



**American Association of Hip and Knee Surgeons**  
**Fifteenth Annual Fall Meeting**  
**November 4-6, 2005**  
**Gaylord Texan Resort, Dallas, Texas**

**Goals and Objectives**

The AAHKS 15th Annual Meeting is designed to provide practicing orthopaedic surgeons with state-of-the-art information about the surgical applications and treatment protocols for the diagnosis and management of total hip and knee replacement, and to enhance the care of patients with arthritis and degenerative diseases. Both free paper presentations and interactive symposia will be utilized. The program is designed to meet the seven essentials of the Accreditation Council for Continuing Medical Education, and as a result, program participants will receive the highest quality education and become eligible for up to thirteen hours of Category 1 CME credit.

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 hip and knee joints.
- Determine indications and complications in total hip and knee arthroplasty
- Critique presentations of surgical techniques and demonstrations of treatment options
- Evaluate the efficacy of new treatment options through evidence-based data

The Scientific Sessions will include the most current research in joint arthroplasty. Clinical papers will focus on:

- Advancing the Science through Research
- Bearing Surfaces in THR
- Technology for his/her practice and patients
- Minimally invasive Surgery
- Perioperative variables affecting outcomes
- Primary THR
- Perioperative Controversies
- Primary Knee Replacement
- Complications: Prevention, Investigation and Effects
- Revision TKR
- Revision THR

**Symposia—Topics include:**

- Why I Chose This Technology For My Practice And Patients
- Minimally Invasive Surgery: The Issues
- Health Policy Update

# AAHKS 15th Annual Meeting Scientific Program

(Times and Topics subject to change.)

## November 4, 2005

2:00-9:00 PM	Registration	Texas Ballroom Foyer
Noon-9:00 PM	Speaker Ready Room	Dallas Room 7
2:00-5:00 PM	Exhibit/Poster setup	Texas Ballroom Exhibit Area
	<b>Concurrent sessions:</b>	
3:30-5:00 PM	(Optional Mini-Symposium) <b>A Closer Look: The Evolving relationship between Orthopaedic Surgeons and the Medical Service Industry (1 Hour CME)</b> <i>Presented by Current Communications Company through a generous grant from DePuy, a Johnson and Johnson Company</i>	Texas Ballroom A
3:00-5:00 PM	(Optional Mini-Symposium) <b>Contemporary Issues in Bone Cement</b> <i>Presented by Advanced Biomaterial Systems</i>	Dallas Rooms 3-4
3:00-6:00 PM	<b>Board of Directors Meeting</b>	Dallas Rooms 1-2
5:30-8:30 PM	Posters/Exhibits Open	Texas Ballroom Exhibit Area
6:00-8:30 PM	<b>Welcome Reception</b> (All attendees invited)	Texas Ballroom Exhibit Area
6:00-7:30 PM	<b>Knee Problem Case Session</b> <i>MODERATOR: Daniel J. Berry, MD</i> <i>Panel: Douglas A. Dennis, MD, Wayne G. Paprosky, MD, Thomas K. Fehring, MD, and William J. Robb, III, MD</i>	Texas Ballroom A
6:00-7:30 PM	<b>Hip Problem Case Session</b> <i>MODERATOR: Lawrence D. Dorr, MD</i> <i>Panel: Brian S. Parsley, MD, John J. Callaghan, MD, David G. Lewallen, MD and Carlos J. Lavernia, MD</i>	San Antonio Rooms 4-6
7:30-8:30 PM	<b>Fundraiser for U.S. Congressman</b> <b>Michael C. Burgess, MD (R-Texas)</b>	Ft. Worth Rooms 5-7

## Saturday, November 5, 2005

6:00 AM-6:00 PM	Registration	Texas Ballroom Foyer
6:00 AM-6:00 PM	Speaker Ready Room	Dallas Room 7
6:00-7:00 AM	<b>Breakfast Buffet</b>	Texas Ballroom Exhibit Area
6:00 AM-3:45 PM	Posters/Exhibits Open	Texas Ballroom Exhibit Area
6:45-7:25 AM	<b>Business Meeting</b> (Members only)	Texas Ballroom A

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7:30-7:45 AM	<b>President's Welcome / Brief Report</b> <i>Joseph C. McCarthy, MD, Boston, MA</i>	Texas Ballroom A
	<b>Tribute to William W. Tipton, Jr., MD</b> <i>Richard F. Santore, MD, San Diego, CA</i>	Texas Ballroom A
<b>SESSION ONE:</b>	<b>ADVANCING THE SCIENCE THROUGH RESEARCH</b>	
7:45-8:29 AM	<i>MODERATORS: Thomas P. Schmalzried, MD* and Steven J. Incavo, MD*</i>	
7:45 AM Paper #1	<b>Arthrofibrosis Following Total Knee Arthroplasty: Insight Into Molecular Mechanism</b> <i>Javad Parvizi, MD, Philadelphia, PA</i>	
7:50AM	<b>Discussion</b>	
7:56 AM Paper #2	<b>Muscle Damage after Total Hip Arthroplasty Done with the Two-Incision Minimally Invasive and the Mini-Posterior Techniques</b> <i>Rodrigo M. Mardones, MD, Santiago, Chile</i>	
8:01 AM	<b>Discussion</b>	
8:07 AM Paper #3	<b>Patellar Tendon Attachment and Healing to Porous Tantalum: An Experimental Canine Study</b> <i>David G. Lewallen, MD, Rochester, MN</i>	
8:12 AM	<b>Discussion</b>	
8:18 AM Paper #4	<b>Differentiating Infection from Aseptic Loosening: Analysis of Synovial Fluid Gene Expression Patterns</b> <i>Carl A. Deirmengian, MD, Philadelphia, PA</i>	
8:23 AM	<b>Discussion</b>	
<b>SESSION TWO:</b>	<b>BEARING SURFACES IN THR</b>	
8:29-9:13 AM	<i>MODERATORS: John J. Callaghan, MD and Steven J. MacDonald, MD</i>	
8:29 AM Paper #5	<b>Early Wear Performance of Highly Cross-Linked Polyethylene in Total Hip Arthroplasty: A Prospective Randomized Controlled Study</b> <i>Richard W. McCalden, MD, London, Ontario, Canada</i>	
8:34 AM	<b>Discussion</b>	
8:40 AM Paper #6	<b>Three Year Prospective Study of Serum and Urine Metal Levels in Patients with Metal-On-Metal Total Hip and Surface Arthroplasty</b> <i>Joshua J. Jacobs, MD,* Chicago, IL</i>	
8:45 AM	<b>Discussion</b>	
8:51 AM Paper #7	<b>Comparison of Acetabular Wear and Osteolysis in RAM Extruded Versus Machined Compression Molded UHMWPE</b> <i>John M. Martell, MD, Chicago, IL</i>	
8:56 AM	<b>Discussion</b>	
9:02 AM Paper #8	<b>Serum Metal Ion Levels and Bearing Surfaces in Total Hip Arthroplasty</b> <i>Vijay J. Rasquinha, MD, New York, NY</i>	
9:07 AM	<b>Discussion</b>	

