clinical symptoms do not necessarily correlate with the size and presence of a pseudotumor found on MARS-MRI. Based on our results from the present study, we feel that regularly used follow-up exams (x-rays and clinical exam) will undervalue the prevalence of asymptomatic pseudotumors in MoM THA.

Cervical Myelopathy Doubles the Rate of Dislocation and Fracture After Total Hip Arthroplasty (THA)

Mitchell R. Klement, MD, Daniel J. Blizzard, MD, MS, Colin T. Penrose, BA, BS, Charles Sheets PT, Thorsten M. Seyler, MD, PhD, Michael A. Gallizzi, MD, Michael P. Bolognesi, MD, Robert E. Isaacs, MD, Christopher R. Brown, MD

Introduction: Myelopathy can effect balance and gait kinematics through reduced knee extension during the swing-face, widened-base, shortened stride, and increased cadence. Collectively these abnormalities lead to altered hip mechanics and an increased fall risk. The purpose of this study is to evaluate the effect of myelopathy on peri-operative and short-term outcomes following THA. We hypothesize that patients with myelopathy significantly increase surgical complications compared to control.

Methods: The Medicare sample was searched from 2005-2012 using International Classification of Disease, 9th Edition (ICD-9) codes. This search yielded 3332 patients with pre-existing cervical myelopathy that subsequently underwent THA. Risk ratios (RR) with 95% confidence intervals (CIs) were calculated for 30-day, 90-day, 1 year, and 2 year follow-up for complications including: hip dislocation, periprosthetic fracture, revision surgery, and post-operative infection.

Results: Compared to controls, patients with myelopathy had a RR of 2.29 (CI: 1.90-2.72) for 30-day dislocation and 2.04 (CI: 1.65-2.52) for 90-day dislocation and a significantly higher RR at all time-points for revision surgery (30-day: 1.77, 90-day: 1.58, 2-year: 1.79), and peri-prosthetic fracture (30-day: 1.76, 90-day: 1.58, 2-year: 1.72). Spinal decompression prior to THA was found to be protective for 30 and 90-day complications with only the RR for revision surgery significantly increased. However, at last follow-up RR for all complications was elevated even in group of myelopathy patients that underwent decompression.

Conclusion: These results show that myelopathy has a significant, negative effect on both postoperative and short-term complications following THA. Gait and balance disturbances with myelopathy are increasingly evident during complex locomotion tasks. Accordingly, functional goals and baseline gait should be assessed and discussed with the patient pre-operatively to direct post-operative therapy precautions and guide component selection and positioning to potentially maximize stability over range-of-motion given the increased propensity for fractures and dislocations.

Decreased Cardiac Morbidity and Mortality in Higher Risk Populations Undergoing Elective Total Knee Arthroplasty Procedures Following Surgical Care Improvement Project Guidelines

Thomas B. Bemenderfer, MD, Rachel Seymour, PhD, Nigel Rozario, BS, Charity Patterson, PhD, Madhav Karunakar, MD

Introduction: The Sugical Care Improvement Project (SCIP) was established to reduce surgical complications. SCIP guidelines require perioperative beta-blocker therapy for patients on beta-blockers prior to surgery. Tachycardia in patients with coronary artery disease causes perioperative myocardial ischemia, whch is associated with postoperative cardiac complications. Beta-adrenergic sympatholysis reduces the incidence of myocardial ischemia. Recent studies demonstated that perioperative beta-blockade prevents nonfatal myocardial infarctions (MI) but increases the risk of stroke, death, and hypotension. This study evaluates whether the incidence of cardiac-related morbidity and mortality changed following SCIP guidelines in elective total knee arthroplasty (TKA).

Methods: The Healthcare Cost and Utilization Project (HCUP) National Inpatient Sample (NIS) was utilized to collect a retrospective cohort of patients undergoing elective TKA between 2003-2011. Trends in patient demographics, postoperative cardiac complications, stroke, hypotension, and overall- and outcome-related mortality were compared between pre-SCIP (2003-2005) and post-SCIP eras (2007-2011). Rao-Scott chi-square statistical tests with weighted proportions based on HCUP-NIS guidelines were utilized to determine statistical significance (p-value<0.05).

Results: The following significant differences in demographics were observed: increase in male proportion (35.0->36.7%), diabetes mellitus (17.9->21.4), substance abuse (10.9->16.6%), obesity (12.6->20.8%), hypertension (62.9->67.1%), and history of congestive heart failure (0.023->0.283%). Consistent with previous literature, there was a significant increase in postoperative hypotension (0.8->1.7%). However, there was a significant decrease in postoperative MI (0.3->0.2%), stroke (0.07->0.04%), cardiac arrest (0.08->0.05%), inpatient mortality (0.13->0.07%), and cardiac-specific mortality: acute heart failure (9.9->3.0%), cardiac dysrhythmias (1.0->0.5%), and cardiac arrest (62.2->43.2%).

Conclusion: SCIP guidelines reduced postoperative fatal cardiac complications in patient underoing TKA. This reduction occurred despite an increase in patients with more cardiac comorbidities. This information can be used to revise risk stratification and counseling for patients with cardiac disease who undergo TKA.

Which Adverse Events are Associated with Revision vs. Primary Total Joint Arthroplasty?

Daniel D. Bohl, MD, Andre M. Samuel, BBA, Adam M. Lukasiewicz, MSC, Matthew L. Webb, BA, Bryce A. Basques, MD, Craig J. Della Valle, MD, Brett R. Levine, MD, Jonathan N. Grauer, MD

Introduction: Revision total joint arthroplasty is increasingly common and may have higher rates of some (but not all) postoperative adverse events compared with primary procedures performed in the same patients. However, this has not yet been investigated using high-quality non-administrative data with sufficient sample size. The purpose of this study is to characterize differences in (1) specific adverse event rates, (2) postoperative hospital length of stay, and (3) hospital readmission between primary and revision total joint arthroplasty.

Methods: Patients were identified who underwent primary or revision total hip arthroplasty (THA) or total knee arthroplasty (TKA) as part of the America College of Surgeons National Surgical Quality Improvement Program (NSQIP) during 2011-2013. 43,247 primary THA, 5,060 revision THA, 65,694 primary TKA, and 4,911 revision TKA patients were identified. Rates of adverse events and other perioperative outcomes were compared between primary and revision procedures with adjustment for baseline characteristics.

Results: For both THA and TKA, patients undergoing revision procedures had higher rates of systemic sepsis, deep incisional surgical site infection, and organ/space surgical site infection ($p<0.05$ for each). Patients undergoing revision procedures did not have higher rates of pulmonary embolism, deep vein thrombosis, or many other specific adverse events ($p\geq0.05$ for each). Mean postoperative length of stay was longer ($p<0.01$) and the rate of readmission was greater ($p<0.01$) for patients undergoing revision than primary procedures.

Conclusion: Patients undergoing revision procedures have higher rates of periprosthetic joint infection and sepsis but not most other complications following total joint arthroplasty. This finding contrasts administrative database findings suggesting higher rates of venous thromboembolism for patients undergoing revision procedures. Public reporting of adverse events should be interpreted in the context of the differences between primary and revision procedures. Similarly, reimbursement systems should reflect the greater amount of postoperative care that patients undergoing revision procedures require.

The Effect of Smoking on Thirty-day Postoperative Complications after Total Hip Arthroplasty: A Propensity Score Matched Analysis

Shawn Sahota, MD, Francis Lovecchio, BA,
Matthew Beal, MD, David Manning, MD

Introduction: Total hip arthroplasty (THA) is safe and effective but burdensome to the national health care budget. Costly complications are targets of national quality initiatives, and patients and providers are interested in identifying targets for risk mitigation. Smoking is linked to health issues but its role in perioperative complication following THA is less well-known. We aim to identify smoking's independent contribution to risk of short-term complication following THA using matched and adjusted propensity-score analysis.

Methods: Patients undergoing THA between 2011-2012 were selected from the American College of Surgeon's National Surgical Quality Improvement Program's database. Exclusion criteria were bilateral procedures, concomitant procedures, diagnosis other than osteoarthritis, and patients with missing data. Outcomes of interest included readmission, reoperation, mortality, surgical complications, and medical complications. To control for demographic, comorbidity, laboratory, and operative differences between smokers and non-smokers, propensity-score was used to generate a 1:1 match. Propensity-score adjusted logistic regression was used to generate adjusted odds ratios.

Results: 60,353 patients were identified and 12,588 met inclusion criteria, of which 1501 (11.9%) were smokers. After adjusting for differences, smokers had higher rates of surgical site infection (0.6% vs. 0.1%, p=0.034), sepsis (0.8% vs. 0.3%, p=0.045), and readmission (4.0% vs. 2.7%, p=0.041) compared to non-smokers. Smokers were 3.3 times more likely to be readmitted (OR 3.3, 95% CI 1.4-7.7), and had higher likelihood of surgical complication (OR 1.8, 95% CI 1.2-2.8). Rates of medical complications (8.7% vs. 10.1%, p=0.184) and mortality (0.1% vs. 0.1%, p=1.0) were comparable.

Conclusion: Using matched and adjusted propensity-scoring analysis to rigidly control for confounders, smoking was associated with higher rates of overall surgical complication, surgical site infection and readmission following THA. Smoking is a modifiable condition that adversely affects outcomes following THA and is an ideal candidate for risk mitigation efforts prior to arthroplasty.

The Interaction of Obesity and Diabetes in Determining Risk of Complication Following Total Joint Arthroplasty

Linda I. Suleiman, MD, Hasham Alvi, MD, Adam I. Edelstein, MD, Mary J. Kwasny ScD, Matthew Beal, MD, David W. Manning, MD

Introduction: Obesity and diabetes have been identified as contributors to risk in total joint arthroplasty (TJA). This investigation seeks to assess and quantify the interaction between obesity and diabetes on risk of complication following TJA.

Methods: We utilized regression modeling of the ACS-NSQIP dataset from 2005-2012 to assess risk for Centers for Medicare Services (CMS)-reportable complications (pneumonia, myocardial infarction, death, pulmonary embolism, surgical site infection, surgical site bleeding, catheter-associated urinary track infection, mechanical complication, and readmission) in patients undergoing TJA. BMI was expressed as a continuous variable using piecewise restricted cubic splines. Diabetes was coded as no DM, non-insulin dependent (NIDDM), or insulin dependent (IDDM). The risk accrual interaction between obesity and diabetes was assessed. The spline fit model of BMI was examined for any deflection points.

Results: 82,006 patients were identified and overall incidence of CMS-reportable complications was 5039 (6.1%). We tested for interactive effects between BMI specified with cubic splines and DM and found no interaction (p=0.179). Diabetes was associated with increased risk of complications irrespective of BMI {NIDDM (OR 1.14, 95% CI 1.05-1.24), IDDM (OR 1.66, 95% CI 1.47-1.88)}. Any BMI with IDDM conveyed increased risk compared to NIDDM or No DM ($p<0.001$). Any BMI with NIDDM conveyed increased risk compared to no DM ($P<0.007$). Spline fit representation of BMI and risk probability showed no deflections corresponding to World Health Organization (WHO) obesity class. Obesity-related risk transitions from linear to exponential at a BMI of 45. A BMI of 40 without diabetes conveys less risk for CMS-reportable complications than BMI of 25 with IDDM.

Conclusion: Diabetes increases risk for CMS-reportable complications following TJA irrespective of BMI. The interaction between obesity and diabetes is strictly additive. Obesity, when represented as a continuous variable, demonstrates the arbitrary nature of surgical BMI cut offs.

Chronic Kidney Disease Linearly Predicts Outcomes After Elective Total Joint Arthroplasty

Timothy L. Tan, MD, Edward Filippone, MD, Dean D. Tan, BS, Michael M. Kheir, BS, Antonia F. Chen, MD, MBA

Introduction: Kidney disease has been widely associated with increased complications in total joint arthroplasty (TJA). The purpose of this study is to determine the association of kidney disease severity as measured by the chronic kidney disease (CKD) staging system with complications and outcomes after TJA.

Methods: A retrospective review of an institutional database of 12,308 primary TJAs (6,361 hips and 5,947 knees) from 2008 to 2013 was performed. The following preoperative variables were obtained from medical records: chemistry 7 panel, Elixhauser comorbidities, and demographic factors. CKD stages were defined based on estimated glomerular filtration rate in ml/min/1.73m2 (eGFR): (1) 90+, (2) 60-89, (3A) 45-59, (3B) 30-44, (4) 15-29, and (5) <15. Multivariate analysis was performed to assess the independent influence of CKD stage on the aforementioned endpoints.

Results: Patients with CKD stage greater than 2 demonstrated an increased risk of transfusions (CKD 3A odds ratio [OR]: 1.67, CKD 3B OR: 2.80, CKD 4 OR: 2.24), length of stay greater than 3 days (CKD 3A OR: 1.34, CKD 3B OR: 1.39, CKD 4 OR: 3.57), and in-hospital complications (CKD 3A OR: 1.21, CKD 3B OR: 1.80, CKD 4 OR: 3.36) compared to all patients with eGFR > 60. Additionally, the relationship between eGFR and the above complications were found to increase linearly rather than exponentially at a certain threshold. In contrast, CKD stage was not associated with septic or aseptic revisions.

Conclusion: Severe CKD is associated with an increased risk of transfusion, length of stay, and in hospital complications. Rather than finding a clear threshold, complications increased linearly with disease severity. Surgeons should be cognizant of this increase when evaluating TJA patients with renal disease.

Elixhauser Comorbidity Method Is More Accurate than the Charlson Index in Predicting 90-day Mortality and Morbidity for Hip Fracture Patients

Nathan D. Orvets, MD, Jonathan Yin, MD, Brian A. Silvia, MD, PhD

Introduction: Risk adjustment in regard to safety and quality of care models has become more prevalent in clinical practice. Comorbidities influence clinical decision making and guide patient informed consent. There is currently no consensus model for orthopaedic patients. Previous reports, using national survey data, note little predictive improvement when patient comorbidities are included beyond demographic information alone. We hypothesize that a clinically relevant difference may be apparent in patients with a higher rate of comorbidities. The present study investigates the strength of the Elixhauser and Charlson comorbidity models compared to a base demographic model (age, sex, and year of operation) in predicting morbidity in hip fracture patients at a single Level 1 trauma center.

Methods: 315 patients who underwent hip fracture surgery were retrospectively reviewed. Their comorbidities were scored according to the Elixhauser and Charlson comorbidity methods. Outcome events were (1) 90-day mortality and (2) adverse inpatient events (acute renal failure, cardiac, DVT/PE, hypoxia). Receiver operating characteristic (ROC) curves were generated using logistic regression for all models. The area under the ROC curve (AUC) was compared to establish the predictive performance of each model.

Results: Mean age of the cohort is 80.7±8.8 years with 75.1% being female. The mean 90-day mortality and adverse event rates were 12.1% and 35.7%, respectively. The Elixhauser model was better at predicting 90-day mortality (AUC 0.90±0.03) than the Charlson index (AUC 0.82±0.04) and the base model (AUC 0.66±0.04). The Elixhauser model (AUC 0.79±0.03) also outperformed the Charlson index (0.74±0.03) and the base model (AUC 0.61±0.03) in predicting inpatient adverse events.

Conclusion: The Elixhauser method is more predictive for peri-operative morbidity and mortality than the Charlson comorbidity index or a demographic base model in this patient sub-group. This supports that use of comorbidities to influence risk adjustment for this high risk patient group.

Iliopsoas Impingement after Primary Total Hip Arthroplasty: Operative and Non-operative Treatment Outcomes

Brian P. Chalmers, MD, Peter K. Sculco, MD, Rafael Sierra, MD, Robert T. Trousdale, MD, Daniel J. Berry, MD

Introduction: An under-recognized cause of persistent groin pain after total hip arthroplasty (THA) is impingement of the iliopsoas tendon. A retroverted, oversized, or lateralized cup causing component prominence of the anterior-inferior rim is a leading source of impingement. We present the largest series evaluating efficacy of conservative management, tenotomy, and acetabular revision.

Methods: 51 patients with iliopsoas impingement after primary THA with an uncemented cup and polyethylene bearing from 1996 to 2014 were retrospectively reviewed. 22 patients underwent acetabular revision, 9 tenotomy, and 20 continued non-operative management. Mean age was 65 years and mean follow-up was 3.3 years. Anterior acetabular component prominence was measured on direct lateral hip radiographs.

Results: Mean HHS was 79 in the non-operative group and 82 in the operative group (p=0.6) at follow-up. 10 patients (50%) experienced groin pain resolution in the non-operative group vs. 24 patients (78%) in the operative group (p=0.04). Preoperative anterior acetabular component prominence of at least 8-mm was predictive of success of acetabular revision and failure of tenotomy. Tenotomy provided a mean HHS of 89 and groin pain resolution in all 6 patients (100%) with less than 8-mm of acetabular prominence. In patients with 8-mm or greater prominence, acetabular revision tended towards better groin pain resolution (12 of 13 patients, 92%) than tenotomy (1 of 3 patients, 33%) (p=0.07). One tenotomy patient with 12-mm prominence was revised for continued groin pain. There were no other revisions, reoperations, or complications.

Conclusion: Continued non-operative management resolved groin pain in 50% of patients. Iliopsoas release alone was successful in patients with minimal component prominence. Acetabular revision was more predictable for groin pain resolution in patients with notable component prominence. Both were associated with a low rate of complications.

Development and Evaluation of a Preoperative Risk Calculator for Periprosthetic Joint Infection

Timothy L. Tan, MD, Mitchel Maltenfort, PhD, Antonia F. Chen, MD, MBA
Alisina Shahi, MD, Amber Madden, BA, Javad Parvizi, MD

Introduction: Preoperative identification of patients at risk of developing periprosthetic joint infection (PJI) is imperative to allow medical optimization and targeted prophylaxis. The purpose of this study was to create a preoperative risk calculator for PJI by assessing a patient's individual risks for developing PJI, infection with resistant organisms, and infection with Staphylococcus aureus.

Methods: A retrospective review of 27,117 patients (43,253 TJAs), including 1,035 with PJI, treated at our institution between 1999 to 2014, was performed. A total of 41 risk factors including demographics, comorbidities, and surgical variables were evaluated. Patients with inadequate data in our prospective PJI data registry were interviewed through telephone. Organism information was acquired from microbiological records. Multivariate analysis was performed and coefficients were scaled to produce integer scoring.

Results: Among the 41 variables studied, 25 were not found to be risk factors for PJI. Of the remaining factors and in the descending order of significance, prior surgeries, drug abuse, revision surgery, human immunodeficiency virus, coagulopathy, renal disease, congestive heart failure, psychoses, rheumatological disease, knee involvement, diabetes, anemia, male gender, liver disease, smoking, and body mass index were demonstrated to be independent risk factors for PJI. Furthermore, heart valve disease, pulmonary disease, and metastatic disease increased the risk of PJI caused by resistant organisms, with the latter also associated with S.aureus. Area under the curvers were 0.83 for any PJI, 0.86 for resistant PJI, and 0.84 for S. aureus PJI models.

Conclusion: This study on a large number of patients from a single institution has determined the relative weight of various risk factors for PJI. Some of the identified factors are indeed modifiable and need to be addressed prior to elective arthroplasty. It is imperative that surgeons are aware of these risk factors and implement all possible preventative measures, including targeted prophylaxis, in high-risk patients.

A Multi-center Randomized Clinical Trial of Articulating and Static Spacers for Periprosthetic Hip Infection

Erdan Kayupov, MSE, Peter N. Chalmers, MD, Mario Moric, MS, Timothy Tan, MD, Scott M. Sporer, MD, Gregory Deirmengian, MD, Javad Parvizi, MD, Matthew S. Austin, MD, Craig J. Della Valle, MD

Introduction: Although the use of an interim antibiotic spacer is considered standard for a two-stage exchange for periprosthetic joint infection (PJI), the use of an articulating versus a static spacer is controversial. The purpose of this multicenter, randomized trial is to compare articulating and static spacers for the treatment of PJI after total hip arthroplasty (THA).

Methods: 36 Patients who met MSIS criteria for PJI following a primary THA at 3 centers were randomized; 17 into the articulating and 19 in the static group. Power analysis determined that 44 total patients were needed to identify a difference in operative time during the second stage (β=0.80 and α=0.05). Demographics between the two groups were not significantly different, suggesting appropriate randomization. Statistical analysis was performed using t-tests for normally distributed variables and Wilcoxon tests for non-normal distributions.

Results: For the stage 1 procedure there were no differences in operative time (201 articulating vs. 195 minutes static, p=0.702), blood loss (762 vs. 579 ml, p=0.163), units of blood transfused (0.35 vs. 0.74, p=0.176) or likelihood of discharge to home with the number of patients available for study. Similarly, at reimplantation there were no differences in operative time (194 articulating vs. 187 minutes static, p=0.840), blood loss (642 vs. 469 ml, p=0.235), units of blood transfused (0.64 vs. 1.06, p=0.309), or discharge disposition. Length of stay was significantly longer in the static group following stage 1 (5.2 vs. 8.7 days, p=0.011) and stage 2 (3.9 vs. 6 days, p=0.009). Three patients in the static group and 2 in the articulating group required a second debridement and spacer prior to reimplantation.

Conclusions: Initial results of this multicenter randomized trial demonstrate few differences between the two techniques. Length of stay, however was longer in the static group, which could have important economic consequences for the hospital.

Recurrent Periprosthetic Joint Infection after Irrigation and Debridement with Component Retention is Most Often Due to Identical Organisms

Benjamin Zmistowski, MD, Jorge Manrique, MD,
Ripal Patel, MD, **Antonia F. Chen, MD, MBA**

Introduction: Nearly half of all patients treated with irrigation and debridement (I&D;) after total joint arthroplasty have recurrent infection, however, organism persistence between infection events remains unreported. The purpose of this study was to investigate the incidence of organism persistence in cases of failed I&D; and identify predictors of organism persistence.

Methods: Using a prospectively collected institutional database, 146 patients (153 joints) undergoing I&D; between 4/2000 and 7/2013 were identified. There were 60 hips (40%) and 93 knees (60%). The overall success rate of I&D; in this group was 52% (80/153). The failure group was limited to those patients with growth on culture at both initial failure and recurrent failure (46 cases). Analyses were performed to identify potential predictors of organism persistence, including age, gender, body mass index, initial infecting organism, time to infection, time to failure, Charlson comorbidity index and other comorbidities.

Results: In the study group, 78.3% (36/46) failed with the same organism. Knees with failed I&D; had an organism persistence of 92.3% (24/26) compared to 60% hips (12/20; p=0.01). Patients with diabetes were more likely to fail with a new organism (44.4%; 4/9) than patients without diabetes (16.2%; 6/37; p=0.08). Lastly, patients initially infected with MRSA had a higher risk of failing due to organism persistence (100%; 13/13) compared to other organisms (23/33; 69.7%; p=0.04). Interestingly, organism persistence was not associated with the time to failure.

Conclusion: I&D; with prosthetic retention had a success rate of less than 50% and typically failed due to organism persistence rather than a new infection. Predictors of organism persistence included knee infections and MRSA. Failure of I&D; with a new organism was higher in hip infections and diabetic patients. I&D; should have a limited role in treating PJI, especially in knees and identified MRSA.

Success of Debridement and Implant Retention in Periprosthetic Joint Infection – Does the Surgeon Matter?

Mark Zhu, MBChB, Saiprasad Ravi, BS,
Christopher Luey, FRACP, MBChB, **Simon Young, FRACS, MBChB**

Introduction: Prosthetic joint infection (PJI) is a devastating complication following total joint arthroplasty. In acute haematogenous and early post operative PJI, debridement and implant retention (DAIR) surgery is often the initial treatment and success rates vary. This study aimed to identify factors affecting success rates of DAIR and in particular whether involvement of a lower limb arthroplasty surgeon can affect outcome.

Methods: This retrospective review included one hundred and sixty-two patients undergoing DAIR for first-episode PJI following hip and knee arthroplasty at one of three tertiary hospitals. Treatment success was defined as no relapse within two years of DAIR. Data on patient, hospital, and surgical factors were identified including duration of symptoms, time from primary, previous revisions, age of prosthesis, bacterial subtype, whether modular component exchange was performed and whether an arthroplasty surgeon performed the procedure. Adjusted multivariate analysis was performed to identify factors associated with success of DAIR.

Results: Overall success rate of DAIR was 60%. A specialist arthroplasty surgeon was present in 42% of cases, they performed modular exchange in 51% of cases compared to 32.5% for other surgeons. Inclusion of modular exchange in the procedure was the only factor associated with DAIR success (OR 3.1, p=0.013). Time to theatre of less than 24 hours (OR 0.59, p=0.27), duration of symptoms less than one week (OR 1.28, p=0.28), age of prosthesis less than 3 months (OR 1.47, p=0.61) and having an arthroplasty surgeon perform DAIR (OR 1.6, p=0.34) did not lead to statistically significant improvements in success rate.

Conclusion: Modular exchange was associated with a significantly higher success rate for both hip and knee PJI, suggesting thorough debridement is important in DAIR. Arthroplasty surgeons were more likely to perform modular exchange, but their presence in theatre alone did not reduce the risk of failure.

Risk of Re-infection Following Treatment of Infected Total Knee Arthroplasty

Adam Cochran, MD, Kevin Ong, PhD, Edmund Lau, MS, Michael Mont, MD, Arthur Malkani, MD

Introduction: The purpose of this study was to identify the incidence and risk factors for re-infection following primary treatment of an infected total knee arthroplasty.

Methods: 1,493,924 primary TKA patients were identified from the 100% Medicare data between October 1, 2005 and December 31, 2011. Patients who encountered periprosthetic joint infection (PJI) following TKA were identified using 996.66. The risk of subsequent PJI was stratified based on the first-line treatment and compared between the various first-line treatment groups using Multivariate Cox regression.

Results: 16,622 patients (1.1%) were diagnosed with PJI. The Kaplan-Meier risk of PJI was 0.77% at 1 year, 1.03% at 2 years, 1.21% at 3 years, 1.34% at 4 years, 1.46% at 5 years, and 1.58% at 6 years. Age ($p<0.001$), Charlson score ($p<0.001$), hospital control ($p<0.001$), race ($p=0.036$), census region ($p=0.031$), gender ($p<0.001$) were identified as risk factors for PJI. 20.75% (n=2,806) were treated with I&D;, 15.90% (n=2,150) treated with I&D; and liner exchange, 22.70% (n=3,069) treated with one-stage revision, 39.67% (n=5,364) treated with two-stage revision, and 0.98% (n=132) treated with amputation. 25.96% of patients with PJI had subsequent PJI following first-line treatment. Patients who underwent I&D; as a first-line treatment had the highest risk of re-infection, with risks of 28.18% at 1 year and 43.23% at 6 years. One-stage revision patients had 33.9% greater adjusted risk of re-infection than two-stage revision patients ($p<0.001$).

Conclusion: Two stage reimplantation had the highest success rate following treatment of an infected TKA. Given the higher failure rate and costs associated with I & D, and one stage revision guidelines needs to be established for their specific indications.

Two-stage Debridement with Prosthesis Retention for Acute Periprosthetic Infections Following Knee Arthroplasty

Matthew C. Niesen, MD, Adam J. Schwartz, MD,
Christopher P. Beauchamp, MD,
Henry D. Clarke, MD, Mark J. Spangehl, MD

Introduction: The risk of periprosthetic infection (PJI) after primary total knee arthroplasty is approximately 1%. This increases to approximately 5-10% in revision arthroplasty. Debridement with prosthesis retention is one option in acute infection (APJI). However, failure rates for debridement have been reported to be as high as 60-80%. This study sought to determine the success rate of a 2-stage retention debridement protocol in patients with APJI following primary or revision arthroplasty of the knee.

Methods: We retrospectively reviewed 44 patients (25 men and 19 women, average age 65.7 years) who underwent 2 stage debridement for APJI (8 post-operative and 36 acute hematogenous) following knee arthroplasty (27 primary, 17 revision). All patients met criteria for PJI as defined by Musculoskeletal Infection Society criteria. Our protocol included 1) initial debridement with placement of high dose antibiotic beads, 2) repeat debridement an average of 5.1 days later with exchange of modular parts, 3) 6 weeks of IV antibiotics. Minimum followup was 1 year. Patients were classified as successfully treated if they did not require re-operation for recurrent infection and had no evidence of infection clinically.

Results: 38 of the 44 patients with an APJI following primary or revision knee arthroplasty (86.4 %) were successfully treated at an average follow up of 43.6 months. Patients treated successfully underwent debridement at an average of 4.1 days after onset of symptoms, while those that failed underwent debridement at an average of 11.2 days after onset of symptoms (p= .011).

Conclusions: The control of infection in 38 of 44 patients (86.4%) compares favorably with historical rates. Patients with APJI following primary or revision knee arthroplasty can be successfully treated using a two- stage debridement with prosthesis retention protocol. Likelihood of success was significantly greater when duration of symptoms prior to I&D; was minimized to approximately 5 days.

Two-stage Debridement with Prosthesis Retention for Acute Periprosthetic Joint Infections Following Primary Hip or Knee Arthroplasty

Matthew C. Niesen, MD, Mark J. Spangehl, MD, Henry D. Clarke, MD, Adam J. Schwartz, MD, Christopher P. Beauchamp, MD

Introduction: The risk of periprosthetic infection (PJI) after primary hip and knee arthroplasty is approximately 1%. Failure rates for debridement in PJI have been reported to be as high as 60-70%. We previously described a two-stage debridement and prosthesis retention protocol for acute periprosthetic joint infections (APJI). This study sought to determine the success rate using this protocol in a patients with APJI following primary arthroplasty of the hip or knee.

