FINAL

SCIENTIFIC PROGRAM

Saturday—March 10, 2018
Ernest Morial Convention Center
La Nouvelle Ballroom C
New Orleans, Louisiana
General Program Information

The Mission of The Knee Society

The Mission of The Knee Society is to promote outstanding care to patients with knee disorders through innovative research and education.

Meeting Objectives

The objectives of the Specialty Day (Open) scientific program of The Knee Society and AAHKS are to update clinical skills and basic knowledge through research findings, to discuss the various surgical and non-surgical treatments and management of conditions related to the knee joint, to determine indications and complications in total knee arthroplasty, to critique presentations of surgical techniques and demonstrations of treatment options, and to evaluate the efficacy of new treatment options through evidence-based data.

CME Accreditation

This activity has been planned and implemented in accordance with the accreditation requirements and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of the American Academy of Orthopaedic Surgeons and The Knee Society. The American Academy of Orthopaedic Surgeons is accredited by the ACCME to provide continuing medical education for physicians. The American Academy of Orthopaedic Surgeons designates this live activity for a maximum of 7.5 AMA PRA Category 1 Credits™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Evaluation

Your opinion matters! Please complete your evaluation online at: https://www.surveymonkey.com/r/KSSD2018 or use the QR code to access with your handheld smart device:

Photography

Please refrain from unauthorized photography and video recording of presentations. Your registration for, and attendance of, this session gives The Knee Society permission to capture images of session attendees and to use these images for internal and marketing purposes.
Save the Date and Join Us In Las Vegas!

The AAOS 2019 Annual Meeting and Specialty Day

March 12-16, 2019
# Acknowledgements

<table>
<thead>
<tr>
<th>Past Presidents of The Knee Society</th>
<th>Past Presidents of AAHKS</th>
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<tr>
<td>1983 Chitranjan S. Ranawat, MD</td>
<td>1991 J. Phillip Nelson, MD (Deceased)</td>
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<tr>
<td>1985 Richard S. Bryan, MD (Deceased)</td>
<td>1994 Richard C. Johnston, MD, MS</td>
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<td>1986 John N. Insall, MD (Deceased)</td>
<td>1995 Lawrence D. Dorr, MD</td>
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<td>1987 Charles O. Townley, MD (Deceased)</td>
<td>1996 Hugh S. Tullos, MD (Deceased)</td>
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<td>1988 David G. Murray, MD</td>
<td>1997 Merrill A. Ritter, MD</td>
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<td>1989 Frederick C. Ewald, MD</td>
<td>1998 Richard H. Rothman, MD, PhD</td>
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<td>1990 Lawrence D. Dorr, MD</td>
<td>1999 James A. Rand, MD</td>
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<td>1991 Herbert Kaufer, MD</td>
<td>2000 Richard B. Welch, MD</td>
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<td>1992 Paul A. Lotke, MD</td>
<td>2001 John J. Callaghan, MD</td>
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<td>1993 Leonard Marmor, MD (Deceased)</td>
<td>2002 Douglas A. Dennis, MD</td>
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<td>1994 David S. Hungerford, MD</td>
<td>2003 Clifford W. Colwell, Jr., MD</td>
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<td>1995 Richard D. Scott, MD</td>
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<td>1996 Victor M. Goldberg, MD (Deceased)</td>
<td>2005 Joseph C. McCarthy, MD</td>
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<td>1997 W. Norman Scott, MD</td>
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<td>1998 James A. Rand, MD</td>
<td>2007 Daniel J. Berry, MD</td>
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<td>1999 Kenneth A. Krackow, MD</td>
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<td>2000 Thomas S. Thornhill, MD</td>
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<td>2001 Clifford W. Colwell, Jr., MD</td>
<td>2010 Mary I. O’Connor, MD</td>
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<td>2002 Robert E. Booth, Jr., MD</td>
<td>2011 Carlos J. Lavernia, MD</td>
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<td>2003 Cecil H. Rorabeck, MD</td>
<td>2012 Thomas P. Vail, MD</td>
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<td>2004 Merrill A. Ritter, MD</td>
<td>2013 Thomas K. Fehring, MD</td>
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<td>2005 Russell E. Windsor, MD</td>
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<td>2006 Gerard A. Engh, MD</td>
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<td>2007 Michael A. Kelly, MD</td>
<td>2016 William A. Jiranek, MD, FACS</td>
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<td>2011 Robert B. Bourne, MD, FRCSC</td>
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<td>2013 Steven J. MacDonald, MD, FRCSC</td>
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<td>2016 Thomas P. Sculco, MD</td>
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Acknowledgements

The Knee Society Executive Board
Adolph V. Lombardi, Jr., MD – President
Robert L. Barrack, MD – 1st Vice President
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THIS COURSE IS ABOUT ME!

Contemporary Approaches to Adult Hip and Knee Reconstruction®

Scott M. Sporer, MD and
R. Michael Meneghini, MD - Program Co-Chairs

Presented by The Hip Society and The Knee Society

FRIDAY, MAY 18, 2018
9:30 am - 5:45 pm (times are approximate)

In partnership with:
Indiana University Health Saxony Hospital
13000 E 136th St, Fishers, IN 46037

Visit www.hipsoc.org learn more and to REGISTER
Call (847) 698-1638 | Email hip@aaos.org
JOINT ARTHROPLASTY MOUNTAIN MEETING (JAMM)
Park City, Utah

PRESENTED IN PARTNERSHIP BY:

Coming to a mountain near you in January 2019
Email foley@aaos.org to receive updates on JAMM2019
The 2018 Knee Society Lifetime Achievement Award Recipient

Session II (9:30 am – 10:15 pm)

Peter S. Walker, PhD

Dr. Walker was educated in England at the Royal Grammar School, Newcastle; then at the University of Cambridge; after a 3-year engineering traineeship, he completed a PhD at the University of Leeds 1966-69 under Professors Dowson and Wright. Since then he has been an active participant in the field of biomechanics of joints and the design of joint replacements, with a major emphasis on the knee. He has collaborated with surgeons and bioengineers at renowned institutions, including Hospital for Special Surgery, Howmedica (Stryker), Brigham & Women’s Hospital, Royal National Orthopaedic Hospital, University College London, and currently at New York University Langone Orthopaedic Hospital. He has co-authored over 300 articles with almost 12,000 citations. The basic research has contributed to innovative ideas for total knee design, while many of the test machines and methodologies have been emulated by other labs. Peter Walker has been a co-designer of several successful total knee systems, the most notable being the Total Condylar, Graduated Knee System, Kinematic & Kinemax, Smiles Bone Tumor System, NexGen and Persona.

Specific contributions to the field have included:

- The basic mechanism of the lubrication of joints, by Boosted Lubrication.
- The mechanisms of laxity and stability of the knee, particularly under load-bearing, which was applied as the principle of the Total Condylar Knee.
- Development of the Stanmore Knee Simulator, to evaluate the wear and kinematics of total knees, the basis for the ISO and ASTM standards for knee wear.
- Design of bone tumor implants, incorporating the Smiles Rotating Hinge and HA fixation collars, which have shown several decades of survivorship even in young patients.
- Optimizing total knee function with Guided Motion Knee Design & Surgical Balancing, recent work directed towards further improving the performance of total knees.

For many years, Dr. Walker has participated in the Orthopaedic Research Society, the American Academy of Orthopaedic Surgeons, The Knee Society, The Hip Society, the International Society for Technology in Arthroplasty, and the European Society of Biomechanics; to be part of the community of researchers and surgeons who have moved the entire field forward in an extraordinary way. It has been a particular privilege to be a member of The Knee Society with its eminent members and leadership role in innovation and education. The most rewarding part of the work experience has been the personal contacts, whether teachers, colleagues, collaborators, trainees or students. Providing interesting and rewarding projects to Residents, Fellows and Students has been particularly gratifying.

Congratulations, Dr. Walker!
The 2018 Knee Society Lifetime Achievement Award Recipient

Session II (9:30 am – 10:15 pm)

Richard S. Laskin, MD (posthumously)

Dr. Richard S. Laskin grew up in Brooklyn, New York, the first in his family to attend either college or medical school. He was a brilliant student and accelerated through college at Hofstra University, graduating in 1960, and then receiving his medical degree from New York University College of Medicine in 1964. He did his residency at Albert Einstein College of Medicine. He subsequently served in Vietnam in the U. S. Army and received a number of decorations, including the Purple Heart for injuries received during a grenade attack.

Dick was early on recognized as a leader in orthopaedic surgery and at a very young age became the Chief of Orthopaedic Surgery at the Long Island Jewish Hospital and residency program. Dick Laskin’s great love in orthopaedic surgery was knee replacement surgery and he dedicated his career to improving implant design and techniques. He joined the staff at Hospital for Special Surgery in 1991 and his impact on the hospital was remarkable. He was a great teacher and mentor to residents, fellows and staff. A brilliant writer and a gifted speaker, Dick Laskin would learn the language of the country in which he was speaking and give presentations in Spanish, Italian, Japanese and Chinese. His talks were always filled with much knowledge as well as humor, and inevitably cartoons flew in and out of the presentations.

Dr. Laskin was active in The Knee Society and served as its Program Director on several occasions and on its Board of Directors. In 1997, he became Deputy Editor for The Knee Society at Clinical Orthopaedic and Related Research, a post he held and expertly fulfilled until 2007. In 2004, he became the first Editor of the HSS Journal and established it as an outstanding peer-reviewed musculoskeletal publication. He was the force behind its success and his presence was felt in every aspect of the journal. He was also Director of the Arthroplasty Service at HSS, and received the Lifetime Achievement Award from Hospital for Special Surgery posthumously in June 2008.

Dick Laskin was passionate about everything he did. He loved model trains, electronic gadgets, opera, marathons, and his family. He was a giant among men, a truly good person who cared about his patients and committed his life to improving knee replacement surgery.
Fundamentals of Hip and Knee Arthroplasty for Orthopaedic Residents

Presented by AAOS, AAHKS, The Knee Society and The Hip Society

THREE DATES
THREE LOCATIONS

April 13 – 15
Baltimore, MD
Ronald Delanois, MD
Gregory Golladay, MD
Course Directors

April 27 – 29
Rosemont, IL
R. Michael Meneghini, MD
Brett R. Levine, MD
Course Directors

May 18 – 20
Long Beach, CA
Erik N. Hansen, MD
Mark J. Spangehl, MD
Course Directors

Resident – Expand your surgical skills for hip and knee arthroplasty!

Build your surgical skills leading to proficiency at hip and knee arthroplasty in this interactive skills course designed exclusively for orthopaedic residents! Spend the majority of your time practicing bone cuts, correct ligament balancing for TKA, determining correct implant sizing and restoring biomechanics in THA, and more!

Work on anatomical specimens under the guidance of expert faculty. Panel discussions and faculty-led small group interactions round out your skills lab experience.

AAOS/AAHKS/KS/IHS Resident Member/Resident/Post-Residency Fellow $250

To register, call AAOS Customer Service at 1-800-626-6726

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Congratulations: The 2018 Knee Society Scientific Award Winners

Session III (9:30 am – 10:15 am)

The 2018 John N. Insall Award

Unsupervised Home Exercise Equivalent to Traditional Outpatient Therapy After Primary TKA: A Randomized Controlled Trial

Presenter: Antonia F. Chen, MD, MBA

Co-Authors: Andrew N. Fleischman, MD; Meredith P. Crizer, BS; Majd Tarabichi, MD; Shelby Smith, BS; Richard H. Rothman, MD, PhD; Jess H. Lonner, MD

The 2018 Chitranjan S. Ranawat Award

Developing and Implementing a Novel Guideline Strategy Reduced Postoperative Opioid Prescribing Following TKA and THA

Presenter: Cody C. Wyles, MD

Co-Authors: Mario Hevesi, MD; Eleanor R. Tousdale, MD; Daniel S. Ubl, MPH; Halena M. Gazelka, MD; Elizabeth B. Habermann, MD, PhD; Robert T. Trousdale, MD; Mark W. Pagnano, MD; Tad M. Mabry, MD

The 2018 Mark Coventry Award

Does Ceramic Bearing Articulation Improve the Clinical Outcomes of Total Knee Arthroplasty in Younger Patients?

Presenter: Young-Hoo Kim, MD

Co-Authors: Jang-Won Park, MD; Jun-Shik Kim, MD
The John N. Insall Traveling Fellowship

John N. Insall’s legendary contributions to knee surgery were based on an academic pursuit of excellence in clinical research and patient care. His research endeavors encompassed biomechanics, surgical techniques and vigilant post-operative clinical follow-up. Inherent in his life’s work was the importance of educating knee surgeons worldwide. In recognition of his contributions and a desire to perpetuate his legacy, The Knee Society with the support of the Insall Foundation has endorsed the Insall Traveling Fellowship.

Since 2002, a group of four international surgeons have traveled around North America for one month to various Knee Society member programs. This fellowship continues to foster education and research, with a sharing of ideas, techniques and camaraderie between the traveling fellows and The Knee Society members.

The annual deadline to apply for the Insall Fellowship is October 1. Fellowship will take place in the year following the application deadline. To download the application, go to www.kneesociety.org and look under the Education tab.

With any questions regarding the Fellowship, please contact:
Kathleen E. Lenhardt
Phone: (646) 293-7520
Email: klenhardt@iskinstitute.com

Congratulations to the 2018 Insall Traveling Fellows:

Derek Amanatullah, MD
Stanford University
Redwood City, CA

Stephen Duncan, MD
University of Kentucky
Lexington, KY

Stefano M. Rossi, MD
University Hospital of Pavia, Italy

Peter K. Sculco, MD
Hospital for Special Surgery
New York, NY

Happy 50th Anniversary,
The Hip Society!

Members of The Knee Society salute their sister organization, The Hip Society, on its 50th Anniversary!
AAHKS
Clinical Affiliate Membership
STRENGTHEN YOUR PRACTICE

GAIN KNOWLEDGE. MAKE CONNECTIONS. ADVANCE PATIENT CARE.

Your orthopaedic team members will find membership in the American Association of Hip and Knee Surgeons as valuable as you do. Please encourage them to explore membership today!

AAHKS®
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WWW.AAHKS.ORG/JOIN-AAHKS

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MIAMI | MAY 4-5, 2018

AAHKS SPRING MEETING

“Best meeting I have ever attended in terms of content and organization.”
- 2017 evaluation survey

Small group breakouts using a case-based ICL format facilitates one-on-one interaction with leaders in the field of hip and knee arthroplasty.

New! AAHKS Past President, Carlos J. Lavernia, MD, will host a Spanish-language academic session and social event for international attendees.

Visit the AAHKS website for CME info, program, faculty and to register.

www.AAHKS.org
AAOS/AAHKS/The Knee Society
Innovative Surgical Techniques and Emerging Technology in Knee Arthroplasty: UKA to Revision

March 22 – 24, 2018
OLC Education & Conference Center, Rosemont, IL

Henry D. Clarke, MD, and James A. Browne, MD, Course Directors

This exciting surgical skills course led by top surgeons in the field will bring you up to speed on current best practices, as well as emerging technologies designed to enhance patient outcomes after total knee arthroplasty.

Course highlights include:

• Hands-on experience with new robotic technology and patient-specific instrumentation
• Current concepts in TKA
• Small group breakout sessions and case-based panel discussions
• Bring your own cases for review!