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9:13 AM	<b>JAMES A. RAND AWARD WINNER</b> <i>PRESENTATION OF AWARD: Douglas A. Dennis, MD and Mary I. O'Connor, MD</i>	
	<b>Hospital Volume and Outcomes of Total Hip Arthroplasty in the United States</b> <i>Christopher J. Doro, MD, Ann Arbor, MI</i>	
9:19 AM	<b>Discussion</b>	
9:25 AM	<b>LAWRENCE D. DORR AWARD WINNER</b> <i>PRESENTATION OF AWARD: Joseph C. McCarthy, MD and John J. Callaghan, MD</i>	
	<b>A Randomized, Prospective Evaluation of Outcome After Total Hip Arthroplasty Using Crosslinked Marathon® and Non-Crosslinked Enduron® Polyethylene</b> <i>C. Anderson Engh, Jr., MD,* Alexandria, VA</i>	
9:33 AM	<b>Discussion</b>	
	<b>SYMPOSIUM I WHY I CHOSE THIS TECHNOLOGY FOR MY PRACTICE AND PATIENTS</b>	
9:39-10:20 AM	<i>MODERATOR: A. Seth Greenwald, DPhil (Oxon)</i>	
9:39-9:45 AM	<b>Ceramic Articulating Surfaces in THR</b> <i>James A. D'Antonio, MD,* Moon Township, PA</i>	
9:46-9:52 AM	<b>Metal on Metal THR</b> <i>Lawrence D. Dorr, MD,* Inglewood, CA</i>	
9:53-9:59 AM	<b>Highly-Crosslinked Polyethylene in THR</b> <i>Daniel J. Berry, MD,* Rochester, MN</i>	
10:00-10:06 AM	<b>Rotating Platform TKR</b> <i>Douglas A. Dennis, MD, Denver, CO</i>	
10:07-10:13 AM	<b>Modular Fixed Bearing TKR</b> <i>Paul F. Lachiewicz, MD,* Chapel Hill, NC</i>	
10:14-10:20 AM	<b>Monoblock TKR</b> <i>David G. Lewallen, MD, Rochester, MN</i>	
10:20-10:35 AM	<b>Discussion</b>	
10:35-10:55 AM	BREAK	Texas Ballroom Exhibit Area
10:55-11:55 AM	<b>KEYNOTE SPEAKERS-I</b> <i>MODERATOR: Joseph C. McCarthy, MD</i>	Texas Ballroom A
10:55-11:10 AM	<b>“Medicare: Soup to Nuts in 15 Minutes”</b> <i>William D. Rogers, MD, FACEP</i> <i>CMS Medical Officer, Physicians Regulatory Issues Team</i>	
11:10-11:17 AM	<b>What has been Accomplished at the Federal Level this Past Year</b> <i>The Honorable Thomas E. Price, MD, Congressman, Roswell, GA</i>	
11:17-11:32 AM	<b>Liability Reform</b> <i>Stuart L. Weinstein, MD, AAOS President, Iowa City, IA</i>	
11:32-11:47 AM	<b>Discussion</b>	
11:47 AM-12:40 PM	<b>KEYNOTE SPEAKERS-II</b> <i>MODERATOR: William J. Robb, Jr., MD*</i>	
11:47-11:59 AM	<b>AAOS and the AAHKS—Exploring New Partnerships</b> <i>Richard F. Kyle, MD, First VP AAOS, Minneapolis, MN</i>	

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12:00-12:07 PM	<b>The New AAOS Strategic Plan—Opportunities in Education and Advocacy</b> <i>Karen Hackett, CEO AAOS, Rosemont, IL</i>	
12:08-12:15 PM	<b>AAOS PAC and COMSS Activity Updates</b> <i>Robert Jasak, COMSS Federal Representative, AAOS Washington, DC Office</i>	
12:16-12:31 PM	<b>“How Joint Replacement Changed My Life”</b> <i>Johnny Bench, National Baseball Hall of Fame Legend, Cincinnati Reds (1967-1983)</i>	
12:32-12:40 PM	<b>Discussion</b>	
12:40-1:15 PM	LUNCH	Texas Ballroom Exhibit Area
1:15-1:35 PM	<b>Research Committee Update</b> <i>Steven M. Teeny, MD, Research Committee Chair, Tacoma, WA</i>	
	<b>AAHKS Membership Survey Results:</b> Current treatment practices of members of AAHKS for the treatment of osteonecrosis of the adult femoral head <i>Brian J. McGrory, MD, Portland, ME</i>	
	<b>SESSION THREE</b>	
1:35-2:30 PM	<b>MINIMALLY INVASIVE SURGERY: EARLY RESULTS</b> <i>MODERATORS: Lawrence D. Dorr, MD and Daniel J. Berry, MD*</i>	
1:30 PM Paper #9	<b>Incidence of Reoperation and Reasons for Reoperation after Minimally Invasive Unicompartamental Knee Arthroplasty</b> <i>William G. Hamilton, MD, Alexandria, VA</i>	
1:35 PM	<b>Discussion</b>	
1:41 PM Paper #10	<b>Two-Incision Total Hip Arthroplasties had Modest Outcomes and Some Substantial Complications</b> <i>Mark W. Pagnano, MD,* Rochester, MN</i>	
1:46 PM	<b>Discussion</b>	
1:52 PM Paper #11	<b>Patients Preferred a Mini-Posterior THA over a Contralateral 2-Incision THA: Results in Patients Treated with the Same Anesthetic and Rehab Protocol</b> <i>Robert T. Trousdale, MD,* Rochester, MN</i>	
1:57 PM	<b>Discussion</b>	
2:03 PM Paper #12	<b>Minimally Invasive Hip Replacement: Surgeons versus Patients Perspective</b> <i>Peter F. Sharkey, MD, Philadelphia, PA</i>	
2:08 PM	<b>Discussion</b>	
	<b>SYMPOSIUM II</b>	
2:14-3:09 PM	<b>MINIMALLY INVASIVE SURGERY: The Issues</b> <i>MODERATOR: Mary I. O’Connor, MD*</i>	
2:14-2:22 PM	<b>Minimal Single Incision Anterior THA</b> <i>William J. Hozack, MD,* Philadelphia, PA</i>	
2:23–2:31 PM	<b>Minimal Single Incision Posterior THA</b> <i>Thomas P. Vail, MD,* Durham, NC</i>	
2:32–2:40 PM	<b>Minimal Incision for TKA</b> <i>Richard S. Laskin, MD, New York, NY</i>	

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2:41–2:49 PM      **Hazards of Minimal Incision for TKA**  
*David F. Dalury, MD, Baltimore, MD*

2:50–3:10 PM      **Discussion**

3:10-3:34 PM      BREAK Texas Ballroom Exhibit Area

**SESSION FOUR**      **PERIOPERATIVE VARIABLES AFFECTING OUTCOMES**

3:34-4:29 PM      *MODERATORS: Kevin J. Bozic, MD and James B. Benjamin, MD*

3:34 PM      **A Randomized Blinded Clinical Trial Assessing Efficacy of**  
 Paper #13      **Peri-Articular Injection Using Multimodal Analgesia in**  
                          **Total Knee Replacement**  
*Steven J. MacDonald, MD, London, Ontario, Canada*

3:40 PM      **Discussion**

3:45 PM      **Post-Op Pain Following Total Knee Arthroplasty: A Prospective,**  
 Paper #14      **Double-Blinded, Randomized Study Comparing Patient-**  
                          **Controlled-Analgesic Pump, Pericapsular Injection, and**  
                          **Femoral Nerve Block**  
*Amanda Marshall, MD, Charlotte, NC*

3:50 PM      **Discussion**

3:56 PM      **The Effect of a New Multi-Modal Perioperative Anesthetic Regimen**  
 Paper #15      **on Postoperative Pain, Side Effects, Rehabilitation and Lengths of**  
                          **Hospital Stay Following Total Joint Arthroplasty**  
*Brayton R. Shirley, MD, Salt Lake City, UT*

4:01 PM      **Discussion**

4:07 PM      **Is There an Association between Pre-Op Emotional Health and**  
 Paper #16      **Post-Op Exercise Adherence after TKR**  
*David C. Ayers, MD, Worcester, MA*

4:12 PM      **Discussion**

4:18 PM      **Post-Discharge Costs in Arthroplasty Surgery**  
 Paper #17      *Carlos J. Lavernia, MD,\* Miami, FL*

4:23 PM      **Discussion**

**SESSION FIVE**      **PRIMARY THR**

4:29–5:13 PM      *MODERATORS: William J. Hozack, MD and Thomas K. Fehring, MD*

4:29 PM      **Acetabular Component Deformation with Press-Fit Fixation**  
 Paper #18      *William L. Griffin, MD, Charlotte, NC*