Methods: We retrospectively reviewed 43 patients (22 men and 21 women with an average age of 68.8 years) who underwent a 2 stage debridement protocol for APJI (9 post-operative and 34 acute hematogenous) following primary arthroplasty (27 knees and 16 hips) between 2002 and 2014. All patients met criteria for PJI as defined by Musculoskeletal Infection Society criteria. Our protocol consisted of 1) initial debridement with placement of high dose antibiotic beads, 2) repeat debridement at an average of 5.3 days later with exchange of modular parts and 3) 6 weeks of IV antibiotics. The minimum followup was 1 year. Patients were classified as successfully treated if they did not require re-operation for recurrent infection and had no evidence of infection clinically.

Results: 39 of the 43 patients with an APJI following primary joint arthroplasty (90.7%) were successfully treated at an average follow up of 44 months (range 12-155 months). Patients underwent stage 1 debridement at an average of 4.77 days after onset of symptoms.

Conclusion: Patients with APJI following primary arthroplasty of the hip or knee can be successfully treated using a two- stage debridement with prosthesis retention protocol with high dose antibiotic beads. These results compare favorably with historical controls. The combination of two debridements and the use of high dose antibiotic beads may have played a role in the success rate of this treatment protocol.

Positive Cultures during Reimplantation Increase the Risk of Subsequent Failure in Two-stage Exchange Arthroplasty

Timothy L. Tan, MD, Miguel Gomez, MD, Jorge Manrique, MD, Antonia F. Chen, MD, MBA, Javad Parvizi, MD, FRCS

Introduction: It is strongly recommended that tissue and synovial fluid culture samples be obtained during reimplantation performed as part of a two-stage exchange arthroplasty. The incidence of positive cultures during reimplantation and the influence of positive cultures on subsequent outcome are unknown. This study was designed to determine the incidence of positive cultures during reimplantation and to investigate the association between positive cultures at reimplantation and the subsequent outcome.

Methods: A retrospective review was conducted on 267 patients that met the Musculoskeletal Infection Society (MSIS) criteria for periprosthetic joint infection (PJI) that completed both stages of two-stage exchange arthroplasty. Intraoperative culture results from tissue and/or synovial fluid were obtained. Cultures were positive in 33 cases (12.4%) undergoing reimplantation surgery. Treatment failure was assessed based on the Delphi consensus definition. Logistic regression analysis was performed to assess the predictors of a positive culture and risk factors for failure.

Results: Treatment failure was 45.5% for those with a positive intraoperative culture and 20.9% in those with negative cultures at the time of reimplantation. When controlling for organism virulence, comorbidities, and other confounding factors, treatment failure was higher (odds ratio [OR]: 3.3; 95% confidence interval [CI]: 1.3-4.5) and occurred at an earlier time point (hazard ratio: 2.5; 95% CI: 1.3-4.5) in patients with a positive culture. The treatment failure rate was not different (p=0.70) between cases with two or more (36.4%) and one positive culture (42.8%).

Conclusion: Positive intraoperative cultures during reimplantation, regardless of the number, were independently associated with two times the risk of subsequent infection and earlier treatment failure. Surgeons should be aware that a positive culture independently increases the risk of subsequent failure and needs to be taken seriously. Given the significance of these findings, future studies are needed to evaluate the optimal management of positive cultures during reimplantation surgery.

The CRP Test May Not Detect PJIs Cause by Less-virulent Organisms

Carl Deirmengian, MD, Patrick Citrano, BA, Simmi Gulati, MS, Erick Kazarian, BA, James Stave, PhD, Keith Kardos, PhD

Introduction: The C-reactive protein has been described as an accurate serum and synovial fluid (SF) biomarker for PJI. However, a recent institutional database on PJIs has reported on a high rate of normal serum CRP results in the setting of less-virulent organisms. The purpose of this study is to identify any organism-specific influences on the SF CRP level.

Methods: This retrospective study reviewed 12,144 SF samples, collected from joint arthroplasties, which were sent to one commercial laboratory for testing. Of these, 909 SF samples had a positive culture and were also tested for a SF CRP level. There were 584 SF samples yielding less virulent organisms, and 325 yielding virulent organisms. The median CRP and percentage of "false negative" CRP results was also calculated for each category, using a SF CRP cutoff of 6.6(mg/L) as determined by previous studies.

Results: The median SF CRP level is highly dependent on the infecting organism. The median SF CRP levels associated with S epidermidis(13.4mg/L) and yeast(6.2mg/L) were significantly lower than that of S.aureus(41.6mg/L), E.coli(53.7mg/L), and S.mitis(32.9mg/L), with all $p < 0.015$. The median SF CRP level was significantly lower for less-virulent organisms, when compared to those organisms classified as virulent (14.3mg/L vs. 33.9mg/L; $p<0.001$). The rate of "false-negative" SF CRP values was 50% for yeast, 29% for S epidermidis, 28% for all less-virulent organisms and 9% for all virulent organisms.

Conclusion: This study, including a very large number of culture-positive SF samples, demonstrated a high dependence of the SF CRP on the identity of the infecting organism, and supports recent research on the serum CRP suggesting the same. Although the use of a CRP level is an important part of the work-up for PJI, surgeons must beware that this protein may yield a false-negative result in the setting of less-virulent organisms.

Alpha-defensin is an Accurate Test for PJI

Erdan Kayupov, MSE, Gregory Kazarian, BA, Darren Plummer, MD,
Carl Deirmengian, MD, Craig J. Della Valle, MD

Introduction: The Alpha-Defensin test for PJI has been reported to be the most highly accurate individual test for PJI. The purpose of the study was to assess the sensitivity and specificity of the alpha-defensin test at our institution.

Methods: This prospective single-center study included 147 total joint arthroplasty patients who had a synovial fluid alpha-defensin test for PJI, classified by the Musculoskeletal Infection Society (MSIS) consensus criteria. The cohort consisted of 99 knees and 48 hips, and a mean age of 64 years. 17 patients had failure due to an adverse local tissue reaction (ALTR), and 9 had spacer blocks awaiting reimplantation. Patients were not excluded because of antibiotic treatment or co-morbidities. 19 PJIs met MSIS criteria (13 culture-positive and 6 culture-negative) and 128 cases had aseptic failure. Statistical analysis included the calculation of test sensitivity and specificity, with corresponding 95% confidence intervals.

Results: All 19 PJIs were identified accurately by the alpha-defensin test. The alpha-defensin test had a sensitivity of 100% (95%CI: 82-100%) and a specificity of 95% (95%CI: 89-98%). Five of seven (71%) false-positive alpha-defensin results were among patients with ALTR. When excluding patients with ALTR, the alpha-defensin test had a sensitivity of 100% (95%CI: 82-100%) and a specificity of 98% (95%CI: 94-100%). The mean alpha-defensin level among patients with PJI was significantly elevated compared to those with aseptic failure (3.1 vs. 0.3 (S/CO); $p < 0.001$). There were five MSIS-negative cases with an isolated false-positive culture, and all were associated with a negative alpha-defensin result.

Conclusion: In this institution's first study on the alpha-defensin test, we have confirmed the high accuracy which has been reported at several other institutions. The alpha-defensin test is especially valuable at identifying cases of culture-negative PJI, and in this study successfully identified PJIs caused by less-virulent organisms.

The Utility of Repeated Joint Aspirations to Diagnose a Periprosthetic Joint Infection

Michael Bates, MD, Kaitlin M. Carroll, BS, Erdan Kayupov, BSE, Craig Della Valle, MD, **Michael B. Cross, MD**

Introduction: Diagnosing a periprosthetic joint infection (PJI) continues to be challenging. Joint aspiration is regarded by most to be the gold standard for diagnosing a deep PJI. We set out to determine the precision of repeat aspirations performed within two weeks, and the utility of repeat aspirations to diagnose a PJI.

Methods: A multi-center, retrospective review was conducted on 212 patients who underwent two separate joint aspirations after THA or TKA, for any reason, within 14 days. Patients who had preoperative and intraoperative aspirations were included.. Patients who were prescribed antibiotics between aspirations were excluded. Aspiration data including synovial fluid white blood cell (WBC) and percent neutrophil count (%PMNs), as well as culture results were reviewed for each aspiration pair.

Results: Repeat aspirations taken within 14 days after the index aspiration showed an average deviation in the synovial fluid WBC of 688 ±288 and 5 ±3.5 %PMNs Using a synovial fluid WBC threshold of 3,000 and 80% neutrophils to diagnose a PJI, we found that the second aspiration changed the diagnosis of infection in 9% (19/212). In 6 patients with an infection based on MSIS criteria, but negative cultures on the first aspiration, the second aspiration yielded positive cultures in 67% of these patients.

Conclusion: Our study suggests that a repeat aspiration should be considered if the first aspiration has a synovial fluid WBC between 2300 and 3700, or a % PMN count between 75-85%. Further, the second aspiration was helpful in clarifying the diagnosis of a PJI in 9% of patients and led to an accurate culture result in 67% of culture negative infections. This is the first study to report the average deviation between repeated aspirations, and will aid in determining which patients should be considered “borderline” and undergo a repeat aspiration to rule out a PJI.

Patients with BMI ≥ 35 at Greater Risk of Wound Complications Requiring Reoperation after Direct Anterior THA

Christian P. Christensen, MD, Tharun Karthikeyan, MD, Cale A. Jacobs, PhD

Introduction: Approximately 1.5% to 2% of direct anterior (DA) THAs have been reported to have postoperative wound complications requiring reoperation. The purpose of this retrospective cohort study was to compare the rate of wound complications between patients with BMI ≥ 35 kg/m2 and those with BMI of < 35. We hypothesized that higher BMI would be associated with a greater risk of postoperative wound complications requiring reoperation.

Methods: We identified 538 DA THAs performed by a single board-certified surgeon from our prospective outcomes registry. In all cases, the patient was positioned supine on a fracture table, and similar incisions, soft tissue releases, wound closure techniques, and thombroprophylaxis were used. Wound complications were defined as either infected or non-infected superficial hematomas, persistent wound drainage, or acute prosthetic joint infections that required reoperation. A Fisher Exact Test was used to compare the prevalence of wound complications that required reoperation between groups. Odds Ratios were also calculated to determine if one group was at greater risk of wound complication.

Results: Nine patients from our series of 538 THAs had a wound complication requiring reoperation (1.7%). A significantly greater prevalence of wound complications was demonstrated by those with BMI ≥ 35 (5/78, 6.2% vs. 4/458, 0.9%, p=.005). Patients with BMI ≥ 35 were 7.8 times more likely to have a wound complication requiring reoperation than those with BMI < 35 (Odds Ratio = 7.8 [95% CI: 2.0 to 29.8], p=.003).

Conclusion: Patients with BMI ≥ 35 were 7.8 times more likely to have a postoperative wound complication requiring reoperation after direct anterior THA. These results may be used when counseling patients preoperatively of the risks associated with direct anterior THA, and studies are underway to identify alternative closure techniques and methods to reduce the risk of complication for those with BMI ≥ 35.

Is Obesity Putting Anterior Approach Hips at Higher Risk of Infection?

William G. Hamilton, MD, Nancy L. Parks, MS,
Henry Ho, MS, Jeanine Gargiulo, PA-C

Introduction: When an anterior approach (AA) total hip arthroplasty (THA) is performed in an obese patient, the excessive abdominal pannus can interfere with wound healing postoperatively. The purpose of this study was to examine the rate of infection in AA THA among obese patients.

Methods: From March 2009 to July 2014, 1414 primary THAs were performed through an AA in 1252 patients. All patients were instructed to perform a preoperative chlorhexidine sterilization, perioperative antibiotics were always used, and body exhaust suits were worn by the surgical team. 43.4% of cases were in male patients and the most common diagnosis was osteoarthritis (97.3%). The average patient age was 62.6 years (18 to 95 years). Average patient height was 67.1 inches (51 to 80 inches), and average weight was 182.3 pounds (96 to 345 pounds). Average body mass index (BMI) was 28.3 (16.3-55.2). Patients with a BMI above 35 were classified as severely obese.

Results: 12.4% (175 of 1414) patients had a BMI above 35. Among these, three cases (1.7%) had a deep infection treated surgically within one year. The other 1239 non-obese patients had an infection rate of only 0.4%. Additionally four obese patients (2.3%) had wound dehiscence or debridement, compared with nine (0.7%) non-obese patients ($p=0.02$). The percent of cases with either wound healing problems or postoperative infection with a BMI over 35 was 4% compared to 1.1% among non-obese($p=0.01$). The relative risk of developing an infection among severely obese patients was 4.25 times higher than non-obese patients.

Conclusions: This study shows an alarming increase in rate of wound problems and infection in the obese patient compared to the non-obese in DAA THA. It may be a result of the location of the incision and its proximity to the pannus or inguinal crease, or a consequence of obesity related comorbidities.

High Risk of Wound Complications Following Direct Anterior Total Hip Arthroplasty in Obese Patients

Chad D. Watts, MD, Matthew T. Houdek, MD, Eric R. Wagner, MD, Peter Sculco, MD, Brian Chalmers, MD, Michael J. Taunton, MD

Introduction: Direct anterior (DA) total hip arthroplasty (THA) is associated with perioperative complications, including wound problems. The goals of this study were to investigate the incidence and risk factors for wound complication between DA and posterior THA patients.

Methods: We retrospectively reviewed 716 direct anterior THAs performed by a single surgeon and 3,040 posterior THAs from our institution performed from 2010-2014. Our study group (DA patients) consisted of 716 patients with a mean age of 64 years, mean body mass index (BMI) of 29.4 kg/m2, and 362 (51%) females and mean followup of 12 months. Patients in the posterior comparison group had a mean age of 62 years, mean BMI of 30.1 kg/m2, and included 1,540 (51%) females with an average followup of 13 months.

Results: Wound complications were noted in 1.7% of DA cases, with 75% requiring wound revision. A similar rate of wound complication was noted in the posterior group (1.9%, p=0.76). In DA patients, risk factors for wound complication included BMI ≥30 kg/m2 (HR 4.3, p=0.018) and BMI ≥40 kg/m2 (HR 19.3, p<0.0001). In comparison, BMI ≥30 kg/m2 and BMI ≥40 kg/m2 were relatively less predictive in the posterior group with hazard ratios of 1.4 (0.8-2.3, p=0.22) and 3.8 (1.9-6.8, p=0.0002), respectively.

Conclusion: We found that the incidence of wound infection was similar between DA and posterior approach primary THA at our institution. However, obesity was a stronger risk factor for wound complication in DA patients. Obesity (particularly those with BMI ≥40 kg/m2) was a major risk factor for wound complication following direct anterior THA, with a considerable proportion of wound complications requiring reoperation. Although no patients with wound complication went on to develop deep infection, these findings should be taken into consideration prior to performing direct anterior THA, particularly in morbidly obese patients.

Preoperative Hip Injections Increase the Rate of Periprosthetic Infection after Total Hip Arthroplasty

William W. Schairer, MD, Benedict U. Nwachukwu, MD, MBA, Stephen Lyman, PhD, David Mayman, MD, Seth Jerabek, MD

Introduction: Intraarticular injections are diagnostic and therapeutic. For patients who then receive total hip arthroplasty (THA), there is a theoretical risk of periprosthetic joint infection (PJI) from direct inoculation and/or immune suppression by corticosteroids. Available data are inconclusive, likely due to small sample sizes. This study utilized large population-level databases to evaluate the effect of preoperative hip injection on the one-year rate of PJI in patients undergoing primary THA.

Methods: The Statewide Ambulatory Surgery and Inpatient Databases (SASD and SID) for Florida and California (2005-2012) contain 100% of patient visits. Primary THA patients (except after hip fracture) were included (ICD-9 81.51). We excluded patients with less than one year of available follow-up or without a three-month pre-operative window to observe possible injection (CPT 20610). Patients were grouped as no injection, or pre-THA injection at 12-18 weeks, 6-12 weeks, or 0-6 weeks. We tracked patients for hospital readmission with periprosthetic infection within one year (ICD-9 996.66 or 996.67). PJI rate was measured using Kaplan-Meier failure analysis. Risk Cox proportional hazards estimated risk, reported with hazard ratios (HR), adjusted for age and gender.

Results: 196,521 patients were included; 3,688 (1.9%) received a pre-THA injection: 1,268 patients within 12-18 weeks, 1,562 patients within 6-12 weeks, and 858 patients within 0-6 weeks. The one-year PJI rate was 0.87% in non-injection patients (baseline), 0.87% in the 12-18 week group (HR=1.01, p=0.985), 1.34% in the 6-12 week group (HR 1.58, p=0.038), and 1.52% in the 0-6 week group (HR 1.76, p=0.042).

Conclusion: This large population-level study provides strong evidence of increased risk of PJI when injections are administered within 12 weeks before THA (number needed to harm = 189). THA should not be performed within three months of hip injection to avoid elevated risk of infection, but appears safe if performed more than three months pre-operatively.

Does the Timing of Previous Intra-articular Steroid Injection Affect the Rate of Postoperative Infection after TKA?

Jourdan M. Cancienne, MD, Brian C. Werner, MD, James A. Browne, MD

Introduction: While intra-articular corticosteroid injections for symptomatic relief of knee osteoarthritis are generally regarded as safe, conflicting evidence exists about the association between pre-operative injection and postoperative periprosthetic joint infection (PJI) following total knee arthroplasty (TKA). The goal of the present study was to use a national database to evaluate the association between preoperative intra-articular knee injection at different time intervals and post-operative PJI after TKA.

Methods: A national insurance database was queried for patients who underwent total knee arthroplasty following ipsilateral knee injection between 2005 and 2012. Three injection cohorts were created: injection between 0 and 3 months (n = 5,313), 3 and 6 months (n = 8,919), and 6 and 12 months (n = 8,008) prior to ipsilateral TKA. A control cohort was created by matching patients who underwent TKA without prior injection based on age, gender, obesity, diabetes, and smoking. Infection rates within 3 and 6 months postoperatively were assessed using ICD-9 and CPT codes. Statistical comparisons of cohort demographics and postoperative infections were completed with Pearson x2 analysis.

Results: The injection cohorts were well-matched to the control cohort as there were no significant differences in any assessed demographics between groups. The incidence of PJI after TKA at 3 months (2.6%, OR 2.0, $P < 0.0001$) and 6 months (3.41%, OR 1.5, $P < 0.0001$) was significantly higher in patients who underwent injection within 3 months prior to TKA compared to matched controls [Table 1A-B]. There was no significant difference in infection rates in patients who underwent TKA between 3-12 months after injection compared to matched controls.

Conclusion: The present study demonstrates a significant increase in postoperative PJI in patients who underwent ipsilateral intra-articular knee injection within 3 months prior to TKA. This association was not noted when TKA occurred more than three months after knee injection.

The Risk of an Infection Associated with Intra-articular Injections Prior to Total Knee Arthroplasty

Nirav H. Amin, MD, Giles R. Scuderi, MD, Fred D. Cushner, MD, Didi Omiyi, MD, Bozena Kuczynski, PA-C

Introduction: Intra-articular injections have become a commonly utilized practice to treat patients with osteoarthritis (OA) of the knee. According, the literature has reported up to 30% of patients undergoing a total knee arthroplasty (TKA) will have an intra-articular injection prior to the TKA.

Methods: The risks associated with an intra-articular injection prior to a total knee arthroplasty (TKA) were identified. 1,628 patients were retrospectively studied over a seven-year time period. The patients were divided into two groups; patients who received an intra-articular injection prior to a TKA and patients who did not receive an injection prior to a TKA. The patients who received an injection were subdivided into separate groups; 3-month intervals from 0-3 months, 3-6 months, 6-9 months, 9-12 months, and greater than 12 months. During that time interval the patients who received an injection greater than 12 months prior to a TKA and/or no injection were grouped into the control group.

Results: There were 16 deep infections identified (0.98%). 10 deep infections were identified in the patients who did not receive an injection prior to a TKA (1.18%). 6 deep infections were identified in patients who received an intra-articular injection prior to a TKA (0.77%).

Conclusion: There does not appear to be a correlation with the timing of intra-articular injections and an increased risk of a deep infection with steroid and/or viscosupplementation injections prior to a TKA.

Rate and Risk Factors for Periprosthetic Joint Infection after Same-day and Staged Bilateral Total Hip Arthroplasty

Georgios K. Triantafyllopoulos, MD, MSc,
Lazaros A. Poultsides, MD, PhD, MSC,
Stavros G. Memtsoudis, MD, PhD, Wei Zhang, PhD, MS,
Yan Ma, PhD, Thomas P. Sculco, MD

Introduction: Selected patients with bilateral hip disease may undergo same-day (SD) bilateral Total Hip Arthroplasty (BTHA), whereas others are treated with staged procedures. Our purpose was to compare the odds and identify risk factors for deep periprosthetic joint infection (PJI) among patients undergoing SDBTHA versus staged procedures (within 1 year, or more than 1 year apart).

Methods: Clinical characteristics of patients subjected to SD and staged BTHA between 1/1999 and 12/2013 were retrospectively reviewed (including demographics, comorbidities [Deyo comorbidity index], cumulative length of stay [LOS], primary diagnosis, total/allogeneic transfusion rate). Minimum follow-up was 17 months. A multivariate logistic regression model was constructed to determine differences in odds for PJI between the three groups, adjusted for patient demographics, Deyo index, LOS, primary diagnosis, and blood transfusion parameters. Significance level was set at 0.05.

Results: We identified 6,650 patients (2925 men, 3725 women; mean age 61.3±12.2 years). Of those, 1,808 underwent SDBTHA (Group A), 2,082 staged within 1 year (Group B), and 2,760 staged BTHA more than 1 year apart (Group C). Infection rates for Groups A, B and C were similar (0.5% vs. 0.24% vs. 0.5%, respectively; p=0.3061). The odds for PJI in Group A were similar compared both to Group B (OR=0.632, 95%CI [0.203, 1.962], p=0.4269), and Group C (OR=1.391, 95%CI [0.516, 3.746], p=0.514). Women had 66.1% lower odds of PJI (OR=0.339, 95%CI [0.16, 0.72], p=0.0049) than men. Patients with inflammatory arthritis had 632% (OR=7.321, 95%CI [1.912, 28.028], p=0.0037) higher odds of PJI than patients with degenerative arthritis. Patients receiving allogeneic transfusion had 166% higher odds of PJI than those not subjected to allogeneic transfusion (OR=2.661, 95%CI [1.198, 5.911], p=0.0162).

Conclusion: PJI rates for SD and staged BTHA are similar. Male gender, inflammatory etiology and allogeneic transfusion are significant risk factors for PJI in patients undergoing same-day or staged BTHA.

Implications of Hypoalbuminemia in Revision Total Joint Arthroplasty

Daniel D. Bohl, MD, Mary R. Shen, MS, Erdan Kayupov, BSE, Gregory L. Cvetanovich, MD, Craig J. Della Valle, MD

Introduction: Several studies have suggested that malnutrition may be associated with periprosthetic joint infection (PJI). However, strong evidence for this association is lacking. The purpose of the present study was to determine if the proportion of patients with hypoalbuminemia (a proxy for malnutrition) differs among patients with a septic indication as opposed to an aseptic indication for revision TJA. Further, among patients undergoing revision for an aseptic indication, is hypoalbuminemia predictive of subsequent acute postoperative PJI?

Methods: Patients undergoing revision hip or knee arthroplasty were identified in the American College of Surgeons National Surgical Quality Improvement Program. Hypoalbuminemia (albumin <3.5g/dL) was tested for association with septic versus aseptic indication for revision. Among the subset of patients undergoing aseptic revision, hypoalbuminemia was tested for association with PJI within 30 postoperative days. All analyses were adjusted for differences in demographic, comorbidity, and procedural characteristics.

Results: Of the 4,517 patients identified, 715 (15.8%) underwent revision for PJI. Patients undergoing revision for a septic indication had a higher rate of hypoalbuminemia (42.8% versus 11.8%; relative risk [RR]=3.6, 95% confidence interval [CI]=3.2-4.1, p<0.001). Of the 3,802 patients who underwent revision for an aseptic indication, patients with hypoalbuminemia had a higher rate of acute postoperative PJI (4.5% versus 2.1%; RR=2.1, 95% CI=1.2-3.5, p=0.005).

Conclusion: Patients undergoing revision for a septic indication were over 3 times as likely to be hypoalbuminemic compared with patients undergoing revision for an aseptic indication. Further among patients undergoing revision for an aseptic indication, hypoalbuminemia resulted in a 2-fold increase in risk for PJI within 30 days. As both results are fully adjusted for differences in demographic, comorbidity, and procedural characteristics, these findings add to the evidence that malnutrition predisposes to PJI. Further studies are required to determine if hypoalbuminemia is a modifiable risk factor for acute postoperative and chronic PJI.

No Advantage to Prolonged Antibiotic Therapy Following Total Hip Arthroplasty Irrigation and Debridement

Sumon Nandi, MD

Introduction: Irrigation and debridement (I&D;) with exchange of modular components for the treatment of acute hematogenous total joint arthroplasty infection has a successful clearance rate of 40 to 60%. It is generally accepted that more severe infections require longer duration of antibiotic therapy. The optimal duration of antibiotic therapy following I&D; with modular component exchange has not yet been established. Our aim was to determine if antibiotic duration affects infection-free survival following total hip arthroplasty (THA) I&D; with head and liner exchange.

Methods: We retrospectively reviewed patients at our institution who underwent THA I&D; with head and liner exchange for acute hematogenous infection from 2007 to 2012 with minimum 2-year follow-up. Infecting organisms, duration of postoperative antibiotic therapy, and reoperation for infection recurrence were recorded. Cox proportional hazards model was used to test the effect of antibiotic duration on infection-free survival. With a hazard ratio of 0.42, the power to detect an effect of antibiotic duration on infection-free survival is 0.80.

Results: From 2007 to 2012, there were 52 patients who underwent THA I&D; with head and liner exchange. 42 of these patients with acute hematogenous gram positive cocci infection were used for analysis. 9 patients (21%) required reoperation for infection recurrence. Total postoperative antibiotic duration (intravenous followed by oral) ranged from 6 to 111 weeks. Antibiotic duration did not affect infection-free survival [hazard ratio 0.97, 95%CI 0.93-1.01, p=0.1084].

Conclusion: Our study suggests there is no advantage to antibiotic therapy of greater than 6-weeks duration following THA I&D; with head and liner exchange for acute hematogenous gram positive cocci infection.

Administration of Vancomycin to Patients with a Reported Penicillin Allergy During Total Joint Arthroplasty Results in a Higher Rate of Infection with Gram Negative Organisms

Timothy L. Tan, MD, Bryan D. Springer, MD, John Ruder, MD, Michael R. Ruffolo, MD, Claudio Diaz Ledezma, MD, Javad Parvizi, MD, FRCS, Antonia F. Chen, MD, MBA

Introduction: Perioperative antibiotic prophylaxis remains one of the most important strategies for prevention of periprosthetic joint infection (PJI) with current guideline recommending a first or second generation cephalosporin. Penicillin (PCN) allergy is often reported by patients, which often results in avoidance of cephalosporins due to fear of cross-reactivity. Alternative medications, such as vancomyin, are often used despite reduced antimicrobial coverage. The purpose of this study was to determine if PCN allergic patients who received vancomycin alone prior to elective primary total joint arthroplasty were at increased risk of developing a subsequent PJI.

Methods: A retrospective review of 11,423 primary total joint arthroplasties (TJAs) was performed between 2005 and 2013 at two institutions. Patients reporting PCN or cephalosporin allergy were electronically queried from the anesthesia note. Patients who received multiple prophylactic antibiotics, had unavailable perioperative antibiotic information, or those who received medication other than cefazolin and vancomycin were excluded. PJI was then determined using ICD-9 codes followed by a manual review of the medical record.

Results: The rate of PJI was 1.6% (48/2985) in patients with a reported PCN allergy that received vancomycin alone versus 1.8% (152/8538) in non-PCN allergic patients that received cefazolin alone. Multivariate analysis did not detect an increased risk of PJI when vancomycin was administered alone (odds ratio (OR): 0.9, p=0.53). Patients receiving vancomycin alone had higher rates of Gram negative PJI (OR: 2.4, p=0.05) but lower rates of PJI with antibiotic resistant organisms (OR: 0.2, p=0.04).

Conclusions: While administration of perioperative prophylactic vancomycin alone during elective primary arthroplasty does not seem to result in a higher rate of subsequent PJI, patients who received vancomycin alone developed a higher rate of infection with Gram negative organisms. Future studies are needed to determine the most appropriate prophylactic antibiotic for patients who undergo elective arthroplasty and report PCN allergy.

Quantifying and Predicting Surgeon Work Effort for Primary and Revision Total Knee Arthroplasty

Kevin Jeffrey Bunn, MD, Mark J. Isaacson, DO, Sabir K. Isamaily, BS, Philip C. Noble, PhD, Stephen J. Incavo, MD

Introduction: The additional work required for a revision total knee arthroplasty (TKA) compared to a primary total knee arthroplasty is well noted by surgeons but has not been fully quantified. Revision surgeons acknowledge increased time and resources are required for revision surgery preoperatively, intraoperatively, and postoperatively. Average Medicare hospital payment ($13,464 for primary and $17,331 for revision TKA) represents a 29% increase. The focus of this study is quantify the increased utilization of resources in revision TKA and to determine the preoperative factors that predict the outcome measures.

Methods: A total of 78 patients who underwent revision TKA were compared to 80 patients who underwent primary TKA. All operations were performed at our institution by one of four surgeons. Primary outcomes measured were surgical time, estimated blood loss, length of stay, and complications.