www.aaos.org/3341
<table>
<thead>
<tr>
<th>Time</th>
<th>Session Description</th>
<th>Presenter and Location</th>
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<tbody>
<tr>
<td>7:55 am – 8:00 am</td>
<td><strong>WELCOME</strong>&lt;br&gt;Kevin L. Garvin, MD (Omaha, NE) – President, The Hip Society</td>
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<tr>
<td>8:00 am – 8:45 am</td>
<td><strong>Session I: Primary Surgical Approach/Technique and Implant Selection: Tips and Tricks to Maximize Outcomes (Video-Based)</strong>&lt;br&gt;<strong>Moderator:</strong> Steven J. MacDonald, MD, FRCSC (London, ON, Canada)</td>
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<td>8:00 am – 8:06 am</td>
<td>ABMS Approach in the Lateral Decubitus Position&lt;br&gt;<em>Christopher L. Peters (Salt Lake City, UT)</em></td>
<td>25</td>
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<td>8:06 am – 8:12 am</td>
<td>Direct Anterior Approach Including Tips to Improve Exposure&lt;br&gt;<em>Paul E. Beaulé (Ottawa, ON, Canada)</em></td>
<td>27</td>
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<tr>
<td>8:12 am – 8:18 am</td>
<td>Dysplastic Hip&lt;br&gt;<em>John C. Clohisy, MD (St. Louis, MO)</em></td>
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<td>8:18 am – 8:24 am</td>
<td>Previous Surgery/Retained Hardware&lt;br&gt;<em>Michael J. Archibeck, MD (Albuquerque, NM)</em></td>
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<td>8:24 am – 8:30 am</td>
<td>Previous Lumbar Fusion&lt;br&gt;<em>Gwo-Chin Lee, MD (Philadelphia, PA)</em></td>
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<td>8:30 am – 8:45 am</td>
<td>DISCUSSION</td>
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<td>8:45 am – 9:30 am</td>
<td><strong>Session II: Intraoperative and Early Postoperative Complications:</strong>&lt;br&gt;Surgical Exposure and How to Manage (Video-Based)&lt;br&gt;<strong>Moderator:</strong> C. Anderson Engh, Jr., MD (Alexandria, VA)</td>
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<td>8:45 am – 8:51 am</td>
<td>Intraoperative Acetabular Fracture: How to Gain Exposure and Manage Through an Posterior Approach&lt;br&gt;<em>James I. Huddleston, III, MD (Redwood City, CA)</em></td>
<td>36</td>
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<td>8:51 am – 8:57 am</td>
<td>Failed Acetabular Fixation: How to Gain Exposure and Manage Through an Anterior Approach&lt;br&gt;<em>Joseph T. Moskal, MD (Roanoke, VA)</em></td>
<td>37</td>
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<td>8:57 am – 9:03 am</td>
<td>Management of Early Step Subsidence/Calcar Fracture (Using Either Anterior or Posterior Approach)&lt;br&gt;<em>Paul J. Duwelius, MD (Portland, OR)</em></td>
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<td>9:03 am – 9:09 am</td>
<td>Management of Trochanter Fracture (Intra-Op and Early Post-Op)&lt;br&gt;<em>Rafael J. Sierra, MD (Rochester, MN)</em></td>
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<td>9:09 am – 9:15 am</td>
<td>Component Malposition and Leg Length Inequality: When Should I Go Back and What Should I Do?&lt;br&gt;<em>Robert L. Barrack, MD (St. Louis, MO)</em></td>
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<td>9:15 am – 9:30 am</td>
<td>DISCUSSION</td>
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<td>Time</td>
<td>Session I: The Difficult Primary TKA (Video-Based)</td>
<td>Moderator: Mathias P.G. Bostrom, MD, FACS (New York, NY)</td>
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<td>8:00 am – 8:06 am</td>
<td>Fixed Valgus Knee</td>
<td>Douglas A. Dennis, MD (Denver, CO)</td>
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<td>8:06 am – 8:12 am</td>
<td>The Terrible Varus Knee</td>
<td>Arun B. Mullaji, MD (Mumbai, India)</td>
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<td>8:12 am – 8:18 am</td>
<td>The Obese Patient</td>
<td>David G. Lewallen, MD (Rochester, MN)</td>
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<td>8:18 am – 8:24 am</td>
<td>The Stiff Knee</td>
<td>Wael K. Barsoum, MD (Weston, FL)</td>
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<td>8:24 am – 8:30 am</td>
<td>Previous Incisions/Compromised Soft-Tissue</td>
<td>Henry D. Clarke, MD (Phoenix, AZ)</td>
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<td>8:30 am – 8:45 am</td>
<td>DISCUSSION</td>
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<td>8:45 am – 9:03 am</td>
<td>Can a Bicruciate Retaining TKA Be Successful?</td>
<td>Alfred J. Tria, MD (Princeton, NJ)</td>
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<td>8:51 am – 8:57 am</td>
<td>When Is It Safe to Perform TKA after Steroid/HA Injection?</td>
<td>Thomas P. Sculco, MD (New York, NY)</td>
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<td>8:57 am – 9:03 am</td>
<td>Patient Specific Implants and Instruments</td>
<td>Tom Minas, MD, MS (Chestnut Hill, MA)</td>
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<td>9:03 am – 9:09 am</td>
<td>Alternative Bearing Surfaces</td>
<td>Steven B. Haas, MD (New York, NY)</td>
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<td>9:09 am – 9:15 am</td>
<td>The Pocket Rocket: Handheld Navigation</td>
<td>David J. Mayman, MD (New York, NY)</td>
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<td>9:13 am – 9:30 am</td>
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| 9:30 am – 10:15 am | Session III: Lumbopelvic/Instability: Patient Identification and Methods to Minimize  
**Moderator:** Wayne G. Paprosky, MD, FACS (Winfield, IL) |
| 9:30 am – 9:36 am | Who is at Risk of Instability?  
*Arthur L. Malkani, MD (Louisville, KY)* |
| 9:36 am – 9:42 am | What is the “Safe Zone” for an Individual Patient?  
*Lawrence D. Dorr, MD (Los Angeles, CA)* |
| 9:42 am – 9:48 am | What Implants and Approach Should We Use to Optimize Outcomes: Is It Patient-Specific?  
*James D. Slover, MD, MS (New York, NY)* |
| 9:48 am – 9:54 am | Is There a Role for Computer Navigation?  
*Douglas E. Padgett, MD (New York, NY)* |
| 9:54 am – 10:00 am | When Should I Revise the Hip for Postop Instability and What Should I Do?  
*R. Michael Meneghini, MD (Fishers, IN)* |
| 10:00 am – 10:15 am | DISCUSSION |
| 10:15 am – 10:30 am | COFFEE / REFRESHMENT BREAK |
| 10:30 am – 11:15 am | Session IV: Bearing Surface and Taper Corrosion  
**Moderator:** Thomas P. Schmalzried, MD (Los Angeles, CA) |
| 10:30 am – 10:36 am | Who is at Risk? Should Everybody Be Screened?  
*Henrik Malchau, MD, PhD (Boston, MA)* |
| 10:36 am – 10:42 am | What is the Current Understanding of the Problem?  
*Joshua J. Jacobs, MD (Chicago, IL)* |
| 10:42 am – 10:48 am | What is the Clinical Presentation and How Do I Work Up a Painful Hip?  
*Don S. Garbuz, MD, MHSc, FRCSC (Vancouver, BC, Canada)* |
| 10:48 am – 10:54 am | How Should I Treat This Problem and What are the Outcomes?  
*William L. Griffin, MD (Charlotte, NC)* |
| 10:54 am – 11:00 am | Should We All Be Going to Ceramic?  
*Jay R. Lieberman, MD (Los Angeles, CA)* |
<p>| 11:00 am – 11:15 am | DISCUSSION |</p>
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<tr>
<th>Time</th>
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<tr>
<td>9:30 am</td>
<td><strong>Session III: Special Highlights</strong></td>
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<tr>
<td></td>
<td><strong>The Knee Society’s Scientific Awards</strong></td>
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<td></td>
<td><em>Moderator: Harry E. Rubash, MD (Boston, MA)</em></td>
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<tr>
<td>9:30 am</td>
<td><strong>The John N. Insall Award</strong></td>
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<tr>
<td></td>
<td>“Unsupervised Home Exercise Equivalent to Traditional Outpatient Therapy After Primary TKA: A Randomized Controlled Trial”</td>
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<td>Antonia F. Chen, MD, MBA (Philadelphia, PA)</td>
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<td>9:35 am</td>
<td><strong>The Chitranjan S. Ranawat Award</strong></td>
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<td>“Developing and Implementing a Novel Guideline Strategy Reduced Postoperative Opioid Prescribing Following TKA and THA”</td>
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<td>Cody C. Wyles, MD (Rochester, MN)</td>
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<tr>
<td>9:40 am</td>
<td><strong>The Mark Coventry Award</strong></td>
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<td></td>
<td>“Does Ceramic Bearing Articulation Improve the Clinical Outcomes of Total Knee Arthroplasty in Younger Patients?”</td>
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<td>Young-Hoo Kim, MD (Seoul, Republic of Korea)</td>
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<tr>
<td>9:45 am</td>
<td><strong>The Insall Travelling Fellowship Update</strong></td>
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<td>W. Norman Scott, MD, FACS (New York, NY)</td>
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<tr>
<td>9:50 am</td>
<td><strong>What’s Keeping Knee Surgeon’s Up at Night: A Global Perspective</strong></td>
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<td><em>Moderator: Adolph V. Lombardi, Jr., MD, FACS (New Albany, OH)</em></td>
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<td><em>Panel: Keith R. Berend, MD (New Albany, OH); Fabio Catani, MD (Modena, Italy); Scott M. Sporer, MD, MS (Winfield, IL); Emmanuel Thienpont, MD (Brussels, Belgium)</em></td>
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<tr>
<td>10:10 am</td>
<td><strong>The Knee Society’s 2018 Lifetime Achievement Award</strong></td>
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<tr>
<td>10:11 am</td>
<td>About the Award: Adolph V. Lombardi, Jr., MD, FACS (New Albany, OH)</td>
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<tr>
<td>10:12 am</td>
<td>Introduction: A Seth Greenwald, D.Phil (Oxon) (Cleveland, OH)</td>
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<tr>
<td>10:14 am</td>
<td>2018 Lifetime Achievement Award Recipient: Peter S. Walker, PhD (New York, NY)</td>
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<tr>
<td>10:15 am</td>
<td>on behalf of the 2018 Lifetime Achievement Award Recipient Richard S. Laskin, MD (Posthumously), Steven B. Haas, MD (New York, NY)</td>
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<tr>
<td>10:30 am</td>
<td><strong>Session IV: Lessons Learned from Difficult Cases</strong></td>
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<td><em>Moderator: Aaron A. Hofmann, MD (Salt Lake City, UT)</em></td>
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<td>10:30 am</td>
<td>Panel Discussion</td>
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<td>William B. Macaulay, MD (New York, NY); Geoffrey H. Westrich, MD (New York, NY); Peter F. Sharkey, MD (Media, PA); Nicholas J. Giori, MD (Palo Alto, CA)</td>
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<tr>
<td>11:00 am</td>
<td>DISCUSSION</td>
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**H I P  La Nouvelle Ballroom B**

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<tr>
<th>Time</th>
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<tr>
<td>11:15 am – 12:00 pm</td>
<td>Session V: Special Highlights</td>
<td>Moderator: Kevin L. Garvin, MD (Omaha, NE)</td>
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<tr>
<td>11:15 am – 11:20 am</td>
<td>The Hip Society’s Scientific Awards</td>
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<td>The John Charnley Award</td>
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<td></td>
<td>“Analysis of US Hip Replacement Bundled Payments: Physician-initiated Episodes Out Perform Hospital-initiated Episodes”</td>
<td>William S. Murphy, AB (Boston, MA)</td>
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<tr>
<td>11:20 am – 11:25 am</td>
<td>The Otto Aufranc Award</td>
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<td></td>
<td>“The Genetics of Osteolysis After Total Hip Arthroplasty”</td>
<td>J. Mark Wilkinson, PhD, FRCS (Sheffield, UK)</td>
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<tr>
<td>11:25 am – 11:30 am</td>
<td>The Frank Stinchfield Award</td>
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<td>“Spino-pelvic Hypermobility is Associated with Inferior Outcome Post-THA: Examining the Effect of Spinal Arthrodesis”</td>
<td>George Grammatopoulous, MD, FRCS, PhD (Ottawa, ON, Canada)</td>
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<tr>
<td>11:30 am – 11:35 am</td>
<td>Recap of the 2017 Rothman-Ranawat Traveling Fellowship</td>
<td>Carlos A. Higuera-Rueda, MD (Cleveland, OH); Christopher E. Pelt, MD (Salt Lake City, UT)</td>
</tr>
<tr>
<td>11:38 am – 12:00 pm</td>
<td>The 50th Anniversary of The Hip Society: A Tribute</td>
<td>Moderator: Daniel J. Berry, MD (Rochester, MN)</td>
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<td>Lawrence D. Dorr, MD (Los Angeles, CA); William H. Harris, MD, MS (Lexington, MA); David G. Lewallen, MD (Rochester, MN); Vincent D. Pellegrini, Jr., MD (Charleston, SC)</td>
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<tr>
<td>12:00 pm – 12:05 pm</td>
<td>The Hip Society’s 2018 Lifetime Achievement Award</td>
<td>Presented by: Kevin L. Garvin, MD (Omaha, NE)</td>
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<tr>
<td>12:05 pm – 1:00 pm</td>
<td>LUNCH – Box lunches provided to all participants</td>
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<tr>
<td>1:00 pm – 1:45 pm</td>
<td>Session VI: Lessons Learned from Difficult Cases</td>
<td>Moderator: Robert T. Trousdale, MD (Rochester, MN)</td>
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<tr>
<td>1:00 pm – 1:30 pm</td>
<td>Panel Discussion</td>
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<td>Clive P. Duncan, MD (Vancouver, BC, Canada); Richard W. McCalden, MD (London, ON, Canada); Aaron G. Rosenberg, MD (Deerfield, IL); Ran Schwarzkopf, MD, MSc (New York, NY); Thomas P. Vail, MD (San Francisco, CA)</td>
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<tr>
<td>1:30 pm – 1:45 pm</td>
<td>DISCUSSION</td>
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<tr>
<td>Time</td>
<td>Session V: New Research We Should Know About</td>
<td>Moderator: Mary I. O'Connor, MD (New Haven, CT)</td>
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<tr>
<td>11:15 am – 11:21 am</td>
<td>What Activity Should I Recommend for My Patients?</td>
<td>Philip C. Noble, PhD (Houston, TX)</td>
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<tr>
<td>11:27 am – 11:33 am</td>
<td>Kinematic Alignment</td>
<td>David W. Murray, MD, FRCS (Oxford, UK)</td>
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<td>11:33 am – 11:39 am</td>
<td>RSA Data: What Does It Mean to Me?</td>
<td>Michael J. Dunbar, MD, PhD, FRCSC (Halifax, NS, Canada)</td>
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<tr>
<td>11:39 am – 11:45 am</td>
<td>The Role of Tranexamic Acid</td>
<td>Fred D. Cushner, MD (New York, NY)</td>
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<td>11:45 am – 12:00 pm</td>
<td>DISCUSSION</td>
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<tr>
<th>Time</th>
<th>Session VI: Partial Knee Arthroplasty</th>
<th>Moderator: Andrew A. Freiberg, MD (Boston, MA)</th>
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<tr>
<td>1:00 pm – 1:06 pm</td>
<td>Medial Compartment UKA: Indications/Contraindications</td>
<td>David F. Dalury, MD (Towson, MD)</td>
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<td>1:06 pm – 1:12 pm</td>
<td>Lateral Compartment UKA</td>
<td>William A. Jiranek, MD (Durham, NC)</td>
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<td>1:12 pm – 1:18 pm</td>
<td>Make It Right the First Time: Robot Wars</td>
<td>Jess H. Lonner, MD (Bryn Mawr, PA)</td>
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<td>1:18 pm – 1:24 pm</td>
<td>Without the Grout: Cementless UKA</td>
<td>Christopher A.F. Dodd, MB, ChB, FRCS (Oxford, UK)</td>
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<td>1:24 pm – 1:30 pm</td>
<td>Do Them Both: Bicompartmental TKA</td>
<td>Jean-Noël Argenson, MD (Marseille, France)</td>
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<td>1:30 pm – 1:45 pm</td>
<td>DISCUSSION</td>
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<tr>
<td>Time</td>
<td>Session VII: Revision THA: Surgical Options for Success (Case-Based)</td>
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<tr>
<td>1:45 pm – 1:49 pm</td>
<td>Safe Removal of Femoral and Acetabular Components  John Antoniou, MD, FRCSC, PhD (Montreal, QC, Canada)</td>
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<tr>
<td>1:49 pm – 1:53 pm</td>
<td>Acetabular Reconstruction: When Do I Need to Use Augments? Wayne G. Paprosky, MD, FACS (Winfield, IL)</td>
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<tr>
<td>1:53 pm – 1:57 pm</td>
<td>Femoral Revision: What is the Best Stem to Use? Matthew S. Austin, MD (Philadelphia, PA)</td>
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<tr>
<td>1:57 pm – 2:01 pm</td>
<td>Management of Periprosthetic Femur Fractures George J. Haidukewych, MD (Orlando, FL)</td>
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<tr>
<td>2:01 pm – 2:05 pm</td>
<td>What Do I Do if the Abductors are Deficient? Michael D. Ries, MD (Reno, NV)</td>
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<tr>
<td>2:05 pm – 2:30 pm</td>
<td>DISCUSSION and Additional Cases</td>
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<tr>
<th>Time</th>
<th>Session VIII: Infection</th>
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<tr>
<td>2:30 pm – 2:36 pm</td>
<td>Making the Diagnosis: What is the Gold Standard? Stephen J. Incavo, MD (Houston, TX)</td>
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<tr>
<td>2:36 pm – 2:42 pm</td>
<td>Indication for I&amp;D: Is There Ever a Role? Ryan M. Nunley, MD (St. Louis, MO)</td>
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<tr>
<td>2:42 pm – 2:48 pm</td>
<td>One-Stage vs. Two-Stage vs. Partial Resection Craig J. Della Valle, MD (Chicago, IL)</td>
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<td>2:48 pm – 2:54 pm</td>
<td>When Do I Replant and What Do I Need to Worry About? Bassam A. Masri, MD, FRCSC (Vancouver, BC, Canada)</td>
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<td>2:54 pm – 3:00 pm</td>
<td>Postoperative Antibiotics: How Long Are They Needed? Michael A. Mont, MD (Cleveland, OH)</td>
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<td>DISCUSSION</td>
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3:15 am – 3:30 am COFFEE / REFRESHMENT BREAK
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<tr>
<td>1:45 pm – 1:51 pm</td>
<td>Step One: Is this Infected?</td>
<td>Javad Parvizi, MD, FRCS (Philadelphia, PA)</td>
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<td>1:51 pm – 1:57 pm</td>
<td>Should I Just Wash It Out?</td>
<td>Bryan D. Springer, MD (Charlotte, NC)</td>
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<td>1:57 pm – 2:03 pm</td>
<td>Articulating Spacers: What Works?</td>
<td>Michael P. Bolognesi, MD, MS (Durham, NC)</td>
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<tr>
<td>2:03 pm – 2:09 pm</td>
<td>One-Stage vs. Two-Stage Treatment of PJI</td>
<td>Thomas K. Fehring, MD (Charlotte, NC)</td>
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<tr>
<td>2:09 pm – 2:15 pm</td>
<td>The Burden of Infection</td>
<td>Kelly G. Vince, MD, FRCSC (Kamo, New Zealand)</td>
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<tr>
<td>2:15 pm – 2:30 pm</td>
<td>DISCUSSION</td>
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<tr>
<th>Time</th>
<th>Session VIII: Revision TKA: What Matters Most (Video-Based)</th>
<th>Moderator: John J. Callaghan, MD (Iowa City, IA)</th>
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<tr>
<td>2:30 pm – 2:36 pm</td>
<td>First Things First: Exposure in Total Knee Revision</td>
<td>Daniel J. Berry, MD (Rochester, MN)</td>
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<tr>
<td>2:36 pm – 2:42 pm</td>
<td>Fixation Strategies: Stems/Cones/Sleeves</td>
<td>Paul F. Lachiewicz, MD (Chapel Hill, NC)</td>
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<tr>
<td>2:42 pm – 2:48 pm</td>
<td>Supracondylar Periprosthetic Femur Fracture</td>
<td>David Backstein, MD, MEd, FRCSC (Toronto, ON, Canada)</td>
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<td>2:48 pm – 2:54 pm</td>
<td>Constraint in Total Knee Revision</td>
<td>William J. Maloney, III, MD (Redwood City, CA)</td>
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<td>2:54 pm – 3:00 pm</td>
<td>Extensor Mechanism Reconstruction: Cadavers and Mesh</td>
<td>James A. Browne, MD (Charlottesville, VA)</td>
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<tr>
<td>3:00 pm – 3:15 pm</td>
<td>DISCUSSION</td>
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<td>3:15 pm – 3:30 pm</td>
<td>COFFEE/REFRESHMENT BREAK</td>
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Session IX and X are combined with The Hip Society and will be held in La Nouvelle Ballroom B
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<tr>
<td>3:30 pm</td>
<td>COMBINED SESSION IX: Outpatient TJA</td>
<td>Adolph V. Lombardi, Jr., MD, FACS (New Albany, OH), President of The Knee Society</td>
</tr>
<tr>
<td>3:30 pm</td>
<td>Outpatient Arthroplasty: The Time is Now</td>
<td>Richard Iorio, MD (New York, NY)</td>
</tr>
<tr>
<td>3:36 pm</td>
<td>Identifying the Optimal Patient</td>
<td>Michael E. Berend, MD (Indianapolis, IN)</td>
</tr>
<tr>
<td>3:42 pm</td>
<td>Management of Blood Loss</td>
<td>William G. Hamilton, MD (Alexandria, VA)</td>
</tr>
<tr>
<td>3:48 pm</td>
<td>Perioperative Pain Management</td>
<td>Mark W. Pagnano, MD (Rochester, MN)</td>
</tr>
<tr>
<td>3:54 pm</td>
<td>The International Perspective</td>
<td>Fares S. Haddad, BSc, MCh (Orth), FRCS (Orth), FRCS (Ed) Dip, Sports Med FFSEM (London, UK)</td>
</tr>
<tr>
<td>4:00 pm</td>
<td>DISCUSSION</td>
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<tr>
<td>4:15 pm</td>
<td>Update from the AAHKS 2017 Annual Meeting</td>
<td>Mark I. Froimson, MD, MBA (Hunting Valley, OH), President of AAHKS</td>
</tr>
<tr>
<td>4:20 pm</td>
<td>COMBINED SESSION X: Value and Economics in TJA</td>
<td>Kevin L. Garvin, MD (Omaha, NE), President of The Hip Society</td>
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<tr>
<td>4:20 pm</td>
<td>Bundled Payments in Total Joint Arthroplasty: How Does Risk and Readmission Impact Cost of Care</td>
<td>Giles R. Scuderi, MD (New York, NY)</td>
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<tr>
<td>4:26 pm</td>
<td>Where Do We Stand with Value-Based Payments? A Washington Update</td>
<td>Kevin J. Bozic, MD, MBA (Austin, TX)</td>
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<tr>
<td>4:32 pm</td>
<td>Patient-Reported Outcomes Measures Made Easy</td>
<td>David C. Ayers, MD (Worcester, MA)</td>
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<td>4:38 pm</td>
<td>Hospital-Physician Alignment</td>
<td>C. Lowry Barnes, MD (Little Rock, AR)</td>
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<tr>
<td>4:44 pm</td>
<td>Surgical Centers, Consulting and Implant Recall: What You Should Do to Protect Yourself</td>
<td>Mark I. Froimson, MD, MBA (Hunting Valley, OH)</td>
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<tr>
<td>4:50 pm</td>
<td>DISCUSSION</td>
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<tr>
<td>5:00 pm</td>
<td>Closing Remarks / Meeting Adjourned</td>
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</table>
I. **Valgus Knee Classification (Krackow⁴)**
   A. Type I: Lateral Femoral Bone Loss With Lateral Ligamentous Contracture & **Intact** Medial Ligamentous Structures
   B. Type II: Contracted Lateral Ligaments With **Attenuation** of Medial Ligamentous Structures
   C. Type III: Severe Valgus Deformity With Mal-positioning of the Joint Line

II. **Lateral Soft Tissue Anatomy**
   A. Dynamic Stabilizers
      1. Popliteus / Biceps Femoris / Iliotibial Band
   B. Static Stabilizers
      1. Arcuate Ligament (Posterolateral Capsule)
      2. Lateral Collateral Ligament (LCL) / Fabellofibular Ligament
   C. Extension Stabilizers
      1. Arcuate Ligament / Iliotibial Band / Biceps Femoris
   D. Flexion & Extension Stabilizers
      1. LCL / Popliteus / Arcuate Ligament/ Lateral Gastrocnemius

III. **Valgus Knee: Common Features**
   A. Contracted Lateral Ligaments / Posterolateral Capsule
   B. Attenuated Medial Structures (Type II & III)
   C. Hypoplastic Lateral Femoral Condyle (LFC)
   D. Fixed External Rotation Contracture (ITB Contracture)

IV. **Preoperative Evaluation**
   A. Physical Examination
      2. Analyze For Valgus Thrust & Associated Deformities
         • Flexion Contracture / Recurvatum
   B. **Preoperative Radiographs**
      1. Standing AP
         • Assess Deformity & Medial Joint Space. If Increased, Consider Lessening Femoral / Tibial Resections
      2. Lateral: Assess LFC Hypoplasia

V. **Intraoperative Soft Tissue Release Sequence**
A. Numerous Methods Proposed & No Exact Consensus Exists Regarding Optimal Sequence of Soft Tissue Release.