4:34 PM      **Discussion**

4:40 PM      **Long-Term Outcome and Risk Factors of Proximal Femoral Fracture**  
 Paper #19      **in Uncemented and Cemented Total Hip Replacement in 3089 Hips**  
*Michael E. Berend, MD,\* Mooresville, IN*

4:45 PM      **Discussion**

4:51 PM      **Tapered Titanium Porous Plasma Sprayed Femoral**  
 Paper #20      **Component in Patients Aged 40 Years and Younger**  
*Keith R. Berend, MD,\* Columbus, OH*

4:56 PM      **Discussion**

5:02 PM      **Does Neck/Liner Impingement Increase Wear of UHMPE Liners?**  
 Paper #21      *Molly M. Usrey, MS, Houston, TX*

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5:07 PM	<b>Discussion</b>	
5:13 PM Paper #22	<b>One-Stage Bilateral Total Hip Arthroplasty as Compared with Unilateral Hip Total Arthroplasty</b> <i>Richard H. Rothman, MD, Philadelphia, PA</i>	
5:18 PM	<b>Discussion</b>	
<b>SYMPOSIUM III</b>	<b>HEALTH POLICY UPDATE</b>	
5:24-6:05 PM		
5:24 – 5:26 PM	<b>Introduction</b> <i>MODERATOR: Brian S. Parsley, MD,* Houston, TX</i>	
5:27 - 5:32 PM	<b>The Five-Year Review: 2007 and Beyond</b> <i>Carlos J. Lavernia, MD, Miami, FL</i>	
5:33- 5:40 PM	<b>AAHKS Health Policy Initiatives</b> <i>Brian S. Parsley, MD, Houston, TX</i>	
5:41- 5:46 PM	<b>Partnering with the AAOS</b> <i>Karen Hackett, FACHE, Rosemont, IL</i>	
5:47 – 5:52 PM	<b>Options to Consider Other than Medicare</b> <i>Thomas K. Fehring, MD, Charlotte, NC</i>	
5:53-6:05 PM	<b>Discussion</b>	
6:05 PM	<b>ADJOURN</b>	
6:15-7:15 PM	<b>POSTER RECEPTION</b> (All are welcome)	Texas Ballroom Poster Area
7:45-9:30 PM	<b>Private Board/Past Presidents Dinner</b>	Appaloosa Room 1

## Sunday, November 6, 2005

5:30-10:00 AM	Registration	Texas Ballroom Foyer
6:00-10:30 AM	Speaker Ready Room	Dallas Room 7
6:00-7:00 AM	<b>Continental Breakfast</b>	Texas Ballroom Foyer
7:00-9:00 AM	Poster Teardown	Texas Ballroom Poster Area
6:45-7:00 AM	<b>Research Update (ORS/OREF/NIH)</b> <i>Richard D. Coutts, MD, San Diego, CA and David C. Ayers, MD, Worcester, MA</i>	
<b>SESSION SIX</b>	<b>PRIMARY KNEE REPLACEMENT</b>	
7:00-7:55 AM	<i>MODERATORS: Douglas A. Dennis, MD and Michael E. Berend, MD</i>	
7:00 AM Paper #23	<b>Influences of Patient, Implant and Alignment on Survival of Medial Unicondylar Arthroplasty</b> <i>Matthew B. Collier, MS, Alexandria, VA</i>	
7:05 AM	<b>Discussion</b>	
7:11 AM Paper #24	<b>The Effect of the Insall-Salvati Ratio on Outcome after Total Knee Arthroplasty</b> <i>Jeffery L. Pierson, MD,* Indianapolis, IN</i>	
7:16 AM	<b>Discussion</b>	

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- 7:22 AM  
Paper #25 **Correcting Lateral Patellar Tilt at the Time of TKA can Result in Over-Utilization of Lateral Release**  
*James B. Benjamin, MD,\* Tucson, AZ*
- 7:27 AM **Discussion**
- 7:33 AM  
Paper #26 **PCL Substitution is Not Essential for Excellent Post-Operative Outcomes in TKA**  
*Brian S. Parsley, MD, Houston, TX*
- 7:38 AM **Discussion**
- 7:44 AM  
Paper #27 **Design Specific Increase In Range Of Motion With PFC Sigma RP-F: A Matched Control Study**  
*Sanjay K. Gupta, MD, New York, NY*
- 7:49 AM **Discussion**
- SESSION SEVEN** **COMPLICATIONS: PREVENTION, INVESTIGATION, AND EFFECTS**  
7:55-8:39 AM **MODERATORS: Carlos J. Lavernia, MD\* and Brian S. Parsley, MD**
- 7:55 AM  
Paper #28 **Total Joint Arthroplasty: When do Fatal or Near Fatal Complications Occur?**  
*William J. Hozack, MD,\* Philadelphia, PA*
- 8:00 AM **Discussion**
- 8:06 AM  
Paper #29 **The Role of FDG-PET Imaging in Diagnosing Periprosthetic Infection after Total Hip Arthroplasty**  
*Javad Parvizi, MD, Philadelphia, PA*
- 8:11 AM **Discussion**
- 8:17 AM  
Paper #30 **The Impact of Infected Total Hip Arthroplasty on Hospital and Surgeon Resource Utilization and Patient Access to Care**  
*Kevin J. Bozic, MD, San Francisco, CA*
- 8:22 AM **Discussion**
- 8:28 AM  
Paper #31 **Prophylaxis with VenaFlow and Enoxaparin vs VenaFlow and Aspirin for Thromboembolic Disease Prevention in Total Knee Arthroplasty**  
*Geoffrey H. Westrich, MD, New York, NY*
- 8:33 AM **Discussion**
- SESSION EIGHT** **REVISION TKR**  
8:39-9:34 AM **MODERATORS: David C. Ayers, MD and Brian J. McGrory, MD**
- 8:39 AM  
Paper #32 **Long Term Survivorship and Analysis of Failure Modes of 1000 Cemented Total Knee Arthroplasties**  
*Michael B. Vessely, MD,\* Lake Oswego, OR*
- 8:44 AM **Discussion**
- 8:50 AM  
Paper #33 **High Incidence of Fractures of the Polyethylene Tibial Post in a Posterior Cruciate-Substituting Total Knee System**  
*B. Sonny Bal, MD, Columbia, MO*
- 8:55 AM **Discussion**
- 9:01 AM  
Paper #34 **Femoral Component Failure in Hybrid Total Knee Arthroplasty at 17 Years**  
*Gavan P. Duffy, MD,\* Jacksonville, FL*
- 9:06 AM **Discussion**

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- 9:12 AM  
Paper #35      **Surgical Management of Symptomatic Instability Following Failed Primary Total Knee Arthroplasty**  
*Theodore P. Firestone, MD,\* Phoenix, AZ*
- 9:17 AM      **Discussion**
- SESSION NINE**      **REVISION THR**
- 9:23-10:30 AM      *MODERATORS: Adolph V. Lombardi, Jr., MD and David G. Lewallen, MD*
- 9:23 AM  
Paper #36      **A Prospective Outcomes Analysis of Femoral Component Fixation in Revision Total Hip Arthroplasty Comparing Modular, Cementless Fixation with Cemented Femoral Fixation**  
*Richard Iorio, MD,\* Burlington, MA*
- 9:28 AM      **Discussion**
- 9:34 AM  
Paper #37      **Extra Large Uncemented Hemispherical Acetabular Components for Revision Total Hip Arthroplasty: Results at a Mean of 12 Years**  
*Daniel J. Berry, MD,\* Rochester, MN*
- 9:39 AM      **Discussion**
- 9:45 AM  
Paper #38      **CT Follow-Up Evaluation of Operative Intervention for Peri-Acetabular Lysis**  
*Lalit Puri, MD, Chicago, IL*
- 9:50 AM      **Discussion**
- 9:56 AM  
Paper #39      **The Use of a Trabecular Metal Acetabular Component and Trabecular Metal Augment for Severe Acetabular Defects**  
*Scott M. Sporer, MD,\* Winfield, IL*
- 10:01 AM      **Discussion**
- 10:06 AM  
Paper #40      **Acetabular Revision using a Trabecular Metal Acetabular Component for Severe Acetabular Bone Loss Associated with a Pelvic Discontinuity**  
*Wayne G. Paprosky, MD, Winfield, IL*
- 10:11 AM      **Discussion**
- 10:16 AM      **Adjourn**

**Please return your completed Evaluation Form to the Registration Desk at the end of the Meeting. Thank you for your participation!**

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### Arthrofibrosis Following Total Knee Arthroplasty: Insight Into Molecular Mechanism

Javad Parvizi, MD, FRCS, Marla J Steinbeck, PhD, Theresa A Freeman, PhD,  
Michael D Ries, MD, James A Rand MD, Peter F Sharkey, MD

Knee stiffness is a disabling condition that can affect 3 to 4% of patients undergoing total knee arthroplasty. Although a number of factors are known to result in this undesirable complication, stiffness following knee arthroplasty can develop in patients for whom no 'identifiable' cause exists.