Results: Revision TKA had 49% increased surgical time compared to primary TKA (77.9 minutes vs 116.3 minutes, $p<0.001$). EBL was increased 91% in the revision group (60.3 mL vs 115.4 mL, $p=0.014$). There were two superficial infections and two deep infections in the revision TKA group, and the primary TKA group experienced no infections. Significant tibial and femoral bone loss were associated with increased surgical time ($p=0.03$, 0.02 respectively). Use of longer stemmed tibial components was associated with increased surgical time ($p=0.02$).

Conclusions: Revision total knee arthroplasty had increased surgical time, EBL, and complications compared to primary TKA. Longer surgical time was associated with prior revision surgery, long stemmed components, and increased bone loss. Examining these limited values, which likely underestimate overall surgeon work effort, demonstrates a substantial increase in work effort not commensurate with current Medicare reimbursement. Inadequate reimbursement for revision TKA may lead to limited patient access to care.

Results of Contemporary Rotating Hinge Total Knee Arthroplasties

Matthew P. Abdel, MD, Umberto Cottino, MD,
David G. Lewallen, MD, Arlen D. Hanssen, MD

Introduction: Rotating hinge (RH) total knee arthroplasties (TKAs) are considered salvage procedures. While excellent immediate stability is achieved, the historically high failure rate has tempered their use. The goal of this study was to determine the clinical outcomes, radiographic results, and survivorship of contemporary RH TKAs in the largest series to date.

Methods: We identified 408 consecutive RH TKAs implanted for non-oncologic indications between 2002 and 2012 at a single academic institution. 268 (66%) RH TKAs were implanted for aseptic etiologies, while 140 (34%) were utilized for reimplantations. In 74 cases (18%), a RH was used in a primary setting, whereas it was implanted in 334 (82%) as a revision construct. Clinical outcomes were assessed with Knee Society (KS) scores, and Kaplan-Meier survivorship analyses were completed at 10 years. Mean age was 69 years. Mean follow-up was 4 years.

Results: At most recent follow-up, the mean KS Knee score increased to 81 ($p<0.0001$), and the mean KS Functional score increased to 36 ($p<0.0001$). At a mean of 4 years, 17% of tibial components were radiographically loose, as were 8% of femoral components. Metaphyseal cones were used in 112 knees (27%). At most recent follow-up, 59 revision procedures and 25 reoperations had been performed. Survivorship free of any revision was 90% at 2 years and 67% at 10 years. Survivorship free of aseptic loosening was 98% at 2 years and 94% at 10 years. Survivorship analysis revealed a trend toward lower risk of revision (HR 1.42) and reoperation (HR 1.55) in patients with cones despite their use in the most severe of bone defects.

Conclusion: Contemporary RH TKAs have markedly improved 10-year implant survivorship free of aseptic loosening to 94%. Greater emphasis on metaphyseal fixation has aided in this improvement. Patients can also expect a significant improvement in clinical outcomes.

The Outcome of Semi-constrained Rotating-platform Implants for Revision Total Knee Arthroplasty

Casey Stuhlman, MD, Eric Wagner, MD,
Benjamin Wilke, MD, Robert Trousdale, MD

Introduction: Semi–constrained total knee arthroplasty (TKA) implants are commonly utilized to provide additional stability in the revision setting. Rotating-platform (RP) implants have been hypothesized to reduce the transmission of shear stress created by increased constraint. The purpose of this study was to evaluate the outcomes of semi-constrained RP implants in the revision setting.

Methods: Utilizing our institution's Total Joint Registry, we reviewed all patients who underwent a revision TKA with a semi-constrained RP implant from January 2006 to December 2008. Forty-eight patients were reviewed, 52% of which were female. The predominant indication for revision was component loosening (31.3%), while staged reimplantation following prior infection (27.1%) was the second most common. The average patient age was 66.8 years (range, 43 – 88 years) and the average BMI was 33.1 (range, 22 – 49).

Results: The mean duration of follow-up was 5.7 years (range, 4 – 7.6 years). Repeat revisions were performed in 3 patients (6.25%), including 1 isolated femoral revision, 1 revision of all components, and 1 resection arthroplasty and antibiotic spacer placement. The 2 and 5-year survival rates were 98% and 96%, respectively. There was no evidence of periprosthetic osteolysis or tibial implant loosening at final follow-up. The mean Knee Society Clinical and Functional Scores improved from 49.8 to 84.6 and 47.9 to 60.5, respectively, at final follow-up. Eight-five percent of patients reported an improvement in their knee. The mean ROM improved from 77.7 degrees preoperatively to 101.8 degrees, with 90% of patients having greater than 90 degrees ROM at final follow-up. Seventy-five percent of patients reported minimal or no pain at latest follow-up. No factors had a significant impact on complications, revision rates, or clinical outcomes.

Conclusion: The semi-constrained RP implant used in revision total knee arthroplasty has acceptable implant survival and functional outcomes in the mid-term follow-up period.

More Metal, More Problems – Length of Endoprosthetic Reconstruction in Revision Arthroplasty is Associated with Complications and Reoperations

Jeffrey Barry, MD, Zachary Thielen, MD, David Sing, BS, Paul Yi, MD, Erik Hansen, MD, Michael Ries, MD

Introduction: Complex revision arthroplasty often requires endoprosthetic reconstruction due to substantial bone loss, poor bone quality, soft tissue insufficiency and infection. Prior studies have reported on single types of endoprostheses. We hypothesize that length of endoprosthetic reconstruction correlates with decreased implant survivorship and increasing rates of complications including infection and reoperation.

Methods: All TKA's for segmental distal femoral bone loss treated with femoral endoprosthetic reconstruction for non-tumor diagnoses from 1995-2013 were retrospectively reviewed. Cases were categorized as distal femoral replacement (DIS), diaphyseal femoral replacement (DIA), or total femoral replacement (TFR). Patient demographics and outcome variables including number of prior surgeries, reoperations, infections, implant survival, and ambulatory status were collected. Minimum length of follow-up was 2 years or explantation.

Results: Of 52 patients, 36 (12 DIS, 10 DIA, 14 TFR; average follow-up 4.5 years) met inclusion criteria for outcomes analysis after follow-up losses and 2 perioperative mortalities. Larger endoprostheses had higher numbers of prior surgeries (DIS=3.9, DIA=3.1, TFR=11.8, p=0.002), higher all-cause reoperation rates (DIS=33%, DIA=90%, TFR=64.3%; p=0.029) and higher infection rates (DIS=25%, DIA=90%, TFR=57%; p=0.009). Infection free survival at 2 years (DIS=70%, DIA=20%, TFR=58%) and 5 years (DIS=70%, DIA=10%, TFR=25%) was worse for larger implants (p=0.022). With numbers available, trends towards higher rates of chronic antibiotic suppression (DIS=16.7%, DIA=60%, TFR=50%; p=0.088) were seen. Consequently, larger implant survival rates were more comparable but still significantly worse at 2 years (DIS=100%, DIA=40%, TFR=85%) and 5 years (DIS=90%, DIA=30%, TFR=72%; p<0.001). Ambulatory status was similar between all groups with 69.7% ambulatory at last follow-up.

Conclusion: Endoprosthetic replacement of the distal femur is indicated for treatment of failed TKA with segmental distal femoral bone loss and can restore satisfactory ambulatory function. Reoperation and infection rates are higher for segmental endoprosthetic replacement extending proximal to the supracondylar metaphyseal-diaphyseal junction compared to distal femoral replacement.

Utility and Reliability of Fluorscopic Images in Determining Loosening in Total Knee Arthroplasty

Peter K. Sculco, MD, Brian P. Chalmers, MD, Keith Fehring, MD, Michael Taunton, MD, Robert T. Trousdale, MD

Introduction: Pain after total knee arthroplasty (TKA) may be secondary to implant loosening, which is challenging to diagnose on standard radiographs. Fluoroscopic images that enhance the implant interfaces are often obtained, but their utility and reliability has not been studied. We sought to determine if these fluoroscopically guided images improved the sensitivity, specificity, intraobserver, and interobserver reliability of determining clinically relevant loosening in TKA components compared to standard radiographs.

Methods: Standard radiographs and fluoroscopically enhanced images were retrospectively obtained from sixty patients with painful TKAs undergoing revision. Thirty knees revised for aseptic loosening and, for a control, thirty knees for other indications were reviewed. The radiographs were randomized, and two reviewers independently determined whether each tibial and femoral component was clinically loose. We then analyzed the sensitivity, specificity, and intra- and inter-observer reliability.

Results: Enhanced fluoroscopic images improved the detection of clinical loosening in tibial components compared to standard radiographs (87.5% vs. 74.5% respectively, p=0.002). Sensitivity in detecting femoral component loosening was poor overall and was not improved by fluoroscopic images vs. standard radiographs (57.5% vs 57% respectively, p=0.9). For the tibial component, specificity was not improved by fluoroscopic images over standard radiographs (89% vs 88.5% respectively, p=0.9). However, specificity for the femoral component was significantly worse in fluoroscopic vs. standard radiographs (81% vs. 87% respectively, p=0.03).

Conclusion: Fluoroscopically guided radiographs significantly increased the sensitivity of detecting tibial component loosening. The detection of femoral component loosening was poor for both imaging types, but fluoroscopic radiographs may increase the false positive rate for detecting femoral loosening. Interobserver and intraobserver reliability was not significantly improved with the use of fluoroscopic images.

The Fate of Revision Total Knee Arthroplasty with Preoperative Abnormalities in Either Sedimentation Rate or C-reactive Protein

John M. Hardcastle, MD, David H. So, MD, **Gwo-Chin Lee, MD**

Introduction: While septic failures usually have elevations of both markers and aseptic failures have normal levels of both ESR and CRP, there are instances during which one of the 2 markers is abnormal. The purpose of this study is to evaluate the outcome of patients with failed TKAs and a single abnormality in either ESR or CPR prior to revision TKA.

Methods: We retrospectively reviewed 1007 consecutive revision TKAs from 2003 to 2011. Following initial exclusion for sepsis, periprosthetic fracture and incomplete clinical data, analysis was performed on 458 aseptic revisions. There were 131 revision TKAs with 1 elevated marker (28.6%). Patients with less than 24 months follow-up or undergoing reimplantation from infection were excluded from final analysis, leaving 216 aseptic revisions (94 patients with 1 abnormal marker) All joints underwent preoperative aspiration and none met established criteria for infection. This group of patients was compared to a control group (n=122) undergoing revision for aseptic reasons with normal preoperative ESR and CRP. The primary outcome was re-revision TKA for any reason.

Results: The 2 groups were similar in terms of age, gender, ASA class, and Charlson Comorbidity Index. Patients with one abnormal marker were more likely to require reoperation (21% vs. 6.6%, OR=3.85, p=0.001) for infection (8.5% vs. 1.6%, OR=5.58, p=0.016) and for aseptic loosening (8.5% vs. 2.5%, OR=3.69, p=0.044). There was no difference in other failure modes following initial revision. The average time to revision in the study group was 28.3 months compared to 40.0 months in the control group (p=0.213).

Conclusions: A single abnormality in either the ESR or CRP increased the likelihood of both infection and reoperation following revision TKA. Additional tests including leukocyte esterase, genetic expression and/or biomarkers should be part of the diagnostic algorithm in these cases to help discern septic from aseptic failures.

Stability of Novel Porous Metal Metaphyseal Tibial Cones Designed for Surgical Efficiency is Comparable to Traditional Cones

R. Michael Meneghini, MD, Steven F. Harwin, MD,
Manoshi Bhowmik-Stoker, PhD,
Amanda Kirk, MS, Victor Krebs, MD

Introduction: Severe metaphyseal bone loss presents operative complexity to surgeons during revision total knee arthroplasty (TKA). Porous metal cones have shown high success rates in the setting of bone loss. However, existing cones have limitations such as a tedious surgical technique and limitations in size, which combine to potentially compromise stability and decrease surgical efficiency. The purpose of this study is to compare the initial mechanical stability of novel porous tibial cones designed to optimize surgical efficiency to traditional porous metal cones.

Methods: Mechanical testing of novel porous metal tibial cones and traditional porous tantalum cones was performed. Micromotion of the baseplate/cone construct with respect to the tibia was measured in 10 test models during a stair descent loading pattern. Six linear variable displacement transducers were placed on anterior, posterior, medial and lateral aspects of the construct to measure varus/valgus displacement, internal/external rotation, compression and lift off. Unpaired T-tests and one sided T-tests were used to evaluate statistical comparison of peak to peak micromotion, compression, and lift off.

Results: The novel porous metal tibial cones demonstrated similar micromotion values under loading compared to the traditional porous metal cones with the numbers available ($p \geq 0.05$) in internal external rotation, varus/valgus and lift off during a simulated stair descent activity. Less micromotion was observed in the novel porous metal cones in medial varus/valgus ($p=0.004$) and posterior compressive micromotion ($p=0.002$) compared to traditional porous tantalum cones.

Conclusion: Based on a stair-descent simulated biomechanical testing model, novel porous metal tibial cones designed for surgical efficiency demonstrated optimized stability and minimized micromotion compared to traditional porous tantalum metaphyseal cones. Corroboration of these biomechanical findings in short and long-term clinical studies is warranted.

Mid-term Results of Porous Tantalum Femoral Cones in Revision Total Knee Arthroplasty

G. David Potter, MD, Matthew P. Abdel, MD,
David G. Lewallen, MD, Arlen D. Hanssen, MD

Introduction: Large femoral bone loss in the setting of revision total knee arthroplasty (TKA) is a challenging concern. The purpose of this study was to determine the mid-term clinical outcomes, radiographic fixation, and survivorship of tantalum femoral cones used during revision TKAs.

Methods: 159 highly porous tantalum metaphyseal femoral cones (157 patients) were implanted from 2003-2011 at a single institution. Knee Society scores, radiographic results, and implant survivorship were analyzed. The mean age was 64 years, with 52% being male. The mean follow-up was 5 years.

Results: The mean Knee Society score increased from 47 to 65 at most recent follow-up (p=0.105). Radiographically, all unrevised femoral cones were well-fixed without any evidence of loosening. At 5 years, 23 cones were revised: 14 for infection, 6 for aseptic loosening of the cone, and 3 for ligamentous instability. As such, the 5-year survivorship free from revision of the cone due to aseptic loosening was 96%, free from revision of the cone due to any reason was 84%, and free of any reoperation was 70%.

Conclusion: In largest series to date, femoral cones remain a durable and reliable option for restoration of metaphyseal fixation during revision TKA with severe bone loss. As our experience has increased, such cones are now utilized with short cemented stems.

Effect of Diaphyseal-engaging Femoral and Tibial Stem Length on Mechanical Alignment in Revision Total Knee Arthroplasty

Rishi Balkissoon, MD, MPH, Raymond Yong, Jr., BA, Scott M. Sporer, MD, MS

Introduction: Restoration of neutral mechanical alignment (MA) during primary total knee arthroplasty (TKA) has long been an accepted goal to prevent early implant failure. In revision TKA malalignment has also been demonstrated to affect implant survival. Optimal stem length for femoral and tibial components in revision TKA remains controversial. Few studies demonstrate the effect of stem length on MA after revision TKA. We propose that short diaphyseal-engaging stems are more likely to result in optimal MA, while long diaphyseal-engaging stems may be more susceptible to malpositioning by subtle diaphyseal bowing resulting in greater deviation from neutral MA.

Methods: We retrospectively evaluated preoperative and postoperative MA in 182 patients undergoing revision TKA using Zimmer NexGen LCCK stemmed components by a single surgeon. Subjects were stratified by tibial and femoral stem length to determine the relationship between stem length and postoperative MA by two-tailed t-testing to compare means with 5% level of significance.

Results: No differences in postoperative MA were seen when long (155 mm) femoral stems paired with any tibial stem (n=109, μ=0.97 degrees varus ±2.81 degrees) were compared to short (≤ 100 mm) femoral and tibial stems (n=71, μ=0.70 degrees varus ±2.10 degrees), p=0.24. This was similar when long femoral and long tibial stems were used (n=18, μ=0.72 degrees varus ±3.1 degrees), p=0.49; when any femoral stem was paired with long tibial stems (n=19, μ=1.34 degrees varus ±2.98 degrees), p=0.20; or when long femoral stems were paired short tibial stems (n=91, μ=0.86 degrees varus ±2.80 degrees), p=0.35. A short femoral stem was paired with a long tibial stem in a single subject resulting in a 3.5 degree varus MA.

Conclusion: Restoration of neutral mechanical alignment may be achieved when hybrid diaphyseal-engaging stems are used for revision TKA regardless of femoral or tibial stem length.

Comparison of Articulating Spacer Techniques in Revision Total Knee Arthroplasty for Sepsis. A Metanalysis.

John Casey Spivey, MD, **George N. Guild III, MD,** Giles R. Scudari, MD

Introduction: Periprosthetic infection after total knee arthroplasty is a devastating complication following total knee arthroplasty. Articulating spacers are an effective method in treating periprosthetic joint infections, but the optimal articulating spacer construct has yet to be identified. This systematic review of the literature was performed to determine which method is superior in regards to outcome scores, range of motion, infection eradication, and ease of reimplantation.

Methods: Databases were searched and included MEDLINE, MEDLINE In-Process, EMBASE, BIOSIS, Clinicaltrials.gov and Cochrane Database of Systematic Reviews identifying 34 articles meeting inclusion criteria producing 1053 spacers for comparison.

Results: There was no difference in pre-operative and post-operative Knee Society Scores between the four articulating spacer groups ($P < 0.09$ and $P < 0.64$). Cement on cement-prefabricated spacers had an increased pre-operative range of motion of 74.5 o ± 7.8 ($P < 0.006$), however the post-operative range of motion of 87.0 ± 14.7 was statically lower ($P < 0.03$) when compared to the other spacers. There was no significant differences ($P < 0.24$) on interim range of motion among the spacer groups. No statistical differences on re-infection rates exist among the four types of articulating spacers ($P < 0.68$). Difficulty of re-implantation was similar between groups ($P < 0.10$). There were less spacer specific complications with the metal on polyethylene compared to the other groups ($P < 0.043$) and no spacer fractures.

Conclusion: The four groups of articulating spacers provided similar KSS scores, and ease of re-implantation. The cement on cement-prefabricated spacers had a significantly lower post-operative range of motion when compared to the other spacers. Also no statistical differences in re-infection rates existed among the evaluated spacers. The metal on polyethylene group however avoided the unique complication of spacer fracture and had a lower overall mechanical complication rate.

Long-term Mortality following Revision Total Hip Arthroplasty (THA)

Hilal Maradit Kremers, MD, MSC, Matthew P. Abdel, MD,
Jeanine E. Ransom, BS, Daniel J. Berry, MD, David G. Lewallen, MD

Introduction: Mortality following primary THA is lower than the general population, but it is unknown whether this is true following revision THA. We examined long-term mortality following revision THA.

Methods: The study included 5417 revision THAs performed at a large medical center between 1969 and 2011. Surgical indications for revision THA were grouped into 3 categories: prosthetic joint infections (938, 17%); fractures (646, 12%); and loosening, wear, or dislocation (3833, 71%). Patients were followed up at regular intervals until death or last clinical follow-up. Relative mortality was evaluated using the person-years approach. The observed number of deaths in the revision THA cohort was compared to the expected number of deaths using the United States life tables and the standardized mortality ratios (SMR). SMR were calculated overall and the 3 subgroups surgical indications.

Results: Mean age was 65 years and 56% were male. During follow-up, we identified a total of 2468 deaths in this cohort as compared to 2507 expected deaths. Although the overall age- and sex-adjusted mortality was similar to the general population (SMR: 0.985, 95% CI: 0.946, 1.024). 98), there were differences across the 3 indication groups. The risk of death was elevated among patients who underwent revision THA for infections (SMR: 1.256, 95% CI: 1.135, 1.386). Risk of death was similar to the general population among patients who underwent revision THA for fractures (SMR: 1.097, 95% CI: 0.982, 1.221). Risk of death was lower than the general population among patients who underwent revision THA for aseptic loosening, wear, dislocation (SMR: 0.921, 95% CI: 0.879, 0.966).

Conclusion: Long-term survival following revision THA differs according to surgical indications. Survival is better than the general population among patients whose surgery was for aseptic, mechanical reasons whereas survival is worse than the general population for patients with prosthetic joint infections.

Modular Fluted Tapered Stems in Aseptic Revision Total Hip Arthroplasty

Matthew P. Abdel, MD, Umberto Cottino, MD,
David G. Lewallen, MD, Daniel J. Berry, MD

Introduction: Titanium modular fluted tapered (TMFT) stems have become one of the most commonly used method in North America. However, results have been limited. The goal of the current study was to determine the results of TMFT stems utilized in aseptic revision total hip arthroplasties (THAs) in largest series to date.

Methods: We identified 519 femoral revisions performed for aseptic loosening treated with a TMFT stem. Paprosky classification was used to classify bone loss: 0.5% had a type 1, 16% type 2, 42% type 3A, 19.5% type 3B, and 22% type 4. Median stem diameter was 18-mm. Harris hip score [HHS]), radiographic stability, and Kaplan-Meier survivorship were assessed. Mean age was 70 years, mean BMI was 29 kg/m2, and mean follow-up was 4 years.

Results: The mean HHS improved significantly from a preoperative of 51 to 76 at 2 years ($p < 0.001$) and was maintained at 10 years (HHS = 75). At most recent follow-up, there were 16 femoral revisions (7 for aseptic loosening, 3 for instability, 4 for infection, and 2 for periprosthetic fracture). In addition, another 12 reoperations occurred. There was no difference in failure rate between the different preoperative bone loss categories. The 10-year survivorship free of femoral revision for aseptic loosening was 98%, free of femoral revision for any reason was 96%, and free of any reoperation was 87%. Implant survivorship free of aseptic femoral loosening was not correlated with gender ($p= 0.39$). In living and unrevised patients, early stem subsidence occurred in 17 patients (mean = 15-mm). However, all subsequently stabilized and none had loosening.

Conclusions: In this large series, TFMTs provided a high rate of survivorship free of aseptic femoral loosening and free of femoral revision for any reason at 10 years. The high rate of long- term femoral fixation occurred across all categories of preoperative bone loss.

Tapered vs. Cylindrical Stem Fixation Stability in a Femoral Bone Loss Model

Robert D. Russell, MD, Bill Pierce, BS, Michael H. Huo, MD

Introduction: Distal fixation achieved with a tapered stem design has demonstrated favorable clinical results in revision total hip arthroplasty in the setting of severe bone defects. However, stem subsidence is common with this stem design. The purpose of this study is to compare the initial fixation stability of a tapered stem design to a fully porous coated cylindrical stem design in a model of severe femoral bone deficiency.

Methods: Tapered and cylindrical stems (n=8) were implanted into a Sawbones model with progressively shorter segments for fixation (9 cm, 6 cm, or 3 cm). The stems were axially loaded, and the force to produce subsidence was recorded.

Results: Average loads to produce 150 μm of displacement with a 3 cm segment were higher for the tapered stem (393 N vs 221 N, $p>0.01$). There was no difference in the average force to produce 150 μm of displacement in the 6 cm or 9 cm segments. Average loads to produce failure (4 mm subsidence) were also higher for tapered stems with a 3 cm segment (1574 N vs. 500 N, $p<0.0001$). A regression analysis determined the minimum segment length of 1.5 to 2.5 cm to obtain stable fixation with a tapered stem design ($R2=0.78$, $p<0.001$).

Conclusion: Tapered stems required higher loads to produce subsidence than cylindrical stems in a revision THA model. Revision tapered stems require a minimum intact segment of 1.5 to 2.5 cm to obtain adequate initial fixation stability. Revision tapered stems have superior initial fixation stability to cylindrical stems in the setting of severe bone loss.

Assessment of Polyethylene Surface Damage on a Dual Mobility Acetabular System

Chelsea N. Koch, BS, Christina I. Esposito, PhD,
Timothy M. Wright, PhD, Geoffrey H. Westrich, MD

Introduction: Dual mobility total hip arthroplasty (THA) designs were introduced to increase stability, but limited data exist about their in vivo wear performance. We assessed polyethylene surface damage on retrieved dual mobility components, categorized deformation patterns, and evaluated the intraprosthetic dislocation of the construct.

Methods: Retrieved dual mobility liners were graded for polyethylene damage: 18 inner bearings and 32 outer bearings. Twelve liners were tested to determine the dislocation force when levering the head from the liner by applying load 100mm from the head at 20N/s. A coordinate measuring machine (CMM) was used to measure 28 inner and 24 outer bearings. Comparisons between CMM scans of retrieved and size-matched pristine inserts were made to assess the amount and patterns of surface deformation.

Results: Inner bearings had more scratching, pitting, and embedded debris ($p<0.001$ for all), and less deformation and burnishing ($p<0.001$; $p=0.01$) than outer bearings. SEM imaging showed embedded metallic particles (identified as titanium alloy using EDAX) ranging from 100-350μm on both bearings. The average lever-out load was 261 ± 52N. No difference was found in lever-out load among outer diameter sizes ($p=0.122$), and no correlation existed between lever-out load and the time the components had been implanted ($p=0.91$). Dislocation was due to locking mechanism failure, as confirmed by CMM profiles. Average deformation was higher for inner than outer bearings (0.04±0.01mm vs. 0.02±0.03mm; $p<0.001$). 84% of outer bearings appeared unworn, 8% showed edge loading, 4% showed concentric wear, and 4% showed both edge loading and concentric wear. 88% of inner bearings showed concentric wear; the remainder appeared unworn.

Conclusion: Concern exists for wear related implications caused by the additional bearing in dual mobility THAs. In our series, inner bearings showed more evidence of damage than outer bearings, suggesting the primary source of motion occurs at the inner articulation.

XLPE Acetabular Liners Exhibit Damage after Short-term Articulation with Scratched OXINIUM Femoral Heads

Alberto Carli, MD, MSc, FRCSC, Chelsea N. Koch, BS,
Christina I. Esposito, PhD, Timothy M. Wright, PhD, Douglas E. Padgett, MD

Introduction: Recent reports demonstrated that oxidized zirconium (OxZr) heads can show evidence of scratching and significant surface damage upon retrieval. While simulator studies showed minimal wear of highly cross-linked polyethylene (XLPE) liners articulated with OxZr, no one has compared in vivo deformation and damage patterns on retrieved liners that had articulated against damaged and undamaged OxZr heads.

Methods: 42 XLPE liners and their articulating OxZr femoral heads were retrieved during revision surgery. All heads were graded for visual damage as pristine (grade 1), minimally scratched (grade 2), or severely scratched (grade 3). Surface roughness profiles were generated for the dominant scratch on each head using a non-contact interferomic profilometer. XLPE inserts were subjectively graded for surface damage. The severity of dimensional deviations on the inner XLPE bearings was determined from 3D laser scanning.

Results: Those liners that articulated with grade 3 heads exhibited significantly greater damage scores for abrasion ($p=0.008$) and embedded debris ($p=0.006$), and significantly greater average and maximum deviations ($p=0.018$; $p=0.039$, respectively) when compared to liners that articulated with grade 1 and 2 heads. Scratched heads were mostly from cases revised for dislocation (15 grade 3, and 3 grade 2 heads). Head scratch roughness was significantly correlated with abrasion, embedded debris, and total damage score of XLPE ($p=0.008$; $p=0.005$; $p=0.038$, respectively).

Conclusion: Patients with OxZr heads and a history of dislocation appear to have an increased prevalence of severe head damage that may lead to increased liner wear over time. We propose that OxZr patients with a history of dislocation be followed closely to assess for evidence of wear and/or osteolysis. In the event that you do revise a patient for recurrent dislocation, we recommend exchanging the OxZr head.

The Fate of Serum Cobalt following Revision of a Recalled Dual Modularity Femoral Component

Russell G. Cohen, MD, Sheridan L. Cohen, BSc Candidate, **Jim Nevelos, PhD**

Introduction: Dual modularity femoral components were designed to independently address offset, version and leg lengths. The fate of the taper at the neck-stem junction has been met with catastrophic failure in some designs.

Methods: A retrospective review of a single surgeons clinical experience revising 101 of 196 Rejuvenate stems (Stryker, Mahwah, NJ) was evaluated for the effects of surgery on the serum cobalt level. Only patients with a unilateral hip replacement with the recalled stem were included in the study. Preoperative cobalt levels were compared to blood levels drawn at six weeks and 6 months postoperatively. Intraoperative joint fluid cobalt levels were also evaluated and recorded for each patient.

Results: The average preoperative serum cobalt level was 7.9 parts per billion (range 2ppb-26ppb). The level of cobalt from joint fluid sampled at the time of surgery averaged 655 ppb (range 9ppb->1000ppb). The average drop in serum cobalt level at 6 weeks after revision surgery was 4.8 ppb, or an average of a 60% reduction. At 6 months post op, all patients had complete resolution of their serum cobalt to an undetectable range, regardless of the joint fluid cobalt level.

Conclusion: Revision of the corroded modular junction resulted in the resolution of cobalt from patients' blood without the need for additional modalities or therapies. Resolution occurred despite the very high intraarticular concentration found at surgery. These results allow the surgeon to provide a level of confidence to their patients who require removal of a failed dual modularity stem and the effect that the surgery will have on clearing the cobalt from their serum and the time frame for resolution of the abnormal circulating levels.

Dual Mobility Cups: An Effective Prosthesis in Revision Total Hip Arthroplasties for Preventing Dislocations

Michael A. Mont, MD, Julio J. Jauregui, MD, Todd P. Pierce, MD, Randa K. Elmallah, MD, Jeffrey J. Cherian, DO, Robert Pivec, MD, Bhaveen H. Kapadia, MD, Ronald E. Delanois, MD

Introduction: Post-operative dislocation is one of the most common complications following total hip arthroplasty (THA), and dual mobility articulations have been designed to provide greater hip stability. However, there are few studies that have assessed outcomes of these designs in revision THAs. Our purpose was to evaluate differences in dislocation rates, aseptic survivorship, and patient outcomes between dual mobility articulations and conventional arthroplasties in the revision setting.