B. Historical Release / Early Years of TKA
   1. LCL / Popliteus Release From Lateral Epicondyle
   2. ITB Release 8-10cm Proximal to Joint Line
   3. Biceps Femoris / Lat. Gastroc Release (Severe Cases)
   4. Above Releases No Longer Favored Due to Lateral Flexion Instability

C. Current Favored Release Sequence (Type I & II / Insall², Ranawat⁶)

![Fig. 1](image)

**Fig. 1.** The pie crust technique is performed with a laminar spreader distracting the femorotibial joint space. First, a transverse incision is made through the arcuate complex at the level of the tibial bone cut (A). Next, multiple stab incisions are made through the lateral structures (B).

1. Resect Distal Femur / Proximal Tibia
2. Remove Peripheral Osteophytes
3. Distract Extension Gap With A Laminar Spreader
4. Transverse Release Through Arcuate Ligament at Level of Tibial Resection
5. Pre-Crusting of Iliotibial Band 1-2cm Above Tibial Resection
6. Preserve Popliteus & LCL To Maintain Lateral Flexion Stability
7. Flexion Gap Balance Obtained Primarily by Proper Rotation of Femoral Component Rather Than Soft Tissue Releases in Flexion (Ranawat⁶)
8. Severe Cases
   - Release LCL / Popliteus / Posterior Capsule / Lateral Head of Gastrocnemius
   - May Require Constrained Prosthesis
   - Protect Peroneal Nerve (Located 1.49cm (0.91-2.18cm) From Posterolateral Aspect of Proximal Tibia¹)

D. Selective Lateral Ligamentous Release (Whiteside⁷)

1. Assess What Structures Are Tight In Extension, Flexion, Or In Both Flexion and Extension
2. Tight in Extension Only: Release ITB
3. Tight in Flexion Only: Release LCL & Popliteus

4. Tight in Extension & Flexion
   - Initially Release LCL & Popliteus
   - May Require Release of ITB & Arcuate Ligament

E. Medial Ligamentous Advancement (Krackow⁴)
   1. Considered in Severe Type II & III Cases. Can Be Advanced Proximally or Distally. Clinical Data Scant.

References:


The Terrible Varus Knee
Arun B. Mullaji, MD

The Terrible Varus Deformity
Soft-tissue release plays an integral part in primary total knee arthroplasty by ‘balancing’ the knee. Asian patients often present late and consequently may have large deformities due to significant bone loss and contractures medially, and stretching of the lateral collateral ligament. Extra-articular deformities may aggravate the situation further and make correction of these deformities more arduous.

Several techniques have been described for correction of deformity by soft-tissue releases. However, releasing the collateral ligament during TKA has unintended consequences such as the creation of significant mediolateral instability and a flexion gap which exceeds the extension gap; both of these may require a constrained prosthesis to achieve stability. We will show that soft-tissue balance can be achieved even in cases of severe varus deformity without performing a superficial medial collateral ligament release.

The steps are
i) Determining pre-operatively whether deformity is predominantly intra-articular or extra-articular
ii) Individualizing the valgus resection angle and bony resection depth
iii) Reduction osteotomy, posteromedial capsule resection, sliding medial condylar osteotomy, extra-articular corrective osteotomy
iv) Compensating for bone loss
v) Only rarely deploying a more constrained device.

Case examples will be presented to illustrate the entire spectrum of varus deformities.

REFERENCES
Performing TKA in the obese patient can be difficult physically, is often associated with technical challenges, and results in higher complication rates with the greatest concern being infection. Important considerations when operating on these patients and resulting key tasks or decisions can be broken down into the following:

1) **Preoperative Assessment and Optimization**
   - **Weight Loss**: Should start when symptoms first develop, long before surgery is required. Infrequently the case at present, but **THIS MUST CHANGE**.
   - **No set BMI limit**, but approach this like other major Co-morbidities (i.e. cardiac)
   - **Set a goal** (< 40 BMI) to try and achieve this before surgery and then aggressively manage symptoms non operatively to get there.
   - More important than BMI: **soft tissue density** (harder = harder!) and **pre-tibial soft tissue thickness** (higher correlation to infection risk than BMI)
   - **Nutritional Assessment**: check Albumin, pre-albumin and transferrin
   - Refer to **Dietician**
   - Consider **Bariatric Surgery Consultation** if BMI > 45
   - **Diabetes control**: perioperative blood glucose levels more important than HgbA1c
   - **Smoking Cessation!!!** (Nicotine patch OK)
   - **Optimize medical comorbidities**: cardiac, vascular, OSA and pulmonary

2) **Surgical Exposure**
   - **Generous Skin Incision**, extend as needed for visualization,
   - Avoid large Subcutaneous flaps
   - **Medial subperiosteal dissection** to posteromedial corner and externally rotate foot
   - **Sublux** (do not evert) the patella
   - **Quad snip** if needed
   - **Hip retractors** helpful for big patient knee surgery
   - **2 assistants**: one for the leg, the other for retraction
   - Consider the following order for bone cuts (even if a change from usual): Distal Femur, then Tibia, then the remaining femoral cuts
   - Adequate tibial resection (10 to 12mm): **DO NOT UNDER-RESECT the Tibia**

3) **Implant Choices**
   - Use **modular tibial tray** and avoid all-poly tibia or monoblock designs: hard to put in
   - Try and **Avoid Patellar Resurfacing**, especially in large males to reduce later periprosthetic patellar fracture risk
   - Consider adding **short stems** to both components (but especially the tibia)
   - **OK to check an intraoperative x-ray** for alignment of trials before cementing
4) **Infection Prophylaxis**

- **Prophylactic Antibiotics**: preop, intra op, & postop - **ADJUST DOSE BY WEIGHT**
- **Antibiotic containing cement**
- **Dilute Betadine** Soaks intra op
- **Careful layered closure**: critical
- After multiple other combinations current preference for skin closure: **running subcuticular suture and adhesive skin closure**
- **Avoid staples or interrupted sutures** for skin: reduced vascularity vs running subQ
- If serous drainage over 48 hrs.: rest the limb in extension to achieve seal
- **Avoid daily dressing changes**: Consider “special” dressings (Silver, etc.)
- Aggressively treat wound problems: **Prolonged drainage-return to the OR**
Technical challenges surgeons face when performing total knee arthroplasty (TKA) in stiff knees (i.e., less than 50° arc of motion) include difficulty in obtaining adequate exposure, proper soft tissue balance and patellofemoral tracking. Other issues the surgeon must address may include hamstring and iliotibial band contractures, large osteophytes, quadriceps mechanism pathology, intra-articular adhesions and other problems depending on whether the patient is stiff in extension or flexion. Studies have reported favorable outcomes following TKA in stiff knees, although these outcomes are inferior to those achieved by patients with more normal preoperative range of motion. Gains in arc of motion can range from 50° to 90°. The most common complications following TKA for stiff knees are persistent post-TKA stiffness and flexion contractures, with reported complication rates in the literature ranging from 5% to 43%. Poor outcomes following V-Y quadricepsplasty have been reported in several studies, as evidenced in one study by a mean postoperative extension lag of 15° (range, 10° – 23°). In a recent study reported mean postoperative Knee Society Scores (KSS) of knees stiff in flexion were 71.2 (± 12.5) at a minimum of 2 years postoperative, an enormous improvement over the average preoperative scores for those patients of 14 ± 5.2. Similar improvements were reported in the Knee Society Function Score, which improved from 8.3 (± 3.8) to 64.3 (7.6). TKA in stiff knees is not without challenges and complications, but it can provide significant improvements in terms of pain, range of motion, and function for these patients.
Pre-operative planning is critical for minimizing soft tissue problems about the knee. Both systemic factors and the characteristics of the knee should be considered prior to knee arthroplasty. Patient specific medical co-morbidities that can influence wound healing and the development of wound infections should be assessed and optimized. These include diabetes, malnutrition, inflammatory arthritis, tobacco smoking, anemia, peripheral vascular disease and obesity.

Local factors include the vascular anatomy of the knee and prior incisions and injuries to the skin that may the disrupt inflow. The local vascular anatomy of the knee is unforgiving. Historically, most of the perfusion to the skin has been considered to be derived from perforators deep to the fascia, especially from the medial side of the knee, in the distribution of the saphenous artery and descending genicular artery. Therefore, laterally based flaps should be avoided and any prior vertical incision should be carefully considered. General guidelines for selection and placement of skin incisions include use of a single, longitudinal anterior midline incision that provides the most extensile exposure when no prior incisions are present. Prior incisions about the knee should be carefully evaluated. Factors believed to be important, include age and length of the incision. A single, transverse incision can be crossed by a new perpendicular anterior incision with relatively little concern. When a single, prior longitudinal anterior incision exists, this incision should be used, even if the location is not quite optimal. If placement of this prior incision is not directly midline, the proximal and distal ends of the incision may be extended back to toward the midline in order to reduce wound tension. If the prior incision is located away from the midline, and would necessitate creation of a large laterally based subcutaneous flap, use of a new incision may be considered. In these circumstances, expert opinion has historically defined that skin bridges greater than 3 to 5cm should be maintained. When a challenging prior, single incision or multiple incisions are identified, the use of intra-operative indocyanine green laser angiography has anecdotally, recently proven helpful in defining the individual variations in perforator vessels about the knee in specific patients. This technique appears to be helpful for both planning incision placement, prior to an incision, and evaluating healing potential for the skin at the wound edges at the end of knee arthroplasty.

In some circumstances where numerous prior incisions exist, or where the skin and subcutaneous tissues have been severely damaged, for example, following trauma, radiation, or infection, prophylactic soft tissue procedures may be considered. These techniques, including tissue expansion, and local rotational fasciocutaneous flaps or free flaps, have been successfully used to avoid post arthroplasty wound healing problems. Developing a working relationship with a plastic surgeon and joint decision making regarding appropriate pre-operative strategies for patients with challenging soft tissue problems prior to TKA should be considered. Patients who require salvage soft tissue procedures after TKA, such as muscle flaps, appear to experience higher complication rates, and poorer outcomes, than patients with potential wound healing problems that are managed pre-emptively.
Conclusions:
In summary, unless acute infection or fracture necessitates urgent surgical intervention, pre-emptive optimization of patient systemic and local knee factors is encouraged to improve primary wound healing after knee arthroplasty.

References:


Can a Bicruciate Retaining TKA Be Successful?
Alfred J. Tria, Jr., MD

Introduction: Bicruciate TKA was introduced in the 1980s. There were some successful designs but surgeons did not fully embrace the technology. In the past 2-3 years new designs have appeared with mixed results. This paper will report the early results of a new design and asks three questions: Can the surgery be performed routinely without complications? Will the results at least be equal to those of the present day prostheses? Will the prosthetic design survive the test of time?

Methods: The retrospective study reviews the results of all bicruciate TKAs performed from March, 2016, until March, 2017. A comparison group was established of patients who underwent a standard PS TKA during the same period of time. The groups were matched for age, sex, BMI, diagnosis, and knee deformity. The charts were reviewed by three of the authors who were not involved in the surgical procedures. The x-rays were studied for the tibial coronal and sagittal plane alignment and the overall anatomical alignment. Outliers were defined as greater than 3 degrees from the ideal alignment: tibial coronal plane alignment of zero degrees, tibial sagittal alignment 3-7 degrees, and overall anatomic alignment 4-10 degrees.

Results: 25 patients were scheduled for a bicruciate TKA and 22 patients underwent 24 knees (2 bilateral surgeries). Two of the knees had an incompetent ACL at the time of surgery and one patient had a large tibial surface and the component size was not yet available. The three knees were converted to a PS design. There were no bone island injuries or disruptions. 24 patients in the comparison group underwent a standard PS TKA without any surgical complications. Table 1 contains the comparison results. There were no significant differences in post op range of motion, complications, x-rays outliers, and KOOS scores.

Discussion: The results show that the operation can be completed in a routine fashion without complications. The early results are similar to those of a standard TKA. The implants have shown no failure indications as of yet and there are no significant radioluencies on follow up x-rays; however, the follow up is very short (average 6 months).

The major weakness of this study is the short period of follow up and the fact that one of the authors is a designing surgeon. Two of the proposed questions have been answered and the final one concerning the prosthetic design will require some further time.
<table>
<thead>
<tr>
<th></th>
<th>G2</th>
<th>XR</th>
<th>p-value</th>
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<tr>
<td><strong>Age (years)</strong></td>
<td>68.5 ± 8.6</td>
<td>67.3 ± 10.3</td>
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<td><strong>Sex (% F)</strong></td>
<td>16F, 6M (73%)</td>
<td>18F, 5M (78%)</td>
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<td><strong>BMI (kg/m²)</strong></td>
<td>31.1 ± 4.5</td>
<td>26.5 ± 2.8</td>
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<td><strong>Follow-up (months)</strong></td>
<td>6.6 ± 3.8</td>
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<td><strong>ASA</strong></td>
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<td>2.1 ± 0.6</td>
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<td><strong>Tourniquet (mins)</strong></td>
<td>39.4 ± 11</td>
<td>75.7 ± 13.2</td>
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<td><strong>Procedure (mins)</strong></td>
<td>66.8 ± 13.4</td>
<td>110.5 ± 29.1</td>
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<td><strong>EBL (ml)</strong></td>
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<td>252.2 ± 10.4</td>
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<td><strong>Alignment</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Preoperative</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Varus</td>
<td>16 (5.6° ± 1.4°)</td>
<td>22 (6.2° ± 2.1°)</td>
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</tr>
<tr>
<td>Valgus</td>
<td>6 (9.5° ± 5.6°)</td>
<td>1 (7.0°)</td>
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<tr>
<td><strong>Post-op Tibial Tray</strong></td>
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<tr>
<td>Varus</td>
<td>7 (-2.6° ± 1.9°)</td>
<td>5 (-1.8° ± 1.5°)</td>
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<td>Valgus</td>
<td>15 (1.9° ± 1.5°)</td>
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<td>A/P Slope</td>
<td>4.0° ± 2.2°</td>
<td>-0.6° ± 2.8°</td>
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<td><strong>Post-op Knee Overall</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Varus</td>
<td>1 (-1.1°)</td>
<td>1 (-3.0°)</td>
<td>--</td>
</tr>
<tr>
<td>Valgus</td>
<td>21 (6.3° ± 3.9°)</td>
<td>22 (6.3° ± 3.8°)</td>
<td>0.99</td>
</tr>
<tr>
<td><strong>Range of Motion</strong></td>
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<tr>
<td><strong>Preoperative</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Extension</td>
<td>3.9° ± 2.6°</td>
<td>2.8° ± 3.3°</td>
<td>0.22</td>
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<tr>
<td>Flexion</td>
<td>119.3° ± 10.4°</td>
<td>125.7° ± 9.1°</td>
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<tr>
<td>Total</td>
<td>115° ± 11.4°</td>
<td>123° ± 11.6°</td>
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<td><strong>4-6 Week Post-op</strong></td>
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<tr>
<td>Extension</td>
<td>3° ± 2.5°</td>
<td>1.9° ± 2.5°</td>
<td>0.18</td>
</tr>
<tr>
<td>Flexion</td>
<td>116.5° ± 11.1°</td>
<td>115.8° ± 12.2°</td>
<td>0.85</td>
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<tr>
<td>Total</td>
<td>113.5° ± 12.6°</td>
<td>113.9° ± 12.8°</td>
<td>0.92</td>
</tr>
<tr>
<td><strong>KOOS</strong></td>
<td>68.4 ± 15.4</td>
<td>72.4 ± 14.8</td>
<td>0.46</td>
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</table>
When Is It Safe to Perform TKA after Steroid/HA Injection?
Thomas P. Sculco, MD

Introduction: Intra-articular injections such as corticosteroid (CS) or hyaluronic acid (HA) are used in managing knee osteoarthritis. Recent studies have shown that intra-articular injections within 3 months before TKA increase the risk of periprosthetic joint infection (PJI) postoperatively. It is suspected that this risk is from the immunosuppressive effect of CS or from direct inoculation. Previous large-scale studies rely on a generic CPT injection code, but no previous study has differentiated in the type of medication injected and the risk of PJI. This study utilized pharmaceutical data to compare patients who received preoperative CS or HA injections to determine whether a specific injection type increases the risk of PJI.

Methods: Unilateral TKA patients were selected using CPT codes using a nationwide private insurer database (Pearl Diver – Humana). Those with ipsilateral preoperative injections were then identified, grouping by medication codes (CPT-J) for CS or HA. To simplify the comparison, patients who had received both types of injections within one year before TKA were excluded. PJI was defined via appropriate ICD-9 and CPT codes within 12 months following the TKA. Risk of PJI was compared between groups (no injection, CS, HA). Statistical comparisons were performed using logistic regression controlling for age, gender, and comorbidities.

Results: Of 86,325 patients, 5.0% received HA and 24.7% received CS within 1 year of TKA. The overall infection rate was 3.76% in the no-injection group. Multivariable regression showed independent risk for both CS (odds ratio = 1.14) and HA (OR=1.29). There was no increased risk with injections more than 3 months prior to TKA. Direct comparison of CS and HA showed no significant difference.

Discussion and Conclusion: Preoperative CS or HA injection within 3 months of TKA both had increased risk of PJI, but there was no difference between the two medications. Based on this data we recommend avoiding both injection types in the 3 months prior to TKA.
Patient Specific Implants and Instruments
Tom Minas, MD, MS

Introduction: A CT based, customized, patient specific family of instruments and implants have been developed for uni and bicompartamental as well as total knee arthroplasty. Customized Individually Made (CIM) implants and 3D printed customized surgical instruments fit each patient’s unique anatomy, unicompartmental knee arthroplasty,(UKA),medial and lateral, bicompartamental knee arthroplasty(BKA) medial patellofemoral or lateral patellofemoral and total knee arthroplasty,(TKA).

Off the shelf (OTS) unicompartmental arthroplasty have been designed primarily for the medial compartment which is rectangular for the tibia and femur-longer AP than Medial-Lateral. To perform a lateral UKA a compromise to fit is usually necessary in order to have a lateral UKA restore a congruent articulation. In addition, fits for large males and small females are a problem. CIM implants offer an exact fit and balance to the knee and improved outcomes in the short term.1

Bicompartmental Knee Arthroplasty (BKA) and instruments for bicompartamental knee osteoarthritis (OA) has been developed to delay the need for total knee arthroplasty (TKA), with minimal bone removal and preservation of both cruciates. This treatment has been used in younger patients whose knees have been multiply operated upon, (average > 3 surgeries/knee), as a salvage procedure prior to TKA.

Methods: In this case series, a review of prospectively collected data from patients who underwent CIM BKA between September 2010 and February 2016 was performed. We evaluated 55 patients (59 knees; average age, 51 years; range, 37-65) over an average of 45 months follow-up (range 12 – 72), treated by a single surgeon for symptomatic bicompartamental joint disease combined medial or lateral with patellofemoral OA. There were 35 women and 24 men with an average body mass index of 28.3 (range, 19.2-41.8). A total of 41 knees underwent BKA combined medial and patellofemoral replacement (BKA-MP) and 18 knees underwent BKA combined lateral with patellofemoral replacement (BKA-LP). Survival analysis was performed using the Kaplan-Meier method, with conversion to total knee arthroplasty (TKA) as the endpoint. The modified Cincinnati Knee Rating Scale, Western Ontario and McMaster Universities Osteoarthritis Index, Visual Analog Scale, and Short Form-36 were used to evaluate clinical outcomes. Patients also self-reported knee function and satisfaction.