The cause of 'idiopathic' stiffness following knee arthroplasty remains elusive. This study represents the findings of a series of molecular studies performed on periarticular tissue samples retrieved from patients with arthrofibrosis undergoing revision surgery. We have demonstrated that activation of inflammatory cells results in the production of Reactive Oxygen and Nitrogen Species (RONS) such as superoxide anion, H<sub>2</sub>O<sub>2</sub>, hypochlorous acid/chlorine gas (HOCl/Cl<sub>2</sub>) and nitric oxide. These products can in turn lead to the breakdown and disorganization of periarticular proteins, in particular collagen. We have also shown that extensive scar formation around the knee joint is initiated and propagated, at least in part, by the release of ROS products in susceptible patients. Some individuals with a deficiency in the degradation pathway or others with exaggerated production, all leading to relative abundance of ROS, are at risk of aggressive scar formation during tissue repair that can lead to stiffness following knee surgery. A series of preliminary genetic studies have been performed to identify potential biomarkers. We believe understanding the molecular mechanism of arthrofibrosis can lead to design and administration of treatment protocols, aimed at reducing ROS accumulation, that can potentially minimize or prevent this undesirable complication.

### Muscle Damage After Total Hip Arthroplasty Done with the Two-Incision Minimally Invasive and the Mini-Posterior Techniques

Rodrigo Mardones, MD, Mark W Pagano, MD, Robert T Trousdale, MD, Michael Nemanich

**Introduction:** Some surgeons suggest that two-incision total hips are done without cutting any muscle or tendon. To our knowledge that claim is not supported by any published clinical or basic science data. This study quantified the amount and location of damage to the hip musculature after two-incision total hip arthroplasty and compared that with the damage after a mini-posterior hip.

**Materials & Methods:** Our institutional review board approved a 20 cadaver matched-pair analysis. The two-incision side was assigned randomly; the mini-posterior technique was done contralaterally. Two-incision hips were done with fluoroscopy as described by Mears and Berger using an uncemented socket and a straight, fully-coated femoral stem. The mini-posterior hips were done with the same implants.

**Results:** After component placement the extent and location of muscle damage was graded using Tornetta and colleagues' method. Every 2-incision hip had measurable damage to the abductors, the external rotators or both. Every mini-posterior hip had the external rotators taken down and there was additional measurable damage to the abductors.

**Conclusion:** This study does not support the contention that a two-incision total hip is done without cutting any muscle or tendon. No 2-incision hips were done without cutting or damaging gluteus medius or minimus muscle or piriformis or conjoint tendon of the hip. Similarly, no mini-posterior hips were done without damaging a portion of the medius or minimus muscle even after taking down the external rotators as part of the exposure.

## Patellar Tendon Attachment and Healing to Porous Tantalum: An Experimental Canine Study

Ari Itala, John Reach, Franklin H Sim, Kai-Nan An, David G Lewallen, MD

**Introduction:** In patients with patellar tendon avulsion associated with TKA, or those with massive proximal tibial bone loss and segmental replacement, restoration of extensor mechanism integrity by direct patellar tendon healing to a prosthetic surface might provide for improved functional outcomes. Porous tantalum is an interesting new biomaterial which appears to provide for rapid bone and soft tissue ingrowth into the interconnected porosities of the material. (Bobyne et al., 1999; Reach et al. 2004) This study was done to determine whether patellar tendon attachment to a porous tantalum surface might result in tendon healing sufficient to resist physiologic loads.

**Materials & Methods:** In 33 skeletally-mature canines the patellar tendons were elevated sharply and then reattached to the area of the tibial tuberosity by fixing the tendon between two tantalum washers with a screw. Animals were allowed full weight-bearing post surgery, and were sacrificed after 3, 6 and 12 weeks of healing. Clinical function using gait analysis, tendon mechanical stiffness and strength (to failure) and histomorphometric changes were evaluated at all 3 time points

**Results:** Gait analysis showed that the vertical ground reaction force from the operated hind limb recovered to the level of contralateral limb by 6 weeks ( $p>0.05$ ). Compared to the contralateral control limb intact tendon values, tensile strength and stiffness of the tendon implant constructs increased dramatically between 3 and 6 weeks with strength values exceeding 75% of intact control, and stiffness values ranging between 80 and 90% after 6 weeks. (see table) Histological analysis showed extensive tendon tissue ingrowth deep into the voids of the porous material.

Time Postop	Tensile Strength (vs ipsilateral control)	Stiffness (vs control)
3 weeks	34 ± 13%	63 ± 41%
6 weeks	76 ± 12%	89 ± 46%
12 weeks	77 ± 3%	83 ± 33%

**Conclusion:** This study demonstrates that under stable mechanical interface conditions patellar tendon healing to a porous tantalum surface can be achieved with rapid return of strength and stiffness over the first 6 to 12 weeks in this experimental model. These results suggest that tendon fixation and healing to prosthetic devices may well be feasible using this material. This should allow improved treatment of patients undergoing reconstruction for massive bone loss or following segmental resection of the proximal tibia (and other critical tendonous attachment sites).

### Differentiating Infection from Aseptic Loosening: Analysis of Synovial Fluid Gene Expression Patterns

Carl Deirmengian, MD, Jess H. Lonner, MD, and Robert E. Booth Jr, MD

We have previously demonstrated that white blood cells aspirated from patients with *S. aureus* infected knees have a gene expression pattern that is dramatically different than patients with gout of the knee. The purpose of this study is to apply this new concept indistinguishing infected total knee arthroplasties from aseptically loose total knee arthroplasties. Synovial fluid was aspirated from patients with a total knee arthroplasty undergoing surgical intervention for acute infection or aseptic loosening. Patients with acute infection had elevated synovial fluid white blood cell counts (> 5,000), elevated ESR, elevated CRP, and positive bacterial cultures. Patients with aseptic loosening had low synovial fluid cell counts (<3,000), loose components, and low clinical suspicion of infection. Ribonucleic acid was isolated from the synovial-fluid white blood cells and was analyzed on the Affymetrix U133Aplus2 GeneChip. The white blood cells from patients with infection have a gene expression pattern that is different than patients with aseptic loosening. There are 2461 genes that have an expression level that is significantly different between the groups. These genes fall into families with common function, and corresponded to the gene profile found to differentiate infection from gout in a previous study. These gene families include interleukins, antibacterial peptides, the defense response, and the toll receptor bacterial detection family. Synovial white blood cells are responsive cells that exhibit specific gene expression patterns during infection, differentiating them from the cells in aseptic conditions. With further study, inexpensive synovial fluid tests with a high sensitivity and specificity for infection could be developed.

### Early Wear Performance Of Highly Cross-linked Polyethylene In Total Hip Arthroplasty: A Prospective Randomized Controlled Study.