Methods: Patients who underwent revision THA with dual mobility articulations (n=60) were matched (1:2) to patients who had conventional single articulation prostheses (n=120). They were matched for body mass index, age, gender, and Paprosky acetabular defect classification, and were followed up for a mean of 30 months (range, 18 to 52 months). The outcomes were evaluated pre-operatively and at final follow-up using Harris Hip Scores, the University of California Los Angeles activity scale, and the Short Form-36 questionnaires.

Results: The dual mobility group had lower dislocation (1.7% (1 out of 60) versus 5.8% (7 out of 120)) and aseptic loosening rates (1.7% (1 out of 60) versus 4.2% (5 out of 120)) compared to the control group. There were no significant differences in functional outcomes, activity level, or overall physical and mental health status between the two cohorts.

Conclusion: When used in the revision setting, dual mobility bearings had fewer dislocations. We believe that these designs may lead to clinically significant improvements in complications while also improving patient reported and functional outcomes, but larger cohort studies are necessary for evaluation.

Dual Mobility Articulations for Patients at High Risk for Dislocation

Darren R. Plummer, MD, MBA, Jonathan M. Christy, MD,
Scott M. Sporer, MD, Wayne G. Paprosky, MD, Craig Della Valle, MD

Introduction: Instability remains one of the most common complications following revision total hip arthroplasty (THA). Dual mobility articulations are a potential option for patients who are at high risk for postoperative instability following revision THA, although little data is available on their use in these most challenging cases. The purpose of this study was to evaluate the performance of dual mobility articulations in patients at high risk for dislocation following revision THA.

Methods: We reviewed the results of 36 consecutive revision THAs performed on patients considered high risk for instability. Indications for inclusion included abductor insufficiency, recurrent instability, failure of constrained liner, or inadequate intra-operative stability when trialing. Implants utilized included 13 monoblock dual mobility shells, 14 modular dual mobility shells, seven monoblock shells cemented into an acetabular component and two modular dual mobility liners cemented into an acetabular component. Patients were followed for a minimum of two years (mean 2.4, range 2 to 4 years) and evaluated clinically using the Harris Hip Score (HSS) and radiographically for implant loosening. Clinical outcomes were evaluated using a student's t-test with a p-value of < 0.05 considered significant.

Results: At a minimum of two years, there were four (11.1%) repeat revisions including both dual mobility liners that were cemented into an acetabular component and two for deep infection treated with a two-stage exchange. There was one dislocation that was successfully closed reduced. The mean HHS improved from 45 to 90 points ($p<0.05$), with 34 patients rated as a good or excellent outcome.

Conclusion: Dual mobility articulations are associated with a low rate of failure with no revisions for instability in this challenging group of patients. We strongly recommend against attempting to cement a dual mobility liner into an acetabular component as both constructs in this series failed rapidly.

Reduced Instability in Revision Total Hip Arthroplasties with Dual Mobility Constructs

Molly A. Keegan, MD, Peter Sculco, MD, Matthew P. Abdel, MD, Arlen D. Hanssen, MD, Michael J. Taunton, MD

Introduction: Instability is one most common complications of revision total hip arthroplasty (THA). Dual-mobility (DM) constructs and large femoral heads (i.e. 40-mm) are two feasible non-constrained bearing options used in revision THA to address instability. Currently, there are few large-scale studies comparing the outcomes of DM constructs to large femoral heads in the setting of revision THA.

Methods: From 2011 to 2013, a consecutive series of 238 revision THAs treated with either a DM construct or large femoral head (i.e.40-mm) were retrospectively reviewed. Primary endpoints included instability and revision for instability. 102 DM constructs and 136 large head revision THAs were identified. In the DM group, mean age was 67 and mean BMI was 29.8 kg/m2. In the large head group, mean age was 64 and mean BMI was 31 kg/m2. Median effective head size in the DM group was 46 mm.

Results: 31% of DM constructs were utilized for revision for a diagnosis of instability, whereas that rate was 5% in the large head group, indicating a bias to use DM constructs in the most difficult instability cases. Even with that bias, the instability rate was 3% in the DM group versus 8% in the large head group (p=0.09). Similarly, reoperation for instability was 0% in the DM group vs. 5% in the large femoral head group (p=0.02).

Conclusion: On review of 238 revision THAs, those receiving a dual-mobility construct had clinically lower rates of instability and reoperation, despite being 3-fold more likely to be used in revision cases for instability. These results suggest that dual-mobility constructs may reduce instability rates compared to large femoral heads. While larger numbers with extended follow-up are required, the early data is convincing. Summary: In revision THA, DM constructs may reduce instability rates compared with large femoral heads at short-term follow-up.

Outcomes of Custom Tri-flange Acetabular Components in Revision Total Hip Arthroplasty and Predictors of Failure

Brian T. Barlow, MD, Kathryn Oi, BA, Yuo-yu Lee, MS, Alberto Carli, MD, FRCSC, Mathias Bostrom, MD

Introduction: The purpose of the study is to assess the outcome of custom triflange acetabular components (CTAC) used for reconstruction of severe acetabular defects and to determine radiographic or patient factors predictive of failure.

Methods: A retrospective review of 63 patients with pre- and postoperative radiographs and >24 months of follow up was completed. Continuous variables were compared between failed versus successful CTAC using Wilcoxon rank-sum test. Categorical data were compared using Chi-square test or Fisher exact test, whenever appropriate. WOMAC scores were compared between failed versus successful CTAC using Wilcoxon rank-sum test.

Results: The failure rate of the CTAC was 15.6%. The average age was 62.7 years (SD ±1.73) and the mean BMI was 26.9 (SD ±0.77). Average follow up was 4.32 years (SD ±2.94). Patients had 2.08 revisions prior to CTAC implantation. The hip center in the CTAC was lateralized by 11.9mm (SD ±1.57mm) compared to the contralateral hip. This was increased to 18.29mm (SD ±4.5mm) in the group of failed CTAC compared to 9.86mm (SD ±1.79) in the intact group. The WOMAC pain score improved from 48.0 (±25.4) to 79.7 (±21.1) at most recent follow up ($p<0.0001$). The WOMAC stiffness score improved from 45.9 (±23.2) to 73.8 (±22.4) at most recent follow up ($p=0.0005$). The WOMAC function score improved from 38.9 (±14.2) to 79.3 (±22.0) at most recent follow up ($p=0.0002$). WOMAC scores were not significantly different between intact and failed CTAC.

Conclusion: CTAC have an approximately 85% survival rate at a mean follow up of 4.3 years. CTAC tend to lateralize the hip center by approximately 1.0cm and there is a trend towards nearly 2.0cm of lateralization in the small subset of failed CTAC. Future efforts should focus on medializing the hip center in CTAC to improve ingrowth and survivorship

Here Today, Gone Tomorrow: An Examination of the Survivorship of Orthopaedic Devices Advertised in a Major Medical Journal

Eric L. Smith, MD, Taryn LeRoy, BA, Jonas Miller, MS,
Mary E. Pevear, BA, Michael Baratz, MD, Charles Cassidy, MD

Introduction: Orthopaedic surgeons trust peer-reviewed journals to provide new information on techniques and products to enhance their practice. Medical journals contain advertisements marketing new products. To date there has not been an evaluation of the natural history of these advertised products. It was our observation that medical devices advertised in peer-reviewed journals were no longer clinically available five to ten years after being advertised. This retrospective study evaluates the availability of products advertised in a high-impact orthopaedic journal.

Methods: We created a database of 427 unique orthopaedic products advertised in the Journal of Bone and Joint Surgery (America) between 2003 and 2008. Products included implantable devices, medications, surgical instruments, and biological products. Product information was collected from company filings, FDA databases, and industry databases such as DynaMed. Additionally, we consulted sales representatives - in person and on the phone as well as currently practicing orthopaedic surgeons to verify findings. Products were categorized as: available (current form), available (modified), available (under different company), available (temporary recall), discontinued (voluntarily), and discontinued (forced recall).

Results: Of the 427 products assessed, 13.8% were discontinued five to ten years after being advertised. Three percent were discontinued via forced recall and 10.8% discontinued voluntarily. Of the products available, 60.2% were in current form, 12.9% modified, 11.9% under a different company, and 1.2% available, but temporarily recalled. We further broke down products into the following categories: Biologics, Orthopaedic Devices, Medication, and Surgical Tools/Accessories. Biologics had the highest discontinuance rate (27.3%), followed by Surgical Tools/Accessories (15.9%), Medications (13.6%), and Orthopaedic Devices (12.2%).

Conclusion: Five to ten years after initial advertisement, nearly 40% of products were no longer available in their original advertised form. Orthopaedic surgeons should consider these results when adopting new technology into their practice. We feel these results may represent a combination of product evolution and poor clinical performance of products advertised.

Pre-operative MRI as a Prognostic Factor for Outcomes of Core Decompression for Osteonecrosis of the Femoral Head

Sean P. Calloway, MD, Robert K. Heck, MD, Ryan P. Mulligan, MD, Dexter Witte, MD, Andy Ellzey, MD

Introduction: Osteonecrosis of the femoral head (ONFH) is a potentially debilitating condition that is commonly progressive, leading to eventual need for total hip arthroplasty (THA). Hip core decompression has become common, but failures are frequent and literature to guide the surgeon to appropriately patient selection is limited. The aim of this study is to examine how pre-operative MRI findings correlate with outcomes of core decompression.

Methods: Inclusion criteria are patients with a preoperative MRI, Steinberg stage I/II osteonecrosis, and > 1 year of documented follow-up. Patients were stratified according to percent involvement of the femoral head (0-15%, 15-30%, >30%) and hip effusion grade (0-3). The lead surgeon performed core decompression on all patients. Failure of procedure is defined as the patient requiring a THA.

Results: One hundred patients were included with an average follow up of 40 months (12 to 97 months). Forty-two of one hundred (42%) underwent THA. Increased grade of effusion was an independent risk factor for THA (OR=2.30, 95% CI (1.27-4.18), p=0.006). THA was ultimately necessary in 1/13 (8%) patients with grade 0 effusion, 17/42 (42%) grade 1, 12/35 (34%) grade 2, and 12/12 (100%) grade 3. Percent involvement of the femoral head was also an independent risk factor for THA (OR=4.66, 95% CI (2.07-10.52), p<0.001). THA was performed in 0/17 (0%) of patients with 0-15% head involvement, 10/32 (31%) with 15-30% head involvement, and 32/51 (63%) with >30% head involvement.

Conclusion: Grade of hip effusion and percent involvement of the femoral head are prognostic indicators of core decompression for ONFH. Patients with minimal hip effusion and/or minimal involvement of femoral head should be counseled to undergo a less invasive procedure like core decompression. Conversely, patients with a large hip effusion or significant amount of diseased femoral head may be better served with total hip arthroplasty.

Gender Differences in the Three Dimensional (3D) Pathomorphology of Femoroacetabular Impingement (FAI)

James R. Ross, MD, Christopher M. Larson, MD, Rebecca M. Stone, MS, Emma Schelling, BS, Asheesh Bedi, MD

Introduction: There is increased interest in gender-specific differences in the pathoanatomy of pre-arthritic hip disease. The purpose of this study was to determine the effect of gender on proximal femoral and acetabular morphology in patients with symptomatic FAI.

Methods: Pre-operative CT scans of 172 hips (124 males; 48 females) that underwent hip arthroscopy for the treatment of FAI were analyzed. There were no differences in mean age (25.7 years, males and 25.3 years, females) between genders. A CT-based software was used to measure and characterize proximal femoral and acetabular morphology. 3D models were created and used to simulate range of motion to osseous impingement in flexion, internal rotation in 90° of flexion (IRF), and the flexion adduction internal rotation (FADIR) positions.

Results: Females had greater femoral anteversion (19.4° vs. 13.6°; $p<0.001$) and neck-shaft (134.5° vs. 131.3°; $p<0.001$) angles. Males had significantly more acetabular retroversion at 1:30 (1.9° vs. 5.2°; $p=0.03$) and 3:00 (14.8° vs. 17.6°; $p<0.001$). There was no difference in the LCEA (32.0° males vs. 30.5° females; $p=0.72$). Borderline dysplasia (LCEA 20-25) was present in 1.6% of males and 10.4% of females. Males had a significantly greater mean maximum alpha angle (77.4° vs. 66.1°; $p<0.001$) and was located more superolaterally (1:00 vs. 1:30; $p<0.001$). Males had an elevated alpha angle (> 50°) over a larger area (11:45 to 3:15) when compared to females (12:30 to 2:30). Mean ROM to impingement was greater among females for flexion (121.5° vs. 115.8°), IRF (34.8° vs. 24.5°), and FADIR (26.5° vs. 16.4°; all $p < 0.01$).

Conclusion: We found distinct, gender-dependent impingement patterns in patients with symptomatic FAI. Males were noted to have greater cam-type deformity and lateral extension compared to females. Additionally, males had more acetabular retroversion. Arthroscopic management with attention to the unique gender based pathologies may result in improved outcomes.

Pelvic Incidence Plays a Role in Pelvic Mobility & Acetabular Version in Patients with Femoroacetabular Impingement

James R. Ross, MD, Jeffrey J. Nepple, MD, Eric P. Tannenbaum, MD, Christopher M. Larson, MD, Asheesh Bedi, MD

Introduction: High complication rates have been reported when monoblock metal on metal (MoM) hips are revised. Complications include aseptic loosening of the revised cup, extraction induced acetabular fracture and dissociation as well as instability and infection. One strategy in monoblock MoM hips requiring revision is conversion to a dual mobility polyethylene bearing without cup extraction. We asked whether this strategy had a lower complication rate then formal acetabular revision.

Methods: Review of our institution's TJR identified 34 patients who underwent revisions of monoblock MoM THAs to a dual mobility construct between January 2012 and December 2014. Mean patient age was 64 (range, 27-86), and 65% were women. No hips were lost to follow-up. All hips met inclusion criteria which included a cementless, non-modular MoM implant with revision to a dual mobility construct. Major complications including instability, infection, aseptic loosening, and wound complication were documented and compared to a group of patients who had formal acetabular revision of a monoblock MoM component.

Results: Of 34 patients undergoing dual mobility revision, there was 1 early complication – instability requiring formal acetabular revision (3%). Of the 114 patients who underwent formal acetabular revision, there were 28 early complications (20%). Complications included aseptic loosening, deep infection, dislocation, acetabular fracture, superficial infection, infected hematoma, hematoma, and delayed wound healing.

Conclusion: Dual mobility is a viable option for treatment of failed monoblock metal on metal THA. Early complications are significantly lower (3% vs. 20%) when compared with complete acetabular revision. Longer follow up is needed to demonstrate the effectiveness of these articulations. This technique is only appropriate in fully hemispheric monoblock cups. This technique should not be used in cups that are less than a hemisphere with a sharp inner rim or in cups in poor position that could lead to edge loading.

Reoperation Rate after Primary Hip Arthroscopy for the Treatment of Chondrolabral Pathology and FAI

Stephen Aoki, MD, Travis Maak, MD, Mike B. Anderson, MS, R. Presley Swann, MD, Christopher E. Pelt, MD, **Christopher L. Peters, MD**

Introduction: The primary objective of this study was to determine the rate of reoperation following primary hip arthroscopy (HA) in an academic medical center.

Methods: We retrospectively reviewed all primary HAs performed between January 1, 2000 and May 1, 2014 (n=793). Hips were included in the study (n=709) if they underwent primary hip arthroscopy that included a femoroplasty, acetabuloplasty and/or a labral repair or debridement. Fourteen hips were excluded for prior hip surgery or trauma. 695 hips in 617 patients were reviewed. Reoperation was defined as any repeat hip arthroscopy, conversion to THA, and any other surgery located within the vicinity of the pelvis.

Results: The total rate of reoperation was 11% (73/695) with eight patients (1%) converting to THA. The mean time to reoperation was 1.74 years (range, 6 weeks to 11 years). Reoperations (n=73) consisted of capsular plication for instability in 37 hips (51%), femoroplasty (10/73, 14%), debridement (9/73, 13%), psoas release (8/73, 11%), excision of heterotopic ossification (8/73, 11%), acetabuloplasty (4/73, 6%) and one patient underwent reoperation at an outside facility. Further, one patient underwent an inguinal hernia repair following the primary HA while two underwent subsequent discectomy, two received a subsequent epidural and one patient had a fusion of the L4-L5 vertebrae.

Conclusion: The overall reoperation rate of 11% in this series of 695 hips is consistent with prior reports. The majority of reoperations following primary hip arthroscopy were capsular repair for perceived hip instability. This is in contrast to prior reports that indicate persistent structural disease was the most common reason for hip arthroscopy failure. The low rate of conversion to THA indicates proper patient selection and surgical technique are associated with a high rate of hip survivorship at short-term follow-up.

Predictors of Clinical Outcomes after Hip Arthroscopy: A Prospective Analysis of 1038 Patients with Two-year Follow-up

Benjamin G. Domb, MD, Timothy J. Martin, MA,
Chengcheng Gui, BS, Sivashankar Chandrasekaran, MD, FRACS,
Carlos Suarez-Ahedo, MD, **Parth Lodhia, MD, FRCSC**

Introduction: As hip arthroscopy has expanded in popularity and volume, there has been increased need for elucidation of the indications for the procedure, and the predictive factors of clinical outcomes. The purpose of this study was to evaluate clinical outcomes of hip arthroscopy in a prospective study and to analyze this cohort to identify predictive factors of improvement.

Methods: Data was collected prospectively on all patients undergoing hip arthroscopy between February 2008 and June 2012. We included all patients undergoing hip arthroscopy who completed four PROs at minimum two-year follow-up, including the modified Harris Hip Score, (mHHS), Non-arthritic Hip Score (NAHS), Hip Outcome Score – Activities of Daily Living and Sports Subscale (HOS-ADL, HOS-SSS). The NAHS was selected as our primary outcome instrument. All patients with any previous hip conditions were excluded. We analyzed 34 preoperative and intraoperative variables using bivariate and multivariate analyses compared to NAHS scores.

Results: The cohort consisted of 1038 patients with a mean follow-up of 30.1 months (range: 24.0 – 61.2 months). The mean age of the group was 36.4 years (range: 13.2 – 76.4 years). All postoperative PRO scores showed significant improvement ($p < 0.001$) at two years compared to preoperative scores. Bivariate analysis identified fifteen variables (seven categorical and eight continuous), and multivariate analysis identified 10 variables that were predictive of two-year postoperative NAHS scores. Preoperative NAHS, HOS-ADL, mHHS, age, duration of symptoms, body mass index (BMI), and revision hip arthroscopy were identified as predictive factors in both bivariate and multivariate analyses. The predictive value of preoperative NAHS was accentuated for patients with higher BMI.

Conclusion: This study reports favorable clinical outcomes in the largest cohort of hip arthroscopies with minimum two-year follow-up in the literature to date. Factors identified as predictive in both bivariate and multivariate analyses included preoperative NAHS, Hip HOS-ADL, mHHS, age, duration of symptoms, BMI, and revision hip arthroscopy. These predictive factors may be clinically useful in determining prognosis and operative indications for hip arthroscopy.

Demographics and Early Functional Outcomes of Periacetabular Osteotomy for Symptomatic Mild Acetabular Dysplasia

Benjamin F. Ricciardi, MD, Kara G. Fields, MS, Catherine Wentzel, BS, Danyal Nawabi, MD, FRCS, Bryan T. Kelly, MD, Ernest L. Sink, MD

Introduction: Management of symptomatic mild acetabular dysplasia remains controversial. The purpose of our study is to identify demographics, complications, and early functional outcome scores in patients treated with periacetabular osteotomy (PAO) for mild acetabular dysplasia.

Methods: Patients were enrolled from a single center prospective hip registry from March 2010 to July 2014. Patients with a minimum of 6 months follow up were divided into two cohorts (N=78 patients): Mild acetabular dysplasia group (LCEA ≥18° and ≤ 25°; N=27 patients) versus Severe acetabular dysplasia group (LCEA≤ 17°; N=51 patients). Demographic characteristics, radiographic findings, complications, and functional outcome scores [mHHS, HOS, and iHOT-33] were recorded at 6 months and 1 year post-operatively when available.

Results: Age and sex distribution did not differ between Mild versus Severe Dysplasia, with female predominance in both groups. Preoperative LCEA was (median [quartile 1, quartile 3]) 20° [19°, 22°] in the Mild versus 13° [5°, 15°] in the Severe Dysplasia groups ($p<0.001$). Preoperative ACEA was greater in the Mild versus Severe Dysplasia group (24° [19°, 32°] versus 13° [0°, 20°]; $p<0.001$). Acetabular version, femoral version, femoral neck-shaft angle, Tönnis grade, and alpha angles were not different between the two groups. Achievement of radiographic correction and complications did not differ between the two groups. Functional outcome scores showed similar improvements in mHHS, HOS ADL, HOS Sport, and iHOT-33 at all follow up time points between the two groups. 85% and 94% of patients in the Severe and Mild Dysplasia group respectively achieved minimal important change in mHSS at minimum 1 year follow up.

Conclusion: Patients with symptomatic mild acetabular dysplasia have similar demographic and preoperative characteristics to patients with more severe dysplasia. PAO is effective for improving patients symptoms in mild dysplasia and was similar to the results in patients with more severe dysplasia at short-term follow up.

Three-dimensional CT Analysis Identifies Distinct Variations in Acetabular Morphology in the Dysplastic Hip

Jeffrey Nepple, MD, James R. Ross, MD,
Asheesh Bedi, MD, **John C. Clohisy, MD**

Introduction: Acetabular dysplasia is well recognized as a cause of hip pain in young adults. The purpose of the current study was to characterize acetabular morphology utilizing computed tomography (CT) in patients with symptomatic acetabular dysplasia that underwent PAO.

Methods: Low-dose CT scans (0.75-1.25 mSv, equivalent radiation exposure to 3-5 AP pelvis radiographs) were obtained in 33 patients with symptomatic acetabular dysplasia prior to surgical intervention. Plain radiographs and three-dimensional CT reconstructions were utilized to characterize acetabular morphology. Severity of dysplasia was classified utilizing lateral center edge angle (LCEA) measurements on plain radiographs as: borderline (20-25°), mild (15-20°), and moderate-severe (<15°). CT parameters included acetabular version at 1:00/2:00/3:00, radial coverage (1:00 intervals, 9:00 posterior to 3:00 anterior), and the presence/absence of the posterior wall and crossover signs (on simulated radiographs constructed from CT). The location of acetabular insufficiency was classified as global (similar anterior and posterior involvement), anterior-superior (with maintained posterior coverage), or posterior-superior (with maintained anterior coverage) utilizing three-dimensional coverage maps relative to normative data.

Results: Thirty-three hip (33 patients) including 25 females (75.8%) and 8 males (24.2%) were analyzed. Based on plain radiographs, 14 hips (42.4%) were classified as borderline, 11 (33.3%) as mild, and 8 (24.2%) as moderate-severe dysplasia. Based on novel three-dimensional CT analysis, anterior-superior insufficiency was seen in 13 hips (39.4%), while posterior superior insufficiency occurred in 11 hips (33.3%) and global insufficiency in 9 hips (27.3%). The patterns of acetabular deficiency were similar for differing severities of dysplasia. Anterior-superior insufficiency was present in 48.0% of females, compared to 12.5% of males (p=0.108). Posterior-superior acetabular insufficiency was present in 54.5% of males, compared to only 9.1% of females (p=0.008).

Conclusion: Three-dimensional characterization of acetabular morphology in patients with symptomatic dysplasia demonstrates significant variability between patients. Most notable is the predominance of posterior-superior acetabular deficiency in males, compared to anterior-superior and global insufficiency in females.

Is Combined Surgical Hip Dislocation and Periacetabular Osteotomy a Safe Procedure for Complex Hip Deformities?

Kayla M. Thomason, BS, **Stephen T. Duncan, MD,** Geneva Baca, BA,
Gail Pashos, BS, Perry L. Schoenecker, MD,
Ljiljana Bogunovic, MD, John C. Clohisy, MD

Introduction: Surgical hip dislocation (SHD) and the Bernese periacetabular osteotomy (PAO) are well-described hip preservation techniques used to treat femoroacetabular impingement and acetabular dysplasia. Uncommonly, complex pre-arthritic hip conditions with major femoral and acetabular deformities require a combined SHD/PAO; yet, the morbidity of utilizing this combined approach is unknown. We set out to define the incidence and character of post-operative complications when a combined SHD/PAO is performed and whether the complication risk is acceptable.

Methods: Retrospective analysis of patients treated with a combined SHD/PAO for complex hip deformities was performed. Complications were graded according to the modified Dindo-Clavien classification as previously published and validated: Grade I, required no deviation from routine post-operative care; Grade II, required outpatient intervention only; Grade III, required inpatient intervention including surgical management; Grade IV, resulted in long-term morbidity or loss of joint; and Grade V, resulted in death.

Results: 33 hips (32 patients; 11 males, 21 females) underwent SHD/PAO at a mean age of 20 years and average follow-up 30 months (12-78). Excluding grade I complications, the complication rate was 12%. Major (Grade III or IV) complications occurred in 6.1% of cases. The one (3.0%) Grade III complication included symptomatic snapping psoas and a labral tear requiring hip arthroscopy (labral repair and iliopsoas lengthening) with excellent final results. The one (3.0%) Grade IV complication included a deep surgical site infection with early joint failure requiring total hip arthroplasty (THA) with excellent clinical results. Excepting the single THA, there were no long-term disabilities associated with the combined SHD/PAO. There were no major neurovascular injuries, osteonecrosis, fractures, or nonunions.Discussion and

Conclusion: Combined SHD/PAO for the treatment of complex, concomitant deformities of the proximal femur and acetabulum is associated with an acceptable risk of complications. The vast majority of the complications encountered were managed without permanent disability.

Perioperative Factors and their Effect on the Fibrinolytic System in Arthroplasty Patients

Andrew Burleson, MD, Nil Guler, MD, Jennifer Saluk, BS,
Andrew Banos, MD, BS, Debra Hoppensteadt, PhD, BS, Harold Rees, MD, BS,
Jaweed Fareed, PhD, BS, William Hopkinson, MD, FACS, BS

Introduction: Total joint arthroplasty patients are mostly advanced age and with concomitant medical comorbidities such as increased body mass index (BMI) and impaired glucose tolerance. These factors, and type of surgery, may affect the fibrinolytic system in these patients. Aim:To investigate the effect of age, sex, BMI, type of surgery, and tranexamic acid (TXA) treatment on the fibrinolytic system in total joint arthroplasty patients.

Methods: 99 consecutive patients undergoing total joint arthroplasty (32 total hip arthroplasties and 67 total knee arthroplasties) by three fellowship trained arthroplasty surgeons were included in this study. Blood samples were drawn at preoperative clinic appointments and on postoperative day one. Antigenic levels of D-Dimer, PAI-1, and tPA were measured using a commercially available ELISA kit. Antiplasmin activity was measured by using functional method. Age, gender, hemoglobin (Hgb) levels and BMI were collected from the electronic medical record.

Results: Preoperative D-Dimer and tPA levels were positively correlated with age, while preoperative antiplasmin was negatively correlated with age. BMI was only associated with preoperative tPA levels. There was no significant difference in postoperative levels of D-Dimer, PAI-1, tPA, or antiplasmin between patients treated with TXA, or without. Percentage change for D-Dimer, and tPA showed significantly lower values in patients treated with TXA compared to the non-treated group. Postoperative Hgb values and percentage change for Hgb were not different in patients treated with TXA or not. Type of surgery, Total knee arthroplasty vs. total hip arthroplasty, did not affect the fibrinolytic markers.

Conclusion: These results confirm that advanced age and elevated BMI positively contributes to fibrinolytic dysregulation in total joint arthroplasty patients, while TXA seems to decrease the fibrinolytic activity in these patients.

Characterization of the Neuroanatomy of the Hip Joint to Optimize Periarticular Injection Techniques in Total Hip Arthroplasty

Matthew J. Simons, MD, Nirav H. Amin, MD,
Fred D. Cushner, MD, Giles R. Scuderi, MD

Introduction: The purpose of the current study was to identify and map the neuroanatomy of the hip to optimize periarticular injection (PAI) techniques in THA.

Methods: The available literature was searched using terms associated with hip innervation and 70 articles identified, of which 17 met the inclusion criteria.

Results: Grossly, the anterior hip joint capsule was predominantly supplied by articular branches of the femoral and obturator nerves. The femoral nerve is responsible for innervation of the anterior and anterolateral capsule and the obturator nerve supplies the anteromedial capsule. The posterolateral capsule is innervated by articular branches from the superior gluteal nerve. The nerve to the quadratus femoris muscle contributes innervation to the posteroinferior section of the hip joint capsule. Less consistent is the sciatic nerve contribution, which is shown to supply the posterosuperior capsule. Histologically, nerve marker expression was highest in the superolateral capsule, as were the number of mechanoreceptors (9.6 per high powered field (hpf)) and free nerve endings (3.2/hpf). The anterior capsule showed moderate amounts of mechanoreceptors (4.0/hpf) and free nerve endings (2.2/hpf). In two studies, there were no sensory fibers found in the posterior and inferior aspects of the capsule. Using a clockface system of reference around the acetabulum, the highest presence of nerve fibers are found about the anterior and posterior labrum especially from 10-2 o'clock on a right hip. Overall, the anterior aspect (1-2 o'clock) shows the highest levels of free nerve endings and mechanoreceptors. Two studies found dense amounts of fibers at the chondrolabral junction. In the adult, the literature shows the transverse acetabular ligament to be moderately innervated.