Results: Overall, survival rates were 96% and 94% at 2 and 5 years, respectively. There was no significant difference in survival rates between BKA-MP and BKA-LP (P = 0.7667). Of 52 patients (56 knees) who did not require conversion to TKA, all patient-reported functional scores significantly improved postoperatively (p < .05). Three knees (5.1%, BKA-MP in 2 and BKA-LP in 1) required conversion to TKA at an average of 26 months (range, 11-48) postoperatively. One for progression of disease, one for tibial subsidence and one a delayed infection after an initial excellent outcome , one year post op in a diabetic male, BMI 40. Other than these failed patients 18 knees (22%) required subsequent surgical procedures, which was primarily arthroscopic synovectomy due to adhesions in 14 knees. These were in patients with multiple prior surgeries to BKA. Despite subsequent surgeries, 91% of the patients rated their knees as good or excellent and answered that they were satisfied their knee surgery at the latest follow-up.
• CIM TKA implant provides an exact fit and restores the exact femoral J-curves, medial, lateral and trochlea as well as joint line and offsets. Two tibial inserts assist in accomplishing the individual medial and lateral joint lines and offsets distally and posteriorly to avoid laxity throughout the range of full flexion and extension. In anatomical restoration the hypothesis that follows is; 'Form equals function', aimed to improve functional outcomes and patient satisfaction.

• **Methods:** In this case series of young arthritics, average age 56.9 years,(see Table 1), a review of prospectively collected data from patients undergoing CIM TKA including 1st and 2nd generation implants, between May 2011 and April 2016. We evaluated 201 patients (232 knees including 98 knees with 1st generation and 134 knees with 2nd generation; average age, 57 years) over an average 34.9 months follow-up (median, 36; range, 12 – 72), who were treated by a single surgeon for symptomatic osteoarthritis in the knee. An average BMI was 31.1 (range, 18.7-59). There were 98 men and 138 women. Survival analysis was performed using the Kaplan-Meier method, with revision TKA as the endpoint. The modified Cincinnati Knee Rating Scale, Western Ontario and McMaster Universities Osteoarthritis Index, Visual Analog Scale, and Short Form-36 were used to evaluate clinical outcomes. Patients also self-reported knee function and satisfaction.

• **Results:** Overall, survival rates were 98% and 92% at 2 and 5 years, respectively. There were no statistical differences between outcomes and failures of generation one and two implants. Of 193 patients (222 knees) who did not require revision TKA, all patient-reported functional scores significantly improved postoperatively (p < .05). Of these patients, 87% rated their knees as good or excellent, 90% answered that they were satisfied their knee surgery. Ten knees (4.3%) required revision TKA with conventional implants at an average of 35 months (range, 18-61) Thirty knees (13%) required subsequent surgical procedures including arthroscopic synovectomy due to adhesions in 28 knees and open liner exchange for acute septic arthritis in 2 knees.

• Table 1-Patient demographics by age

<table>
<thead>
<tr>
<th></th>
<th>Overall (n = 232 knees)</th>
<th>&lt;40 (n = 11 knees)</th>
<th>41-50 (n = 52 knees)</th>
<th>51-60 (n = 89 knees)</th>
<th>&gt;61 (n = 80 knees)</th>
</tr>
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<tbody>
<tr>
<td>Average age</td>
<td>56.9</td>
<td>36</td>
<td>47</td>
<td>56</td>
<td>67</td>
</tr>
<tr>
<td>Female/male</td>
<td>134/98</td>
<td>4/7</td>
<td>33/19</td>
<td>59/30</td>
<td>38/42</td>
</tr>
<tr>
<td>Average BMI</td>
<td>31.1</td>
<td>30.9</td>
<td>33</td>
<td>31.1</td>
<td>29.9</td>
</tr>
<tr>
<td>Failed knees</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Failure rate</td>
<td>4.3%</td>
<td>9%</td>
<td>0%</td>
<td>6.7%</td>
<td>3.8%</td>
</tr>
</tbody>
</table>

**Conclusion:** Our results showed that CIM TKA provided significant improvement in pain and function. Notably, in a young cohort of patients, satisfaction appears to have a more favorable outcome in CIM TKA than historically, in conventional TKA, though a comparative study with long-term follow-up will be needed.

Abbreviations: TKA, total knee arthroplasty; CIM, Customized Individually Made

Polyethylene wear in total knee arthroplasty (TKA) is a still unsolved problem resulting in osteolysis and long-term failure of knee joint replacement. Highly Cross-linked polyethylenes (XLPE) have been shown to significantly reduce wear in both hip and knee arthroplasty. Initial concerns about decreased mechanical properties in TKA have not been a clinical problem in studies at 5-10 years. (1-5) Oxidation is also significantly reduced with XLPE, but may not be completely eliminated.

Antioxidants additives have more recently been introduced, however clinical improvements have not yet been shown.

The use of Oxidized Zirconium (OZ) femoral components were introduced to minimize wear and thus potentially increase long-term implant survival. OZ implants are more lubricious and harder than CrCo. OZ has been shown to have significantly less femoral scratching and reduced polyethylene wear and in both in vitro and retrieval studies. Further wear reduction is achieved when OZ femoral implants are combined with XLPE. (6-8)

While XLPE and OZ have been shown to reduce polyethylene wear, further long term clinical studies are necessary to determine if they lead to increased implant survivorship.

References


3. Minoda Y et al., Comparison between highly cross-linked and conventional polyethylene in total knee arthroplasty. Knee, 2009


The Pocket Rocket: Handheld Navigation
David J. Mayman, MD

Background: Dynamic tibial tray sensors are playing an increasing role in coronal-plane TKA balancing. Sensor-balance is proposed to lead to improved patient satisfaction and outcomes compared with sensor-unbalanced TKA, and traditional manual-balanced TKA performed without the sensor. What is not known is whether there is a learning curve with this technology, and whether sensor-use can improve manual TKA balance skills once the sensor is taken away, and consequently “train” the surgeon.

Methods: We conducted a single-surgeon prospective study on 104 consecutive TKAs performed at our institution. In Nonblinded Phase I (n=49), sensor-directed releases were performed during trialing and final intercompartmental pressures were recorded. In Blinded Phase II (n=55), manual-balanced TKA was performed and final sensor readings were recorded by a blinded observer after final cementation. We used cumulative summation (CUSUM) analysis and sequential probability ratio testing to analyze the surgeon learning curve in both phases.

Results: In Nonblinded Phase I, sensor-balance mastery was attained most easily at 10°, followed by 90°, and most difficult to attain at 45° of flexion. In Blinded Phase II, manual-balance was lost most quickly at 45°, followed by 90°, and preserved for longest at 10°of flexion. The number of cases in the steady state periods (early phase periods where there is a mix of sensor-balance and sensor-imbalance) for both phases is similar.

Conclusions: A surgeon who consistently uses the dynamic sensor demonstrates a learning curve with its use, and an “attrition” curve once it is removed. Consistent sensor-balance can only be guaranteed with constant sensor use.

Clinical Relevance: This study demonstrates that by quantifying subjective coronal plane “tightness” and “looseness”, dynamic sensors can be used as a teaching tool and may be useful in trainee education.
THE JOHN N. INSALL AWARD

Unsupervised Home Exercise Equivalent to Traditional Outpatient Therapy After Primary TKA: A Randomized Controlled Trial

Andrew N. Fleischman, MD; Meredith P. Crizer, BS; Majd Tarabichi, MD; Shelby Smith, BS; Richard H. Rothman, MD, PhD; Jess H. Lonner, MD; Antonia F. Chen, MD, MBA

Background: Concerns of cost and convenience after surgery have sparked interest in unsupervised, home-based rehabilitation. Our goal was to compare the efficacy of an unsupervised home exercise program to the routine prescription of formal outpatient physical therapy (PT) after primary total knee arthroplasty (TKA).

Questions/Purposes: (1) Do patients utilizing an unsupervised home exercise program have a similar return of knee flexion postoperatively compared with patients undergoing formal outpatient PT? and (2) Does a web-based platform for home exercise provide any advantage compared to a printed PT manual or formal OPT based on patient-reported functional outcomes and return to daily activities?

Patients and Methods: A randomized trial was conducted on 242 primary TKA patients from March 2016 to June 2017. Patients were randomized to one of three groups: outpatient physiotherapy (OPT), unsupervised home-exercise using a web-based platform (Web PT), or unsupervised home-exercise using a printed-paper manual (Paper PT). Home exercise patients were required to crossover to OPT if knee flexion was <70° at 2 weeks or <90° at 4 weeks. The primary outcome, knee flexion, was recorded preoperatively and after 4-6 weeks and 6 months. Secondary outcomes included KOOS, time back to activities of daily living (ADLs), time off narcotics, and visual analog scale (VAS) satisfaction. Analyses were ‘intention-to-treat’.

Results: Change in knee flexion from baseline was similar after 4-6 weeks (OPT -1.0°, Web PT 1.3°, and Paper PT -2.7°; p=0.21) and 6 months (OPT 8.7°, Web PT 9.4°, and Paper PT 9.6°; p=0.86). Additionally, there was no difference in change in KOOS from baseline after 4-6 weeks or 6 months, time back to ADLs, time off narcotics and VAS satisfaction between groups. There was no difference in readmission rates (3 OPT, 1 Web PT, 1 Paper PT), and no patients required reoperation.

Conclusions: Unsupervised home exercise is an effective rehabilitation strategy for the majority of patients undergoing primary TKA. It may be time to reconsider the current practice of automatically designating patients for OPT.
Developing and Implementing a Novel Guideline Strategy Reduced Postoperative Opioid Prescribing Following TKA and THA
Cody C. Wyles, MD; Mario Hevesi, MD; Eleanor R. Trousdale, MD; Daniel S. Ubl, MPH; Halena M. Gazelka, MD; Elizabeth B. Habermann, MD, PhD; Robert T. Trousdale, MD; Mark W. Pagnano, MD; Tad M. Mabry, MD

Background: Opioid prescription management is a substantial contemporary challenge for orthopaedic surgeons, especially in light of the opioid epidemic. Currently, there is a lack of evidence-based guidelines to aid orthopaedic surgeons in responsible opioid prescribing. Our institution recently developed opioid prescription guidelines for patients undergoing a variety of common orthopaedic procedures including total knee arthroplasty (TKA) and total hip arthroplasty (THA) with the goal of optimizing and standardizing postoperative opioid prescriptions at discharge.

Questions/Purposes: (1) Can useful opioid prescribing guidelines, based on contemporary orthopaedic prescribing data for TKA and THA patients, be developed, implemented and adopted? (2) How do opioid prescriptions at discharge and 30-day refill rates change in opioid naïve patients undergoing primary TKA and THA before and after implementation of a novel prescribing guideline strategy? (3) What patient, surgical, and in-hospital factors influence opioid prescription quantity and refill rate?

Methods: Orthopaedic procedure-specific opioid prescribing guidelines were developed by a multidisciplinary team in early 2017 and institutionally implemented beginning August 1, 2017. All opioid naïve primary TKA and THA patients at a single tertiary care institution were evaluated through September 30, 2017 as the post-guideline era cohort. This group (n=292 patients) was compared to all opioid naïve TKA and THA patients from 2016 at the same institution (n=1,822 patients). The primary outcome assessed was adherence to the new guidelines with a secondary outcome of opioid medication refills ordered within 30 days from any provider. Variation in discharge opioid prescribing practices in opioid naïve patients was assessed for each surgical procedure before and after guideline implementation. Multivariable logistic regression analyses were performed with outcomes of guideline compliance and refills and adjusted for demographic, surgical, and patient care factors.

Results: Can useful opioid prescribing guidelines, based on contemporary orthopaedic prescribing data for TKA and THA patients, be developed, implemented and adopted?
New institutional guidelines for TKA and THA patients recommend a maximum postoperative prescription of 400 oral morphine equivalents (OME), comparable to 50 tablets of 5 mg Oxycodone or 80 tablets of 50 mg Tramadol. This is a significant decrement (40%) from historical institutional prescribing practices for those same procedures.

How do opioid prescriptions at discharge and 30-day refill rates change in opioid naïve patients undergoing primary TKA and THA before and after implementation of a novel prescribing guideline strategy?
Median prescribed OME in the pre-guideline era was 750 OME (Inter-quartile range (IQR): 600-900 OME) for TKA and 750 OME (IQR: 575-900 OME) for THA, whereas the median prescribed OME in the post-guideline era for both TKA and THA was 387.5 OME (IQR: 350-500 OME) (p<0.001). Despite large observed improvements to date, the projected change once equilibrium is achieved in the post-guideline era is...
underestimated as adherence continues to increase. Prescribing goals were met by 11% of discharges in the pre-guideline era, which improved to 53% by month one and 80% by month two after guideline implementation (p<0.001). Refill rate for TKA patients was 34.5% in the pre-guideline era and 39.7% in the post-guideline era (p=0.21). Refill rate for THA patients was 15.9% in the pre-guideline era and 16.3% in the post-guideline era (p=0.90).

What patient, surgical, and in-hospital management factors influence opioid prescription quantity and refill rate? Multivariable regression demonstrated that guideline implementation was the most significant factor in successfully discharging TKA and THA patients with opioid prescriptions ≤400 OME. Among TKA patients, the adjusted odds increase of achieving opioid prescriptions ≤400 OME following implementation of guidelines was 49.5 (95% CI=25.7-95.6) (p<0.001); among THA patients, the adjusted odds increase was 42.0 (95% CI=20.9-84.1) (p<0.001). Multivariable regression demonstrated that guideline implementation did not significantly alter opioid prescription refill rate among TKA and THA patients. A variety of patient factors contributed to a small, but statistically significant degree in refill rate and achievement of opioid prescriptions ≤400 OME.

Conclusions: This study provides a proof-of-concept that guidelines to reduce postoperative opioid consumption are a facile measure that can drive dramatic improvement in a short period of time. To our knowledge, this is the first study documenting a change of this nature through practice guideline standardization in total joint arthroplasty. The guidelines proposed by this report should serve to inform the critical debate of establishing evidence-based practices for postoperative pain management following TKA and THA.

Level of Evidence: Level II, Therapeutic
THE MARK COVENTRY AWARD

Does Ceramic Bearing Articulation Improve the Clinical Outcomes of Total Knee Arthroplasty in Younger Patients?
Young-Hoo Kim, MD; Jang-Won Park, MD; Jun-Shik Kim, MD

Background: Measures to reduce the revision rate of total knee prostheses because of wear-related issues are important to examine, particularly because younger patients have a disproportionately high risk of revision. Questions/Purposes (1) Are long-term Knee Society knee and function scores better in younger patients with an oxidized zirconium (OxZr) TKA compared with those with a cobalt-chrome (CoCr) TKA? (2) Are there differences in radiographic signs of loosening or CT findings of osteolysis between OxZr TKAs and CoCr TKAs? (3) Are there fewer polyethylene wear particles in the OxZr TKA than CoCr TKA? (4) Do the groups differ in terms of survivorship free from revision surgery at 12.8 years?

Methods: From April 2003 to January 2007, we enrolled 110 patients younger than 55 years of age in this randomized, double-blind, prospective trial. Each patient served as his or her own control and each received an OxZr femoral component in one knee and a CoCr femoral component (Genesis II; Smith & Nephew, Memphis, TN, USA) in the other. The minimum followup was 10 years (mean, 12.8; range, 10 years-14 years); two died and nine were lost to followup before that time, leaving 99 patients (198 knees) for analysis. There were 28 men and 71 women with a mean age of 52.8 years ± 6.4 years (range, 40 years-55 years). We obtained Knee Society knee scores for each knee, but Knee Society function scores, WOMAC scores, and University of California, Los Angeles (UCLA) activity scores were obtained for each patient preoperatively and at each followup. At 12.8 years followup, we obtained CT scans in all patients. Polyethylene wear particles in the synovial fluid were analyzed at the final followup using thermogravimetric methods and scanning electron microscopy (SEM). Survivorship was ascertained using the Kaplan-Meier calculator. To minimize the chance of Type II error and increase the power of our study, we adjusted the power to detect a minimum difference in the Knee Society knee score of 5 points with an alpha level of 0.05 and a power of 80%, which revealed that a total of 85 knee would be required in each group.

Results: At the most recent followup, the mean Knee Society knee scores (92 points versus 93 points, p=0.857), function scores (85 points versus 85 points, p=1.000), WOMAC scores (23 points versus 23 points, p=1.000), UCLA activity scores (6.5 points versus 6.5 points, p=1.000) and range of knee motion (125° versus 127°, p=0.365) were not different between the two groups. There was no radiographic evidence of loosening and no osteolysis visible on CT scan in either group. The weight of polyethylene wear particles produced at the bearing surface was 0.046±0.010 g in 1 g synovial fluid in patients with an OxZr femoral component and 0.0448±0.0108 g in patients with a Co-Cr femoral component (p=0.583). Kaplan-Meier survivorship free from revision was 97% for the OxZr group (95% CI, 93-100) and 98% for the CoCr group (95%CI, 93-100) at 12.8 years after surgery (p=0.918).
Conclusions: Given the absence of demonstrated superiority of either the CoCr implant or the OxZr implant, we recommend that surgeons and healthcare systems can reasonably choose the less-expensive device for routine use, unless there is some compelling reason in individual patient to choose one over the other such as severe, documented metal sensitivity.

Level of Evidence: Level I, therapeutic study.
What Activity Should I Recommend for My Patients?

Philip C. Noble, PhD

TKR patients perform a very broad range of sporting and recreational activities that vary with age and lifestyle. While participation in contact sports is uncommon, many patients still engage in other high demand activities, including tennis, cycling, golf, jogging, weight-lifting and other physical exercises. Attitudes of joint surgeons to the risks and benefits of athletic activities have moderated over the past 30 years. Early in the history of TKA, patients were often told that “low-impact activities” were acceptable for maintenance of general health, but “high-impact activities should be avoided.” At that time, physical activities considered acceptable were generally limited to golfing, swimming, cycling, sailing, scuba-diving and cross-country skiing.

A survey by Healy et al of the members of the Knee Society in 1999 led to expansion of this list to include low-impact aerobics, stationary bicycling, bowling and horseback riding. Some additional activities were categorized as “permissible” if the patient performed them prior to surgery. Patients were cautioned against participating in running, contact sports (e.g. football, basketball, lacrosse), and high-demand competitive sports (e.g. volleyball, racquetball, singles tennis). More recently (2007), Swanson et al performed a survey of 139 members of the American Association of Hip and Knee Surgeons to determine their recommendations for a range of 15 activities for patients after TKR and THR. Based on these publications and more recent systematic reviews we have generated a summary of the most comprehensive set of consensus guidelines for patient activities following (see Table 1). For further detail, please review the discussion of factors influencing recommendations to individual patients presented by Clifford and Mallon.

Many of the recommendations concerning allowable activities after TKR have developed through a consensus of established practice in the absence of scientific evidence demonstrating the risks and outcomes associated with specific activities. Surprisingly, there is little, if any, data showing that vigorous athletic activity leads to increased risk of failure of TKR in the short term, despite original fears of component dislocation, fracture or traumatic disruption. Nonetheless, as polyethylene wear increases with the number of loading cycles and the magnitude of the joint load, increased risk of osteolysis in active patients is a concern. However, evidence from select populations of patients participating in high demand sports, including tennis, running, golf and downhill skiing, shows that sporting performance often improves after joint replacement without any change in survivorship in the short to mid-term.

The only published studies relating activity to wear and osteolysis have been performed in THR where contradictory results have been reported by different investigators. This appears to be related to the level of prior sporting experience of the patients being studied and, in the case of cemented components, the quality of the cement mantle achieved at surgery. In TKR, Lavernia et al compared patient activity to wear and creep of knee prostheses of an early design retrieved at autopsy. Their measurements showed patient activity was associated with the deformation (creep) of the tibial inserts, but not the volume of polyethylene wear.