Richard W McCalden, MD, Steven J MacDonald, MD, Cecil H Rorabeck, MD,  
Robert B Bourne, MD, David G Chess, MD

**Introduction:** This study reports on the early clinical and wear performance of a prospective randomized controlled trial comparing highly cross-linked to standard polyethylene in total hip arthroplasty.

**Methods:** One hundred patients enrolled in a prospective randomized controlled trial received identical hybrid total hip arthroplasties with the exception of the polyethylene insert. 50 patients received a conventional polyethylene and 50 patients received a highly cross-linked polyethylene liner. Clinical outcomes were determined using Harris Hip, WOMAC and SF-12 scores. Head penetration rates were determined using a validated radiographic technique (Hip Analysis Suite) based on radiographs at 6 weeks, one, two and three years post-operatively.

**Results:** At two years minimum follow-up (range 2.5-4.5 yrs), there were no differences in Harris Hip, WOMAC or SF-12 scores. Wear analysis at one year post-op showed high penetration rates for both groups (mean 3D wear approximately 0.25 mm/year) consistent with the bedding-in phenomena. At most recent radiographic follow-up (two or three years), there was a statistically significant although modest difference in wear rates between the two groups with a 2D and 3D wear rate of  $0.14 \pm 0.10$  mm/yr and  $0.15 \pm 0.02$  mm/yr respectively for conventional polyethylene compared to  $0.09 \pm 0.04$  mm/yr and  $0.11 \pm 0.02$  mm/yr for cross-linked polyethylene. This represented a 32 and 29 percent reduction in 2D and 3D wear rates respectively with cross-linked polyethylene.

**Discussion/Conclusions:** At early follow-up, there were no clinical differences. There was a modest wear reduction (approximately 30%) with highly cross-linked polyethylene, considerably less than expected based on laboratory testing. Longer follow-up, after the bedding-in process is completed, is required to demonstrate the wear reduction afforded by highly cross-linked polyethylene.

## Three-Year Prospective Study of Serum and Urine Metal Levels In Patients With Metal-On-Metal Total Hip and Surface Arthroplasty

Joshua J Jacobs, MD, A K Skipor, MD, P A Campbell, MD, S Gitelis, MD,  
R A Berger, MD, T P Schmalzried, MD, and H C Amstutz, MD

**Introduction:** Metal-on-metal (MOM) articulating surfaces are becoming increasingly popular for hip replacement surgery. This ongoing prospective longitudinal study examines the serum chromium (SrCr), and cobalt (SrCo) and urine chromium (UrCr) levels in patients with MOM surface (SA) and total hip (THA) arthroplasty to specifically examine the relationship between head size and serum and urine metal levels.

**Methods:** Group 1 consisted of 22 patients with SA of the hip using the Conserve+ implant. Femoral head sizes ranged from 46-52 mm. Group 2 consisted of 15 patients with THA using the Perfecta or Extended Porous femoral component and the Transcend Quadrant cup. Femoral head size was 32 mm. The articulating surfaces in both implants are of identical metallurgy and manufacturing processes (Wright Medical). Serum and urine samples were collected and assayed pre-operatively and at 3, 6, 12, 24 and 36 months post implantation.

**Results:** All postoperative median levels, in both groups, were statistically greater than pre-operative levels. The median metal levels were statistically greater in the SA's for CrS and CoS at 2-4 months postoperatively. No other statistical differences were observed between the two groups.

**Discussion:** This study is among the first to address the effect of head size on serum and urine metal content in patients with metal-on-metal bearings in which the metallurgy of the bearings is identical in all patients. This data demonstrates that beyond four months postoperative, the larger head sizes associated with MOM SA (about 50% larger than the THA) do not lead to higher circulating or excreted metal levels.

**The FDA has not cleared the pharmaceutical and/or medical devices for the use described in this presentation (Conserve+).**

### Comparison Of Acetabular Wear And Osteolysis In RAM Extruded Versus Machined Compression Molded UHMWPE.

Richard W McCalden, MD, Constant A Busch, MD, **John M Martell, MD**, Steven J MacDonald, MD, Robert B Bourne, MD, Cecil H Rorabeck, MD

**Introduction:** Reduced implant survivorship due to aseptic loosening has prompted research into alternative bearing materials. Simulator testing is useful, but clinical studies are the gold standard to evaluate the wear characteristics of new bearing materials. Net compression molded polyethylene has clinically reported improved wear characteristics over traditionally used RAM extruded UHMWPE. Machining of the compression molded acetabular component however may be detrimental to its wear properties.

**Methods:** Ninety-two patients matched for gender, body mass index, primary pathology, Charnley grade, and length of follow up underwent uncemented total hip replacement using an identical acetabular and femoral implant. Group 1 (52 patients) had a RAM extruded polyethylene liner (GUR 4150 HP) and Group 2 (40 patients) had a machined compression molded polyethylene liner (Montell H 1900). UHMWPE sterilisation regimes were identical. Anteroposterior and lateral radiographs were analysed for acetabular wear using the Martell technique at a minimum follow up of five years and a maximum mean follow up of 87.4 months for group 1 (SD=8.7) and 84.9 months for group 2 (SD 7.7).

**Results:** Both 2D and 3D linear and volumetric wear rates in patients with a RAM extruded polyethylene acetabular component were 23-29% less compared to patients that received a machined compression molded acetabular liner. There was a statistical difference in age between to the two groups (P=0.007) with group 1 having a mean age of 62 versus 55 in group 2. Looking at acetabular wear in patients over 55 years, machined compression poly was still 16-31 % worse then RAM extruded polyethylene although statistical difference could not be reached for 3D linear and volumetric wear. The incidence of acetabular osteolysis on review of radiographs at maximum follow up was similar in both groups (group 1 =16.3% versus group 2 =15%).

**Conclusions:** Despite favourable reports of improved wear characteristics of net compression molded UHMWPE, this study shows a 23- 29% increase in 2D and 3D linear and volumetric wear in machined compression molded acetabular components. It appears that machining of compression molded polyethylene bar stock, to obtain the final component, is detrimental to the wear properties of the acetabular liner.

### Serum Metal Ion Levels and Bearing Surfaces in Total Hip Arthroplasty

Vijay J Rasquinha, MD, Chitranjan S Ranawat, MD, Joshua J Jacobs, MD,  
Anastasia K Skipor, MD, Jose A Rodriguez, MD

**Purpose:** This study aims to evaluate steady state serum metal ion levels in patients with four different bearing surfaces.

**Methods:** After IRB approval, 40 patients with minimum 5 years well functioning primary total hip arthroplasty were enrolled to have serum metal ions measured. The patients comprised four cohorts (10 patients each) with cemented metal on all polyethylene, non-cemented metal on polyethylene, non-cemented ceramic on polyethylene and non-cemented metal on metal primary total hip arthroplasty. All patients were operated on by a single surgeon and were evaluated using HSS clinical and standardized radiographic criteria. Serum metal ions comprising chromium, cobalt and titanium levels (parts per billion) were measured and the cohorts were compared for significant differences between the groups ( $p < 0.05$ ).

**Results:** Clinical and radiographic evaluation confirmed well-functioning hips and no component loosening, osteolysis, malposition or impending failure. Serum chromium and cobalt levels in the metal on metal cohort were significantly higher ( $p < 0.05$ ) compared to the other cohorts. Serum titanium levels in the metal on metal cohort were not significantly different ( $p > 0.05$ ) compared to the other cohorts. Non-cemented ceramic-poly patients had significantly lower ( $p < 0.05$ ) serum chromium levels compared to cemented and non-cemented metal-poly patients and significantly higher ( $p < 0.05$ ) serum titanium levels compared to cemented metal-all poly patients.

**Discussion:** Steady state serum metal ions with metal on metal articulations were significantly higher in terms of chromium and cobalt compared to the other bearing surfaces and fixation modes. Chromium debris generated at the metal head neck modular junction affects serum levels and is significantly lower in ceramic-polyethylene hip bearings.