Conclusion: After the cup and liner are placed, it may be reasonable to direct PAIs toward the remnant labrum from 10-2 o'clock and focus on the anterior and superior capsular tissue if retained. Prior to stem insertion, the visible periosteum may then be injected circumferentially about the femur. Fascia and incised soft tissue may then be injected prior to closure.

Comparative Effectiveness of Viscosupplement and Corticosteroid Injections for Knee Osteoarthritis

Jonathan R. Staples, MD, **James A. Keeney, MD**

Introduction: We performed this study to define the relative cost effectiveness of viscosupplement (VSI) and corticosteroid (CSI) injections in the treatment of knee osteoarthritis.

Methods: After obtaining Institutional Review Board approval, we retrospectively evaluated 155 consecutive patients (200 knees) receiving CSI or VSI for knee OA at a single institution. Radiographic disease severity was assessed using weightbearing AP and lateral radiographs. The type, number, and frequency of injections received over 4 years and surgical interventions over 7 years were documented. Clinical effectiveness was defined by symptom resolution or recurrent injection at an accepted time interval for therapeutic benefit (CSI-3 months, VSI- 6 months). Injection failure was defined by inadequate pain relief, rescue injection within the therapeutic window, or surgical intervention within 2 years of first treatment. Univariate analysis was used to assess for differential response to treatment based on radiographic disease severity. Cost effectiveness was assessed using average reimbursement for major joint arthrocentesis ($110/injection) coupled with facility contracted material cost for CSI ($6.45/ injection), VSI ($240-405/ series) injections, proportional response based on injection type (CSI vs VSI) and radiographic disease severity.

Results: There was a trend for more successful treatment with CSI than VSI (70.2% vs 57.0%, p=0.07), that was significant among patients with moderate OA (82.1% vs 45.5%, p=0.03). Annualized successful CSI cost was less than successful VSI ($202 vs $1073), with the least cost-effective care delivered to patients with mild OA receiving VSI ($1963) and most cost-effective care for patients with mild radiographic arthritis receiving CSI ($86).

Conclusion: CSI are more cost effective than VSI in the management of knee OA and should be used as a first line injection approach for most patients. Concerns over disease progression and arthroplasty risk after CSI, potentially a reason to consider VSI among younger patients, were not observed in this study.

Efficacy of Intraarticular Corticosteroid Injections in Patients with Symptomatic Knee Osteoarthritis

Elizabeth G. Matzkin, MD, Emily J. Curry, BA, Michael Henry, BS, Qingwu Kong, MS, Miranda Rogers, MS, **Eric L. Smith, MD**

Introduction: Osteoarthritis (OA) is the most prevalent form of arthritis. The American Academy of Orthopaedic Surgeons recommends intraarticular (IA) corticosteroid injections for short-term pain relief in patients with knee OA. The evidence to support this recommendation is mixed. The purpose of this study was to investigate the efficacy of IA corticosteroid injections in symptomatic knee OA and to identify factors that impact treatment response.

Methods: Following a power analysis, 126 subjects older than 40 years with knee OA, categorized by Kellgren-Lawrence (KL) OA-grade were enrolled into a prospective, multi-centered cohort study. Subjects received one injection of betamethasone/triamcinolone with 1% lidocaine into their affected knee and completed the WOMAC, RAND-36, and Visual Analog Scale (VAS) at pre-injection baseline (BL) and at 3-weeks, 6-weeks, 3-months, and 6-months post-injection.

Results: Subjects significantly improved in VAS pain scores and WOMAC scores of pain, stiffness, physical function, and total score at all time-points compared to BL ($p<0.001$). The RAND-36 demonstrated significant improvements in physical functioning ($p=0.002$), physical role functioning ($p<0.001$), and bodily pain ($p<0.001$). Obese patients recorded worse WOMAC scores in most categories compared to non-obese patients, however obese patients demonstrated significant improvement in WOMAC and VAS scores compared to BL. Subjects with KL grade I-II had significantly better WOMAC scores than subjects with grade III-IV at 6-weeks, 3-months, and 6-months post-injection ($p<0.05$). Obese patients with high KL grade had significantly worse WOMAC scores over time ($p=0.004$) than all other sub-groups.

Conclusion: Patients receiving IA corticosteroid injections improved in pain and function. Clinicians should expect less improvement for those with obesity and/or advanced arthritis. Clinical benefits of IA injections decrease after 3 weeks in these patients.

Noninvasive Hemoglobin Monitoring: A Rapid, Reliable, and Cost-effective Method Following Total Joint Replacement

John R. Martin, MD, Christopher L. Camp, MD, Ernie Y. Young, MD, Matthew P. Abdel, MD, Michael J. Taunton, MD, Robert T. Trousdale, MD

Introduction: We performed a prospective analysis to compare the reliability, cost, and patient preference of nHgb monitoring to invasive Hgb (iHgb) monitoring via a traditional blood draw.

Methods: One hundred consecutive patients were enrolled following TJA. On postoperative day one, nHgb and iHgb were obtained within 30 minutes of one another. iHgb and nHgb values, cost, patient satisfaction, and the time required to obtain each reading were recorded. Concordance and intraclass correlation coefficients (ICCs) were utilized to compare the relatedness of the two Hgb values. A Student's t-test was utilized to compare mean Hgb values, time, pain, and patient preference for all readings.

Results: There was no significant difference in mean Hgb, with the iHgb value beingwas 11.3 g/dL (range, 8.2-14.3 g/dL) and the nHgb value being was 11.5 g/dL (range, 7.0-16.0 g/dL) ($p = 0.37$). The concordance correlation and ICCs between the two Hgb values were 0.69 each. 100% of patients with a nHgb of $\geq$ 10.5 g/dL had a iHgb value $\geq$8.0 g/dL. The mean time to obtain a Hgb value was 0.86 minutes for nHgb and 51.1 minutes for iHgb ($p = 0.0001$). At our institution, the cost of iHgb was $28 per blood draw compared to $2 for each iHgb, resulting in a savings of $26 per blood draw. 88% of patients preferred the nHgb, 7% preferred iHgb, and 5% were uncertain.

Conclusion: Noninvasive Hgb monitoring was found to be more efficient, less expensive, and preferred by patients over iHgb. Providers could consider screening TJA patients with nHgb and only ordering iHgb if the nHgb is < 10.5 g/dL. If this protocol were applied to the first blood draw in these 100 patients, $2,000 would have been saved. Extrapolated to the US TJA practice, $20 million could be saved annually.

Enhanced Biocompatibility to Co-Cr Alloy by Surface Treatment with 3-D metal Printing

Young Wook Lim, MD, PhD, Seung Chan Kim, MD, PhD,
Soon Yong Kwon, MD, PhD, Yong Sik Kim, MD, PhD

Introduction: 3-D Printing with direct metal tooling (DMT) technology was innovatively introduced in the field of surface treatment of prosthesis to improve, moreover to overcome the problems of plasma spray, hopefully resulting in opening the possibility of another page of coating technology. We presumed such modification on the surface of Co-Cr alloy by DMT would improve the ability of Co-Cr alloys to osseointegrate.

Methods: We therefore compared the in vitro ability of cells to adhere to DMT coated Co-Cr alloy to that of two different types of surface modifications: machined and titanium plasma sprayed (TPS). We performed scanned electron microscopy investigations to assess the structure and morphology of the surfaces. Biologic and morphologic responses to human osteoblast cell lines were then examined by measuring cell proliferation, cell differentiation (alkaline phosphatase activity), RUNX-2, fibronectin.

Results: The cell proliferation rate, alkaline phosphatase activity, and cell adhesion in the DMT group increased in comparison to those in the machined and TPS groups. Human Osteoblast cells on DMT-coated surface were strongly adhered, and proliferated well compared to those on the other surfaces.

Conclusion: The surface modifications of DMT coating enhanced the biocompatibility (proliferation and migration of osteoblast cells) of Co-Cr alloy. This process is not unique to Co-Cr alloy; it can be applied to other metals to improve their biocompatibility, thus allowing a broad range of materials to be used for cementless implants.

A CPT code for Conversion Knee Arthroplasty is Warranted

Tyler M. Kreitz, MD, Gregory Penny, BS, Mitchell G. Maltenfort, PhD, Carl Deirmengian, MD, Gregory Deirmengian, MD

Introduction: The surgeon compensation for TKA is not currently increased when the technical complexity of the case is elevated. In addition, “double coding” for knee replacement, to bill for additional effort required to remove hardware or use more advanced implants, is not allowed. We investigate the extra time and effort associated with conversion knee arthroplasty.

Methods: Sixty-three total knee arthroplasty cases in the setting of previous knee hardware were identified from our institution between 2007 and 2015. Propensity score matching was used to match knee conversions to primary TKA based on age, gender, and BMI in a three to one ratio. Patients who underwent knee conversions were compared to primary TKA with regard to operative time, readmission rate, and repeat procedures within 90 days from the index procedure.

Results: The mean operating room time for primary TKA was 83.3 minutes (range 29-213 minutes). The mean operating room time for knee conversion was significantly greater by an additional 20 minutes; mean 103.6 minutes (range 56-256 minutes, $p<0.0001$). Rates of readmission and repeat procedures within 90 days were both 5.7% and 12.7% for total knee and knee conversion arthroplasty respectively.

Conclusion: Total knee conversion results in a 24% increase in operative time and more than twice the rate of readmission and repeat procedures within 90 days compared to TKA. The increased time and effort may result in a busy surgeon reluctant to take on these complex cases in favor of routine primary TKA. This suggests the need for an additional CPT code for knee conversion arthroplasty to compensate surgeons for the extra time and effort required for these cases.

Costs and Medicare Reimbursements for Conversion and Primary Total Hip Arthroplasty

Alfred C. Kuo, MD, PhD, John Bonano, BA,
Matt Callahan, MBA, **Thomas P. Vail, MD**

Introduction: Conversion of previous hip surgery to total hip arthroplasty [Current Procedural Terminology (CPT) code 27132] is often more technically complex than primary total hip arthroplasty (THA; CPT 27130) and can be associated with a higher rate of complications. However, current Medicare reimbursement policies do not distinguish conversion THA (cTHA) without previous arthroplasty from primary THA. Both procedures are included in Diagnosis-Related Group (DRG) 469 (Major Joint Procedures Lower Extremity with major comorbidities or complications) and DRG 470 (Major Joint Procedures Lower Extremity without major comorbidities or complications). The goal of this study was to describe the costs and reimbursements associated with primary THA and cTHA.

Methods: Costs and reimbursements for the hospitalizations of Medicare patients who underwent unilateral primary THA or unilateral cTHA with DRG 470 at a single academic medical center from 2011 until 2014 were obtained. Procedural times and lengths of stay were also determined. Mean values and standard errors were calculated. Student's t-tests were used to assess for statistically significant differences ($p < 0.05$).

Results: Fifteen patients underwent cTHA and 361 patients underwent primary THA. Average total cost ($29,719 versus $24,568; $p = 0.0007$), procedural time (119 versus 77 minutes; $p < 0.0001$), and length of stay (3.6 vs 3.0 days; $p = 0.05$) were significantly higher for cTHA patients. Average Medicare reimbursements were similar for the two groups ($23,833 versus $24,388; $p = 0.45$). The average net loss for the medical center was significantly higher for cTHA patients ($5,886 versus $179; $p = 0.0007$).

Conclusion: cTHA is associated with higher costs than primary THA. Current Medicare hospital reimbursement policy for conversion of previous nonarthroplasty hip surgery to THA does not account for this difference.

Non-elective Joint Arthroplasty is Associated with Increased Length of Stay and Alternative Discharge Disposition

Eric M. Greber, MD, Charles Lowry Barnes, MD, Gordon Newbern, MD, Kevin Cullinan, MD, Paul K. Edwards, MD

Introduction: Alternative payment models such as episode-of-care and bundled payments attempt to reduce cost. The purpose of this study is to determine if "non-elective/complex" joint arthroplasty (CJA) patients are associated with a longer length of stay (LOS), a higher rate of discharge to locations other than home, and a higher re-admission rate.

Methods: A retrospective review of all patients undergoing CJA in the DRG code 469/70 from 2013 – 2014 was performed. CPT codes indicating CJA included 27125 (hemiarthroplasty of hip), 27236 (open treatment of femoral neck fracture), 27132 (conversion of hemiarthroplasty or previous hip surgery to total hip arthroplasty), 20680 (removal of deep implant), and 27445 (fracture of distal femur requiring distal femoral replacement). A consecutive subset of eighty patients undergoing elective primary joint arthroplasty (EJA) from the same time period with the CPT codes 27130 (total hip arthroplasty) and 27447 (total knee arthroplasty) were analyzed. LOS, discharge disposition, and re-admission rate were compared between these two groups.

Results: LOS was significantly longer for the CJA cohort (3.11 days) compared to the EJA (1.3 days). 40% of the CJA patients were discharged to a location other than home compared to 2.5% for the EJA. The readmission rate for the CJA group was 12.5% while the EJA group was 2.5%.

Conclusion: As alternative payment models are increasingly more common, it is important that surgeons and hospital institutions identify patients at risk as a cost outlier. We discovered patients with CJA-associated CPT codes have significantly longer LOS, greater rate of discharge to facility other than home, and a higher re-admission rate. These "non-elective/complex" episodes cost more than their counterparts. As payment schemes change, we must continue to develop a better understanding of the intricacies of these alternative models.

How Much Do Patients Value Total Hip and Knee Arthroplasty? A Prospective, Multi-center Study

Paul Maxwell Courtney, MD, Mark Howard, BS, Nitin Goyal, MD, Ran Schwarzkopf, MD, Erik Schnaser, MD, Neil P. Sheth, MD

Introduction: With declining reimbursements and the introduction of alternative payment models, it is not clear what financial value patients place on total hip and knee replacement. The objectives of this study were to determine what patients feel an orthopaedic surgeon should receive as reimbursement and how much patients would be willing to pay out-of-pocket for primary total joint arthroplasty (TJA).

Methods: An anonymous survey was administered to 670 patients at 4 different institutions (2 private practice and 2 academic centers) in the outpatient setting over a 15-month period. An a priori power analysis was determined to ensure an adequate sample size. The survey included demographic data and information about what a surgeon should receive as reimbursement for a primary TJA, how much they would pay out-of pocket for the procedure, and their opinion of current Medicare reimbursement rates.

Results: Of the 557 who participated in the survey (83% response rate), patients felt that, on average, an orthopaedic surgeon should receive a reimbursement of $27,430 for a THA and $19,830 for a TKA. Patients would be willing to pay out-of-pocket a mean of $14,397 for THA (50.3% of total costs) and $12,797 for TKA (46.3% of total costs). When given actual Medicare reimbursement rates, 92% of respondents felt that actual reimbursement was too low or slightly low for THA and 90% felt the same for TKA. While patients in private practice groups had higher education level and household income ($p<0.001$), patients in academic centers would be willing to pay more out-of-pocket costs ($15,922 versus $5,782, $p=0.034$ for THA, $14,419 versus $4,556, $p=0.052$ for TKA).

Conclusion: Patients in both private practice and academic centers feel surgeons are underpaid for primary total hip and knee arthroplasty. Many patients are still willing to pay a significant amount of out-of-pocket expenses for TJA.

Patients' Perception of Value in Bundled Payments for Total Joint Arthoplasty

Adam J. Schwartz, MD, MBA, Allison Shannon MS, PA-C, Nikki Jackson, RN, James Fraser, MD, MPH, Raghu Santanam, PhD, MS

Introduction: A central concern for providers in a bundled payment model is determining how the bundle is distributed. Prior studies have shown that current reimbursement rates are often not aligned with patients' values. While willingness to pay (WTP) surveys are perhaps useful in a fee-for-service arrangement to determine overall reimbursement, the percentage of payment distribution might be as or more important in a bundled payment model.

Methods: All patients undergoing primary total joint arthroplasty (TJA) by a single surgeon were offered participation in a preoperative WTP survey. At a minimum three months postoperatively, patients were mailed instructions for an on-line follow-up survey asking how they would allocate a hypothetical bonus payment.

Results: From January through December 2014, forty-five patients agreed to participate in the preoperative WTP survey. Eighteen patients who were a minimum three-months postoperative also completed the follow-up survey. Patients valued total knee and hip replacement at $24,090 (95%CI $17,134-$31,047) and $32,235 (95%CI $22,455 – $42,016), respectively. At three months postoperatively, patients distributed a hypothetical bonus payment 60% to the surgeon (95%CI: 50%-69%), 33% to the hospital (95%CI: 24%-43%), and 7% (95%CI: 1%-13%) to the implant manufacturer ($p < 0.001$).

Conclusion: Even in this small pilot study, the data suggest that TJA patients have vastly different perceptions of payment distributions than what actually exist. In contrast to the findings of this study, the true distribution of payments for an episode of care averages 65% to the hospital, 27% to the implant manufacturer and 8% to the surgeon. While many drivers of payment distribution exist, this study suggests that patients would allocate a larger proportion of a bundled or bonus payment to their surgeon than is currently disbursed. This finding may also provide a plausible explanation for patients' consistent overestimation of surgeon reimbursements.

Societal Cost Savings of Total Hip Arthroplasty: A Markov Analysis

Andrew J. Lovy, MD, MS, Aakash Keswani, BA,
Calin S. Moucha, MD, Steven McAnany, MD

Introduction: Current cost utility models of THA are limited and do not take into account the indirect value of THA gained through reduced disability payments, and increased work life. The goal of this study was to estimate the value of THA for the treatment of severe hip osteoarthritis (OA) in a hypothetical employed 50 year old patient.

Methods: A Markov state-transition model from the societal perspective was developed to compare the direct and indirect costs of THA and nonsurgical treatment of severe hip OA for an employed, 50 year old U.S patient over 20 years (Figure 1). Direct medical and surgical costs, indirect medical costs, health state utilities, and transition probabilities were incorporated into the Markov model. Assumptions were utilizing published literature, publicly available claims data, and large validated databases.

Results: Total hip arthroplasty dominated nonsurgical treatment of severe hip OA as indirect cost savings offset increased upfront costs. Taking into account direct and indirect costs over 20 years, THA was associated with a societal net benefit of $102,553 while nonsurgical treatment was associated with a societal net cost $73,695. THA was associated with a 20 year cost savings of $176,248 (2015 U.S. dollars) compared to nonsurgical treatment. Sensitivity analysis revealed THA to be the dominant strategy when post THA return to employment exceeded 49% and annual indirect costs were less than $3,808 for employed THA patients (Table 1). THA remained the dominant strategy when THA utility states were greater than 0.78 or nonsurgical utility state was less than 0.76.

Conclusion: Total hip arthroplasty compared to nonsurgical treatment for severe hip OA results in significant societal cost savings in a hypothetical employed 50 year old patient. The estimated 20-year societal savings from the near 50,000 annual THAs performed in U.S. patients aged 45-54 is estimated to be $8.8 billion.

The Tortoise and the Hare Increase Complications during Total Joint Arthroplasty

John Callaghan, MD, **Kyle Duchman, MD,** Andrew Pugely, MD, Christopher Martin, MD, Yubo Gao, PhD

Introduction: Increased operative time (OT) in THA/TKA has been associated with increased complications. Independently evaluating OT as a risk factor remains challenging, as factors both intrinsic and extrinsic to the patient and institution serve as confounding variables. This study investigates the effect of OT on short-term morbidity and mortality following THA/TKA using a large, heterogeneous, multicenter national database.

Methods: The NSQIP database was searched from 2009-2013 to identify elective, primary, THA/TKA procedures. The cohort underwent Winsorization to limit the influence of potentially spurious outliers. Demographic characteristics and 30-day morbidity and mortality data were collected and OT were stratified based on a priori analysis to allow comparison. Appropriate statistics were employed to identify associations and predictors, respectively, of 30-day morbidity and mortality based on OT.

Results: 99,458 patients, with 80.3% having OT ranging from 60-150 minutes, were evaluated. Patients with OT >150 minutes were younger, more frequently male, and more likely to have increased BMI ($p<0.001$) compared to times <150 minutes. OT >150 minutes was associated with an increased rate of wound complications, sepsis, 30-day readmission, reoperation, and overall complication ($p <0.001$) as compared to patients with OT <60 minutes and 60-150 minutes. Further stratification identified a trend toward increased complications with an OT <30 minutes. Logistic regression analysis identified OT <100 minutes as an independent predictor of decreased overall complications, while OT >190 predicted increased overall complications rates (OR 1.5) compared to median OT.

Conclusions: OT of THA/TKA >150 minutes was associated with increased wound and overall 30-day complication rates, while OT >190 minutes was identified as an independent predictor of increased overall complication rates. Increased complications occurred with OT <30 minutes. This data provides useful information for physicians during patient counseling, while also serving as an impetus to address extrinsic, modifiable factors that prolong OT during total joint arthroplasty.

How will the Financial Impact of Major Medical Complications after TKA Change with Bundled Payments?

Michael M. Kheir, BS, R. Carter Clement, MD, MBA, Adrianne Soo, BS, Peter B. Derman, MD, MBA, David N. Flynn, MD, MBA, L. Scott Levin, MD, FACS, Lee A. Fleisher, MD

Introduction: Caring for patients with major complications can be extremely expensive. Traditionally, the Center for Medicare and Medicaid Services (CMS) has attempted to maintain equity and compensate this cost by paying more for patients with major complications (denoted by billing modifiers and include acute medical issues). However, bundled payments may incentivize surgeons to "cherry pick" low-risk patients if proper risk adjustment is not instituted. This study investigated the current financial impact of major medical complications among Medicare TKA patients and how that would change with flat-rate bundled payments.

Methods: Financial and clinical data was retrospectively collected for all Medicare-eligible patients (age 65+) undergoing primary unilateral TKA at an academic center over a 2-year period. Financial impact was measured as contribution margin (CM), and profit. Reimbursement was determined in accordance with CMS policies and costs were derived from the health system's cost-accounting system. A "flat-rate" bundling program was modeled after a common bundling format, with payments covering 30 days of postoperative care, including readmissions or reoperations. Patients with Medicare modifiers for major complications were compared to those without, both in the current and bundled payment models.

Results: Currently, Medicare patients with major complication modifiers generate higher costs, are better reimbursed, and garner higher CM ($p<0.01$). With bundling, the CM and profit generated by these patients would become significantly lower than that of their counterparts without major complications ($p<0.01$). TKA patients who suffer major medical complications currently have a positive financial impact for hospitals. A transition to bundled payments without proper risk adjustment would mean these patients will generate a large negative impact, which may create a treatment prejudice against high-risk patients.

Conclusion: Payers and providers must work together to carefully design bundled payments with rigorous risk stratification to maintain health equity and access to care for high-risk patients or any other patient populations.

Are Bundled Payments an Effective Payment Model in Revision Hip and Knee Arthroplasty?

Paul Maxwell Courtney, MD, Blair Ashley, MD, Chia H. Wu, MD, MBA, Joshua Rozell, MD, Eric L. Hume, Atul F. Kamath, MD

Introduction: The efficacy of alternative payment models (APMs), such as bundled payments, in revision total joint arthroplasty (TJA) has yet to be addressed. The purpose of our study was to examine whether our institution's Bundled Payment for Care Improvement (BPCI) initiative for revision TJA has decreased episode of care costs and examine whether the program disincentivized surgeons from operating on patients with more medical comorbidities.

Methods: A consecutive series of 182 revision total knee and hip arthroplasty procedures were prospectively followed over a 9-month period. All patients with Medicare as their primary insurance participated in the hospital's BPCI initiative. Patient demographics and clinical data were compared between the bundled and non-bundled groups as well as with a control group of 136 consecutive revision procedures in the year prior to the start of the BPCI. Episode of care cost data was obtained from the Centers for Medicare and Medicaid Services (CMS) and was compared to a historical cohort from the same institution.

Results: 101 patients (55%) participated in the BPCI for revision TJA during the study period. The Medicare-only bundled group was older than other study subgroups ($p<0.001$), but otherwise matched for other demographic and co-morbidity data when compared to the non-bundled group. There was no difference in LOS (4.23 vs. 3.79 days,$p=0.244$) or 90-day readmission rate (29% vs. 33%,$p=0.502$). Mean CMS cost for an episode of care was $37,597, compared $40,725 for the historical cohort. Mean post-acute care costs for the BPCI were $12,076 (32.1% of total costs) compared to the historical cohort of $14,193 (34.9%).

Conclusion: A bundled payment model has the potential for success in revision TJA, resulting in a cost savings of $3,128 per episode in our study. Importantly, the initial BPCI experience has not resulted in an overt selection bias for surgeons to choose healthier patients.

How will the Financial Incentive to Provide THA for High-risk Patients Change with Bundled Payments?

Adrianne Soo, BS, R. Carter Clement, MD, MBA, Michael M. Kheir, BS, Peter B. Derman, MD, MBA, David N. Flynn, MD, MBA, L. Scott Levin, MD, FACS, Lee A. Fleisher, MD

Introduction: Caring for patients with major complications can be extremely expensive. Traditionally, the Center for Medicare and Medicaid Services (CMS) has attempted to compensate this cost by paying more for patients with major complications. However, bundled payments may incentivize surgeons to "cherry pick" low-risk patients if proper risk adjustment is not instituted. This study investigated the current financial impact of major medical complications among Medicare THA patients, how that would change with flat-rate bundled payments, and if certain patient characteristics are predictive of these complications.

Methods: Financial and clinical data was retrospectively collected for all Medicare-eligible patients (age 65+) undergoing primary unilateral THA at an academic center over a 2-year period. Financial impact was measured as contribution margin (CM) and profit. A "flat-rate" bundling program was modeled after a common bundling format, with payments covering 30 days of postoperative care. Patients with Medicare modifiers for major complications were compared to those without, both in the current and bundled payment models.

Results: Currently, Medicare patients with major complication modifiers generate higher costs, are better reimbursed, and garner higher CM and profit ($p<0.01$). With bundling, CM and profit generated by these patients would become lower than that of their counterparts without major complications ($p<0.01$). Major complications were more likely among patients with ASA scores of 3+ ($p<0.01$). No correlation was found with age, gender, race or BMI.

Conclusion: THA patients who suffer major medical complications currently have a positive financial impact for hospitals. A transition to bundled payments without proper risk adjustment would mean these patients will generate a large negative impact. Moreover, our results suggest these patients can be identified preoperatively based on ASA scores. Payers and providers must work together to design bundled payments with rigorous risk adjustment to avoid creating financial incentives against high-risk patients or any other patient populations.

The Cost of Post-hospital Acute Care of Total Joint Arthroplasty in a Bundled Payment System

James Murphy, MD, David Kolessar, MD, Thomas R. Bowen, MD, Carmen Crofoot, MD, **Elie Ghanem, MD,** Michael Suk, MD, FACS, MPH, JD

Introduction: The current healthcare delivery process has manifested itself as the 'bundle payment' system, where all parties involved share a fixed dollar amount for a standard service period. In some instances, orthopaedic surgeons are being held accountable for the cost of patient care throughout the global period of 90 days. Historically, there is little published data available on the total cost of care for Diagnosis Related Group (DRG) 469 and 470, which account for most primary hip and knee arthroplasties. Our study will investigate the total episode of care costs with special attention paid to the post hospital component. We hypothesize that a significant portion of the cost is generated during the post-hospital care.

Methods: Medicare claims were evaluated from January 2013 to January 2014. The data was divided into DRG 469 and 470 and further split into Inpatient/Part B and post-acute care. Hospital setting was also separated into an academic facility versus a community based hospital.

Results: For DRG 470 a total of 99 and 80 claims were settled at the academic and community hospitals, respectively (Table 1). The academic center inpatient (IP) costs accounted for 54% and post-acute care accounted for 46% of total costs. The community center, IP costs accounted for 51% and post-acute care accounted for 49%. The same trend continued for DRG 469 which had fewer claims (8) with inpatient costs at 59% and post-acute costs at 41% for both. The post-hospital costs include the cost or readmissions after primary surgery.

Conclusion: The individual orthopaedic surgeon is being solicited to control costs in the bundled payment system; however, 46-49% of the cost is generated during the post-acute care for patients. Health care systems and orthopaedic surgeons work together to reduce overall costs of care. Opportunities for additional cost saving measures should involve post-acute care processes and care providers

Does "6-clicks" Day 1 Postoperative Mobility Score Predict Resource Use after Joint Replacement?

Young-Min Kwon, MD, PhD, Mariano E. Menendez, MD, Charles S. Schumacher, MD, David Ring, MD, PhD, Andrew A. Freiberg, MD, Harry E. Rubash, MD

Introduction: With the health policy focus on shifting healthcare cost efficiency to hospitals and providers, optimizing resource utilization after elective total joint arthroplasty (TJA) is becoming increasingly important. The Activity Measure for Post-Acute Care (AM-PAC) "6-Clicks" Mobility score was recently implemented at our institution to assess mobility among total hip arthroplasty (THA) and total knee arthroplasty (TKA) inpatients. However, little is known about its ability to predict resource use after TJA. We determined whether the AM-PAC Mobility score predicts discharge disposition, hospital length of stay, and 30-day readmissions and emergency department (ED) visits following TJA.

Methods: Using our institutional database, we identified 744 patients undergoing primary THA (40%) or TKA (60%) for osteoarthritis during 2014. The AM-PAC Mobility score was prospectively collected by physical therapists within 24 hours of surgery; lower scores equate to a greater degree of limitation. We constructed multivariable logistic regression models to determine whether the AM-PAC Mobility score influenced postoperative resource use, and assessed its predictive performance using the area under the receiver-operating-characteristic curve (AUC) derived from these regression models.