Laboratory studies have also shown that although volumetric wear increases with the number of loading cycles, and hence the level of patient activity, it is also strongly impacted by the specific combination of knee.
kinematics associated with each activity\textsuperscript{14}. This was demonstrated in a recent study by Reinders et al who measured the wear of a single design of TKR during simulated walking, cycling, stair-climbing and sit-to-stand activities\textsuperscript{14}. A 17-fold difference was seen between activities, ranging from 1.12mm\textsuperscript{3}/Mc during cycling to 19.7mm\textsuperscript{3}/Mc during walking. As approximately 96% of loading cycles imposed on the knee each day are generated by walking, the durability of TKR may be determined by the number of cycles each patient spends in walking, and not performing “high-demand” activities, as originally thought. Clearly evidence derived from studies of TKR patients is needed to resolve this question.

The consensus of published opinion and recent systematic reviews support the following conclusions and recommendations:

1. Joint registries have reported remarkable improvements in the durability of TKA when performed in younger (<65 years) patients using cross-linked polyethylene bearings\textsuperscript{1}. In view of these advances, new studies are needed to re-evaluate the relationship between patient activity, polyethylene wear and loosening in cases performed with these advanced materials.

2. Published studies have rarely examined the specific activities performed by patients both in terms of duration and intensity and the resulting survivorship of the TKA. As the kinematics of the artificial joint and loading of polyethylene bearing surfaces greatly affect its rate of wear, guidelines regarding safe levels of activity must be individualized to each patient and their specific activities.

3. In the absence of data enabling predictions of implant wear and osteolysis, the most recent recommendations regarding physical activities have been developed through opinion and consensus. A summary of these recommendations appears in Table 1.

4. Most surgeons require that their TKA patients undergo six months of post-operative recovery before returning to sporting activities, although this requirement does not appear to be based on scientific evidence.

References


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<th>Recommended/Allowed</th>
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Table 1. Recommendations regarding specific activities after TKR based on a synthesis of published surveys of surgeons’ opinions and published recommendations 2,3,4,11,12,15
Highly Crosslinked and Antioxidant Poly: What Does the Data Show?
Timothy M. Wright, PhD

The first commercially available forms of highly crosslinked ultrahigh molecular weight polyethylene (UHMWPE) are now nearing the completion of two decades as bearing materials for hip replacements, and the reduced wear afforded by high crosslink levels has been accompanied by a near elimination in clinical failures caused by debris-generated osteolysis.1,2 Similarly, highly crosslinked polyethylenes introduced more recently into total knee replacements have been performing well,3,4 though the lack of improvement in clinical outcomes have led some to question the need for the added cost.5,6

Despite ongoing success, concerns persist. Oxidation in both annealed and remelted highly crosslinked polyethylenes have been measured in retrieved hip and knee components.7-9 Furthermore, retrieved components also demonstrate decreased crosslink density even at short term follow-up and especially in highly loaded regions at or near the bearing surface.9,10 These potentially deleterious changes appear to be minimal for now, but orthopaedic implant manufacturers have nonetheless introduced antioxidants to UHMWPE in an effort to scavenge and stabilize free radicals, thus providing additional protection against oxidation. The most common is vitamin E, though other types (e.g., hindered phenols) are also being used, with the antioxidant either blended into the resin powder during the production process or diffused into the finished polyethylene component. Both approaches are used commercially with no clinical evidence of the superiority of one over the other.

Preclinical testing supports the fact that antioxidants are effective in controlling oxidation and improving mechanical properties such as fatigue strength over those of remelted highly crosslinked polyethylene.11 Retrieval studies of antioxidant polyethylene are understandably short term with conflicting results as to whether antioxidants are providing added protection against in vivo oxidation.12,13 Clinical results with antioxidant polyethylenes in total knee replacement are also short term, but show no clear advantage over highly crosslinked polyethylene. The Australian registry shows no difference comparing the rate of revision between highly crosslinked and antioxidant polyethylenes after four years of clinical use,14 and similar findings have been reported from the Kaiser registry.15

The overriding question that remains unanswered is whether the addition of antioxidant is necessary. For example, randomized, controlled studies of total hip replacements with follow-up out to five years showed total amounts of head penetration of 0.08 to 0.13 mm for vitamin E polyethylene versus 0.01 to 0.2 mm for highly crosslinked polyethylene without vitamin E.15,17 Longer studies with first generation highly crosslinked UHMPE (again, without vitamin E additions) had penetration rates of only about 0.04 mm/yr at follow-up times as long as 13 years.18,19 If the concern is oxidation and increased wear, these in vivo data suggest no distinct advantage of adding antioxidants.

This lack of evidence has not stopped aggressive marketing of antioxidant polyethylenes. In 2017, these materials constituted 15% of the acetabular liners sold in the U.S, and more than a quarter (27%) of the tibial inserts.20 Cost is a likely driver; antioxidant UHMWPE acetabular components are being sold at a 43% premium over highly crosslinked UHMWPE components.21 This level of increased cost without foreseeable gains in clinical outcomes is difficult to justify given the current economics of arthroplasty.
References

20. Stan Mendenhall, Editor, Orthopaedic Network News (personal communication).
Surgeons implant Knee Replacements in different ways, using different techniques and different underlying principles. In general there are two different alignment aims, although many surgeons tend to compromise between these: Either the aim is to implant the knee replacement so the leg is mechanically aligned (MA) in the coronal plane, with the mechanical axis of femur and tibia aligned and the components perpendicular to this; or alternatively the aim is to place the components so that their surfaces are where the original anatomical surfaces were before the arthritic disease process began. This approach should restore the pre-disease alignment of the leg, and is called kinematic alignment (KA). There are different ways these aims are achieved, which may include bone resections, which can be measured or based on ligament tensions, and ligament releases.

Although KA appears to restore more normal kinematics than MA, in total knee replacement (TKR) neither approach restores the kinematics of the knee to normal. This is because the ligaments and replaced surfaces are not normal. However with unicompartmental replacement (UKR) by restoring anatomy and preserving normal function, pre-disease leg alignment and normal kinematics can be restored.

There are many publications suggesting that with almost all approaches to TKR good results can be achieved, but an appreciable proportion of patients are not satisfied with their knee replacement. There have been a number of TKR studies comparing KA and MA, including randomised studies and meta-analyses. The results of these studies are inconsistent with some showing no difference in functional results and others showing advantages for KA. However with KA there is more variability in leg alignment than with MA, reflecting the variability in normal knee alignment. As a results a higher proportion of KA knees have leg alignment that is far from neutral. Therefore KA TKR may have a higher risk of long term failure than MA TKR. In contrast with UKR, the restoration of pre-disease alignment and normal kinematics results in good function and, with certain implants, alignment that is far from neutral is not associated with an increased failure rate.
RSA Data: What Does It Mean to Me?

Michael J. Dunbar, MD, PhD, FRCSC

Radiosterometric Analysis (RSA) is a precise radiographic technique developed in Sweden in the late 1980’s in which a prosthesis of interest, most often a tibial component in total knee arthroplasty (TKA), and the adjacent host bone, most often the proximal tibia, are marked at the time of surgery with small tantalum markers. Bi-planar stereo radiographs are taken over a fiducial box post-operatively and at regular post-operative intervals that allow for the detection of micro-motion between the implant and host bone over time as compared to an immediate post-operative exam.

The pattern of motion over time is of interest and is reported as migration. Migration can be described as a single maximum directionless vector, known as maximum total point motion (MTPM), or with six degrees of freedom around a coordinate axis referenced to the prosthesis, known as object based RSA. MTPM is the historical reference.

Prostheses that migrate a significant amount in the first year after implantation, and/or prostheses that migrate significantly between one and two years are considered at risk of premature loosening and failure. Long term outcomes can be reliably predicted by the data generated in the first two years.

Further, because of the precision of RSA and because of the significant amount of comparative reference data, RSA is an ideal first pass screening tool as part of phased innovation. More specifically, small numbers of patients, typically 25 to 30, are required for RSA to determine if a new implant design is at risk for failure of fixation before the technology is introduced to a larger surgical audience.

Considering the above, RSA is well suited for studying factors that might affect initial fixation at the implant-bone interface such as the use of tourniquet (blood at the interface), the modulus of the implant material, the use of a post and cam and cemented compared to uncemented fixation. RSA studies suggest that early fixation is more reliably achieved with cemented tibial fixation in TKA, but that if initial fixation is achieved, uncemented fixation has an advantage long term over cemented fixation with respect to aseptic loosening. RSA is increasingly being used to investigate the effect of patient specific factors on fixation, such as BMI, gender, bone density, dynamic gait forces, alignment, and even smoking.

Selected Readings:


The Role of Tranexamic Acid
Fred D. Cushner, MD

Introduction: The burden of total joint arthroplasty continues to increase with nearly two million hip and knee replacements by the year 2020.[1] One of the most common complications following a total joint arthroplasty is postoperative anemia. Postoperative anemia increases the risk for allogenic blood transfusions. Blood transfusions increase the risk of surgical site infections, allergic reactions and venous thromboembolism as well as increase the cost and length of stay.[2] From 2000 to 2009 the rate of transfusion following total knee arthroplasty (TKA) rose from 7.7% to 12.2%.[3] Over that same time period the rate of transfusion in total hip arthroplasty (THA) rose from 11.2% to 19.1%. [4]

Tranexamic acid (TXA), an antifibrinolytic carboxylic acid, is known to decrease the rate of fibrin breakdown and clot lysis. TXA is a competitive inhibitor of plasminogen, blocking the active form plasmin from binding to fibrin. To decrease plasminogen activity by 80% a tissue concentration of 10ug/ml is needed. Intravenous TXA has a half-life of 80 hours and is primarily cleared renally. When given orally it is absorbed through the gut at a 33-40% rate.[5, 6] At toxic doses (50mg/kg) TXA may induce seizures or disturb color vision however there does not appear to be any difference in the rate of thrombotic complications.[7, 8] TXA has been used safely for many years in cardiac surgery with usual doses ranging from 10-30 mg/kg doses.

The two most common delivery methods for TXA are intravenous and topical. The goal of both delivery systems is to obtain a concentration near 10 ug/ml to obtain an 80% inhibition of plasminogen.[5] Ideally concentrated delivery of TXA directly to the tissues of interest will reduce any systemic side effects seen in IV administration. Multiple studies and recent meta-analyses have shown no difference in the rate of deep venous thrombosis, pulmonary embolism, stroke, myocardial infarction or wound infection between IV and topical TXA.[9-12]

Despite its off label use in major joint replacement TXA has become a well-accepted adjuvant to improve perioperative blood loss. Currently TXA is FDA approved only for tooth extraction in hemophilia patients however; long time use in other areas of medicine allows orthopedists to use the medication confidently. Despite the growing body of evidence in the orthopedic literature of the efficacy of TXA the route, concentration and timing of dosing for TXA remains controversial.

Conclusion: The effectiveness of tranexamic in major joint replacement is readily apparent when reviewing the literature. The optimal dosing regimen remains in limbo. After a comprehensive review of the literature there does not seem to be a significant difference especially in terms of safety between the various methods.
Suggested Readings

Medial Compartment UKA: Indications/Contraindications
David F. Dalury, MD

We are now into the fourth decade of Unicompartmental Knee Replacement. Compared to Total Knees, perceived advantages include less bone resection, blood loss and surgical incision as well as fewer complications and more rapid recovery and better functional outcomes. In most published series, patients who have both a TKR and a UKR prefer their UKR.

There has been an expansion of the traditional criteria for patient selection. Activity level as well as obesity, age and the location of pain are no longer considered contraindications for the surgery. A significant deformity of 10 degrees in the coronal plane and 15 degrees in the sagittal plane along with a non-functional ACL continue to be areas of concern. The status of the patella-femoral joint remains controversial with many authors ignoring it and others voicing concerns about survivorship with damages in this region.

Most joint registries show higher reoperation rates for UKR compared with TKR. However, there are many publications demonstrating excellent clinical results which rival TKRs into the second decade. Long term data has also shown that not all devices are equally durable. While differences exist between mobile and fixed bearing devices, data has not proven the superiority of one over the other.

UKR has traditionally felt to be a viable option for approximately 5-10 of patients but with an increased emphasis on cost and the rush to outpatient surgery, as well as the increased use of robots, there is an expectation that UKR utilization will increase.

Proper patient selection is critical to successful outcomes. This, along with a proper technique utilizing an appropriate device can deliver outcomes that rival, and in many cases outperform TKR.
References


Lateral Compartment UKA
William A. Jiranek, MD

I. Incidence of Lateral unis
   a. Incidence is about 1/5 knees with operative unicompartmental arthritis
   b. Equal male/ female

II. Indications for lateral uni
   a. Predominant lateral comp. OA
   b. PF subluxation and OA a contraindication
   c. Varus stress views of the knee can indicate medial comp. wear is not sure by PE

III. Results of Lateral Unis
   a. Survival in many series equal to, if not better than medial unis

IV. Technique for lateral uni
   a. Lateral parapatellar arthrotomy often easier
      i. If have to convert to TKA, need to be able to do TKA through lateral approach
      ii. Many surgeons choose to scope the knee first, vs doing procedure through a medial parapatellar incision.
      iii. If IT band is tight, consider sliding release off of Gerdy’s tubercle
   b. Unique considerations for a lateral uni
      i. “screw home” mechanism of lateral distal femur, and lateral proximal tibia
      ii. “increased laxity” of the lateral compartment
      iii. Lateral fem condyle smaller than medial condyle
   c. Surgical technique
      i. Lateral tibial resection should be conservative (7-8 mm off the non worn portion of the lateral plateau)
      ii. Slight internal rotation of the vertical tibial cut, and slight external rotation of the femoral component to accommodate the “screw home” mechanism
      iii. Lateral femoral components are generally smaller than medial components
      iv. Avoid “overstuffing” of the lateral comp – replace only what is resected
      v. Re component positioning, shoot for central tracking of fem comp in tibial comp through a full ROM

V. References
Make It Right the First Time: Robot Wars
Jess H. Lonner, MD

The results and durability of unicompartmental arthroplasty are impacted by a variety of factors, including the pattern of arthritis, deformity and pain location, as well as prosthesis design, polyethylene quality, and implant alignment, position and fixation. Excessive posterior tibial slope or varus of the tibial component and/or mechanical axis of the limb may predispose the prosthesis to early failure. Achieving consistently accurate alignment of the tibial component in UKA using conventional approaches is difficult. Outliers beyond 2° of the desired alignment may occur in as many as 40%-60% of cases using conventional methods, and the range of component alignment varies considerably, even in the hands of skilled knee surgeons. The problem is compounded when using minimally invasive surgical approaches, which is how most contemporary UKA’s are likely performed. While UKA has proven durable in the hands of high volume UKA surgeons, failure rates have been much higher in lower volume centers and among surgeons performing relatively few UKAs.

Semi-autonomous robotic technology has been introduced to optimize accuracy of implant positioning and soft tissue balance in UKA, with the expectation of resultant improvement in durability and implant survivorship. Currently, nearly 20% of UKA’s in the U.S. are being performed with robotic assistance. It is anticipated that there will be substantial growth in market penetration over the next decade, projecting that nearly 37% of UKA’s and 23% of TKA’s will be performed with robotics in 10 years (Medical Device and Diagnostic Industry, March 5, 2015 [http://www.mddionline.com]). First generation robotic technology improved substantially implant position compared to conventional methods; however, high capital costs, uncertainty regarding the value of advanced technologies, and the need for preoperative CT scans were barriers to broader adoption. Newer image-free semi-autonomous robotic technology both optimizes implant position and soft tissue balance without the need for preoperative CT scans and with price points and portability that make it suitable for use in an ASC, where 40% of systems are being utilized. Two semi-autonomous robotic systems are available in the U.S. currently – one safeguards against inadvertent bone preparation by haptic constraint and requires preoperative CT imaging for the planning algorithm; the other modulates the exposure or speed of the handheld robotic bur to provide accuracy and does not require a preoperative CT scan.

Outcomes:
Compared to conventional methods, both robotic systems have improved significantly the precision of bone preparation and reduced variance in implant position.

| Summary of Positioning – Robotic Techniques vs Conventional |
|------------------|----------------|----------------|----------------|
| RMS Error       | CT-based | Image-free   | Conventional  |
| Flex/Ext (°)    | 2.1      | 1.6           | 6.0            |
| Varus/Valgus (°)| 2.1      | 1.8           | 4.1            |
| Int/Ext (°)     | 3.0      | 1.7           | 6.3            |
| Prox/Dist (mm)  | 1.0      | 1.1           | 2.8            |
| Ant/Post (mm)   | 1.6      | 1.2           | 2.4            |
| Med/Lat (mm)    | 1.0      | 0.8           | 1.6            |

While several studies have proven the accuracy of robotic technology compared to conventional methods of UKA, Bell et al performed the first prospective, randomized controlled trial of robotic vs conventional UKA in 120 patients (62 robotic UKAs and 58 conventional UKAs). Post-operative CT scans were used to demonstrate that robotic-assisted UKA resulted in lower RMS errors in all parameters for both the tibial and femoral
components, and that positioning in robotic-assisted UKA was within 2° of the target coronal, sagittal, and axial positions in a significantly higher percentage of patients compared to conventional techniques (p<0.02 for all parameters).

In addition to improvements in component and limb alignment, robot assistance has been shown to result in a more conservative tibial cut compared to conventional methods. In a comparison of 8,421 robot-assisted UKA and 27,989 conventional UKA, Ponzio et al found that polyethylene thickness – a proxy of resection depth – was 8mm or 9mm in 93.6% of robotic cases vs 84.5% of conventional cases. Inserts >10mm occurred in 6.4% of robotic cases vs 15.5% of conventional cases, and maximum polyethylene thickness was 11mm vs 14mm for robotic vs conventional, respectively. There were no significant differences between sizing of Mako and Navio cases. More conservative tibial resections are important in UKA for two primary reasons. First, proximal tibial bone becomes weaker with deeper resection and thus it is biomechanically advantageous to minimize bone resection. Second, in the event of a future revision to TKA, more aggressive tibial resections are substantially more challenging to reconstruct and more likely to require the use of tibial augments.

At this time, mid- and long-term outcomes studies are lacking in robotic-assisted UKA, in large part because of its nascency. Pearle and colleagues performed a multi-center review of 1135 robotic-assisted UKAs with minimum two-year follow up (mean 29.6 months, range: 22-52 months). They reported 98.8% survivorship with a total of 11 revisions, a survivorship slightly better than other large reports of conventional UKA at this short term follow up period. Additionally, 92% of patients reported they were satisfied with the operation. The study found no differences in the first 30 cases (i.e. those done during a theoretical learning curve) compared to subsequent operations.

Data is now emerging regarding the functional outcomes derived as a result of the enhanced positioning and soft tissue balance in robotically assisted UKA. One prospective study by Blyth et al. compared the early clinical outcomes in 139 patients undergoing medial UKA randomized to using either manual traditional surgical cutting jigs or robotic-assisted technology. From the first post-operative day through to week 8 post-operatively, the median pain scores for the robotic arm-assisted group were 55.4% lower than those observed in the manual surgery group (p = 0.040), and at three months post-operatively, the robotic arm-assisted group had better Knee Society Scores (KSS), although no difference was noted with the Oxford Knee Scores. At one year post-operatively, there were no longer significant differences in the KSS; however, a greater proportion of patients receiving robotic-assisted surgery improved their UCLA activity scores. Furthermore, in highly active patients (preop UCLA > 5), robotic assisted knees did significantly better in Oxford Knee Scores, Visual Analogue Scores and Forgotten Joint Scores.

**Safety:**
Unlike autonomous robotic technology in which inadvertent soft tissue injury has been reported to occur in roughly 5% of cases, there have been no soft tissue injuries from either of the two semi-autonomous robotic sculpting tools in over 1000 consecutive cases performed by this author. Finally, systems that require a preoperative CT scan pose an increased radiation risk. Ponzio et al recently reported that each preoperative CT scan for robotic-assisted knee arthroplasty (using an image guided protocol) is associated with a mean effective dose of radiation of 4.8 mSv, which is approximately equivalent to 48 chest radiographs. Further, in that study at least 25 percent of patients had been subjected to multiple scans, with some being exposed to cumulative effective doses of up to 103 mSv. This risk should not be considered completely negligible given that 10 mSv may be associated with an increase in the possibility of fatal cancer and an estimated 29,000 excess cancer cases in the United States annually are reportedly caused by CT scans. However, this
increased radiation risk is not inherent to all robotic systems. Image free systems do not require CT scans and are thus are not associated with this potential disadvantage and radiation risk.