**Hospital Volume and Outcomes of Total Hip  
Arthroplasty in the United States**

**Christopher J Doro, MD**

The purpose of this study was to examine the effect of hospital volume on outcomes for primary and revision total hip arthroplasty (THA). The Nationwide Inpatient Sample (NIS) database was used to identify our patient set. Outcome variables included in-hospital mortality and prolonged length of stay (PLOS). Primary THA mortality was 0.16% in the highest volume quartile and 0.29% in the lowest volume quartile ( $p < 0.001$ ). The rates of PLOS showed improved outcomes in the highest volume hospitals. Similar trends were found for revision THA, with an in-hospital mortality of 1.20% for lowest volume hospitals and 0.48% for highest volume hospitals ( $p < 0.001$ ). Hospitals with higher volume had superior inpatient outcomes for total hip arthroplasty and revision arthroplasty.

### A Randomized, Prospective Evaluation of Outcome After Total Hip Arthroplasty Using Crosslinked Marathon® and Non-Crosslinked Enduron® Polyethylene

C. Anderson Engh, Jr., MD, Stuart D. Ginn, BS, Christi J. Sychterz, MS,  
Robert H Hopper, Jr., PhD, and Charles A. Engh, MD

**Introduction:** Crosslinked liners were introduced with the promise that they would substantially reduce polyethylene wear. In 1999, our institution initiated a prospective study to compare the outcome of total hip arthroplasty (THA) patients who were randomized to either non-crosslinked Enduron liners or Marathon polyethylene liners that had been crosslinked with 5.0 Mrad of gamma-irradiation and heat treated to eliminate free radicals.

**Methods:** Between January of 1999 and June of 2000, we performed 236 total hip arthroplasties among 226 patients who were enrolled in an IRB-approved prospective study. Patients were implanted with a Duraloc 100 cup (DePuy), a 28-mm CoCr femoral head, and a 4-mm lateralized polyethylene liner. Six patients (6 THAs) were excluded intra-operatively. Among the remaining 230 THAs, 114 were randomized to Enduron and 116 to Marathon. We have evaluated clinical outcome at routine follow-up and used a validated, computer-assisted method (Martell's Hip Analysis Suite), to measure femoral head penetration on serial x-rays. Wear rates were calculated using a linear regression based on at least three x-rays.

**Results:** Minimum 2-year follow-up is available for 219 hips and 156 cases have at least 5-year follow-up. The mean follow-up for all cases is 5.0+1.3 years. There has been one polyethylene exchange for recurrent dislocation among the Enduron liners and one open reduction without component exchange among the Marathon liners. Closed reductions have been performed for one additional Marathon and two other Enduron THAs. Patient satisfaction was 98% among the Enduron group and 96% for the Marathon group ( $p=0.44$ ). The mean wear rate was 0.20+0.12 mm/yr for the Enduron liners and 0.02+0.06 mm/yr for the Marathon group ( $p<0.001$ ).

**Discussion & Conclusion:** The clinical outcome among both the Marathon and Enduron liners is similar. However, the Marathon liners demonstrate 90% less wear than the non-crosslinked Enduron liners. The clinical wear performance confirms predictions based on laboratory simulations. Continued follow-up will be required to determine if the reduction in wear among the Marathon liners results in less osteolysis.

## Symposium 1

## Why I Chose this Technology for my Practice and Patients

### Alumina Ceramic Bearings for Total Hip Arthroplasty

James A. D'Antonio, MD, William N. Capello, MD, Michael T. Manley, PhD

- Summary:** At five-year minimum follow-up, alumina ceramic bearings are functioning well with fewer revisions and less osteolysis than the control cohort.
- Introduction:** Alumina ceramic bearings have known superior wear resistance, lubrication, and scratch resistance, and do not carry a risk of metal ion release. A U.S. IDE clinical trial began in 1996 utilizing new improved alumina ceramic materials and implant design. This report evaluates study patients with a minimum five-year follow-up.
- Methods:** Three-hundred-seventeen patients (341 hips) currently have mean six year (range, 5 to 8 year) clinical and radiographic follow-up. Subjects include 257 alumina-alumina ceramic and 84 metal-on-polyethylene controls with a mean age at time of surgery of 54 years.
- Results:** There was no significant difference between the ceramic bearing and the control cohort with regard to demographics or clinical scores at five to eight years. Mean Harris Hip Score is 97 for both groups at most recent follow-up. Proximal femoral osteolysis was found in 0.6% for the ceramic bearing group compared to 22.1% in the control group. Revision rate was 1.8% for the ceramic bearing group compared to 7.4% for the control group. There have been no ceramic fractures or ceramic bearing failures to date.
- Discussion & Conclusion:** These findings demonstrate that, at minimum five-year follow-up, ceramic bearings perform as well as the metal-on-polyethylene clinically, with fewer revisions and less osteolysis. This would suggest that alumina ceramic bearings are a safe option for patients who are younger and more active.

### Highly Crosslinked Polyethylene in THR

Daniel J. Berry, MD

Ceramic-on-ceramic, metal-on-metal, and highly crosslinked polyethylene bearings in modern incarnations all appear to have favorable mid-term results, and all may play a valuable role in the hip surgeons' armamentarium for specific indications.

All three of these new bearings have much reduced in vivo wear compared to conventional polyethylene. Highly crosslinked polyethylene does not have quite as low a wear rate as hard-on-hard surfaces but does provide some other benefits hard bearings do not share. Crosslinked polyethylene, when used properly, is unlikely to share the fracture risk of ceramic bearings and does not have increased metal ion levels seen in metal bearings. Crosslinked polyethylene is less sensitive to intra-articular impingement than hard-on-hard bearings. Crosslinked polyethylene allows the surgeon more flexibility with respect to elevated rim and lateralized liner options than hard surfaces. Crosslinked polyethylene is much less expensive than hard surfaces.

Mid-term clinical data emerging from many centers demonstrate substantial in vivo wear reductions of crosslinked compared to conventional polyethylene. The latest available data from many centers will be presented.

## **Research Committee Update AAHKS Membership Survey Results:**

### Current treatment practices of members of AAHKS for the treatment of osteonecrosis of the adult femoral head

**Brian J. McGrory, MD**, Sally York, MN, RNC, Richard Iorio, MD, William Macaulay, MD, Richard R. Pelker, MD

A standardized protocol for evaluating and treating osteonecrosis (ON) of the adult femoral head does not currently exist in the United States, despite continued scientific investigation and the introduction of new treatments and surgical techniques. In order to understand current treatment practices, a survey was mailed to the active members of the American Association of Hip and Knee Surgeons.

The rate of response of 54% establishes a 95% +/- 5% confidence level, and the survey provides orthopaedic surgeons with a compilation of responses that may ultimately serve as a foundation for a standard evaluation and treatment protocol for adult osteonecrosis of the hip.

Total hip replacement is the most popular intervention for post collapse (crescent sign and progressive) stages of osteonecrosis; core decompression is the most commonly offered treatment for symptomatic pre-collapse ON.

### Incidence of Reoperation and Reasons for Reoperation after Minimally Invasive Unicompartmental Knee Arthroplasty

**William G. Hamilton, MD**, Matthew B. Collier, MS, Eshan Tarabee, MS, James P. McAuley, MD, C. Anderson Engh, Jr., MD, Gerard A. Engh, MD

The goal of this report is to review reoperations undertaken within the first 3 years of the initial 221 unicompartmental arthroplasties performed using a minimally invasive technique and the same component design. A comparison was then performed between these cases and the 514 medial unicompartmental arthroplasties performed with an open exposure over the prior 17 years. In the minimally invasive group, 9/221 (4.1%) knees were revised (8 for component loosening, 1 for deep infection). 16/212 unrevised knees have required a total of 18 non-revision reoperations. Overall, 25/221 knees required at least one reoperation (total reoperation rate: 11.3%). By comparison, the historical open exposure group had 35/514 (6.8%) knees that required revision, 10/514 (1.9%) knees that required a non-revision reoperation, and total reoperation rate of 45/514 (8.6%). While a majority of these reoperations were due to excessively shelf aged polyethylene, the revision rate due to aseptic loosening was 5/514 (1.0%). Despite an accelerated recovery and decreased hospital stay in our minimally invasive unicompartmental arthroplasties, the rate of revision due to aseptic loosening (3.7% vs. 1.0%) and the overall reoperation rate (11.3% vs. 8.6%) compare unfavourably to those performed with an open technique. Familiarity with the concerns related to the minimally invasive technique may help reduce the need for reoperation while maintaining benefits of less invasive approaches.