Results: Lower AM-PAC Mobility scores were linked to greater likelihood of non-homebound discharge (OR 0.78 per 1-unit increase, 95% CI 0.73-0.83, $p<0.001$) and prolonged hospital stay (OR 0.87 per 1-unit increase, 95% CI 0.81-0.93, $p<0.001$), but were not associated with 30-day readmissions and ED visits. The AM-PAC Mobility score was better at predicting discharge disposition (AUC 0.71, 95% CI 0.67-0.75) than length of stay (AUC 0.62, 95% CI 0.57-0.68).

Conclusion: Patients' mobility within the first 24 hours of TJA captured utilizing a simple "6-Clicks" score predicts discharge disposition and hospital length of stay. As hospital quality measures play a growing role in reimbursement, the AM-PAC Mobility score may be a useful postoperative tool in promptly identifying patients at risk of prolonged hospitalization and non-routine discharge.

Outpatient Total Joint Replacement: Is It Safe? Evaluation of Complications and Readmission Rates

John Callaghan, MD, **Jesse Otero, MD,** PhD, Andrew Pugely, MD, Yubo Gao, PhD, Nicholas Bedard, MD, Christopher Martin, MD

Introduction: To determine the relative safety of outpatient TJA, we identified differences in 30-day post-operative complication and readmission rates between patients undergoing inpatient and outpatient TJA.

Methods: Patients undergoing elective TJA between 2011 and 2013 were selected from the NSQIP Database using primary CPT codes for total knee arthroplasty and total hip arthroplasty, and were divided into cohorts of patients with or without inpatient admission. Propensity score matching was performed to minimize the potential confounding influences of patient comorbidities and differences in procedure type. Thirty-day complication and readmission rate were then compared between the matched cohorts of patients discharged the day of surgery and those admitted after surgery. Comparison of 30-day complication rates among the cohorts was performed using ANOVA.

Results: 105,901 TJA patients were admitted and 702 were discharged the day of surgery. After propensity score matching, patients in the outpatient cohort were generally younger and had a lower ASA class than those admitted after surgery, but there was no significant difference between cohorts with regard to gender, or history of cardiac, pulmonary, or renal disease. Operative times were significantly shorter for outpatient surgeries than admitted patients. The rate of any complication was higher for patients admitted after TJA (17.38% v 8.83%, $P<0.0001$) (Table 1). Admitted patients had significantly higher rates blood transfusion (12.68% v 7.26%, $p=0.0007$) and deep venous thrombosis (1.57% v 0.14%, $p=0.0061$), but no significant difference was observed in post-operative wound complications including superficial and deep infection or in pulmonary embolism, myocardial infarction, or stroke. Thirty-day readmission rate was also higher for admitted patients than for those undergoing outpatient TJA (4.24% v 1.51%, $p=0.015$).

Conclusion: With the selection bias utilized by surgeons at the hospitals submitting to NSQIP, 30-day complication (8.8%) and readmission (1.51%) rates we at least comparable for outpatient versus inpatient TJA.

The Sticky Wicket of Length of Stay and Reimbursement Calculations

Susan M. Odum, PhD, Bryce A. Van Doren, MPH, MPA, Thomas K. Fehring, MD, J. Bohannon Mason, MD

Introduction: In 2013, Centers for Medicare and Medicaid (CMS) released the 2014 Medicare Physician fee schedule determined by the Relative Value Scale Update Committee (RUC). RVU decreased by 5% and 11% respectively for hip and knee arthroplasty (THA,TKA). The purpose of this study was to determine if the 10-year trend in hospital length of stay (LOS) supports the 2014 RVU reduction.

Methods: The 2003-2012 HCUP NIS data releases were used to sample 866,543 primary TJA discharges with Medicare coverage and 15,000 discharges were excluded due to missing data. A multivariable regression using a generalized estimating equation was used to model longitudinal change in log (ln) transformed LOS. This adjusts for patient factors (comorbidities, age, race, discharge status), procedure type (knee/hip), hospital type (urban-teaching, urban-no teach, rural-no teach), four census region and in-hospital complication (none, minor, major).

Results: With all variables held constant, the average LOS over the 10-year study period was 3.96 days (95% CI 3.46-4.47). In 2003, median LOS was 4 (IQR 3-5) compared to 3 (IQR 3 – 3) in 2012. The coefficient estimates from the multivariate regression illustrate a significant ($p<0.0001$) annual incremental, decrease in ln LOS from 2003 to 2012. After controlling for several factors, the ln LOS decreased 25% by 2012.

Conclusion: The current RUC reimbursement formula appropriately accounts for 3 inpatient care days. Future RUC evaluations for reimbursement should utilize robust data evaluations similar to those used in this study for each segment of their reimbursement formula. Additionally, surgeons should not be financially penalized in efforts to further reduce LOS by creation of pathways, techniques and management strategies, which in turn result in savings to the healthcare system.

RAPT Score Predicts Inpatient Hospital Length of Stay Following Total Joint Arthroplasty

David Nicoloro, PT, MS, Dina Murad-Antun, MPT, Hany Bedair, MD

Introduction: The Risk Assessment and Prediction Tool (RAPT) is a preoperative patient assessment tool scored from 1-12 that reliably predicts discharge disposition (home vs. rehab) in TJA patients, with higher scores strongly correlated to home discharges. The purpose of this study is to determine if the RAPT score can predict inpatient hospital length of stay (LOS) following TJA.

Methods: In this prospective study, the RAPT score was determined preoperatively for all 644 primary THA and TKA patients from March 2014-2015. Scores and hospital LOS were compared using Spearman correlation for non-parametric data. Scores were compared to LOS as groups (RAPT scores 1-5, 6-9, and 10-12) using a Kruskal-Wallis Test for 2+ non-parametric samples and individually using linear regression. Individual RAPT score elements were entered into a logistic regression and compared to LOS <2 and >3 days.

Results: Significant negative correlation was identified between LOS and RAPT score ($R2 = -0.387$, $p<0.01$). Mean LOS was found to be significantly different between the three RAPT groups, with the lowest scoring group having the longest LOS (mean 3.32d), and the highest scoring group having the shortest LOS (mean 2.46d; $p<0.01$). Linear regression analysis demonstrated a strong correlation ($R2=0.885$) between RAPT Score and LOS with each incremental increase in the RAPT score correlating to a 10% reduction in LOS. Youngest age, male gender, longest pre-surgical walking distance, and "yes" to caregiver assist post-op were all associated with LOS <2 in the multivariate analysis ($p<0.01$).

Conclusion: RAPT scores appear associated with hospital LOS after TJA, with lower RAPT scores suggesting longer LOS, and the highest RAPT scores suggestive of shorter LOS. With TJA volumes forecasted to increase by 100-600% in the next 15 years, tools that can help predict resource utilization will be an increasingly more important element of the episode of care.

Can We Predict Discharge Status After Total Joint Arthroplasty? A Simple Calculator to Predict Home Discharge

John Callaghan, MD, Andrew Pugely, MD,
Nicholas Bedard, MD, Christopher Martin, MD, Yubo Gao, PhD,
Christopher Anthony, MD, Nicolas Noiseux, MD

Introduction: Post-operative discharge to a skilled facility following TJA is associated with increased costs and complications. While regional variation in discharge disposition exists, we hypothesize that intrinsic patient characteristics heavily influence the probability of discharge status.Thus the purpose of this study was to identify the risk factors for discharge to a skilled facility, quantify risk-factor impacts, and use them to build a predictive calculator.

Methods: The NSQIP database was queried from 2009-2013 to identify patients who underwent primary, THA/TKA. Patient demographics, comorbidties, and operative variables were identified and compared between those discharging home and not home. Univariate analysis and logistic regression models were employed to identify associations and predictors of discharge home. The predictor variables were weighted based on the Beta-coefficient from the logistic regression equation and converted to discrete values that were incorporated into a simple numerical calculator. Model discrimination was predictive with a c-index of 0.70.

Results: 107,300 patients underwent TJA. 69.2% were discharged home, 30.8% to a facility. Patients discharged to facility were older, female, had higher aggregate comorbidities, and required some functional assistance before surgery ($p<0.001$ for all). The 30-day risk of mortality was 10 fold higher to a facility ($p<0.001$). The 30-day risk of any morbidity was 3-times higher (8.2% vs 25.5%). Patient age, pre-operative functional status and living location, non-elective surgery, and ASA Class were most predictive of discharge to a facility. Patients with higher risk calculator scores had greater chance of discharge to a facility (40 and 80 points indicated 75% and 99% probability, respectively, $p<0.001$).

Conclusions: 30% of patients discharged to a facility following THA/TKA. Surgeons, and hospitals may use this simple calculator to start discharge planning before surgery. With the advent of peri-operative “bundled payments” this data will also help policymakers build risk-adjustment models to allow fair resource distribution.

Short Stay Total Joint Replacement: Any Difference Between Day 0 and Day 1 Discharge?

John Callaghan, MD, **Jesse Otero, MD, PhD,** Andrew Pugely, MD, Nicholas Bedard, MD, Christopher Martin, MD, Yubo Gao, PhD

Introduction: Increased length of hospital stay after total joint arthroplasty has been associated with increased 30-day readmission rates. We sought to identify differences in 30-day post-operative complication and readmission rates between patients undergoing outpatient TJA and those discharged on post-operative day (POD) 1-4+.

Methods: Patients undergoing elective TJA between 2011 and 2013 were selected from the NSQIP Database using primary CPT codes for TKA, UKA, and THA. Patient demographics, co-morbidities, and thirty-day complication and readmission rates were determined for patients discharged the day of surgery (POD0) and those discharged on POD1-4+. Comparison of complication rates among the cohorts was performed using ANOVA, concentrated on POD0 vs POD1.

Results: 762 patients were discharged on POD0; 3,229 POD1; 27,041 POD2; 55,958 POD3, and 21,694 POD4+. In general, patients in the POD4+ group were significantly older ($p<0.0001$) and had the highest rates of diabetes, pulmonary disease, coronary artery disease, cerebrovascular disease, renal disease, and proportion of patients in ASA class 3 and 4 of the four groups ($p<0.0001$). Comparing the POD0 and 1 groups, patients in the POD0 group were older, had a higher BMI and a higher rate of diabetes ($p<0.0001$). There was no significant difference between groups with respect to cardiac, pulmonary, or renal disease, or length of operation. In the POD0 group, there was a significantly higher rate of complications (11.3% v 4.4%, $p<0.0001$). In particular, patients discharged the day of surgery had higher rates of deep wound infection, deep venous thrombosis, myocardial infarction, blood transfusion, reoperation, and mortality ($p<0.05$).

Conclusion: Complication rates significantly increased as length of hospitalization increased. However, in the population studied, the complication rate for patients discharged on POD0 is significantly greater than for patients discharged on POD1. This data prompts a sense of caution regarding the relative safety of outpatient total joint arthroplasty.

Incorporating Hip Fracture Hemiarthroplasty into a Bundled Payment System for Total Joint Arthroplasty Is Not Economically Viable

Elisabeth Graboski, BS, James Murphy, MD, David Kolessar, MD, Thomas Bowen, MD, Carmen Crofoot, MD, **Elie Ghanem, MD**

Introduction: A 'bundle payment' system has been proposed as a way to decrease episode cost of care. All elective total hip and knee arthroplasties, as well as hemiarthroplasty for hip fracture (CPT 27236), are being grouped under the Diagnosis Related code (DRG) 469 and 470. Patients who undergo a hip fracture have more medical comorbidities and are less medically optimized than elective total joint arthroplasty patients. We hypothesize that including CTP 27236 in DRG 469/470 will pose an enormous financial burden on health care systems, rendering surgeons incapable of servicing hip fracture patients.

Methods: All claims at an academic tertiary care center were evaluated using DRG 469 and 470 from January 2013 to January 2014. Total episode cost of care was identified, including post-hospital care. The dataset was analyzed in its entirety and then re-analyzed with the removal of any episodes which contain CPT 27236. Costs were then compared between these three groups (Table 1). Hip fractures who received a total hip arthroplasty were included with the elective total hip arthroplasty.

Results: During the study period, there were 198 encounters in DRG 469/470 for a total cost of $4,817,633 and an average cost of $ 24,332 per episode. Of these episodes, 26 were a hemiarthroplasty (13%) for hip fracture, CPT 27236. The total cost for treating the CPT 27236 group was $ 1,102,818 with an average episode cost of $42,416. Without CPT 27236 included, DRG 469/470 has a total cost $3,714,845 and an average episode cost of $21,598.

Conclusion: The cost of treating a hip fracture using a hemiarthroplasty nearly doubles that of performing an elective total joint arthroplasty. The addition of CPT 27236 to DRG 469/470 will cause great financial burden on the health care system. When considering a bundled payment system for DRG 469/470, the inclusion CPT 27236 is not economically viable.

Should All Patients Be Included in Alternative Payment Models For Primary THA and TKA?

Joshua C. Rozell, MD, P. Maxwell Courtney, MD, Jonathan R. Dattilo, MD, Chia H. Wu, MD, MBA, Gwo-Chin Lee, MD

Introduction: Alternative payment models (APM) to reduce length of stay (LOS) and minimize complications and readmissions, if not adjusted for patient comorbidities, may encourage restrictive access to healthcare. The purpose of this study is to determine conditions that require hospitalization >3 days following elective primary total hip (THA) and knee (TKA) arthroplasty.

Methods: We prospectively evaluated 802 consecutive primary THA (n=273) and TKA (n=529) over a 9-month period. Patients underwent preoperative evaluation medical co-management. Hospital discharge occurred when patients were hemodynamically stable. Patient comorbidities, procedure type, and Charlson Comorbidity Index (CCI) were correlated to hospital stay >3 days using univariate and multivariate analysis to determine risk factors associated with prolonged hospitalization.

Results: The mean length of stay was 3.12 days (range 1-25). One hundred fifteen patients (14.3 %) required inpatient hospitalization beyond 3 days. Univariate analysis showed that patients with preoperative narcotic use, congestive heart failure, stroke, chronic kidney disease (CKD), chronic obstructive pulmonary disease (COPD) and liver disease were more likely be admitted >3 days. Multivariate analysis revealed that kidney disease (OR 3.05, 95% CI 1.50-6.20, p=0.002) and COPD (OR 2.42, 95% CI 1.03-5.67, p=0.041) were independent risk factors for LOS >3 days. An increasing CCI was predictive of increased hospitalization >3 days (OR 1.16, 95% CI 1.05-1.25, p<0.001). Patients with a score of 0 had a 6% rate of requiring LOS >3 days, while patients with a CCI of 5 had a 16% chance. There were 21 readmissions positively correlated with a mean CCI of 4.95, compared to a mean CCI of 2.83 (p=0.021) for patients not readmitted.

Conclusions: CKD and COPD are independent risk factors for increased length of stay and readmissions. The CCI showed strong correlation with LOS and readmissions. Therefore, patients with certain conditions and CCI > 5 should not be included in APM.

Variation of Hospital Expected Complication Rates after Total Knee Arthroplasty in the California Joint Replacement Registry

Jay Patel, MD, MS, Zhongmin Li, PhD, Nelson Soohoo, MD, Kevin Bozic, MD, MBA, James Huddleston, MD

Introduction: Comparison of outcomes after total knee arthroplasty (TKA) depends on an accurate risk adjustment model to account for variation in patient characteristics. This study utilizes a risk adjustment model to determine the degree to which hospitals vary in their expected complication rates.

Methods: 7,873 primary TKA procedures were performed in 26 hospitals in the CJRR between 2011-2015. 90 day complications were identified by ICD-9 codes and grouped into the following categories: postoperative arrhythmia, acute renal failure, congestive heart failure (CHF), myocardial infarction (MI), fracture, dislocation, wound infection, deep venous thrombosis, pulmonary embolus, excessive bleeding, nerve injury, and death. A multivariate logistic risk model for postoperative complication was created using the following patient risk factors: age, gender, race, bilateral procedures, American Society of Anesthesiologists class, diabetes, history of MI, coronary artery disease, CHF, peripheral artery disease, chronic lung disease, and history of venous thromboembolism. The c statistic of the model was 0.646 and chi-squared value was 12.25. The hospital expected complication rate was determined by applying the risk adjustment model to each hospital's patient case mix. A general linear model for analysis of variance was utilized to determine whether the hospitals' expected complication rate differed significantly. A Spearman's rank coefficient was calculated to determine whether hospital expected complication rate is correlated with hospital volume.

Results: The overall observed 90 day complication rate in the CJRR between 2011-15 after TKA was 7.41%. The range of expected complication rates was 6.29% to 11.09% with a significant difference between hospitals ($p<0.0001$). There was no significant correlation between hospital volume and expected complication rate (Spearman coefficient 0.013, $p=0.951$).

Conclusion: There is a significant difference in expected 90 day complication rates after TKA in hospitals in the CJRR based on each hospital's patient characteristics.

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Abdel, Matthew P., MD: 8 (European Journal of Orthopaedic Surgery and Traumatology; Journal of Bone and Joint Surgery - British; Journal of Orthopaedic Research; Journal of Orthopaedics and Traumatology); 9 (Minnesota Orthopaedic Society)

Adams, Joanne, BFA, CMI: 5 (Biomet; Kinamed; OrthoSensor; Pacira Pharmaceuticals, Inc); 8 (Journal of Arthroplasty

Alcerro, Jose C., MD: (n)

Alexander, Clayton, MD: (n)

Alexiades, Michael M., MD: 3B (Biomet); 9 (Weill Cornell Medical College)

Alipit, Vincent, MS: 3A (Stryker); 4 (Stryker)

Alrumaih, Husam, MD: (n)

Alvi, Hasham M., MD: (n)

Amin, Nirav Hasmukh, MD: (n)

Ammeen, Deborah, BS: (n)

An, Thomas J., BA: 4 (Merck); 5 (Johnson & Johnson; Merck)

Anderson, Forrest L., BA: (n)

Anderson, Lucas A., MD: (n)

Anthony, Christopher, MD: (n)

Antosh, Sean, MD: (n)

Aoki, Stephen, MD: 3B (Pivot Medical, Stryker)

Armstrong, Lucas C., MD: (n)

Arnold, Nicholas Ryan, BS: 4 (Alkermes; Celgene)

Ashley, Blair Surran, MD: (n)

Attarian, David E., MD: 7 (Data Trace Publishers); 9 (American Orthopaedic Association)

Austin, Matthew S., MD: 1 (Zimmer); 2 (DePuy, A Johnson & Johnson Company; Zimmer); 3B (Zimmer); 8 (Journal of Arthroplasty); 9 (American Association of Hip and Knee Surgeons; AAOS)

Ayers, David Christopher, MD: 8 (Journal of Bone and Joint Surgery - American); 9 (AAOS; American Orthopaedic Association; American Orthopaedic Association)

Baca, Geneva, BA: (n)

Bala, Abiram, BA: (n)

Balkissoon, Rishi, MD, MPH: 7 (Oakstone Publishing - Practical Reviews in Orthopaedic Surgery); 8 (Geriatric Orthopaedic Surgery & Rehabilitation)

Banos, Andrew, MD: (n)

Baratz, Michael D., MD: (n)

Barlow, Brian T., MD: (n)

Barnes, Charles Lowry, MD: 1 (DJO; Zimmer); 2 (Convatec); 3B (DJO; Zimmer); 3C (None); 4 (Liventa; Responsive Orthopaedics); 5 (ConforMIS; Liventa; Pacira); 6 (Corin U.S.A.); 8 (Clinical Orthopaedics and Related Research; Journal of Arthroplasty; JSOA); 9 (American Association of Hip and Knee Surgeons; AR Orthopaedic Society; HipKnee Arkansas Foundation; Mid American Orthopaedic Association; Southern Orthopaedic Association)

Barnett, Steven L., MD: 2 (DePuy, A Johnson & Johnson Company); 3B (DePuy, A Johnson & Johnson Company; Zimmer); 5 (DePuy, A Johnson & Johnson Company; Stryker)

Barr, Christopher Joseph, BS: 6 (Zimmer); 8(Journal of Bone and Joint Surgery – American; Spine)

Barrack, Robert L., MD: 1 (Stryker); 3B (Stryker); 5 (Biomet; Medical Compression Systems; National Institutes of Health (NIAMS & NICHD); Smith & Nephew; Stryker; Wright Medical Technology, Inc.); 6 (Stryker); 7 (The McGraw-Hill Companies Inc; Wolters Kluwer Health - Lippincott Williams & Wilkins); 8 (Journal of Bone and Joint Surgery - American; Journal of Bone and Joint Surgery - British); 9 (Hip Society; Knee Society)

Barrington, John W., MD: 1 (Biomet); 3B (Biomet; Orthosensor; Pacira; Smith & Nephew); 4 (Iconacy); 5 (Biomet); 6 (Tier 1 Healthcare and Education Research)

Barry, Jeffrey, MD: (n)

Bas, Marcel A., MD: (n)

Basques, Bryce A., MD: (n)

Bates, Michael Devon., MD: (n)

Baykal, Doruk, PhD: (n)

Beal, Matthew D., MD: 1 (Medacta); 3B (Medacta; Zimmer; Zimmer); 5 (Medacta; National Institutes of Health (NIAMS & NICHD), Zimmer, Stryker, Mako Surgical); 9 (AAOS)

Beauchamp, Christopher Paul, MD, FRCS (Ortho): (n)

Beaver, Walter Burns, MD: 1 (Stryker); 2 (Stryker; Stryker,); 3B (DJ Orthopaedics; Stryker; Orthosensor; Pacira Pharm); 5 (DePuy, A Johnson & Johnson Company; Stryker; DonJoy); 9 (ICJR,OrthoCarolina Research Institute)

Bedair, Hany S., MD: (n)

Bedard, Nicholas A., MD: (n)

Bedi, Asheesh, MD: 3B (Arthrex, Inc); 4 (A3 Surgical ;); 7 (SLACK Incorporated; Springer); 8 (Journal of Shoulder and Elbow Surgery;); 9 (American Orthopaedic Society for Sports Medicine;)

Bemenderfer, Thomas Bradford, MD: (n)

Benvenuti, Michael A., BS: 4 (Abbott; AbbVie; Bristol-Myers Squibb; GlaxoSmithKline; Johnson & Johnson; Pfizer; Zimmer)

Berend, Keith, R., MD: 1 (Biomet); 3B (Biomet); 5 (Biomet; Kinamed; Pacira); 8 (Clinical Orthopaedics and Related Research; Journal of Arthroplasty; Journal of Bone and Joint Surgery - American; Orthopedics; Reconstructive Review); 9 (AAOS Board of Specialty Societies (Knee Education Representative); American Association of Hip and Knee Surgeons; Knee Society)

Berry, Daniel J., MD: 1 (DePuy, A Johnson & Johnson Company;; DePuy, A Johnson & Johnson Company); 3B (DePuy, A Johnson & Johnson Company); 5 (DePuy, A Johnson & Johnson Company;; DePuy, A Johnson & Johnson Company); 7 (Elsevier; Wolters Kluwer Health - Lippincott Williams & Wilkins); 8 (Journal of Bone and Joint Surgery - American); 9 (American Joint Replacement Registry; Hip Society; Mayo Clinic Board of Governors)

Bhave, Anil, PT: 1 (Guardian Inc); 3B (DJ Orthopaedics; Merz GMB; On Going Care Solutions; Orthosensor); 8 (World Journal of Orthopedics)

Bhowmik-Stoker, Manoshi, PhD: 3A (Stryker); 4 (Stryker); 6 (Stryker)

Blanes Perez, Alvaro, MD: (n)

Blizzard, Daniel John, MD: (n)

Blunn, Gordon, PhD: 1 (Stanmore Implants); 2 (Baxterstanmore Implants); 3B (Stanmore Implants); 4 (Stanmore Implants); 5 (Biomet; Lima; Medacta); 6 (Stanmore Implant); 7 (Stanmore Implants); 8 (Journal of Biomaterial Research); 9 (British Orthopaedic Research Society)

Boettner, Friedrich, MD: 1 (OrthoDevelopment; Smith & Nephew); 2 (DJO Surgical); 3B (OrthoDevelopment; Smith & Nephew); 5 (Smith & Nephew); 7 (OrthoForum GmbH); 8 (OrthoForum GmbH)

Bogunovic, Ljiljana, MD: (n)

Bohl, Daniel D., MD, MPH:

(n)

Boles, John, BS: (n)

Bolognesi, Michael P., MD: 1 (Biomet; Zimmer); 2 (Biomet; Kinamed; Zimmer); 3B (TJO; Zimmer); 3C (Amedica); 4 (Amedica; TJO); 5 (Biomet; DePuy, A Johnson & Johnson Company; Zimmer); 6 (AOA); 8 (Arthroplasty Today; Journal of Arthroplasty; Journal of Surgical Orthopaedic Advances); 9 (American Association of Hip and Knee Surgeons; Eastern Orthopaedic Association)

Bonano, John Carlo, BA: (n)

Bono, James V., MD: 1 (Stryker,Sectra); 2 (Stryker); 3B (Stryker); 7 (Springer)

Bosco III, Joseph A., MD: 1 (Genovel); 3B (Genovel); 4 (Genovel); 8 (Bulletin of The Hospital for Joint Diseases; Journal of Bone and Joint Surgery – American); 9 (Association of Professionals in Infection Control (APIC); The Orthopedic Learning Center)

Bostrom, Mathias, P. G., MD: 3B (Smith & Nephew); 5 (Bone Support; Smith & Nephew); 8 (Springer); 9 (Orthopaedic Research Society)

Bourgeois, Devin M., BS: (n)

Bowen, Thomas R., MD: (n)

Boylan, Matthew Ryan, BS: (n)

Bozic, Kevin J., MD, MBA: 3B (Institute for Healthcare Improvement; Yale-New Haven Center for Outcomes Research); 9 (AAOS; American Joint Replacement Registry; Orthopaedic Research and Education Foundation)

Bragdon, Charles R., PhD: 1 (Zimmer); 5 (MAKO Surgical; Zimmer)

Brown, Christopher J., MD 1 (Nuvasive); 3B (Nuvasive)

Brown, Matthew L., MD: (n)

Browne, James A., MD: 3B (Biocomposites Ltd; DJ Orthopaedics; Ethicon); 8 (American Journal of Orthopedics; Journal of Arthroplasty)

Bunn, Kevin J., MD: (n)

Burge, Alissa J., MD: (n)

Burks, Geoff G., BS: (n)

Burleson, Andrew, MD: (n)

Burns, Michael Francis, MD: (n)

Cafri, Guy, PhD, MStat: (n)

Callaghan, John J., MD: 1 (DePuy, A Johnson & Johnson Company;); 3B (DePuy, A Johnson & Johnson Company); 7 (Wolters Kluwer Health - Lippincott Williams & Wilkins; Journal of Arthroplasty (Deputy Editor)); 8 (Journal of Arthroplasty); 9 (International Hip Society; Knee Society; Orthopaedic Research and Education Foundation)

Callahan, Matthew Kevin, MSBA: 4 (Johnson & Johnson)

Calloway, Sean Patrick, MD: (n)

Camp, Christopher L., MD: (n)

Campbell, Danielle, MS: 3A (Stryker); 4 (Stryker)

Cancienne, Jourdan Michael, MD: (n)

Carandang, Gerard, MS: (n)

Carli, Alberto, MD, FRCSC, MSc: (n)

Carrino, John Anthony, MD: 3B (BioClinica; Halyard; Pfizer); 3C (GE Healthcare); 4 (Merge); 8 (Arthritis and Rheumatism)

Carroll, Kaitlin M., BS: (n)

Cass, Joseph Ralph, MD: (n)

Cassidy, Charles, MD: 3B (AM Surgical; Synthes); 9 (Massachusetts Orthopaedic Society)

Chalmers, Brian, MD: (n)

Chalmers, Peter Nissen, MD: (n)

Chandrasekaran, Sivashankar, MD: (n)

Chen, Antonia F., MD, MBA: 3B (ACI; Joint Purification Systems); 5 (3M; Myoscience); 7 (SLACK Incorporated); 9 (AAOS)

Cherian, Jeffrey Jai, DO: 3B (DJ Orthopaedics)

Chin, Garwin, BS: (n)

Christensen, Christian P., MD: 2 (Biomet); 5 (Biomet; Zimmer)

Christy, Jonathan M., MD: (n)

Citrano, Patrick, BA: 4 (CD Diagnostics)

Clarke, Henry D., MD: 1 (ConforMIS); 3B (ConforMIS); 3C (Conformis); 5 (Stryker; VIDACARE); 7 (Journal of the American Academy of Orthopaedic Surgeons); 8 (Journal of Arthroplasty; Journal of Knee Surgery; Journal of the American Academy of Orthopaedic Surgeons; Knee); 9 (AAOS, Knee Society, International Congress for Joint Reconstruction, BOS)

Clement, R. Carter, MD: (n)

Clement, Rutledge Carter., MD, MBA: (n)

Clohisy, John C., MD: 3B (Microport Orthopedics, Inc.; Smith & Nephew); 5 (Pivot Medical; Smith & Nephew; Zimmer); 7 (Wolters Kluwer Health - Lippincott Williams & Wilkins)

Cochran, Adam, MD: (n)

Cohen, Russell G., MD: 2 (Stryker); 3B (Stryker)

Cohen, Sheridan L., BSc Candidate: (n)

Collins, Kristi, PA-C: (n)

Comfort, Thomas Krebs., MD: (n)

Conti Mica, Michael R., MD: (n)

Cooper, Herbert John., MD: 3B (KCI; Medacta USA; Smith & Nephew; Zimmer); 5 (KCI); 8 (Journal of Arthroplasty); 9 (AAOS)

Cornell, Charles N., MD: 1 (Exactech, Inc); 7 (Clinical Orthopaedics and Related Research; Journal of the Hospital for Special Surgery – HSS Journal); 8 (Clinical Orthopaedics and Related Research; Journal of Bone and Joint Surgery – American; Journal of the Hospital for Special Surgery – HSS Journal; Springer)