**Conclusion:**
Component placement, quantified soft tissue balance, and radiographic alignment appear to be improved and the incidence of outliers reduced with the use of robotic assistance during UKA. Further assessment is needed to determine whether the improved alignment and balance will impact clinical function and/or durability. Early results are very promising though, creating optimism that the full benefits of robotics in UKA will be further confirmed with additional time and research.

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**Without the Grout: Cementless UKA**

*Christopher A.F. Dodd, MB, ChB, FRCS*

The cementless Oxford was introduced to reduce the discrepancy in revision rate and survival between joint registries and specialist centres by 1) reducing the incidence of radiolucent lines (RLL) which can lead to unnecessary revision in some cases with post operative pain. 2) Avoiding cementation errors which may lead to unexplained pain, loosening and possible accelerated polyethylene wear. 3) It is generally believed that biological fixation may lead to improved long term results. There is, however, no long term data on cementless UKA.

This paper aims to present the 10 yr survival of cementless Oxford mobile bearing UKA. It describes a prospective case series from two centres.

1000 cases from Oxford, UK and Christchurch, NZ involving 9 surgeons are reported. Indications were Anteromedial OA in 995 and patients were assessed preoperatively and at regular intervals using Oxford Knee Score (OKS) and Xrays. Life table survivor analysis was undertaken using an endpoint of Revision defined as exchange/or addition of new component.

Results showed that 65 patients lost to follow up but they were checked against NZJR and outcome determined. 42 patients died. There were 25 revisions giving 97% 10 yr survivorship. Mean improvement in OKS of 18.5 Preop to 42 Postop. 88% had good/excellent results. There were 11 cases of OA progression treated initially by conversion to TKA but later on in the study by addition of lateral UKA. 8 cases of bearing dislocation were treated by bearing exchange. There were 2 cases each of pain, loosening and fracture. There were no cases of infection despite describing 1000 cases involving 9 surgeons.

There was no difference between the results of the designer surgeons (2) and non designer surgeons (7). Cementless fixation clearly has an excellent 10 yr survivorship and clinical outcome. Cementless fixation was offered to all patients and no subgroup did poorly suggesting the indications for cementless are the same as cemented. It can be offered to all patients.

The 10 yr survivorship described here is similar to 10 yr cemented results in high volume centres. The UKNJR (2016) shows improved survivorship with cementless OUKA compared to cemented version (97% v 93%). This has been repeated in the NZJR.

In conclusion cementless UKA provides excellent 10 yr survivorship and outcomes in all patient groups suitable for mobile UKA suggesting it will become the fixation of choice.
Do Them Both: Bicompartmental TKA
Jean-Noël Argenson, MD

There is a renewed interest in combined bicompartmental implants due to their potential for restoring more normal kinematics of the knee, saving both cruciate ligaments and preserving unaffected cartilage. This may represent a good option for younger, active, high-demand patients who wish to return to their previous level of activity.

The most frequent use of bicompartmental arthroplasty consists in the replacement of the tibiofemoral and the patellofemoral joint, while the replacement of both medial and lateral tibiofemoral replacement is also possible. It can be performed with a modular unlinked or a monolithic femoral component, but at present the two separate implant technique represents the best choice. The surgical technique relies now on proven instrumentation dedicated either to patello-femoral or unicompartmental femoro-tibial arthroplasty, and including the respective rotational orientation of both the condylar and trochlear femoral implants.

While our original series of 100 patients without dedicated instrumentation reported a 17% revision rate at 20 years of follow-up, the most recent reports at midterm follow-up are extremely encouraging without implant loosening or progressive arthritis of the unreplaced compartment.

The evaluation of functional outcome performed through a prospective matched-paired study using the Forgotten Join Score, the different sub-scales of the KOOS, the knee range of motion of the Knee Society Score, the Time and Go up test (TUG) and UCLA scores at a minimum follow-up of 2 years, demonstrated that modern bicompartmental arthroplasty can restore a better function of the knee with a higher percentage of forgotten knees and better functional results than patients after total knee arthroplasty.

While bicompartmental knee arthroplasty using modern independent implants can represent an alternative to total knee arthroplasty especially for young patients with intact cruciate ligaments, these short terms encouraging functional and survival results should be validated on a longer term perspective.
References


Should I Just Wash It Out?
Bryan D. Springer, MD

Introduction:
Irrigation and Debridement (with polyethylene exchange) is an attractive, low morbidity option for both the surgeon and patient. It is generally performed in one surgery and has minimal functional disruption. The results in the literature have been inconsistent however, and many treatment variables exist.

Indication for Open Irrigation and Debridement:
It is generally agreed upon that open irrigation and debridement as a treatment for infection following total knee arthroplasty is reserved for patients that present with acute onset of infection. Component retention for treatment of a chronic infection (signs and symptoms > 4 weeks) has been associated with high failure rates and poor outcome and should be considered a contraindication to irrigation and debridement. The classification of infection following total knee arthroplasty has been variable depending on timing of symptoms and duration since the index surgery. The classification system described by Tsukayama is descriptive and allows for a treatment based algorithm. Infections are divided into four categories:

- Type I: Positive intraoperative cultures following revision for presumed aseptic etiology
- Type II: Acute postoperative infection with signs and symptoms that develop less that 4 weeks from index surgery
- Type III: Chronic Infection: Signs and Symptoms of infection have been present for more than 4 weeks regardless of when index surgery was performed
- Type IV: Late acute hematogenous infection: Signs and symptoms are present for less than 4 weeks remote from the index operation.

Based on this classification system, irrigation and debridement has been recommended for the treatment of Type II and Type IV acute infection. Many variables that determine the success and failures of irrigation and debridement, even within this time frame however, will ultimately affect the outcome and the success of this procedure.

Surgical Considerations and Technique:

Operating Room Setup:
It is important for the operating room personnel to understand that the case is infected and treat appropriately. While we prefer to use protective body exhaust suits and laminar flow operating rooms, there is conflicting data on the benefits of these procedure in reducing infection risks. We prefer to use two set ups in the operating room. A separate setup to perform the irrigation and debridement is followed by a separate set up for placing the new polyethylene and closure. This should include the surgeon and the OR team changing into new gown and gloves after the irrigation and debridement. In addition, a separate set of clean, sterile instruments should be used to prevent reintroduction of infection into the knee once the debridement has been performed to reduce the risk of contamination to the joint from the previously used instruments.
Surgical Technique:
The success of open irrigation, debridement and polyethylene exchange is dependent on several factors. One important surgical factor is that an aggressive debridement be performed to remove as much infected tissue and synovium as possible. Once the arthrotomy has been performed, cultures should be taken and appropriate antibiotics administered. We prefer to take a minimum of three to five tissue cultures. The cultures are taken from the synovium and periimplant tissue. Each culture should be taken with a separate instrument to minimize the chances for contamination from one instrument to the specimen.

Overall Results:
The overall results of Irrigation and Debridement in the literature have been quite variable. Evaluating over twenty published articles in the scientific literature, the success of this procedure ranges from 19-83% with the majority of studies showing success rate less than 60%. A meta-analysis by Silva in 2002, looked at all available literature to date on 530 patients that underwent open irrigation and debridement for treatment of acute periprosthetic joint infection. This study included both acute postoperative infections as well as late acute hematogenous infections. The overall success was only 33.6%. Because of the wide range of success/failure, there are clearly several variables that affect outcome. These include the timing of surgery, patient risk factors, surgical technique and the infecting organism.

Timing of Surgery:
The timing of surgery appears to be a critical factor in the success of irrigation and debridement and polyethylene exchange. It has been well established that irrigation and debridement with polyethylene exchange has high failure rates for patients with the onset of symptoms greater than 4 weeks. Schoifet et al reported an overall failure rate of 77% for irrigation and debridement for periprosthetic infection. All treatment failures occurred in patients with greater than 28 days of symptoms. While several studies have shown that the time from onset of symptoms to surgical irrigation and debridement was not a factor in outcome (< 4 weeks), some authors have show improved success with shorter duration of symptoms. Brandt showed a higher probability of treatment failure for those patients treated with irrigation and debridement when surgery was performed > 2 days after onset of symptoms. Marculescu et al reported that duration of symptoms > 8 days was associated with a greater risk of treatment failure by a factor of two. Hsieh et al found that a short duration of symptoms before surgery was the only identifiable risk factor associated with success of irrigation and debridement for patients with a gram negative prosthetic joint infection.

Results Based on Organisms
The most common organisms associated with acute infections are staphylococcus aureus, staphylococcus epidermidis or streptococcus. It is clear from the literature that we are now also seeing an increase in resistant organisms as a cause of deep periprosthetic infection. In fact, in many centers, methicillin resistant staph aureus (MRSA) has become the most commonly infected organism in periprosthetic joint infection. It has been a long held belief that the virulence of the infecting organism affects outcome, with less virulent organism (streptococcus) has improved success compared to more virulent resistant organisms.

In 1997, Brandt et al look specifically at the success of debridement and retention of components infected with staphylococcus aureus. The two year probability of success for 33 patients (7 hips) was 31%. Those patients who underwent irrigation and debridement > 2 days after the onset of symptoms had higher risk of failure. Deirmengian et al in 2003 also looked at treatment of acute postoperative and hematogenous infection in patients with gram-positive infections. All patients had open irrigation and debridement with polyethylene exchange. The overall success rate was 35%, with recurrence of infection as the endpoint. Only one of thirteen...
patients (8%) with acute staph aureus infection had eradication of infection compared to 56% success when staph epidermidis or streptococcus was the infecting organism. This high failure rate led the authors to conclude that component removal should be considered in the face of an acute periprosthetic infection with staph aureus.

Methicillin resistant staphylococcus infections pose a particular challenge with its virulent nature and limited options for antibiotic therapy. Reports would suggest that the overall incidence of MRSA infection in total joint arthroplasty is on the rise. Bradbury et al looked at nineteen cases of acute periprosthetic methicillin-resistant staphylococcus infection treated with open irrigation and debridement and component retention. At minimum two year follow-up, the failure rate was 84%. The authors also summarized in their results, the current available literature on irrigation and debridement for MRSA infections. Of 34 studies, 13 patients were identified with an acute MRSA infection treated with open irrigation and debridement and component retention. The reported failure rate was 77%.

Pearls and Pitfalls:

- The indications for open irrigation and debridement with polyethylene exchange are narrow and should only be considered for patients with acute post operative infections (symptoms < 4 weeks from surgery) or a late acute hematogenous infection with symptoms of less than 4 weeks duration.
- It appears however that time to irrigation and debridement from the onset of symptoms is critical to success, with most literature showing improved success with shorter duration of symptoms (< 2 weeks).
- Meticulous irrigation and debridement with polyethylene exchange is the procedure of choice, and arthroscopic procedures limited the extent of the debridement.
- Controversy remains regarding the duration of antibiotics and the definition of success following irrigation and debridement.
References:
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Articulating Spacers: What Works?
Michael P. Bolognesi, MD, MS

Introduction
Diagnosis is confirmed
Decision is made to resect and move past DAIR

Options for Spacers
Static- cement only or reinforced ("rebar" or IM nail)
Hand crafted all cement
Injected molds
Autoclaved femurs with new sterile polyethylene bearing
Sterile femoral implant and new sterile polyethylene bearing

Surgical Techniques and Tips

Outcomes and Results

Discussion

References

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One-Stage vs. Two-Stage Treatment of PJI
Thomas K. Fehring, MD

Periprosthetic infection is a devastating problem for patient and surgeon alike. By the year 2020 it is projected that there will be 49,000 cases of Periprosthetic infection treated annually in the U.S. The annual cost of the treatment of Periprosthetic infection is projected to exceed 1.5 billion by the year 2020. Prevention strategies are critical in minimizing these numbers. Patient optimization may be the most important defense mechanism to decrease this problem.

The diagnosis of Periprosthetic infection has been clarified over the last few years with the introduction of the MSIS infection criteria as well as the introduction of synovial biomarkers that help with infection identification. While progress has been made in infection diagnosis, treatment alternatives remain the same. Irrigation and debridement with polyethylene exchange remains a viable option in acute perioperative infections and acute hematogenous infections. However the results of this treatment modality are modest at best. Failure rates in many series are over 50 percent with this form of treatment although some isolated series are slightly better. Serial debridement for the treatment of acute periprosthetic infection may provide improved results. However each of these debridement strategies must deal with the persistence of biofilm that hinders their ultimate success rate.

Two stage re-implantation has been the gold standard in the U.S when treating chronic periprosthetic infection. However, the re-infection rate in recent literature is closer to 80% than the 90% often quoted. One stage re-implantation has been described in a few European studies with results that are similar to the two stage process used in the U.S. While this one stage data is encouraging it is difficult to interpret due to limited numbers, organism exclusion and comorbid patient exclusion. These results coupled with patient inconvenience and the economic ramifications of a two stage re-implantation demands reevaluation of the two stage approach.

OREF has sponsored a prospective randomized multicenter study comparing one stage vs two stage treatment for periprosthetic hip and knee infections. The inclusion criterion for this study is broad. Any patient with a primary surgery infection, a known organism and an infection diagnosis according to MSIS criteria is eligible. Patients with resistant organisms or previous irrigation and debridement are also included. The only exclusions are immunosuppressed patients, fungal infections, extensive soft tissue defects or revision surgery. In order to establish appropriate power for this study 300 patients are needed. 12 sites distributed across the U.S are participating in this study. Over the last 18 months we have enrolled 75 patients. It is certainly premature to draw any conclusions from this small data set; however the answer to this long standing question in the field of arthroplasty will be answered soon.
John Charnley, having contributed profoundly to the development of total hip arthroplasty, is famously quoted when confronted with an infection rate exceeding 10%, that the procedure would have to be abandoned if infections could not be reduced significantly. There is a rate of infection that makes even the finest surgical procedure untenable. The burden of prosthetic joint infection is onerous in several important senses.

**Epidemiological**

The technical or epidemiological definition of “burden”, as used with registry data is the ratio of implants revised for infection to the total number of arthroplasties in a specific period. This indicates the “steady state” of infection in a registry. When comparing the “burden” in different registries over successive years, Springer and colleagues found similar rates amongst different registries, of about 1%, a considerable number of cases for any health care system. Despite universal attempts to lower infection rates, infection burden has increased in selected registries from 2010 to 2015. This might be explained by better diagnosis and reporting or surgery on higher risk patients. It might even be expected to increase further as more sophisticated methods of diagnosis reveal infection in what were once considered cases of aseptic loosening. Nonetheless, any increase in this burden is cause for concern.

Kurtz and colleagues, in 2008 quantified the incidence of periprosthetic infection (PPI) for both hip and knee arthroplasties and also found an “increasing number of joints being diagnosed with PPI”. The rate for knees was greater than hips, the length of stay and charges were increased over non-infected cases in both hips and knees and the burden was greatest for urban non-teaching hospitals and lowest for rural hospitals, presumably reflecting different comorbidities in their respective patient populations. The most common reason for revision knee arthroplasty in the United States is infection.

Then, in 2010 Kurtz and colleagues evaluated a sample of the USA medicare population (patients over age 65 years) and found 1,400 infected case in 69,66 TKA’s from the Medicare 5% national sample administrative data set. The infection incidence within 2 years was 1.55% and between 2 and 10 years was 0.46%, quantifying the understanding that infection is more frequently associated with surgery and recovery, as opposed to a late hematogenous spread. Consistent with data from the Australian registry and investigations in young patients, women had a lower risk of infection than men (reflecting the possibly the greater likelihood of prior surgery in the male population). Comorbidities increased the risk of infection and patients receiving public assistance for medicare premiums were at increased risk, reflecting the complex relationship between economic status and health. Hospital factors did not predict an increased risk of infection.

**Economic**

The economic burden of infection in arthroplasty surgery is excruciatingly obvious to everyone involved in caring for these patients. Several studies confirm that the numbers of arthroplasties performed continues to increase and so inevitably, the number of revisions and PJI’s. Revision arthropalsty is very expensive; even more so when infection is involved. While charges for revision surgery increase, reimbursements have decreased, raising important questins about the viability of revision and infection care. Over 4% of the US
population over the age of 50 years has a knee arthroplasty, creating a pool of millions of people at risk for PJI.(11) When younger patients suffer infection, their livelihood id curtailed, placing families in jeopardy.

**Specific groups presenting increased burden**
Several groups of patients are associated with a higher risk of infection.(12) Those with atrial fibrillation prior to arthroplasty, presumably as the result of anticoagulation in addition to cardiac compromise, have a 5.6% versus 0.62% risk of PJI(13) Obesity increases the risk of developing PJI(14) and decreases the success of surgical treatment.(15, 16) Revision arthroplasties, even if performed for aseptic failure are at increased risk of failing from infection- a situation that is more difficult and more expensive to cure.

**Health and Longevity (morbidity)**
Cures for PJI are not certain. If a Two Stage Reimplantation protocol fails(17) then only chronic resection, arthrodesis or amputation are available.(18, 19) None provides particularly good function. The burden to health is profound; in a case controlled study of septic versus aseptic revisions at an average of 4 years (range 2-7) after surgery, the risk of death was six times higher for revisions indicated by infection. Life expectancy after PJI is comparable to severe medical conditions such as congestive heart failure and cancer.

**Distress**
The emotional trial of a PJI is borne first by the patient, then the family and probably third in line is the surgeon whose case has become infected. The surgeon suffers a professional calamity that may be compounded by litigation or fear of it. In some studies, infection is the most common problem when litigation follows TKA.(20) The surgeon treating the infection (often but not always the same person) are usually next in line in degree of emotional suffering. The frustration and anxiety associated with caring for PJI cases contributes to problems such as surgeon “burnout”.(21, 22)

The burden extends to the health care team, the institution and the health care delivery system. When payors are distinct from the delivery system, (Third party insurance) or indeed when they are the same entity (National Health Insurance Plans) they will recognize that enough of these cases may render them insolvent.

**Burden of Responsibility:**
Our literature lacks meaningful information about the results of revision surgery, for a variety of reasons.(23) Most registries do not track the results of revision arthroplasty. There is a burden of responsibility on orthopedic surgeons to diligently assess how arthroplasties fail and to perform well conceived revision surgery that will be expected to succeed. One of the few things worse than a failed arthroplasty is a failed revision. One of the few things that is worse than a failed revision arthroplasty is an infected revision arthroplasty. Infection could severely curtail our ability to provide arthroplasty surgery.

**References:**


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First Things First: Exposure in Total Knee Revision
Daniel J. Berry, MD

I. Introduction

A. Good exposure for revision TKA is an essential prerequisite for safe implant removal, good bone reconstruction and component implantation, and avoidance of complications.

B. 1. An organized and sequential approach to exposure help with efficiency and effectiveness.
   2. Extensile approaches are important to know, but are necessary only in selected cases.

II. Routine Exposure Moves

A. Incision: As long as needed to see everything well.

B. Median parapatellar approach: extend the quadriceps split as far proximally as needed.

C. Good medial proximal tibial exposure: allows external tibial rotation, which helps relax extensor mechanism.

D. Dissect supracondylar soft tissue to reproduce the medial and lateral gutters.

E. Remove scar from beneath quadriceps and patellar tendons.

F. Remove tibial PE: this relaxes the soft tissues and gives you working room.

G. Subluxate the patella laterally if possible. In most revision TKA patellar subluxation rather than eversion is safest.

H. If the femoral component is to be revised, removing it at this stage provides further working room for tibial removal.