### Two-Incision Total Hip Arthroplasties Had Modest Outcomes and Some Substantial Complications

Mark W Pagnano, MD, James M Leone, MD, David G Lewallen, MD, Arlen D Hanssen, MD

**Introduction:** Proponents of two-incision total hip arthroplasty suggest this technique is minimally invasive and promotes rapid rehabilitation with a low prevalence of complications. To our knowledge, however, the limited data that is available involves a selected sub-group of patients who are younger and have fewer medical problems than the typical total hip patient. To sort out the confounding variables of surgical technique, patient age and patient co-morbidities we performed 80 consecutive two-incision hips in unselected patients and compared those with the prior 160 unselected, consecutive traditional open total hips.

**Materials & Methods:** 80 consecutive patients (45 female, 35 male) with a mean age of 70.5 years had a total hip done with the two-incision technique described by Mears and Berger. All patients had an uncemented socket and an uncemented proximally coated stem. The mean operative time was 68 minutes.

**Results:** The prevalence of substantial early complications was 14 percent (11 of 80) and included 4 intraoperative proximal femoral fractures treated with a cable, 3 postoperative periprosthetic femoral fractures that required femoral revision and resulted in one deep infection, 1 anterior dislocation that required open reduction, and 1 femoral subsidence that required no treatment. The prevalence of complications in the prior 160 open THA done with similar implants was 3.75 percent (4 intraoperative proximal femoral fractures, no postoperative fractures, 2 dislocations).

**Conclusions:** Patient and surgeon enthusiasm for the potential benefits of the two-incision total hip must be tempered against a substantial (14 percent) prevalence of complications when the technique is applied widely to typical total hip patients.

### Patients Preferred a Mini-Posterior THA over a Contralateral 2-Incision THA: Results in Patients Treated with the Same Anesthetic and Rehab Protocol

Mark W Pagnano, MD, Arlen D Hanssen, MD, **Robert T Trousdale, MD**

**Introduction:** Much attention has been given to the purported early functional benefits of a so-called 2-incision THA approach. Most of the reports to date however are on selected patients who were treated with advanced anesthetic and rehabilitation protocols that make comparison to historical data difficult. We have had a broad experience with the 2-incision THA and now have a subgroup of patients who have had a 2-incision THA on one side and a mini-posterior THA done on the contralateral side with the same anesthetic and rehabilitation protocol.

**Materials & Methods:** In 2003 and 2004 26 patients had staged bilateral THAs with a 2-incision hip on one side and a mini posterior hip on the other side. A comprehensive anesthesia protocol and rapid rehabilitation protocol were employed after each operation. Patients completed a milestone diary of their early function, were asked to state a preference for one hip or the other and state a reason why.

**Results:** 16 of 26 patients preferred the mini posterior hip: 50% because of better early recovery, 25% because of better cosmetic result and 25% because of combination of better recovery and better cosmetic result. 8 patients preferred the 2-incision THA and all of them attributed that to better early recovery. 2 patients had no preference.

**Conclusion:** Patients who have had both a mini-posterior THA and a 2-incision THA more often preferred the mini-posterior side. In this study, the added technical difficulty of the 2-incision THA was not rewarded with better function or greater patient satisfaction.

### Minimally Invasive Hip Replacement: Surgeons versus Patients Prospective

Javad Parvizi, MD, Aidin Eslampour, MD, Peter F Sharkey, MD,  
William J Hozack, MD, Richard H Rothman, MD

**Introduction:** THA has been performed with excellent outcome for over three decades. In recent years there has been an increasing debate regarding possible role of minimally invasive (MIS) THA. The exact impetus behind introduction of MIS THA is not known. We conducted a questionnaire survey of the American Hip Society members and compared the responses of the surgeons with the response of patients who were being considered for THA.

**Methods:** Questionnaire containing 35 questions was sent to all 100 members of the Hip Society. A similar survey was given to patients with end stage arthritis of the hip attending a single urban center orthopedic center and prior to seeing an orthopedic surgeon. The questionnaires aimed to assess the safety, efficacy, complications, and various other issues associated with MIS THA.

**Results:** 50 members of the Hip Society completed the survey. 50 consecutive patients were surveyed. 80% of surgeons admitted to performing MIS THA of whom 2/3 defined MIS as small incision surgery while the other 1/3 performed THA through an alternative tissue plane (two incision or anterior approach). 77% of surgeons had implemented some changes in their routine practice when performing MIS THA, which included pre-emptive analgesia, preoperative patients education, changes in anesthesia, use of different instruments, aggressive rehabilitation. 65% of surgeons felt that aggressive marketing by industry is the main reason behind MIS THA. 73% of surgeons had encountered some complication related to MIS THA. 53% of surgeons and 13% of patients believed MIS THA was associated with more complication and 86% of surgeons thought MIS THA was not proved to be safe. 66% of patients had heard of MIS THA. The knowledge regarding MIS THA expressed by 80% of patients was either inaccurate or not substantiated by any studies.

**Discussion:** This survey highlights the inadequacy of our current understanding of MIS THA. Aggressive industry marketing is blamed for introduction of MIS THA into the orthopedic community without performing outcome studies to prove safety and efficacy of the procedure. Some of the potential beneficial effects of MIS THA may relate to implementation of changes in surgical, anesthesia and rehabilitation protocols. The survey also identified lack of education on the part of the patients as an important shortcoming.

### Minimal Single Incision Posterior THA

Thomas Parker Vail, MD

Current literature supports the concept that limited tissue trauma is more important than the length of the incision. Pain management and a comprehensive approach to rehabilitation can improve and accelerate the outcome with any approach to the hip. Thus, the ideal approach to the hip should allow customization of the incision length to achieve optimal implant placement through the smallest possible incision for a given patient anatomy. The single posterior incision provides access to the hip joint with maximal visualization and limited tissue trauma. Advantages include the lateral position which moves soft tissue away from the surgical field, incision placement through gluteal skin away from large cutaneous nerves, and avoidance of the gluteus medius muscle. Access is achieved by longitudinal splitting of the gluteus maximus muscle at the interval between its middle and posterior third. The approach proceeds through the interval between the piriformis and gluteus minimus muscle. A capsulotendinous flap is created, the hip is dislocated posteriorly, and the femoral neck is osteotomized. The acetabulum is exposed by translating the femur forward with a retractor placed under the femoral neck and over the anterior rim of the acetabulum.

The short oblique posterior incision was developed in conjunction with anatomic dissections used to define the optimal incision placement for a capsular incision that would preserve the ischiofemoral ligament of the hip capsule. After 1999, this approach was used exclusively in primary hip arthroplasty. In order to determine the complications that could be associated with this approach, we have completed a review of a consecutive series of seven-hundred primary total hip arthroplasties done through a minimal posterior incision. The minimum follow-up was one-year, (range 1 to 5 years) and complications were separated into groups that occurred before and after the 3 month post-operative visit. More than 75% of the patients received a form of regional anaesthesia (spinal, epidural, or regional blocks). An intraoperative radiograph was utilized on every case to assure optimal implant position prior to leaving the OR. All patients received low molecular weight heparin for post-operative thromboprophylaxis. Average length of stay in the hospital was 3.48 days (range, 1 to 29). Within the first 3 months of surgery twenty-two patients (3.1 %) had post-operative extremity complications: 2 DVT's (0.3%), 2 non-fatal PE's (0.3%), 5 dislocations (0.7%), 2 fractures (0.3%), 4 superficial infections (0.6%), 3 deep infections (0.4%), 2 hematomas requiring irrigation and debridement (0.3%), and 2 deaths. After 3 months there were 4 additional infections (4 mos, 9 mos, 18 mos, 3.5 yrs), and 4 additional dislocations (4 mos, 2 yrs, 2 yrs, 4.5 yrs). This extensive consecutive series suggests that a minimal incision approach performed by an experienced surgeon after appropriate training does not compromise the early outcome of a primary total hip arthroplasty, and can be used for all patients.