Cottino, Umberto, MD: (n)

Courtney, Paul Maxwell, MD: (n)

Cremins, Michael S., PhD, PA-C: (n)

Crofoot, Carmen D., MD: (n)

Cross, Michael B., MD: 1 (Smith & Nephew); 3B (Acelity; Exactech, Inc; Intellijoint; Link Orthopaedics; Smith & Nephew); 5 (Smith & Nephew); 8 (Bone and Joint Journal 360; Journal of Orthopaedics and Traumatology; Techniques in Orthopaedics)

Cruz, Alice Margaret, BS: 3A (Stryker)

Cullinan, Kevin M., MD: (n)

Cunn, Gregory, MD: (n)

Curry, Emily J., BA: (n)

Cushner, Fred D., MD: 1 (Smith & Nephew); 2 (CHE; Iroku; Pacira; Smith & Nephew); 3B (Smith & Nephew); 4 (Aperion,Alter G); 5 (Pacira); 7 (Thieme; Elsevier,Smith & Nephew); 8 (American Journal of Orthopedics; Knee,CORR,Orthopedics); 9 (Knee Society)

Cvetanovich, Gregory L., MD: (n)

Dabov, Gregory D., MD: 7 (Saunders/Mosby-Elsevier)

Dahm, Diane Lynn, MD: 1 (Spouse receives royalties from TENEX health.); 4 (Spouse owns stock in TENEX health.); 9 (Arthroscopy Association of North America, Research Committee 2008-Present, Arthroscopy Assocation of North America, Learning Center Committee 2012; AAOS Arthroscopy and Sports Medicine Program Subcommittee)

D'Apuzzo, Michelle R., MD: (n)

Dasa, Vinod, MD: 2 (bioventus); 3B (bioventus; Ferring Pharmaceuticals; myoscience; Seikagaku); 4 (vector medical); 5 (cropper medical)

Dattilo, Jonathan Ross, MD: (n)

Davis, Kenneth, MS: (n)

Davis II, Richard Lee, MD: (n)

Deirmengian, Carl A., MD: 2 (Zimmer); 3B (Synthes; Zimmer; Biomet); 4 (Biostar Venture Fund partner, CD Diagnostics, Trice, Domain); 5 (Zimmer, CD Diagnostics); 7 (Journal of Bone and Joint Surgery - American)

Deirmengian, Gregory K., MD: 2 (Zimmer); 3B (Synthes, Zimmer, Biomet); 4 (CD Diagnostics, Biostar ventures; Domain; Trice); 5 (CD Diagnostics; Zimmer); 7 (Journal of Bone and Joint Surgery - American); 8 (Journal of Arthroplasty)

Dekker II, Robert Gerald, MD: (n)

Del Gaizo, Daniel, J., MD: 2 (Cadence Pharmaceuticals); 3B (SPR Therapeutics); 5 (Stryker; Zimmer); 8 (Journal of Arthroplasty)

Delanois, Ronald Emilio, MD: 2 (Stryker); 3B (Stryker); 9 (Maryland Orthopedic association)

Della Valle, Craig J., MD: 1 (Biomet); 3B (Biomet; DePuy, A Johnson & Johnson Company; Smith & Nephew); 4 (CD Diagnostics); 5 (Biomet; CD Diagnostics; Smith & Nephew; Stryker); 7 (SLACK Incorporated); 8 (Orthopedics Today; SLACK Incorporated); 9 (American Association of Hip and Knee Surgeons; Arthritis Foundation; Hip Society; Knee Society; Mid America Orthopaedic Association)

Demzik, Alysen L., BS: (n)

Derman, Peter B., MD, MBA: (n)

Diaz Ledezma, Claudio A., MD: (n)

DiCarlo, Edward F., MD: (n)

Domb, Benjamin Gilbert, MD: 1 (Arthrex, Inc; DJO Global; Orthomerica); 2 (Arthrex, Inc,; ATI); 3B (Amplitude; Arthrex, Inc; Pacira; Stryker); 4 (Stryker); 5 (Arthrex, Inc; ATI; Breg; Pacira; Stryker); 9 (American Hip Institute; AANA Learning Center Committee)

Doran Jr., James Patrick, MD: (n)

Duchman, Kyle R., MD: (n)

Duggal, Shivi, BS, MBA: (n)

Duncan, Stephen Thomas., MD: 3B (Mitek; Smith & Nephew); 8 (Journal of Arthroplasty); 9 (American Association of Hip and Knee Surgeons)

Duwelius, Paul J., MD: 1 (Zimmer); 2 (Signature Health Care); 3B (Zimmer); 4 (UniteOR); 5 (Providence Orthopedic Foundation & Director of Providence Orthopedic Institute; Zimmer); 7 (Journal of Bone and Joint Surgery - American; Journal of Bone and Joint Surgery - American); 8 (Clinical Orthopaedics and Related Research); 9 (AAOS; Operation Walk-Freedom to Move CEO)

Edelstein, Adam I., MD: (n)

Edusei, Emmanuel, BS: (n)

Edwards, Paul K., MD: 3B (Biomet; DJO)

El Dafrawy, Mostafa, MD: (n)

Elkassabany, Nabil M., MD: (n)

Ellzey, Andy, MD: (n)

Elmallah, Randa Kamal, MD: (n)

Elpers, Marcella, BS: (n)

Emerson Jr., Roger H., MD: 1 (Biomet;); 2 (Medtronic; Biomet; Pacira); 3B (Medtronic; Biomet; Pacira); 4 (Pacira); 5 (Biomet; Pacira Pharmaceuticals)

Endo, Yoshimi, MD: (n)

Engh, Jr, C. Anderson, MD: 1 (DePuy, A Johnson & Johnson Company; DePuy, A Johnson & Johnson Company); 3B (DePuy, A Johnson & Johnson Company); 4 (DePuy, A Johnson & Johnson Company); 5 (DePuy, A Johnson & Johnson Company; Smith & Nephew); 9 (AAOS; American Association of Hip and Knee Surgeons; Hip Society)

Engh, Gerard A., MD: 1 (Smith and Nephew; Innomed); 2 (Cayenne Medical; Smith & Nephew); 3B (Cayenne Medical; Smith & Nephew); 4 (Cayenne Medical); 5 (DePuy, A Johnson & Johnson Company; Inova Health System; Smith & Nephew)

Engstrom, Stephen M., MD: (n)

Erickson, Brandon, MD: (n)

Erickson, Jill A., PA: (n)

Eskelinen, Antti, MD, PhD: 2 (DePuy, A Johnson & Johnson Company)

Eskildsen, Scott M., MD: (n)

Esposito, Christina Ilona, PhD: 5 (EOS Imaging Inc.)

Fareed , Jawed, PhD, BS: (n)

Fehring, Keith A., MD: 1 (DePuy, A Johnson & Johnson Company); 2 (DePuy, A Johnson & Johnson Company); 3B (DePuy, A Johnson & Johnson Company); 5 (DePuy, A Johnson & Johnson Company); 6 (DePuy, A Johnson & Johnson Company); 9 (American Association of Hip and Knee Surgeons; Knee Society)

Fehring, Thomas K., MD: 1 (DePuy, A Johnson & Johnson Company); 2 (DePuy, A Johnson & Johnson Company); 3B (DePuy, A Johnson & Johnson Company); 5 (DePuy, A Johnson & Johnson Company); 9 (American Association of Hip and Knee Surgeons; Knee Society)

Ferguson, David F., MD: (n)

Fields, Kara, MS: 2 (AstraZeneca; Crealta; Takeda); 3B (Takeda); 8 (Arthritis & Rheumatism)

Figgie, Mark P., MD: 1 (Biomet; Lima); 4 (mekanika); 5 (Zimmer); 9 (Knee Society)

Filippone, Edward John, MD: 2 (Mallinckrcrodt)

Fillingham, Yale A., MD: (n)

Fitz, David W., MD: (n)

Fleisher, Lee Alan, MD: 7 (Saunders/Mosby-Elsevier); 8 (Saunders/ Mosby-Elsevier Annals of Surgery; Wolters Kluwer Health – Lippincott Williams & Wilkins); 9 (Association of University Anesthesiologists; Foundation for Anesthesia Education and Research)

Flynn, David Neilson, MD, MBA: (n)

Ford, Marcus C., MD: (n)

Fox, Rabun Samuel, MD: (n)

Franklin, Patricia D., MD, MPH, MBA: 5 (Zimmer)

Fraser, James F., MD: 3A (Stryker); 4 (Stryker)

Fredette, Amanda, BS: (n)

Freiberg, Andrew A., MD: 1 (Biomet; Zimmer); 3B (Zimmer; Biomet; Medtronic); 4 (ArthroSurface; Orthopaedic Technology Group)

Fricka, Kevin B., MD: 2 (Zimmer); 3B (Zimmer); 5 (INOVA Health Care Services; Zimmer); 6 (OrthoCareRN)

Gallizzi, Michael Anthony, MD: 3B (Arthrex, Inc.); 5 (Arthrex, Inc.)

Ganesan, Goutham, PhD: (n)

Gao, Yubo, PhD: (n)

Gardner, Thomas R., MCE: (n)

Gargiulo, Jeanine, PA-C: (n)

Garvin, Kevin L., MD: 3C (TRAK Surgical, Omaha NE); 8 (Wolters Kluwer Health - Lippincott Williams & Wilkins); 9 (AAOS; American Orthopaedic Association; Hip Society; Knee Society)

Geller, Jeffrey A., MD:

3B (OrthoSensor; Smith & Nephew); 5 (Smith & Nephew); 8 (Clinical Orthopaedics and Related Research,Journal of Arthroplasty); 9 (American Association of Hip and Knee Surgeons,American Association of Orthopaedic Surgeons)

George, Spencer Martin, MD: (n)

Gera, Jr., James T., MBA: (n)

Gerlinger, Tad L., MD: 3B (Smith & Nephew); 9 (Society of Military Orthopaedic Surgeons)

Ghanem, Elie S., MD: (n)

Gioe, Terence J., MD: 4 (Eli Lilly; Johnson & Johnson); 8 (Clinical Orthopaedics and Related Research); 9 (AAOS)

Goldman, Ashton Howard, MD: (n)

Goldring, Steven R., MD: 3B (Abbott (wife); Bone Therapeutics, Fidia, Janssen); 5 (Abbott (wife); Boehringer Ingelheim; Merck Serono (wife)); 8 (Arthritis Rheumatism (wife); Osteroarthritis & Cartilage (wife)); 9 (Orthopaedic Research Society (wife); Osteoarthritis Research Society International (wife))

Gomez, Miguel, MD: (n)

Gonzalez Della Valle, Alejandro, MD: 3B (Link Orthopaedics; Merz Pharmaceuticals; Orthodevelopment; Orthosensor)

Good, Robert P., MD: 3A (My son, Michael Good, is employed by a distributor (Advanced Surgical) as a product rep.); 3C (Stelkast)

Gorab, Robert S., MD: 1 (DePuy, A Johnson & Johnson Company); 2 (DePuy, A Johnson & Johnson Company); 3B (DePuy, A Johnson & Johnson Company; DePuy, A Johnson & Johnson Company); 5 (DePuy, A Johnson & Johnson Company; DePuy, A Johnson & Johnson Company)

Gotoff, James, BA: (n)

Goyal, Nitin, MD: 3B (Cayenne Medical; Stryker)

Graboski, Elisabeth M.C., BS: 3A (Merck)

Grady-Benson, John C., MD: 9 (AAOS)

Grant, Tanner W., BS: (n)

Grauer, Jonathan N., MD: 3B (Bioventus; ISTO Technologies; Medtronic; Stryker; Vertex); 8 (American Journal of Orthopedics; Contemporary Spine Surgery; The Spine Journal); 9 (AAOS; Cervical Spine Research Society)

Greber, Eric M., MD: 3A (Stryker - Medical Division)

Green, Cynthia L., PhD: (n)

Greene, Meridith E., PhD: 6 (Biomet; Zimmer)

Grossman, Kelsey, BS: (n)

Gui, Chengcheng, BS: (n)

Guild III, George N., MD: (n)

Gulati, Simmi, MS: (n)

Guler, Nil, MD: (n)

Haas, Steven B., MD: 1 (Smith & Nephew; Innovative Medical Products, Inc); 2 (Smith & Nephew); 3B (Smith & Nephew); 4 (Ortho.Secure); 5 (Smith & Nephew); 6 (APOS Medical & Sports Technologies Ltd.); 9 (Knee Society)

Hamilton, William G., MD: 2 (DePuy, A Johnson & Johnson Company); 3B (DePuy, A Johnson & Johnson Company); 5 (Biomet; DePuy, A Johnson & Johnson Company; Inova Health Care Services

Hamlin, Brian R., MD: 3B (Biomet; DePuy, A Johnson & Johnson Company, Blue Belt Technologies); 4 (Blue Belt Technologies); 8 (Journal of Arthroplasty, Transfusion); 9 (AAOS)

Hansen, Erik Nathan, MD: (n)

Hanssen, Arlen D., MD: 1 (Stryker); 5 (Stryker); 7 (Elsevier); 9 (International Congress for Joint Reconstruction (ICJR))

Hardcastle, John McCall, MD: (n)

Hart, Alister, FRCS: 3B (DePuy, A Johnson & Johnson Company); 5(Biomet; Corin U.S.A.; DePuy, A Johnson & Johnson Company; Finsbury; Mathys Ltd; Smith & Nephew; Stryker; Zimmer)

Hart, Gavin Pollock, MD: (n)

Hartzband, Mark A., MD: 1 (Zimmer); 2 (Zimmer); 3B (Zimmer); 5 (Zimmer)

Harwin, Steven F., MD: 1 (Stryker); 2 (Stryker, Convatec); 3B (Stryker, Convatec); 4 (Stryker); 7 (SLACK Incorporated; Thieme, Inc., Journal of Knee Surgery); 8 (Journal of Arthroplasty, Orthopedics, Journal of Knee Surgery, Surgical Technology International)

Hassan, Mohammed, MD: (n)

Haughom, Bryan, MD: (n)

Havey, Robert, MSC: (n)

Heck Jr., Robert Kurt, MD: 1 (Wright Medical Technology, Inc.); 7 (MosbyElsevier)

Hellman, Michael David, MD: (n)

Henry, Michael, BS: (n)

Hepinstall, Matthew S., MD: 3B (Acelity; IROKO Pharmaceuticals; Smith & Nephew)

Herschmiller, Thomas Alan, MD: (n)

Heyse, Thomas Jan, MD: 2 (Biomet; Implantcast; Smith & Nephew); 3B (Smith & Nephew); 5 (Biomet; Smith & Nephew); 8 (Archives of Orthopaedic And Trauma Surgery, Hospital for Special Surgery Journal)

Higuera Rueda, Carlos A., MD: 3B (Covidien; KCI); 5 (KCI; Myoscience; Stryker); 8 (American Journal of Orthopedics)

Ho, Henry, MSC: (n)

Hopkinson, William J., MD: 4 (Johnson & Johnson; Pfizer; Zimmer); 9 (AAOS)

Hoppensteadt, Debra, PhD, BS: (n)

Hothi, Harry, BEng, MSc, PhD: (n)

Houdek, Matthew T., MD: (n)

Howard, James, MD: 2 (DePuy, A Johnson & Johnson Company; Stryker); 3B (DePuy, A Johnson & Johnson Company; Stryker); 5 (DePuy, A Johnson & Johnson Company); 6 (DePuy, A Johnson & Johnson Company; Microport; Smith & Nephew; Stryker; Zimmer)

Howard, Mark, BS: (n)

Hozack, William J., MD: 1 (Stryker); 3B (Stryker); 5 (Stryker); 8 (Journal of Arthroplasty); 9 (Hip Society)

Huang, Ronald, MD: (n)

Huddleston, James I., MD: 1 (Exactech, Inc); 2 (Exactech, Inc; Zimmer); 3B (Biomet; California Joint Replacement Registry; Exactech, Inc; Porosteon; Zimmer); 4 (Porosteon); 5 (American Knee Society; Biomet; Robert Wood Johnson Foundation); 8 (Journal of Arthroplasty); 9 (American Association of Hip and Knee Surgeons; California Joint Replacement Registry)

Hughes, Christopher, PT: (n)

Hume, Eric L., MD: 3B (Zimmer)

Huo, Michael H., MD: 2 (Johnson & Johnson); 3B (AO Foundation; DePuy, A Johnson & Johnson Company); 5 (Zimmer); 8 (Current Orthopedic Practice; Journal of Bone and Joint Surgery - American); 9 (American Academy of Orthopedic Surgeons (Committee on Evaluation: self-assessment examination))

Ilyas, Imran, FRCS, MD: (n)

Incavo, Stephen J., MD: 1 (Biomet; Innomed; Smith & Nephew; Wright Medical

Technology, Inc.; Zimmer; Zimmer; Zimmer); 3B (Zimmer); 4 (Zimmer); 8 (Journal of Arthroplasty); 9 (Knee Society)

Iorio, Richard, MD: 5 (Orthosensor; pacira); 8 (Clinical Orthopaedics and Related Research; JBJS Reviews; Journal of Arthroplasty; Journal of Bone and Joint Surgery - American; Journal of the American Academy of Orthopaedic Surgeons); 9 (American Association of Hip and Knee Surgeons; Hip Society)

Isaacs, Robert E., MD: 1 (Nuvasive); 3B (Nuvasive); 4 (Nuvasive; Providence; Saferay Spine, LLC; Safewire; Vertera; Vilaspine)

Isaacson, Mark J., DO: (n)

Ishmael, Marshall, BS: (n)

Ismaily, Sabir, BS: (n)

Israelite, Craig L., MD: 3B (Zimmer); 8 (Journal of Arthroplasty; Clinical Orthopaedics and Related Research)

Iwakiri, Kentaro, MD, PhD: (n)

Jackson, Nikki, RN: (n)

Jacobs, Cale A., PhD: 3B (Biomet); 5 (Biomet; Zimmer)

Jacobson Jr., Richard Allen, BS: (n)

Jahng, Kenneth H., MD: (n)

Jain, Rajesh K., MD, MPH: 8 (Journal of Arthroplasty)

Jauregui, Julio J., MD: (n)

Jerabek, Seth A., MD: 2 (Stryker); 3B (Stryker)

Jiranek, William A, MD: 1 (DePuy, A Johnson & Johnson Company); 3B (DePuy, A Johnson & Johnson Company); 4 (Johnson & Johnson); 5 (DePuy, A Johnson & Johnson Company; Stryker); 8 (Orthopaedic Knowledge Online); 9 (American Association of Hip and Knee Surgeons; Lifenet Health, Inc.; OLC Orthopaedic Learning Center)

Johanson, Per-Erik, MD: 5 (Biomet; DePuy, A Johnson & Johnson Company; Lima; Link; Smith & Nephew; Stryker; Zimmer)

Johnson, Staci, M.Ed: (n)

Kamara, Eli, MD: (n)

Kamath, Atul F., MD: 1 (Innomed); 4 (Procter & Gamble); 8 (BMC Musculoskeletal Disorders); 9 (AAOS)

Kamath, Ganesh V., MD: (n)

Kapadia, Bhaveen, MD: 2 (Sage Products, LLC); 3B (Sage Products, LLC)

Kardos, Keith, PhD: 3A (CD Diagnostics); 4 (CD Diagnostics)

Karia, Raj, MPH: (n)

Karim, Azim A., MD: (n)

Karthikeyan, Tharun, MD: (n)

Karunakar, Madhav A., MD: 8 (Journal of Orthopaedic Trauma); 9 (AAOS; Orthopaedic Trauma Association)

Kayupov, Erdan, MS: (n)

Kazarian, Erick, BA: (n)

Kazarian, Gregory, BA: (n)

Keating, E. Michael, MD: (n)

Keegan, Molly A., MD: (n)

Keeney, James A., MD: 9 (Society of Military Orthopaedic Surgeons)

Kelly, Bryan T., MD: 3C (A-3 Surgical; Arthrex, Inc); 4 (A-3 Surgical)

Kendall, Mark, MD: (n)

Kendoff, Daniel, MD, PhD: 2 (Biomet; Zimmer; Zimmer)

Kent, Suzanne E., BS: (n)

Keswani, Aakash, BA: (n)

Khanuja, Paul (Harpal Singh), MD: 8 (Journal of Arthroplasty); 9 (AAOS; American Association of Hip and Knee Surgeons)

Khayatzadeh, Saeed, MSc: (n)

Kheir, Michael M., BS: (n)

Kim, Seung Chan, MD, PhD: (n)

Kim, Yong Sik, MD: 4 (Corentec)

Kirk, Amanda Elizabeth, MS: 3A (Stryker)

Kirschenbaum, Ira H., MD: 1 (Innomed); 4 (DTC Healthcom, LLC; SwiftPath, LLC); 6 (SwiftPath, LLC); 7 (DTC Healthcom); 8 (Medscape); 9 (AAOS)

Klein, Gregg R., MD: 2 (Zimmer); 3B (Zimmer); 5 (Zimmer); 8 (American Journal of Orthopedics; Journal of Bone and Joint Surgery - American; Journal of Arthroplasty); 9 (AAOS)

Klement, Mitchell Robert., MD: (n)

Klingenstein, Gregory G., MD: (n)

Kobayashi, Akio, MD, PhD: 2 (Biomet; Kyocera; Medacta)

Koch, Chelsea, BS: (n)

Kolessar, David J., MD: (n)

Konin, Gabrielle P., MD: (n)

Kong, Qingwu, MS: (n)

Kraay, Matthew J., MD: 3C (Scientific Advisory Board for Cellbank)

Krebs, Viktor E., MD: 1 (Stryker); 2 (Stryker); 3B (Stryker Orthopaedics,); 8 (Journal of Arthroplasty)

Kreitz, Tyler M., MD: (n)

Krych, Aaron John, MD: 3B (Arthrex); 5 (Arthritis Foundation; Histogenics)

Kuczynski, Bozena, RPA-C: (n)

Kuo, Alfred Chung, MD, PhD: (n)

Kurtz, Steven M., PhD: 2 (I am an employee and shareholder of Exponent, a scientific and engineering consulting firm. Exponent has been paid fees by companies and suppliers for my presentations (see 5, below).); 3B (I am an employee and shareholder of Exponent, a scientific and engineering consulting firm. Exponent has been paid fees by companies and suppliers for my consulting services on behalf of such companies and suppliers (see 5, below).); 5 (Active Implants; Aesculap/B.Braun; Ferring Pharmaceuticals; Simplify Medical; Smith & Nephew; Stryker; Zimmer; Biomet; DePuy Synthes; Medtronic; Invibio; Stelkast; Celanese; Formae; Kyocera Medical; Wright Medical Technology; Ceramtec; DJO); 6 (My employer, Exponent, provides consulting services to other medical device companies, not listed under 5, and receives fees for those services.); 7 (Elsevier)

Kwasny, Mary J., PhD: (n)

Kwon, Soon Yong, MD, PhD: (n)

Kwon, Young-Min, MD, PhD: 5 (Biomet, Stryker, Mako, Zimmer)

Lang, Jason Edward., MD: 3B (Smith & Nephew); 5 (Smith & Nephew)

Lanting, Brent, MD: 5 (DePuy, A Johnson & Johnson Company; Smith & Nephew; Stryker; Wright Medical Technology, Inc.; Zimmer)

Larson, Christopher M., MD: 3B (A3 Surgical; Smith & Nephew); 4 (A3 Surgical); 5 (Educational Support – Smith & Nephew); 8 (Arthroscopy)

Lau, Edmund, MS: 3B (Boston Scientific; Stryker; Alcon Corp.; Medtronic)

Laursen, Mogens Berg, MD, PhD: 8 (Acta Orthopaedica European Journal of Ortopaedic Surgery and Traumatology); 9 (Danish Society of Hip and Knee Surgeons)

Lausmann, Christian, MD: (n)

Lavernia, Carlos J., MD, FACS: 1 (Mako Surgical/ Stryker); 3B (Mako Surgical/ Stryker); 4 (Johnson & Johnson; Stryker; Symmetry Medical (Telcomet); Wright Medical Technology, Inc.; Zimmer); 8 (Journal of Arthroplasty); 9 (American Association of Hip and Knee Surgeons,Florida Orthopaedic Society)

Le, Khanh-Van, MS: (n)

Lee, Gwo-Chin, MD: 2 (DePuy, A Johnson & Johnson Company; Ceramtec; Medtronic); 3B (DePuy, A Johnson & Johnson Company; Iroko pharmaceuticals; Mallinckrodt Pharmaceuticals; Pacira; Stryker); 5 (CD Diagnostics; Zimmer; Smith and Nephew); 8 (Clinical Orthopaedics and Related Research; Journal of Arthroplasty; Orthopedics; SLACK Incorporated; Journal of Bone and Joint Surgery); 9 (AAOS)

Lee, Jason Hyunsoo, MD: (n)

Lee, Joanne, BS: (n)

Lee, Yuo-yu, MS: (n)

Lemay, Celeste A., RN, MPH: (n)

Leonardi, Claudia, PhD: (n)

LeRoy, Taryn, BA: (n)

Levin, L. Scott, MD, FACS: 1 (Mayrek, Inc); 5 (AxoGen, Inc); 9 (American College of Surgeons; American Society for Reconstructive Microsurgery; American Society for Surgery of the Hand; International Hand and Composite Tissue Allotransplantation Society; United Network for Organ Sharing; Vascularized Composite Allograft Transplantation Committee; World Society for Reconstructive Microsurgery)

Levine, Brett Russell, MD, MS: 3B (Link Orthopaedics; McGraw-Hill; Orthoview; Zimmer); 5 (Biomet; Zimmer); 8 (Human kinetics; SLACK Incorporated); 9 (American Association of Hip and Knee Surgeons; CORD)

Levine, Harlan B., MD: 2 (Zimmer); 8 (Journal of Arthroplasty)

Lewallen, David G., MD: 1 (Mako/Stryker; Pipeline; Zimmer); 2 (Zimmer); 3B (pipeline biomedical holdings; Zimmer); 3C (Ketai Medical Devices); 4 (Ketai Medical Devices); 9 (American Joint Replacement Registry; Orthopaedic Research and Education Foundation)

L'Hommedieu, Coles E., MD: (n)

Li, Zhongmin, PhD: (n)

Lim, Young Wook, MD, PhD: (n)

Lipman, Joseph D., MS: 1 (Exactech, Inc; Mathys Ltd; Ortho Development Corporation); 3C (Extremity Medical)

Liu, Jiabin, MD, PhD: (n)

Liu, Xulei, MS: (n)

Lodhia, Parth, MD: (n)

Lombardi, Jr., Adolph V., MD, FACS: 1 (Biomet; Innomed; Orthosensor); 3B (Biomet; Orthosensor; Pacira Pharmaceuticals, Inc.); 5 (Biomet; Kinamed; OrthoSensor; Pacira Pharmaceuticals, Inc.); 8 (Clinical Orthopaedics and Related Research; Journal of Arthroplasty; Journal of Bone and Joint Surgery - American; Journal of Orthopaedics and Traumatology; Journal of the American Academy of Orthopaedic Surgeons; Knee; Surgical Technology International); 9 (Hip Society; Knee Society; Mount Carmel Education Center at New Albany; Operation Walk USA)

Lonner, Jess H., MD: 1 (Zimmer; Blue Belt Technologies); 2 (Blue Belt Technologies; Zimmer); 3B (Blue Belt Technologies; CD Diagnostics; Zimmer); 4 (Blue Belt Technologies; CD Diagnostics; Healthpoint Capital); 5 (Zimmer); 7 (Wolters Kluwer Health - Lippincott Williams & Wilkins; Saunders/Mosby-Elsevier); 8 (American Journal of Orthopedics; Wolters Kluwer Health - Lippincott Williams & Wilkins; Journal of Arthroplasty; Saunders/Mosby-Elsevier); 9 (Knee Society)

Lovald, Scott Traver, PhD, MBA: 3B (Exponent)

Lovecchio, Francis, BA: (n)

Lovro, Luke Ryan, BS: (n)

Lovy, Andrew J., MD, MS: (n)

Luey, Christopher, MBChB: (n)

Lukasiewicz, Adam, MSc: (n)

Lyman, Stephen, PhD: 8 (HSS Journal; ISAKOS Journal (new journal); Journal of Bone and Joint Surgery – American); 9 (International Society of Arthroscopy, Knee Surgery, and Orthopaedic Sports Medicine)

Ma, Yan, PhD: (n)

Maak, Travis G., MD: 2 (Arthrex, Inc); 9 (American Orthopaedic Society for Sports Medicine

MacDonald, Daniel W., MS: **5 (StelKast)**

Mackin, Theresa Nicole, BS: (n)

MacLaughlin, Lewis Harte, MD: (n)

Madden, Amber Renee, BA: (n)

Madsen, Adam Ace, DO: (n)

Maheshwari, Aditya V., MD: 8 (World Journal of Orthopedics)

Malchau, Henrik, MD, PhD: 1 (Stryker); 3B (Ceramtec); 3C (Biomet); 4 (RSA Biomedical Inc); 5 (Biomet; Zimmer; MAKO; DePuy; Smith & Nephew;); 9 (International Hip Society; ISAR (International Society for Arthroplasty Registries); RSA Biomedical; Scientific advisor for Biomet in northern Europe)

Malkani, Arthur L., MD: 1 (Stryker); 2 (Stryker); 3B (Stryker); 5 (Synthes; Stryker); 8 (Journal of Arthroplasty); 9 (American Association of Hip and Knee Surgeons)

Maltenfort, Mitchell, PhD: (n)

Mandl, Lisa A., MD, MPH: 7 (Up-To-Date); 8 (Annals of Internal Medicine)

Manning, David W., MD: 1 (Biomet); 2 (Medacta); 3B (Biomet, Medacta); 4 (Iconacy); 9 (AAOS: Program Committee-Subcommittee Adult Hip)

Manrique, Jorge, MD: (n)

Maradit-Kremers, Hilal, MD: (n)

Marshall, Astrid C., BA: (n)

Martin, Christopher T., MD: 6 (Globus Medical; Medtronic); 9 (AAOS; Musculoskeletal Transplant Foundation)

Martin, J. Ryan, MD: 3B (Biomet)

Martin, Timothy James, MA: (n)

Mascioli, Anthony, MD: 3B (Smith & Nephew)

Mason, J. Bohannon, MD: 1 (DePuy, A Johnson & Johnson Company); 3B (DePuy, A Johnson & Johnson Company); 6 (DePuy, A Johnson & Johnson Company); 7 (Journal of Arthroplasty); 9 (American Association of Hip and Knee Surgeons)

Masonis, John L., MD: 1 (Smith & Nephew;; Zimmer); 2 (Smith & Nephew;); 3B (Corin U.S.A.; Smith & Nephew;; Zimmer); 5 (DePuy, A Johnson & Johnson Company; Smith & Nephew; Zimmer;)

Mather III, Richard C., MD: 3B (KNG Health Consulting; Pivot Medical; Smith & Nephew; Stryker); 4 (for[MD]); 9 (Arthroscopy Association of North America; North Carolina Orthopaedic Association)

Matrka, Alexis: 3A (DePuy, A Johnson & Johnson Company)

Mattingly, David A., MD: 1 (DePuy, A Johnson & Johnson Company); 3B (DePuy, A Johnson & Johnson Company)

Matzkin, Elizabeth G., MD: 5 (Zimmer)

Mayer, Ryan, BS: (n)

Mayman, David Jacob, MD: 2 (Mako; Smith & Nephew); 3B (Smith & Nephew; Mako);

4 (OrthAlign)

McAlister, Ian P., MD: (n)

McAllister, Craig M., MD: 2 (Pacira); 4 (celgene; Gilead; Pacira; Regeneron)

McAnany, Steven, MD: (n)

McAsey, Craig Joseph, MD: (n)

McCalden, Richard W., MD: 2 (Smith & Nephew); 3B (Smith & Nephew); 5 (Smith & Nephew; J&J Depuy; Stryker)

McCarthy, Thomas, BS, MBA: 3A (Stryker); 4 (Stryker)

McHugh, Kelly, BA: (n)

McMillan, Rebecca, BSc: (n)

McShane, Michael A., MD: 2 (Zimmer); 3A (Zimmer-Son); 3B (Zimmer-Myself, consultant); 4 (Medtronic Sofamor Danek; Zimmer); 5 (Zimmer-Research grant-Myself, Principal Investigator); 6 (Zimmer)

Meding, John B., MD: 3B (Biomet; Stryker)

Megahed, Romy, BS: (n)

Mehle, Susan Clay, BS: (n)

Memtsoudis, Stavros G., MD, PhD: 3C (B. Braun)

Meneghini, R. Michael, MD: 1 (Stryker); 3B (Stryker); 5 (Stryker); 8 (Journal of Arthroplasty); 9 (Knee Society)

Menendez, Mariano, MD: (n)

Meswania, Jayantilal M., PhD: 1 (Stanmore Implants Worldwide Limited); 3A (FITZBIONICS LIMITEDHalfway LaneGodalming SurreyGU7 2QQ)

Mihalko, William Michael, MD, PhD: 1 (Aesculap/B. Braun); 2 (Aesculap/B. Braun); 3B (Aesculap/B. Braun; Medtronic; Panoramic Healthcare); 5 (Aesculap/B.Braun; MicroPort; Smith & Nephew; Stryker); 7 (Saunders/ Mosby-Elsevier; Springer); 8 (International Journal of Orthopaedics; Journal of Arthroplasty; Journal of Orthopaedic Research; Knee; The Journal of Long Term Effects of Medical Implants); 9 (American Board of Orthopaedic Surgery, Inc.; American Orthopaedic Association; ASTM International)

Milbrandt, Todd A., MD: 9 (Pediatric Orthopaedic Society of North America; Scoliosis Research Society)

Miller, Jonas R., BA, MS: (n)

Miller, Theodore, MD: 7 (Amirsys Publishing Co.)