III. Quadriceps Snip

A. If the knee still cannot be accessed satisfactorily, most surgeons prefer to perform a quadriceps snip at this stage.

B. A variety of configurations of quadriceps snip have been described. An oblique division of the quadriceps tendon, in line with the fibers of the varus lateralis, about 10 cm or a little more above the superior border of the patella, works well.
IV. Results of Quadriceps Snip: Recent Study

A. “Quadriceps Snip in 321 Revision TKA’s: A Contemporary Matched Cohort Study,” Authors: Abdel, Viste, Berry

B. 1. 3107 TKAR; 321 quad snips (10%)
2. Matched 1:1 with 321 TKAR with no snip
3. Mean follow-up 5 years

C. 1. Knee Society score
   - Snip 44→76
   - Control 48→78
2. Knee range of motion
   - Snip 85→93
   - Control 100→100
3. Complications related to extensor mechanism
   - Snip 3/321 (1%)
   - Control 4/321 (1%; p=0.7
4. New extensor lag >10°
   - Snip 0/321
   - Control 4/321
5. 10-year survivorship free of revision or implant failure for any reason
   - Snip 71%
   - Control 70%

D. Conclusions:
   1. Largest study of quad snip to date
   2. Similar results in control and snip patients
   3. No complications directly attributable to snip
   4. No identifiable penalties
   5. Likes prevents complications in selected at-risk patients

V. In uncommon circumstances, the above exposures are not satisfactory.

A. In these cases, a tibial tubercle osteotomy (tapered distally) is effective. Keep the lateral periosteal tissue in continuity.
Fixation Strategies: Stems/Cones/Sleeves
Paul F. Lachiewicz, MD

Metaphyseal bone loss, due to loosening, osteolysis or infection, is common with revision total knee arthroplasty (TKA). Small defects can be treated with screws and cement, bone graft, and non-porous metal wedges or blocks. Large defects are now managed with metaphyseal sleeves, or highly porous metal cones. The AORI classification of bone loss in revision TKA is very helpful with preoperative planning. Type 1 defects do not require augments or graft—use revision components with stems. Type 2A defects can be treated with non-porous metal wedges or blocks or porous sleeve. Type 2B and 3 defects require a bulk structural allograft, metaphyseal sleeve or porous metal cone.

Highly-porous metal metaphyseal cones, usually with a cemented stem, are a unique solution for large uncontained bone defects. Both femoral and tibial cones are available in a variety of shapes and sizes. These cones substitute for bone loss, improve metaphyseal fixation, help correct malalignment, restore joint line, and permit use of a short cemented stem. The technique for these cones involve preparing the remaining bone with a high speed burr or rasp, followed by press-fit of the cone into the remaining metaphysis. The interface is sealed with bone graft and putty. The fixation and osteoconductive properties of the outer surface allow ingrowth and biologic fixation. The revision knee component is then implanted, with antibiotic-cement, into the porous cone inner surface, which provides superior fixation compared to cementing into deficient metaphyseal bone. There are several manufacturers that provide sleeves and cones for knee revision, but the tantalum-“trabecular metal” cones have the largest and longest clinical follow-up. There are numerous reports that confirm the finding of good osseointegration of the cone and fixation of the cemented stem revision components at 5 to 10 years follow-up. Most failures are due to a new or recurrent infection.

There is no consensus for the optimal method of fixation for either the tibial or femoral stem in revision TKA. Both cemented and uncemented stems have advantages and disadvantages. The author favors a short (“stubby”) 30 mm cemented stem extension for most tibial revisions, and a 100 mm cemented stem extension for the femoral component. Uncemented stems, if used for either tibial or femoral component fixation, should likely be longer than 100 mm and engage the diaphysis. End of stem pain has been a reported problem with this technique. TM cones with cemented stem fixation are the author’s preferred method for the reconstruction of large bone defects in revision TKA.

References
Supracondylar Periprosthetic Femur Fracture
David Backstein, MD, MEd, FRCSC

- Many patients have poor bone quality and osteoporosis
- Periprosthetic Fractures (PPF) of the knee are therefore common and increasing in frequency (Meek, JBJS Br, 2011)

Incidence
- Incidence after primary TKA: up to 2.5%
- Incidence after revision TKA: up to 38% (Schuetz, 2013)
- Complication rate following treatment of PPF up to 40%
- 1 year mortality from 4.6-13% (Toogood, 2015)

Patients fall into 2 broad categories
1. **Older, frail patient with minor trauma, loose implants** - I recommend treatment of these patients with revision TKA and possibly distal femoral replacement
2. **Younger patient, higher energy trauma, functioning and well fixed implants** – these patients are more amenable to fracture fixation

Patient Related Risk Factors
- Osteoporosis
- Inflammatory arthritis
- Advanced age
- Female gender
- Steroid use
- Elevated BMI
- Dementia
- Neuromuscular disorders
- Multiple co-morbidities

Fracture Evaluation
- Evaluation is required to distinguish fractures that can be fixed vs. revision TKA / distal femoral replacement
  1. Plain xrays to include entire femur
  2. CT scan helpful in many cases (but not necessary for all):
     - delineate the fracture pattern
     - assess bone quality
     - look for osteolysis
     - look for implant loosening

Management
- Goals of treatment are to achieve a well-functioning TKA. This requires:
1. Well aligned (perfect) union of fracture
2. Stable TKA
3. Functional ROM

- This may be difficult to achieve in very distal fractures, particularly with osteoporotic bone
- Best shot at a good outcome is with the initial treatment
- There is essentially no role for non-operative treatment

Fracture Fixation
- there is some evidence that locked plating may be superior to intramedullary nails
- **retrograde IM nail:**
  - has the benefit of use the TKA scar
  - may be impeded by closed PS box, femoral stem
  - feasibility of retrograde nail often poor due to (Jones et al):
    - excessive force needed for insertion
    - damage to nail during insertion
    - posterior location of entrance risks anterior cortex perforation

- **nail Vs. plate:**
  - its not clear which is superior
  - nonunion is the range of 20% for both nail and locking plate fixation
  - Systematic review of 719 cases: nonunion rate similar for nail and plate but malunion rate significantly greater with nail (Ristevski, 2014)
  - Concept of “far cortical locking” - use far cortex for locking screw associated with less cut out and varus collapse. (Whitehouse 2014)
    - Use a gliding proximal screw to reduce stiffness and improve the biology for healing

Treatment with Revision TKA

- Preferred treatment modality:
  - Functional outcomes of ORIF are often poor - high incidence of stiffness and need for walking aid
  - Often elderly with concomitant medical problems and poor tolerance for immobilization
  - ORIF requires prolonged protected weight bearing, long hospital admissions and need for rehab hospital
  - Problems associated with immobilization in the elderly can be avoided by rapid mobilization with revision TKA

- Distal femoral replacement (DFR) permits:
  - Immediate mobilization
  - Reduced length of hospital stay
  - No chance of non-union or malunion
  - Provides a stable, well aligned TKA
  - Particularly helpful for elderly patients

- Indications for DFR:
1. **Location:** Close proximity to the implant
2. **Quality of bone:** Poor / osteoporosis / comminuted
3. **Fixation:** Implant fixed to small piece of distal bone

- **Technical points:**
  1. Pre-operative planning critical in determining length of distal segment which must be replaced
  2. Need a implant system which can compensate for large segments of bone
  3. CAREFUL subperiosteal dissection required posteriorly (posterior vasculature)
  4. **Avoid hyperextension** – appropriate restoration of femoral length

**Summary**

- The technical goal of achieving a well aligned, stable knee may be very difficult
- Elderly patients benefit from:
  - quick surgery, minimal blood loss
  - rapid mobilization
  - benefit from immediate full weight bearing
- Rapid mobilization benefits the “system” by reducing LOS, intensity of nursing, duration/cost of rehabilitation
Constraint in Total Knee Revision
William J. Maloney, III, MD

It is important to understand the inherent constraint in implant design when planning revision total knee replacement. When evaluating implant constraint, one has to consider the following:

1. Anterior-posterior stability. Anterior posterior stability has the most variability between implant designs. As an example, a posterior stabilized will prevent posterior subluxation of the tibia on the femur but may have no resistance to anterior subluxation.

2. Varus-valgus stability. In general, CR, CS and PS knee designs have no varus-valgus constraint. In contrast, a constrained condylar type design has significant varus-valgus constraint (+/- 0.5 to 1.5 degrees).

3. Rotational stability. There is significant variability in the rotational constraint of CR and CS designs and will depend on the conformity of the tibial insert and the design of inter-condylar area of the insert. PS knees typically have +/- 7 to 15 degrees of rotational constraint and CCK type designs only allow 1 to 3 degrees of rotational freedom.

Constrained condylar designs are typically used when there is lax (but intact) collateral ligaments or a loose flexion gap. Rotating hinged implants that are varus-valgus and anteriorly-posteriorly constrained are used in cases with severe bone loss and loss of collateral ligaments.

Traditional teaching has been to use the least constrained device at the time of the revision knee replacement that does the job. Implant geometry in concert with soft tissue balancing determines stability, range of motion and interface force. The concern is that increased constraint at the articulation, higher forces are transmitted to the implant bone interface and can lead to an increased rate of aseptic loosening.

Current evidence suggests, that with good surgical technique going from a CR, CS or PS design to a CCK type design probably does not lead to a higher revision rate. Lachiewicz and Soileau reported on the use of a constrained condylar implant in primary TKA. The indication for a more constrained implant was valgus deformity with a loose MCL in most cases. Stem extensions were used on both the femoral and tibial implants. No revisions for aspetic loosening were done at follow-up ranging from 2 to 11.5 years. Anderson et al reported on a similar patient population. Constrained implants were used without stem extensions. No loosening was reported.

Based on the current information available, it is reasonable to err on the side of increased when doing revision total knee replacement. In the absence of definitive data, when in doubt about ligamentous stability intra-operatively, have a low threshold to use a constrained condylar implant. Rotating hinges remain indicted in those cases with absent collaterals and severe bone loss.
References:


Chronic extensor mechanism deficiency around a total knee arthroplasty is a potentially catastrophic problem that remains challenging to treat. Multiple techniques to address this problem have been reported, including allograft reconstruction (Achilles tendon or whole extensor mechanism) and synthetic mesh. This presentation will review the indications, techniques, and published results of these different procedures. While the literature fails to show a clear advantage between these techniques in terms of early failure rates, reported longer-term outcomes with allograft suggest deterioration over time. The potential benefits of synthetic mesh reconstruction make this the favored technique of the author. Periprosthetic infection remains a significant cause of failure regardless of technique and portends a poor prognosis. The surgeon and patient should be aware of the complexity and high complication rates associated with these reconstructive procedures.

The references below are suggested reading for those wishing to learn more about the technical aspects of these techniques:


Traditionally, the vast majority of hip and knee joint replacement procedures have been performed in an inpatient hospital setting and required a hospital stay of 3 days or longer. Improved anesthesia and surgical techniques, advances in postoperative care management, and growing patient demand for elective outpatient procedures are combining with healthcare economic factors to drive these operations to hospital outpatient departments, orthopaedic surgical specialty facilities and ambulatory surgery centers (ASC) at an accelerated rate. Over the next 10 years, it has been forecast that inpatient joint replacement volumes will remain relatively flat while outpatient primary joint replacement volumes will experience triple-digit growth.

Surgeons, payers, hospitals and independent facilities are fostering an increasingly favorable environment for total joint replacement (TJR) in the outpatient setting. As the transition to the outpatient setting begins to take hold, facilities must shift their strategic focus to maintain market share and margin. Orthopedic service line leaders can prepare their programs with an assessment of expected demand, competitive pressure and the payer landscape to assess market feasibility. Collaboration among providers, point of service facilities, insurers, and patients will facilitate more outpatient arthroplasty in the years ahead.

CMS believes (1) that most outpatient departments are equipped to perform TKA for Medicare beneficiaries; (2) most outpatient departments may perform TKA; and (3) the procedure is already being performed in numerous hospitals on an outpatient basis. CMS is looking for data to support the belief as to whether these criteria have been satisfied. CMS has allowed that TKA (CPT code 27447 will be assigned to C-APC 5115 (Level 5 Musculoskeletal Procedures) with status indicator “J1”. CMS expects providers will “carefully develop evidence-based patient selection criteria to identify patients who are appropriate candidates for an outpatient TKA procedure as well as exclusionary criteria that would disqualify a patient from receiving an outpatient TKA procedure.” Further, while CMS is not adding TKA to the ASC covered surgical procedures list for CY 2018, it appears that CMS is moving toward to allowing TKA at outpatient and ambulatory surgery centers. While CMS believes that some less medically complex TKA cases could be appropriately and safely performed on an outpatient basis, CMS does not expect to create or endorse specific guidelines or content for the establishment of providers’ patient selection protocols. CMS acknowledges the importance of deferring to patients and providers to decide the appropriate site of service for a particular patient. It is anticipated that total hip arthroplasty will be removed from the in-patient only list in the future.
Identifying the Optimal Patient

Michael E. Berend, MD

Perhaps the most significant developments in joint replacement surgery in the past decade have been in the area of multimodal pain management. This has reduced length of stay in the inpatient hospital environment opening the opportunity for cost savings and paved the way for outpatient joint replacement surgery in appropriately selected patients either in free standing ASC’s or hospital environments. The synergy and implementation of the knowledge gained over the past two decades of arthroplasty care make outpatient joint replacement possible and effective.¹ ²

Refinement of surgical techniques, anesthesia protocols, and patient selection has facilitated a transformation to same day discharge for arthroplasty care in our practice.¹³ -¹⁵ This initially began in September of 2011 with selected Partial Knee Replacement (PKR) cases. The surgical procedures included in the outpatient program have expanded to include primary TKA (Total Knee Arthroplasty), primary THA (Total Hip Arthroplasty), and selected revision cases.

The trend for early discharge has already happened for procedures formerly regarded as “inpatient” procedures such as upper extremity surgery, arthroscopy, ACL reconstruction, foot and ankle procedures, and rotator cuff repair. These cases are now routinely performed in free standing ASC’s. ASC’s afford surgeon flexibility and ownership opportunities. They also allow a “white board” approach to new innovations in outpatient care such as joint replacement surgery of the hip, knee, and shoulder.

The outpatient program centers on the patient needs, family engagement, essentials of home recovery, preoperative education, efficient surgery, and a surgeon controlled environment with highly standardized care. This is a distinct shift in today’s healthcare environment, which has seen the expansion of regulatory demands; focus on Electronic Health Record (EHR), and discussions of potential future value creation.

The hallmark of this program is meticulous protocol execution and surgeon directed care pathways. Preemptive pain control with oral anti-inflammatory agents, gabapentin, regional anesthetic blocks that preserve quad function for TKA (adductor canal block) and pericapsular long acting local anesthetics with the addition of injectable ketorolac and IV acetaminophen are key adjuncts. Over the past two years utilizing this type of program the majority of our partial knee replacement patients are now returning home the day of surgery.¹³ -¹⁵

Since 2011 we helped develop and implement an outpatient program as part of 76 participating physician-owned ambulatory facilities in 19 states. 19,415 joint replacements have been performed. The cohort included 6,146 TKA, 5,102 THA, 7,227 partial knee replacements, and 940 revisions and TSA. Patients had a mean age of 58 years and 50% of the patients were female. 97% of patients were discharged same day, the deep infection rate was 0.2%, and the readmission rate was 0.3%.

Interestingly we have had no readmissions for pain control since the programs inception. The majority of readmissions were for manipulation done as an outpatient with the remainder being known complications following inpatient or outpatient arthroplasty care and not unique to their outpatient care. The program centers on the patient, their family, home recovery, preoperative education, efficient surgery, and represents a shift in
the paradigm of arthroplasty care. It can be highly beneficial to patients, surgeons, anesthesia, facility costs, and payors as arthroplasty procedures shift to the outpatient space. We believe this brings the best VALUE to the patients, surgeons, and the arthroplasty system.

The outpatient program centers on the patient needs, family engagement, essentials of home recovery, preoperative education, efficient surgery, and a surgeon controlled environment with highly standardized care. This is a distinct shift in today’s healthcare environment, which has seen the expansion of regulatory demands; focus on Electronic Health Record (EHR), and distractions from real discussions of demonstrated value creation. The future is bright for both ASC and hospital development of successful outpatient joint replacement program for patients and surgeons alike.

Patient Satisfaction scores were outstanding with this program achieving 98% Great/Good for 2014-15. We believe this brings the best VALUE to the patients, surgeons, and the arthroplasty system and represents the future of arthroplasty care with future growth of both partial knee replacements and outpatient arthroplasty.

The future is bright for both ASC and hospital development of successful outpatient joint replacement program for patients and surgeons alike.
1. Introduction:
   a. Total joint arthroplasties have well known significant average blood loss
      i. Total Hip 4.0 gm/dl
      ii. Total Knee 3.8 gm/dl (1)
   b. Historical transfusion rates are as high as 70% (2)
   c. Despite years of work to optimize blood management, some published data suggests that transfusion rates (especially with allogeneic blood) are rising (3, 4)
   d. There is wide variability between surgeons as well, suggesting that varying protocols can influence transfusion rates
   e. Multiple studies now associate blood transfusions with negative outcomes
      i. Increased surgical site infection (5)
      ii. Increased costs
      iii. Increased length of stay
2. Preoperative
   a. Identify patients that are at increased risk of blood transfusion (6)
      i. Pre-op anemia (Hgb less than 13.0 gm/dl)
      ii. Female patients
         1. Especially smaller stature female patients with lower blood volume
         iii. Revision surgery
         iv. Bilateral surgery
         v. Elderly
   b. Check Hgb prior to surgery (finger monitor in clinic is non-invasive)
   c. For pre-operative anemia, consider tactics to raise hgb
      i. Iron supplement
      ii. Epogen
      iii. IV Iron infusion
3. Intraoperative
   a. Anesthesia
      i. Regional anesthesia - linked to reduced postoperative transfusions (7)
      ii. Hypotension (Mean arterial pressure <60 mm/hg) (8, 9)
   b. Lower operative time
      i. Efficient, organized, quality surgery, leave a dry field
   c. Bipolar sealer
      i. Initial enthusiasm for maintaining a dry surgical field, level 1 studies did not show benefit to using expensive device (10,11)
4. Tranexemic acid
a. Antifibrinolytic agent
b. Reduces average blood loss by 300 cc
c. Multiple different administration protocols
   i. IV (12-18)
      1. Weight based dosing 10-20 mg/kg
      2. Standardized dosing for all patients
         a. Our current regimen: 1 gm IV pre-op, 1 gm IV in PACU
   ii. Topical (19-22)
      1. Usually 2-3 gm mixed in 50-100 cc of saline, spray in wound and allow to soak for 3-5 minutes
   iii. Oral (23, 24)
      1. 1950 mg PO 2 hrs prior to surgery
d. Clinical practice Guideline: AAHKS/AAOS/ASRA/Hip & Knee Society
   i. All individual formulations are effective at reducing blood loss- strong
   ii. No method of administration is clearly superior at reducing blood loss and the risk of transfusion
   iii. The dose of IV or topical TXA does not significantly affect the drug’s ability to reduce blood loss and risk of transfusion
   iv. Multiple doses of IV or oral TXA compared to a single dose does not significantly alter the risk of blood transfusion
   v. Pre-incision IV TXA administration potentially reduces blood loss and risk of transfusion compared to post-incision administration
   vi. Administration of all TXA formulations in patients without history of VTE does not increase the risk of VTE
   vii. Administration of all TXA formulations in patients with a history of VTE, MI, CVA, TIA, or vascular stent does not appear to increase the risk of VTE
   viii. Administration of all TXA formulations does not appear to increase the risk of arterial thrombotic events

5. Postoperative
   a. Change transfusion triggers
   b. Do not treat a “number”, safe algorithms established (1)
      < 7 gm/dl
      • Discuss with patient
      • Transfuse 1 U PRBC
      7-8 with symptoms
      • Volume crystalloid vs colloid, evaluate meds
      • Reevaluate
      Persistent orthostasis, dizziness, fatigue
      • Transfuse 1 U PRBC (rare)
6. Summary
   a. A comprehensive blood management program can reduce transfusion rates to less than 3% for THA and 1% for TKA can facilitate outpatient total joint arthroplasty

References:
17. Ralley, FE, Berta, D, Binnis, V, Howard, J, Naudie, DD. One intraoperative dose of tranexamic acid for patients having primary hip or knee arthroplasty. CORR, 2010, Jul;468: 1905-11
The entirety of the patient experience after contemporary total knee and total hip replacements in 2017 is markedly different from that encountered by patients just a decade ago. Ten years ago most patients were treated in a traditional sick-patient model of care and because they were assumed to require substantial hospital intervention, many cumbersome & costly interventions (e.g. indwelling urinary catheters, patient-controlled-analgesic pumps, autologous blood transfusion, continuous passive motion machines) were a routine part of the early postoperative experience. Today the paradigm has shifted to a well-patient model with a working assumption that once a patient has been medically optimized for surgery then the intervention itself, hip or knee replacement, will not typically create a sick-patient. Instead it is expected that most patients can be treated safely & more effectively with less intensive hospital intervention. While as orthopedic surgeons we are enamored with the latest surgical techniques or interesting technologies most busy surgeons recognize that advances in perioperative pain management, blood management, and early-mobilization therapy protocols account for the greatest share of improvements in patient experience over the past decade.