Mont, Michael A., MD: 1 (Stryker); 3B (DJ Orthopaedics; Medical Compression Systems; Sage Products, Inc.; Stryker; TissueGene); 5 (DJ Orthopaedics; National Institutes of Health (NIAMS & NICHD); Sage Products, Inc.; Stryker; Tissue Gene); 8 (American Journal of Orthopedics; Journal of Arthroplasty; Journal of Bone and Joint Surgery - American; Journal of Knee Surgery; Orthopedics; Surgical Techniques International); 9 (AAOS)

Moric, Mario, MS: 3B (Zimmer)

Moucha, Calin S., MD: 2 (3M); 4 (Auxillium); 7 (Saunders/Mosby-Elsevier)

Mulligan, Ryan Patrick, MD: (n)

Mummert, Joseph, MS: 3A (Stryker); 4 (Stryker)

Murad-Antun, Dina B., PT: (n)

Muratoglu, Orhun K., PhD: 1 (Arthrex, Inc; Aston Medical; Biomet; Conformis; Corin U.S.A.; Iconacy; Mako; Meril Healthcare; Renovis; Zimmer); 2 (Biomet; Corin U.S.A.); 4 (Cambridge Polymer Group; Orthopedic Technology Group); 5 (DePuy, A Johnson & Johnson Company; Mako); 6 (Biomet)

Murphy, Hamadi, MS: (n)

Murphy, James E., MD: (n)

Murtaugh, Taylor, BS: (n)

Nader, Antoun, MD: 3B (Pacira Pharmaceuticals)

Nam, Denis, MD, MSc: 3B (KCI); 4 (OrthAlign Inc.); 5 (EOS Imaging)

Namba, Robert S., MD: 1 (Innomed); 8 (Orthopedics Today)

Nandi, Sumon, MD: 8 (Journal of Arthroplasty); 9 (American Association of Hip and Knee Surgeons)

Naranjo Mendez, Carlos M., MD: (n)

Naseer, Zan, BS: (n)

Nassif, Nader A., MD: (n)

Naudie, Douglas D. R., MD, FRCSC: 1 (Smith & Nephew); 2 (Pfizer; Sanofi-Aventis; Smith & Nephew; Stryker; Zimmer); 3B (Pfizer; Smith & Nephew; Stryker; Zimmer); 5 (Smith & Nephew); 9 (Knee Society)

Nawabi, Danyal H., MD, FRCS (Orth): (n)

Nebergall, Audrey: (n)

Nelson, Charles L., MD: 3B (Zimmer); 9 (American Association of Hip and Knee Surgeons; J. Robert Gladden Society)

Nepple, Jeffrey, MD: 2 (Smith & Nephew); 3B (Smith & Nephew)

Nestor, Bryan J., MD: (n)

Nevelos, Jim, PhD: 3A (Stryker); 4 (Stryker)

Newbern, D. Gordon, MD: 4 (Pacira- maker of Exparel)

Nguyen, Long-Co, BA, BS: (n)

Nho, Shane Jay, MD: 3B (Ossur; Stryker); 5 (Allosource; Arthrex, Inc; Athletico; DJ Orthopaedics; Linvatec; Miomed; Smith & Nephew; Stryker); 8 (Journal of Bone and Joint Surgery)

Nickel, Brian T., MD: (n)

Nicoloro, David, PT, MS: (n)

Nielsen, Christian Perez, MD: (n)

Nielsen, Poul T., MD: 3B (Biomet); 5 (Biomet)

Niesen, Matthew C., MD: (n)

Noble, Philip C., PhD: 1 (Zimmer; Stryker; Omni Sciences, Inc., Springer); 2 (Zimmer); 3B (Zimmer; Omni Sciences, Inc.; DePuy, A Johnson & Johnson Company; Johnson & Johnson); 5 (Zimmer); 7 (Springer); 8 (Journal of Arthroplasty); 9 (Hip Society)

Noiseux, Nicolas Oliver, MD: 3B (MicroPort; Smith & Nephew); 5 (DePuy, A Johnson & Johnson Company; Zimmer)

Nunley, Ryan M., MD: 1 (Microport); 3B (Biocomposites; Blue Belt Technology; Cardinal Health; DePuy, A Johnson & Johnson Company; Integra Sciences; Medtronic; Microport; Polaris; Smith & Nephew); 5 (Biomet; DePuy, A Johnson & Johnson Company; Medical Compression Systems, Inc.; Smith & Nephew; Stryker); 9 (American Association of Hip and Knee Surgeons; Missouri State Orthopaedic Association Board Member; Southern Orthopaedic Association Board Member)

Nwachukwu, Benedict U., MD, MBA: (n)

Obey, Mitchel R., BS: (n)

Odeh, Khalid I., BA: (n)

Odum, Susan M., PhD: 8 (Journal of Arthroplasty); 9 (American Association of Hip and Knee Surgeons)

Oelsner Jr., William Kennedy, BS: 4 (Stryker)

Oi, Kathryn, BA: (n)

Okafor, Louis Chukwunonso, MD: (n)

Ollivier, Matthieu: MD

Omiyi, Didi E., MD: (n)

Ong, Kevin, PhD: 5 (Biomet; Ethicon; Ferring Pharmaceuticals; Medtronic; Pacira Pharmaceuticals; Paradigm Spine; Stryker; Stryker Mako Surgical; Zimmer); 7 (Taylor & Francis); 8 (Journal of Arthroplasty)

Orvets, Nathan D., MD: (n)

O'Sullivan, Thomas, PhD: (n)

Otero, Jesse E., MD: (n)

Owen, John R., MS: (n)

Padgett, Douglas E., MD: 1 (Mako); 2 (Mako); 3B (Mako; Medical Compression Systems; Stryker); 8 (Journal of Arthroplasty;); 9 (The Hip Society; Hospital For Special Surgery)

Pagnano, Mark W., MD: 1 (DePuy, A Johnson & Johnson Company; Stryker); 3B (Pacira); 7 (Clinical Orthopaedics and Related Research); 9 (Hip Society; Knee Society)

Panek, Gina, BS: (n)

Paprosky , Wayne G., MD: 1 (Intellijoint; Mako Surgical Corp; Zimmer); 3B (DePuy, A Johnson & Johnson Company; intellijoint; Stryker; Zimmer); 4 (Intellijoint; Ketai Medical Limited); 6 (Cadence Health); 7 (Wolters Kluwer Health - Lippincott Williams & Wilkins); 8 (Journal of Arthroplasty); 9 (Hip Society)

Parcells, Bertrand W., MD: (n)

Park, Andrew, MD: (n)

Parks, Nancy L., MS: (n)

Parrattee, Sebastien, MD, PhD: 1 (Euros); 3B (Arthrex, Inc.; Graftys Adler Orthopaedics; Smith & Nephew Moximed; Zimmer)

Parrilla, Edgardo, BS: (n)

Parvizi, Javad, MD, FRCS: 3B (CeramTec; ConvaTec; Medtronic; Smith & Nephew; TissueGene; Zimmer); 4 (CD Diagnostics; Hip Innovation Technology; PRN); 5 (3M; Cempra; CeramTec; DePuy, A Johnson & Johnson Company; National Institutes of Health (NIAMS & NICHD); OREF; Smith & Nephew; StelKast; Stryker; Zimmer); 7 (Datatrace; Elsevier; Jaypee Publishing; SLACK Incorporated; Wolters Kluwer Health - Lippincott Williams & Wilkins); 8 (Journal of Arthroplasty; Journal of Bone and Joint Surgery - American; Journal of Bone and Joint Surgery - British); 9 (Eastern Orthopaedic Association; Muller Foundation)

Pashos, Gail, BS: 4 (GlaxoSmithKline)

Patel, Jay J., MD: 3B (DePuy, A Johnson & Johnson Company); 9 (American Association of Hip and Knee Surgeons)

Patel, Ripal P., MD: (n)

Patterson, Charity, PhD: (n)

Patwardhan, Avinash G., PhD: 3 (Spinal Kinetics); 4 (Spinal Kinetics); 5 (Centinel Spine)

Paxton, Elizabeth, MA: (n)

Pelt, Christopher E., MD: 2 (Biomet); 3B (Biomet); 5 (Biomet); 9 (AAOS; American Association of Hip and Knee Surgeons)

Penny, Gregory Stephen, BS: (n)

Penrose, Colin Thomas, BA, BS: (n)

Perdue Jr., Paul William, MD: (n)

Perona, Paul G., MD: 3B (Stryker)

Peters, Christopher L., MD: 1 (Biomet;); 2 (Biomet;); 3B (Biomet;); 8 (Journal of Arthroplasty;); 9 (AAOS; American Association of Hip and Knee Surgeons)

Peters, Dominic, MD: (n)

Petis, Stephen M., MD: (n)

Pevear, Mary Elizabeth, BA: (n)

Philipopoulos, George, BS: (n)

Pierce, William, BS: (n)

Pierce, Todd, MD: (n)

Pivec, Robert, MD: (n)

Plate, Johannes F., MD: (n)

Plummer, Darren R., MBA, MD: (n)

Politi, Joel Roger, MD: 1 (DePuy, A Johnson & Johnson Company); 2 (DePuy, A Johnson & Johnson Company); 3B (DePuy, A Johnson & Johnson Company)

Polkowski II, Gregory G., MD, MSc: 9 (American Association of Hip and Knee Surgeons)

Pollock, Grant Robert, BS: (n)

Ponnusamy, Karthikeyan E., MD: 9 (AAOS)

Porat, Manny D., MD: (n)

Posner, Jason Mitchel, BA: (n)

Post, Robert E., MD, MS: (n)

Potter, Gorden David, MD: (n)

Potter, Hollis, MD: 5 (GE Healthcare); 8 (Cartilage (The International Cartilage Repair Society Journal; Journal of Hip Preservation Surgery; Journal of Orthopaedic Research; Osteoarthritis and Cartilage); 9 (International Society for Magnetic Resonance in Medicine, Board of Trustees)

Poultsides, Lazaros A., MD, MSc, PhD: (n)

Pugely, Andrew J., MD: (n)

Puilido, Luis F., MD: (n)

Randell, Timmothy Ryan, MD: (n)

Ransom, Jeanine E., BS: (n)

Ravi, Saiprasad, BS: (n)

Rees, Harold Wharton, MD: 5 (OREF); 8 (Orthopedics); 9 (AAOS)

Reid, Jeremy J., MD: (n)

Restrepo, Camilo, MD: (n)

Riboh, Jonathon Charles, MD: (n)

Ricciardi, Benjamin F., MD: (n)

Ries, Michael D., MD: 1 (Smith & Nephew;); 3B (Smith & Nephew; Stryker;); 4 (OrthAlign;); 9 (Foundation for the Advancement of Research in Medicine;)

Rimnac, Clare M., PhD: 5 (DePuy, A Johnson & Johnson Company; Exponent, Inc.); 7 (Clinical Orthopaedics and Related Research); 8 (Clinical Orthopaedics and Related Research); 9 (Orthopaedic Research Society)

Rinehart, Joseph Brian, MD: (n)

Ring, David C., MD: 1 (Biomet; Medartis; Skeletal Dynamics; Wright Medical Technology, Inc); 3B (Acumed, LLC; Biomet); 4 (Illuminos); 8 (Clinical Orthopaedics and Related Research; Journal of Hand Surgery – American; Journal of Orthopaedic Trauma; Journal of Shoulder and Elbow Surgery); 9 (American Shoulder and Elbow Surgeons; American Society for Surgery of the Hand)

Ritter, Merrill A., MD: 3B (Iconacy); 4 (Iconacy)

Robinson, Jonathan, MD: (n)

Rodriguez, Jose A., MD: 2 (Link Orthopaedics); 3B (Conformis; Exactech, Inc; Medacta; Smith & Nephew); 5 (DePuy, A Johnson & Johnson Company; Exactech, Inc; Smith & Nephew); 8 (Journal of Arthroplasty; Clinical Orthopaedics and Related Research, HSS Journal); 9 (American Association of Hip and Knee Surgeons)

Rogers, Miranda, MS: (n)

Rogers, Thea, MPH: (n)

Rolfson, Ola, MD, PhD: 9 (International Society of Arthroplasty Registers; Swedish Hip Arthroplasty Register)

Rosenberg, Aaron G., MD, FACS: 1 (Zimmer); 2 (Zimmer); 3B (Zimmer); 4 (Zimmer); 7 (Wolters Kluwer Health - Lippincott); 8 (Wolters Kluwer Health - Lippincott Williams & Wilkins)

Ross, James R., MD: 3B (Smith & Nephew)

Rossi, Mark, PhD: (n)

Roubion, Ryan C., BS: (n)

Rozario, Nigel, BS: (n)

Rozell, Joshua Craig, MD: (n)

Rubash, Harry E., MD: 1 (Ceramtec; Stryker); 3B (Access Mediquip; Flexion; Pacira); 7 (Wolters Kluwer Health - Lippincott Williams

& Wilkins); 9 (Hip Society)

Ruder, John, MD: (n)

Ruffolo, Michael R., MD: (n)

Rupp, Gerald R., MD: (n)

Russell, Jackie, BSN, RN: (n)

Russell, Robert D., MD: (n)

Saboeiro, Gregory, MD: 8 (Journal of Ultrasound in Medicine)

Sahota, Shawn, MD: (n)

Salin, Jeffrey W., DO 230942

Salmond, Katie, BA: (n)

Saluk, Jennifer, BS: (n)

Salvati, Eduardo Agustin, MD: (n)

Samuel, Andre M., BBA: (n)

Santanam, Raghu, PhD, MS: (n)

Sawan, Hind, BS, (n)

Schachtner, Jaclyn Theresia: (n)

Schairer, William W., MD: (n)

Schelling, Emma, BS: (n)

Schmidig, Gregg, BS, MBA: 3A (Stryker); 4 (Stryker)

Schnaser, Erik A., MD: (n)

Schneider, Gary, MD: (n)

Schoenecker, Jonathan G., MD: 5 (ISIS pharmaceuticals)

Schoenecker, Perry L., MD: 8 (Journal of Children's Orthopaedics; Journal of Pediatric Orthopedics); 9 (Pediatric Orthopaedic Society of North America

Schoifet, Scott D., MD: 3B (Stryker)

Scholl, Laura, MS: 3A (Stryker); 4 (Stryker)

Schultz, Vanessa, NP: (n)

Schumacher, Charles Scott, MD: (n)

Schutzer, Steven F., MD: 3C (Renovis); 4 (Renovis); 8 (Journal of Arthroplasty)

Schwartz, Adam J., MD: (n)

Schwarzkopf, Ran, MD, MSc: 3B (Intelijoint; Smith & Nephew); 4 (Gauss surgical; Pristine); 5 (Pricaria); 8 (Arthroplasty Today; Journal of Arthroplasty); 9 (AAOS)

Scuderi, Giles R., MD: 1 (Zimmer,); 2 (Pacira; Zimmer, Medtronics, Convatec); 3B (MERZ Pharmaceutical; Pacira; Zimmer, Medtronics, Convatec); 5 (Pacira); 7 (Springer, Elsevier, Thieme, World Scientific); 8 (Orthopedic Clinics of North America); 9 (ICJR; Operation Walk USA)

Sculco, Peter Keyes, MD: (n)

Sculco, Thomas P., MD: 1 (Exactech, Inc); 8 (American Journal of Orthopedics); 9 (Knee Society)

Seneviratne, Aruna, MD: (n)

Seyler, Thorsten M., MD, PhD: 3B (TJO, PerSys Medical); 3C (Heraeus Medical); 8 (Editorial Board Member, The Open Bone Journal ,Editorial Board Member, Bone & Joint Research)

Seymour, Rachel, PhD: (n)

Shahi, Alisina, MD: 3B (TJO, PerSys Medical); 3C (Heraeus Medical); 8 (Editorial Board Member, The Open Bone Journal ,Editorial Board Member, Bone & Joint Research)

Shannon, Allison, PA-C: (n)

Sharareh, Behnam, BS: (n)

Sharkey, Peter F., MD: 1 (Stelkast; Stryker; Zimmer); 2 (Convatec; Stryker; Zimmer); 3B (Arsenal; Arthrex; Stryker; Zimmer); 4 (Cross Current Buisness Solutions; OBERD; Physician Recommended Nutriceutcals); 5 (Convatec); 7 (American Journal of Orthopedics; Clinical Orthopaedics and Related Research; Journal of Arthroplasty; Journal of Bone and Joint Surgery - American); 8 (American Journal of Orthopedics; Clinical Orthopaedics and Related Research; Journal of Arthroplasty; Journal of Bone and Joint Surgery - American); 9 (AAOS)

Sharrock, Nigel E., MD: 4 (OR Comfort; USCom)

Sheets, Charles, PT: (n)

Shen, Mary, BS, MS: (n)

Sheth, Dhiren S., MD: (n)

Sheth, Neil P., MD: 3B (Zimmer; Zimmer)

Silvia, Brian A., MD, PhD: (n)

Simon, Akil Peter, MD: (n)

Simons, Matthew John, MD: (n)

Sing, David C., BS: (n)

Sink, Ernest L., MD: 9 (Pediatric Orthopaedic Society of North America)

Siqueira, Marcelo Bogliolo Piancastelli, MD: (n)

Skinner, John, FRCS, Codirector London Implant Retrieval Centre (LIRC): 3B (MEDACTA); 5 (MEDACTA); 6 (Depuy, Stryker, Zimmer, Biomet, Matthys, Zimmer, Finsbury (all funding for LIRC)); 9 (President, British Hip Society)

Skolasky Jr., Richard, ScD: 5 (At&T Foundation; DePuy; A Johnson & Johnson Company; DePuy Spine); 8 (Quality of Life Research); 9 (Cervical Spine Research Society; North American Spine Society)

Skolasky, Robert, MD: 9 (North American Spine Society – Governance, Research Project Management)

Slover, James D., MD: 5 (Biomet; DJO, LLC)

Smith, Beth P., PhD: 5 (MAKO Surgical Corp)

Smith, Daniel C., MD: (n)

Smith, Eric B., MD: (n)

Smith, Eric Louis, MD: 3B (Arthrocare; DePuy, A Johnson & Johnson Company; OMNI); 3C (OMNI); 5 (Conformis; DePuy, A Johnson & Johnson Company; OMNI; Pfizer; Stryker)

So, David H., MD: (n)

Somerville, Lyndsay, PhD: (n)

Soo, Adrianne, BS: (n)

SooHoo, Nelson Fong, MD: 8 (Orthopedics Today); 9 (AAOS; American Orthopaedic Foot and Ankle Society)

Spangehl, Mark J., MD: 5 (DePuy, A Johnson & Johnson Company; Stryker; Vidacare); 8 (Arthroplasty Today; Journal of Arthroplasty)

Spivey, John Casey, MD

Sporer, Scott M., MD, MS: 3B (Paciria; Smith & Nephew; Zimmer); 5 (Central Dupage Hospital; Stryker; Zimmer); 7 (SLACK Incorporated); 9 (American Joint Replacement Registy; Hip Society)

Springer, Bryan Donald, MD: 2 (DePuy, A Johnson & Johnson Company, Ceramtec); 3B (Convatec, Polaris; Stryker); 6 (Joint purifications systems.); 8 (Journal of Arthroplasty); 9 (AJRR)

Stambough, Jeffrey Benjamin, MD: (n)

Staples, Jonathan Robert, MD: (n)

Stave, James W., PhD: 3A (CD Diagnostics); 5(Zimmer)

Steiger, David J., MD: (n)

Stepanian, Jeff, PA-C: 2 (Mallinckrodt); 3A (Operativ); 4 (Operativ)

Stocks, Gregory William, MD: 3C (Nimbic Systems, Inc); 4 (Nimbic Systems, Inc)

Stone, Rebecca M., ATC: (n)

Stuart, Michael J., MD: 1 (Arthrex, Inc); 3B (Arthrex, Inc); 5 (Stryker); 8 (American Journal of Sports Medicine)

Stuhlman, Casey R., MD: (n)

Su, Edwin P., MD: 3B (Smith & Nephew); 4 (Orthoalign, Inc); 5 (Smith & Nephew); 8 (American Journal of Orthopedics)

Suarez-Ahedo, Carlos, MD: (n)

Sueyoshi, Tatsuya, MD: (n)

Suk, Michael, MD: 3B (Acumed, LLC; DJ Orthopaedics; Stryker;

Synthes); 8 (American Journal of Orthopedics; Journal of Trauma Management and Outcomes; Military Medicine); 9 (AAOS; AO International; Orthopaedic Trauma Association)

Suleiman, Linda, MD: (n)

Sullivan, Ryan, MD: (n)

Sutphen, Sean Adam, DO: (n)

Swann, Russell P., MD: (n)

Swarup, Ishaan, MD: (n)

Szulc, Alessandra, MA: (n)

Talmo, Carl T., MD: 3A (Astra-Zeneca); 8 (Journal of Arthroplasty)

Tan, Dean Dee, BS: (n)

Tan, Timothy L., MD: (n)

Taunton, Michael J., MD: 3B (DJ Orthopaedics); 5 (Stryker); 8 (Journal of Arthroplasty); 9 (AAOS; Minnesota Orthopedic Society)

Tessier, John E., MD: 6 (Smith & Nephew)

Thielen, Zachary, MD: (n)

Thomason, Kayla Mae, BS: (n)

Townsend, Luke A., BS: (n)

Triantafyllopoulos, Georgios K., MD: (n)

Troelsen, Anders, MD, PhD: 2 (Biomet); 3B (Biomet); 5 (Biomet; Zimmer); 6 (Biomet); 9 (DOS – Danish Orthopaedic Society – Scientific Committee Member); EKS – European Knee Society – Communication Committee Member)

Tromberg, Bruce, PhD: (n)

Trousdale, Robert T., MD: 1 (DePuy, A Johnson & Johnson Company); 3B (DePuy, A Johnson & Johnson Company); 8 (Journal of Arthroplasty); 9 (American Association of Hip and Knee Surgeons; Hip Society; Knee Society)

Vail, Thomas P., MD: 1 (DePuy, A Johnson & Johnson Company); 3B (DePuy, A Johnson & Johnson Company); 9 (American Board of Orthopaedic Surgery, Inc.; Knee Society)

Van Doren, Bryce Allen, MA, MPH: (n)

Vasarhelyi, Edward M., MD, MSc, FRCSC: 3B (DePuy, A Johnson & Johnson Company); 5 (DePuy, A Johnson & Johnson Company; Smith & Nephew; Stryker)

Vellanky, Smitha Sai, MSc: (n)

Villa, Jesus M., MD: (n)

Von Roth, Philipp, MD: (n)

Von Thaer, Sarah, BS: (n)

Voronov, Leonard, PhD: (n)

Wagner, Eric R., MD: (n)

Walters, Jordan, MD: (n)

Walton, Sharon Lichelle, MD: (n)

Ward, Daniel M., MD: 3B (Stryker; Stryker); 4 (Arthromeda); 5 (Stryker; Stryker)

Warth, Lucian C., MD: (n)

Watson, Heather, PhD: 3B (Pacira)

Watts, Chad D., MD: (n)

Wayne, Jennifer S., PhD: 6 (DePuy; OrthoSensor; Synthes; Trimed)

Webb, Matthew Loren, BA: (n)

Wellman, Samuel Secord, MD: 3B (Total Joint Orthopaedics); 5 (Biomet; Zimmer; Stryker; DePuy, A Johnson & Johnson Company); 8 (Journal of Arthroplasty)

Wentzel, Catherine Sally, BS: (n)

Werner, Brian C., MD: (n)

Westermann, Robert W., MD: (n)

Westrich, Geoffrey H., MD: 2 (DJ Orthopaedics; Exactech, Inc; Stryker); 3B (DJ Orthopaedics; Exactech, Inc; Stryker); 5 (DJ Orthopaedics; Exactech, Inc; Stryker); 9 (Eastern Orthopedic Association; Knee Society)

Whittaker, Robert Keith, BS: (n)

Wilke, Benjamin, MD: (n)

Witte III, Dexter, MD: (n)

Wright, David John, BA: (n)

Wright, Timothy M., PhD: 1 (Lima; Mathys Ltd); 3B (Zimmer); 4 (Exactech, Inc; Orthobond); 5 (Stryker); 7 (Wolters Kluwer Health - Lippincott Williams & Wilkins); 9 (Knee Society)

Wu, Chia Heng, MD, MBA: (n)

Wu, Karen, MD: 8 (Frontiers Endovascular and Interventional Neurology; Journal of Neurointerventional Surgery); 9 (American Academy of Neurology; Society for Neurointerventional Surgery)

Wu, Xian, MPH: (n)

Wyles, Cody C., BS: (n)

Xiong, Ao, MD: (n)

Yau, Cameron, MD: (n)

Yi, Paul Hyunsoo, MD: (n)

Yin, Jonathan, MD: (n)

Yong, Jr., Raymond, BA: (n)

Yoo, Je Hyun, MD, PhD: (n)

Young, Ernest, MD: (n)

Young, Simon William, FRACS, MD: 5 (Stryker; Vidacare)

Yu, Stephen, BS: (n)

Zhang, Wei, PhD, MS: (n)

Zhu, Mark, MBChB: (n)

Ziemba-Davis, Mary, BA: (n)

Zmistowski, Benjamin, MD: (n)

AAHKS 25TH ANNIVERSARY

AMERICAN ASSOCIATION OF HIP AND KNEE SURGEONS

THANK YOU TO

PACIRA PHARMACEUTICALS

AND

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POSTER SET-UP TAKES PLACE FROM: 6:00 A.M. - NOON, FRIDAY, NOVEMBER 6