One can think pragmatically to get ahead and stay ahead of 3 predictable physiologic disturbances that adversely impact rapid recovery after knee and hip replacement: fluid/blood loss; pain; and nausea. The modern orthopedic surgeon and his/her care team needs a simple strategy to pro-actively, not reflexively, manage each of those 3 predictable impediments to early recovery. Those surgical teams that routinely get ahead and stay ahead in each of those areas will routinely witness faster recovery, lower costs and greater patient satisfaction and that is clearly a win for patient and surgeon alike.

Effective pain management improves patient satisfaction, decreases hospital stay, and facilitates discharge to home. Today’s emphasis is on a multi-modal strategy that minimizes the use of opioids. Most protocols use preop medications including an NSAID, acetaminophen, an oral opioid and some include gabapentin. Regional anesthesia is typically preferred over general. Both peripheral nerve blocks and periarticular local anesthetic cocktail injections have proved as effective adjuncts in decreasing early postoperative pain. Postoperative oral medications delivered on a schedule, not just as needed, often include acetaminophen, an NSAID and some include gabapentin. Oral and parenteral opioids are reserved for breakthrough pain.

Improved pain management techniques, surgical practices and the introduction of novel interventions have enhanced patients’ post-operative experience after total joint arthroplasty (TJA). Enhanced recovery pathways require a multidisciplinary team to manage pre-operative education, multimodal pain control and accelerated rehabilitation. The current economic climate and restricted budgets favour brief hospitalisation while minimising costs. This has put considerable pressure on hospitals to combine excellent results, early functional recovery and shorter admissions.

In this session, others will have covered some common interventions and methods that shorten length of stay and make outpatient TJA possible. These include pre-operative patient education, pre-emptive analgesia, local infiltration analgesia, pre-operative nutrition, peri-operative rehabilitation, wound dressings, different surgical techniques, minimally invasive surgery and fast-track joint replacement units.

The concept of enhanced recovery has been widely implemented by orthopaedic centres worldwide. The adoption of multimodal pathways and accelerated rehabilitation programmes appear to improve patient care and function while reducing length of stay. The introduction of day-case / outpatient TJA at leading centres has been achieved for a selected subgroup of patients with low morbidity and mortality.

There are undoubted advantages to a robust pathway through which patients can learn about their procedure, optimise their nutritional and physical status, learn what to expect from surgery and the peri-operative period, reduce the risks of surgery and speed up recovery and discharge. Although a number of pathways have been described, there has been a paucity of multicentre randomised trials comparing outcomes from these dedicated centres to those of conventional services. So far the evidence is largely circumstantial.

Implementation of ERPs in each hospital needs to be tailored to the services and expertise available at each centre.

The shift towards day-case or outpatient arthroplasty has resulted from a number of drivers. The desire to limit the morbidity, mortality and cost of surgery has generated an enhanced recovery programme which has been extremely successful in limiting pain and smoothing the patient pathway around the time of surgery. This in turn has had economic benefits in terms of reducing length of stay. Ultimately, the reduction in length of stay increased risks for some patients, whilst it potentially benefitted others. That threshold remains unclear. Other drivers, however, have intervened and, in particular, the push towards generating hospital and surgeon profits by reducing length of stay and transferring the resulting savings into a hospital or surgical budget/ profit have led to a push to discharge patients on the same day. This has been shown to be possible and indeed safe for a selected subset of patients in the United States and is being applied in certain centres in Europe. There is a cohort of young, medically fit, healthy and highly-motivated patients with a good support network in whom this can be applied. The resource saving in terms of hospital stay has to be balanced against extra resources that have to be put in preoperatively and immediately postoperatively to ensure that this pathway is smooth but, ultimately, it may well be to the benefit of that group of patients to have a shorter time in hospital.
The adoption across the world has been much slower and is much less surgically driven than it is in the United States, and that may well relate to the different economic models outside the United States. Current United Kingdom regulations are that surgeons can only have a maximum 5% stake in any surgical unit or SurgiCentre. The motivation, therefore, to shift patients from an inpatient to an outpatient setting is much smaller. Like many innovations, it can be driven by the need to get market share, and hence competitive advertising, and also by patients who see a shortened length of stay as a surrogate for an earlier return to work and to activity. The international perspective on outpatient arthroplasty is that it is the natural endpoint of enhanced recovery protocols but that it has not yet found its happy medium/equilibrium. It can be applied to a select group of patients. The resulting preoperative and postoperative care pathways created will benefit all patients. The belief in most large institutions is that the trend towards decreasing length of stay will continue and will be of benefit of patients and to society as a whole in terms of the overall cost of healthcare. We have yet, however, to define the exact population of patients who could be compromised by this and it, therefore, will continue to be introduced slowly and carefully.
Introduction: This study aims to better understand the impact of patient specific variables on the total cost of care in the total joint arthroplasty population. The impact that these patient specific variables including discharge disposition, comorbidities, and readmissions have on total cost of care will better allow physicians to modify the way care is bundled into episodes, and alleviate excessive financial risk.

Methods: All payment data was retrospectively reviewed for 1,092 (617 Total Knee Arthroplasty and 475 Total Hip Arthroplasty) patients who underwent a procedure during the initiation of a bundled payment model at a single academic center in a major city (January 2014 to November 2016). The LACE index was used to stratify patients as low (0-4), moderate (5-9) or high risk (10+). Discharge disposition, and readmissions were analyzed to understand their financial impact on total cost.

Results: After classifying patients into low, moderate and high risk groups we found a significant increase in total cost per episode of care between the low and moderate risk group in our TJA population. The significant difference between the two cohorts was $5,507.00 (p-value < 0.001) with the low risk cohort displaying a lower total cost of care. The mean difference in cost between cohorts remained significant when comparing the low risk cohort against the high-risk cohort, seeing patients categorized as high risk paying on average $10,604.00 more than those classified as low risk (p-value < 0.001). Patients discharged to a Skilled Nursing Facility and Acute Rehabilitation Facility had the highest total cost, with similar averages of total cost per episode of care. Patients discharged home had the least total cost across discharge disposition groups. Those discharged to a SNF/ Acute Rehabilitation Facility paid on average $11,623.00 more than those discharged home (p< 0.001). There were 34 hospital readmissions consisting of 19 surgical and 15 medical readmissions. A hospital readmission adds on average $17,629.00 to the total cost per episode of care. It was determined that surgical readmissions cost on average $15,313.00 more than medical readmissions (p= 0.001). A high percentage of the total cost per episode of care was attributed to post-discharge fees and services, which seems to increase considerably per LACE group, and is in agreement with results found in similar literature.

Conclusion: It is important for surgeons to modify bundled episodes of care to account for various factors of a patient’s care. Total cost per episode of care for Total Joint Arthroplasty increases linearly alongside patient risk, classified by LACE Score. Hospital readmissions and post discharge destination have a significant impact on total cost. A significant difference in cost was found between medical and surgical readmissions. While medical readmissions may be unavoidable, surgical readmissions are costly, and often preventable.
Where Do We Stand with Value-Based Payments? A Washington Update
Kevin J. Bozic, MD, MBA

There continues to be ongoing discussions revolving around the transition from a fee-for-service (FFS) payment system to one focused on value – defined as health outcomes achieved per dollar spent. Indeed, regardless of political ideology, it is accepted that current healthcare spending is problematic for America’s economy and the future of the country’s health and wellbeing. Over half of the increase in healthcare spending can be attributed to rising service prices and intensity, and currently, healthcare represents 17.9% of the United States’ Gross Domestic Product (GDP). Part of the solution to curtail unsustainable healthcare spending involves the implementation of value-based medicine initiatives.

In Washington, DC, there continues to be support for a shift to value-based payment models, beginning in 2013 with the implementation of the Bundled Payments for Care Improvement (BPCI) program by the CMS Innovation Center. This voluntary program offered or currently offers participants four innovative value-based payment models:

- Model 1) An episode of care was defined as the acute hospital stay only – reimbursement included a discounted fee to the hospital based on historical Medicare rates plus FFS reimbursement to physicians [discontinued in December 2016]
- Model 2) An episode of care included the acute inpatient care plus post-acute care services rendered related to the arthroplasty procedure – reimbursement is provided in a FFS manner but then reconciled against a target CMS price
- Model 3) An episode of care begins immediately following acute in-hospital arthroplasty care with post-acute care services (e.g., skilled nursing facility) – reimbursement is provided in a FFS manner for the post-acute care services but then reconciled against a target CMS price
- Model 4) An episode of care includes all inpatient services related to an arthroplasty procedure, as well as any related readmissions – reimbursement is provided by CMS in a single, prospective manner and the hospital reimburses care providers using such funds.

While BPCI Model 1 is no longer offered, the remaining models are currently being utilized. As of October 1, 2017, 514, 675 and 2 participants were active using Models 2, 3 and 4, respectively. Further, the BPCI initiative will continue through Fall 2018 for all participants in the three models extending their involvement for two additional years. Such a program is an important step in transitioning payment incentives from quantity to quality.

In addition to the BPCI program, the Centers for Medicare & Medicaid Services (CMS) have also implemented the Comprehensive Care for Joint Replacement (CJR) model; this bundled payment structure provides a lump sum to cover all related lower extremity joint replacement care within 90 days, including both in-hospital and post-acute care services rendered (similar to BPCI Model 2). The two MS-DRGs covered under this program are: 1) 469 (Major joint replacement or reattachment
of lower extremity with major complications or comorbidities); and 2) 470 (Major joint replacement or reattachment of lower extremity without major complications or comorbidities).\textsuperscript{6} This program was mandatory for many hospitals not participating in the BPCI initiative, including those that were 1) paid under the Inpatient Prospective Payment System (IPPS), and 2) located in the Metropolitan Statistical Areas (MSAs) – counties with an urban area that has a population of at least 50,000 citizens – selected by CMS.\textsuperscript{6} Currently, hospitals in 67 designated MSAs participate in the program, although 33 MSAs, low volume hospitals and rural hospitals are doing so voluntarily.\textsuperscript{6} These volunteer care centers can elect to opt-in to continue participating in January 2018 or withdraw. Similar to the BPCI program, the CJR model represents the changing payment landscape; indeed, the focus with the CJR model is on financially rewarding healthcare value, which provides benefit to both the provider and the patient.

In 2014, over $7 billion in hospitalization costs alone were spent on greater than 400,000 lower extremity arthroplasty cases covered by Medicare across the United States.\textsuperscript{6} In addition, there was a variation in the cost of care up to $16,500.\textsuperscript{6} These facts, coupled with the unsustainable increase in American healthcare spending, have led to the development of the federal value-based payment programs discussed in detail above. These initiatives attempt to incentivize quality, not quantity, in the healthcare marketplace. As private insurers follow CMS’ lead, more value-based payment options are likely to be introduced, including reimbursement models that incorporate patient-reported outcomes (PROs).

The shift to value-based reimbursement is not without continued challenges, as more initiatives aimed at promoting quality, not quantity, are introduced and heavily debated. Recently, the Medicare Payment Advisory Commission (MedPAC), the committee the advises Congress on appropriate Medicare policy, has recommended the elimination of the Merit-Based Incentive Payment System (MIPS).\textsuperscript{7} The main goal of MIPS is to apply a bonus-type scheme to the traditional FFS model by rewarding physicians for improves outcomes and meaningful EHR use.\textsuperscript{7} Unfortunately, the burden appears to be quite high on physicians, as MedPAC suggests that MIPS reporting requirements cost clinicians over $1 billion in 2017.\textsuperscript{7} Instead of MIPS, MedPAC has suggested that clinicians be offered the opportunity “opt in” to a voluntary rewards program focused on claims data; this would eliminate a significant portion of the reporting burden felt under MIPS.\textsuperscript{8} In this proposed program, Medicare would withhold a small portion of reimbursement dollars from all doctors and allow physicians to “recoup” this money by meeting predetermined quality targets; those who opt not to participate would not be able to recover the withheld funds.\textsuperscript{8} While a final policy decision has yet to be made, this ongoing discussion further reinforces the challenges, yet potential, seen in the shift towards value-based reimbursement and improved healthcare quality across the United States.

In general, it is recognized at the highest levels of the federal government that the shift to value-based payments is a necessity for the health of our country moving forward. Many challenges remain but problems continue to be solved on a daily basis. Recently, current Administrator of CMS, Seema Verma, gave a speech stressing ongoing projects at CMS aimed to assist this movement to a value-based healthcare system focused on patients. She discussed an initiative entitled “Patients Over Paperwork”, which aims to review all regulations at CMS and improve or only keep those that truly put
patients first. Additionally, she introduced “Meaningful Measures”, a collaborative initiative involving a number of healthcare stakeholders aimed to ensure that “measure sets are streamlined, outcomes-based, and meaningful to doctors and patients.” Lastly, she stated that the Center for Medicare and Medicaid Innovation (CMMI) would be collecting ideas via a “Request for Information”, shifting the idea generation from Washington to the communities that serve patients. Administrator Verma’s ultimate goal is to have competition lead to improved patient-centered healthcare focused on quality, not quantity.

Currently, there are a number of exciting initiatives in Washington, DC focused on the ongoing shift from a FFS model to a value-based payment structure. As we continue to learn more through both the successes and failures of current proposals and projects, a more concrete formula for longitudinal success will develop. An exciting future within healthcare is on the horizon.

References

• PROs support the IOM vision for 21st Century to use information technology to support patient-centered, evidence based decisions

• As healthcare moves to a value based reimbursement system PROs are used to define outcomes and quality and therefore are the numerator of the value equation

• PROs have moved into clinical Practice In TJR
  o Orthopedic surgeon reimbursement in US increased by PRO reporting in PQRS through FORCE-TJR
  o Pay for Performance Quality Reporting; CJR; Pilot project by BC of MA
  o PROs used for negotiations with insurance companies, ACOs and referring MDs as a measure of quality

• PROs can be collected in a busy practice with >85% follow-up at 1 year
  o Collect joint specific PRO scores; include pain, function, quality of life (12 questions)
  o General Health PRO from which PCS and MCS can be calculated (10-12 questions)
  o Ayers, Franklin. *Integrating PRO into Ortho.Practice; Proof of Concept from FORCE-TJR* CORR: 471(11) 3482-3488, 2013

• PRO must bring value to visit ; real time scoring; CAT enabled

• PRO used for Shared Decision Making and part of routine clinical care, not “research”

• FORCE-TJR has collected >35,000 patients PROs (Pre-op, 6M and 1 Yr Post-op with 86% collection rate).
  o National TJR research registry and Comparative effectiveness consortium based at University of Massachusetts Medical School
  o Currently includes >225 sites in >28 states in the US
  o Established by a $12 Million P50 Grant from AHRQ
  o Currently collects and measures Level 1,2,3, and 4 data
  o Establish PRO standards at the surgeon and hospital level
  o FORCE members now using FORCE platform and FORCE infra-structure to manage bundled payment programs with CMS (BPCI and CJR) and private payers
  o FORCE –TJR feedback to surgeons/hospitals for quality improvement and real-time operational data to manage bundle payment programs
    ▪ Patient characteristics/mix/ Charlson co-morbidity index
    ▪ Patient selection (timing of surgery)
    ▪ Medical and ortho co-morbid conditions
Discharge location/ use of ancillaries
- TJR outcomes including post-TJR pain and function
- TJR outcomes also including adverse events/ readmissions/return to surgery/ revision surgery
  - FORCE-TJR Now open to new member enrollment

- PROs used to evaluate patient mix at the hospital/surgeon level for medical and MSK co-morbidities
  - Used to answer how do my patients compare to FORCE-TJR cohort on key risk-adjustment factors
  - Ayers, et al. Patient Reported Outcomes After TKR; Need for MSK Co-Morbidity Index
    JBJS-A: 95(20)1833-7, 2013
- Patient Selection and Timing of Surgery; Appropriateness
  - How do my patients compare to other sites on pre-TJR pain and function?
  - Ayers, Franklin. Pre-Op Pain and Function Profiles Reflect Consistent TKA Patient Selection
    Among US Surgeons.   CORR: Jan 2015, 473(1) p76-81
- TJR patient reported outcomes;
  - How does my risk adjusted 1 year pain and function scores compare to FORCE-TJR national cohort?
  - Surgeons/hospitals want to improve!
- PROs improve risk adjustment models for readmissions
  - FORCE-TJR and AAHKS showed that adding pre-op function (PCS), BMI as continuous variable, smoking, modified Charlson co-morbidity score, Orthopedic co-morbidities improve readmission model from CMS C=.62 to FORCE-TJR C=.78
    JBJS-A: 97(88) 668-71, 2015

- PROs used to evaluate Cemented vs. Cemented TKRs; risk adjustment for PROs based on patient characteristics
- PROs already play an important role in clinical practice in TJR and will play an increasingly vital role in assessing quality and value in the future; look for a turn-key internet based option that provides you with real-time scoring of PROs and access to PRO national norms to benchmark your practice
Hospital-Physician Alignment
C. Lowry Barnes, MD

The current healthcare environment allows numerous opportunities for physicians and hospitals to align incentives. Opportunities such as co-management, gain-sharing, as well as partnering in CJR, BPCI, and BPCI-Advanced will be discussed. Large numbers of surgeons are now being employed by hospitals, and models of employment will be shared. As total joints move to out-patient settings, partnerships in ASC’s may become more viable for joint replacement surgeons. Additionally, lower level alignments such as flip rooms, support of third-parties to help with patient engagement, research relationships, and hospital employment of mid-level providers to assist with in-patient care will be reviewed also.
Surgical Centers, Consulting and Implant Recall:
What You Should Do to Protect Yourself
Mark I. Froimson, MD, MBA

Today’s rapidly changing medical and health care environment provides both opportunity and risk for surgeons. As surgeons are the prime advocate for the welfare of their patients, they are constantly and justifiably seeking ways to improve care delivery. Among an array of rapidly evolving issues, three stand out as particularly impactful: the site of care delivery, the adoption of new technology, and the business and financial relationships that are often associated with these. Patient care is rapidly moving to outpatient centers, implants have been introduced and recalled at a blistering pace and physician consulting relationships continue to be seen as both essential and concerning. An important legal and regulatory framework has been developed intended to safeguard patients. But, as with any oversight, there are both beneficial elements and unintended consequences. The surgeon who is actively seeking to test the boundaries of existing practice must do so with a thorough understanding of how to navigate these elements. Innovation and progress must be accompanied by an appropriate measure of prudence and circumspection. By understanding a wide array of stakeholder and environmental perspectives, the proper course and cadence can be set.
CME ACCREDITATION STATEMENT
This activity has been planned and implemented in accordance with the accreditation requirements and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of the American Academy of Orthopaedic Surgeons and the Knee Society. The American Academy of Orthopaedic Surgeons is accredited by the ACCME to provide continuing medical education for physicians.

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

Upon completion of this activity, participants will be able to:
• Update clinical skills and basic knowledge through research findings and biomechanical studies.
• Discuss the various surgical and non-surgical treatments and management of conditions related to the knee joint.
• Determine indications and complications in total knee arthroplasty.
• Critique presentations of surgical techniques and demonstrations of treatment options.
• Evaluate the efficacy of new treatment options through evidence-based data.

FDA STATEMENT
Some pharmaceuticals and/or medical devices at the Specialty Day Meeting have not been cleared by the U.S. Food and Drug Administration (FDA) or have been cleared by the FDA for specific purposes only. The FDA has stated that it is the responsibility of the physician to determine the FDA status of each pharmaceuticals and/or medical devices he or she wishes to use in clinical practice.

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