### A Randomised Blinded Clinical Trial Assessing Efficacy Of Peri-Articular Injection Using Multimodal Analgesia In Total Knee Replacement

Steven J MacDonald, MD

**Introduction:** A prospective randomized blinded clinical trial was performed to assess the efficacy of an interarticular injection during total knee arthroplasty (TKA).

**Methods:** 64 TKA patients were randomized to receive a peri-articular intra-operative injection (ropivacaine, ketorolac, epimorphine and epinephrine) or nothing. The peri-operative anaesthetic analgesic regime was standardized.

**Results:** PCA use at 6, 12 and >24hrs post surgery was significantly less in patients receiving the injection ( $P < 0.01$ ,  $P = 0.016$ ,  $P < 0.01$ ). Patient satisfaction in PACU and 4hrs post operation was greater ( $P = 0.016$ ,  $P = 0.013$ ). VAS for pain during activity in PACU and at 4hrs were significantly less ( $P = 0.04$ ,  $P = 0.007$ ) in the injected group. The average ROM at 6wks was no different. Overall hospital stay and incidence of wound complications were not different between groups.

**Discussion:** Peri-articular intra-operative multimodal analgesia significantly reduces post-operative PCA requirement. Patient satisfaction was greater in the injection group. No cardio and central nervous system toxicity was observed.

### Post-op Pain Following Total Knee Arthroplasty: A Prospective, Double-Blinded, Randomized Study Comparing PCA, Pericapsular Injection, and Femoral Nerve Block

Amanda Marshall, MD, John Masonis, MD, Jeffrey Mokris, MD,  
John Oesterle, MD, John Camp, MD, David Mauerhan, MD

**Introduction:** Total knee arthroplasty (TKA) involves extensive tissue trauma resulting in significant post-operative pain. When inadequately treated, pain intensifies the reflex responses that can lead to serious cardiopulmonary and renal complications hindering early intense physical therapy, the most influential factor in knee rehabilitation. This investigation compares the effectiveness of three different post-op pain management modalities: [1]patient-controlled analgesic pump alone(Control), [2]Femoral Nerve Block(FNB) with PCA, and [3]pericapsular injection of opioid/anesthetic combination(CAP) with PCA.

**Methods:** Pre-operatively, 98 patients were prospectively randomized into the three post-op treatment groups (Control, FNB, and CAP). All patients underwent TKA under spinal anesthesia. The patients and clinical assessors were blinded to the randomization. Morphine consumption, visual analog pain scores, and range of motion was assessed at 2,4,8,12,24, and 48 hours post-op.

**Results:** Visual analog pain scores at all time intervals were similar amongst the CAP and FNB groups. At 4 hours, both CAP and FNB pain scores were significantly less than Control ( $p=.0028$ ). After 8 hours, the three groups showed no significant differences. Range of motion at 24 hours was greater for CAP and FNB groups compared to Control. At all time points, morphine consumption was less in CAP and FNB groups compared to Control, but there was no difference between CAP and FNB groups.

**Conclusions:** The use of supplemental pain management modalities reduces the post-op morphine requirement by approximately 30%. There is no significant difference in regards to pain scores, early range of motion, or morphine consumption between the femoral nerve block and pericapsular injection groups.

### The effect of a new multimodal perioperative anesthetic regimen on postoperative pain, side effects, rehabilitation, and length of hospital stay following total joint arthroplasty

Christopher L. Peters, MD, **Brayton Shirley, MD**, Jill Erickson, PA-C

**Summary/ Conclusion:** Implementation of a new multimodal perioperative pain protocol combined with early mobilization has shortened LOS, achieved better pain control, accomplished PT goals sooner, with less total narcotic consumption.

**Introduction:** Advances in anesthetic technique and perioperative management are often overlooked as important methods to lessen morbidity and speed recovery from total joint replacement. This study evaluated the effect of a new multimodal perioperative pain-management strategy combined with early mobilization on variables including length of stay, pain control, ambulation, narcotic usage and postoperative nausea and vomiting (PONV).

**Methods:** Two cohorts of 50 consecutive total hip arthroplasty (THA) and 50 total knee arthroplasty (TKA) patients from before and after starting the new protocol were compared. The protocol involved scheduled pre- and post-operative oral narcotics and COX-2 inhibitors, spinal anesthesia without long-acting narcotics, femoral nerve catheters for TKA patients, and local anesthetic wound infiltration. Intravenous (IV) narcotics use was discouraged. Ambulation with physical therapy (PT) was attempted for all protocol patients on the day of surgery (DOS). All surgeries were performed using the same approach, incision length and implants. Data was collected from the inpatient medical record.

**Results:** TKA patients length of stay (LOS) decreased from 3.1 days to 2.5 days, while THA patients LOS decreased from 3.7 to 2.5 days. Visual analogue pain scores (VAS) at rest decreased significantly for both TKA and THA patients on POD-1 and 2. VAS scores with PT on POD-1 and 2 were statistically unchanged except for a reduction in protocol THA patients on POD-2. All protocol patients were able to ambulate longer distances and consumed significantly less total narcotics. 8 of 50 protocol TKAs and 15 of 50 THAs required IV-narcotic rescue. One TKA and two THAs required patient-controlled-analgesia (PCA). There was no difference in rates of PONV between the groups.

**Discussion & Conclusion:** Implementation of a new multimodal perioperative pain protocol combined with early mobilization has shortened LOS, achieved better pain control, and accomplished PT goals sooner with less total narcotic consumption. Short-term outcomes and early functional recovery can be significantly improved independent of surgical technique.

### Is There An Association Between Pre-op Emotional Health and Post-op Exercise Adherence After TKR

Patricia Franklin, MD, Wenjun Li, MD, Brittany Boisvert, MD,  
Peter Denoble, MD, **David Ayers, MD**

TKR is an extremely successful operation, yet some patients do not achieve the expected increase in function post-op despite a skilled operative procedure using a prosthetic design with a proven track record. TKR patients who have a low MCS are less likely to improve physically after TKR. We have shown that low MCS patients report more anxiety and depression than high MCS patients. Limited evidence exists regarding rehabilitation after total knee replacement and how MCS may effect post-op rehabilitation and exercise adherence after TKR

- Methods:** 200 unilateral TKR patients were studied prospectively after informed consent. All patients completed SF-12 and WOMAC surveys pre-operatively and at 6 months. A sub-group completed a confidential exercise log documenting daily sets/repetitions for six standard exercises from week 3 through week 12 post-TKR. Analysis controlled for age, gender and BMI.
- Results:** 33% of TKR patients had a MCS <50 before TKR. This low MCS group had less improvement in physical function post-up despite a technically skilled operation without complication with a proven design ( $p < 0.01$ ). Exercise logs illustrate patient variation both within the same patient over time and between different patients. Scatter plots of pre-op MCS vs. exercise adherence show low MCS patients perform less mean daily exercise repetitions overall and exhibit greater variation in individual patients. Random effects model shows an increase in pre-op MCS corresponds to an increase in exercise/ repetition dose ( $p < 0.044$ ) when adjusted for gender, age and BMI
- Discussion:** Preliminary Data suggest low pre-op MCS correlates with fewer daily post-TKR exercise repetitions and with poorer post-op function at 6 months. This information is useful in designing a peri-operative intervention to improve post-op physical function in low MCS patients undergoing TKR. Funded by the AAHKS and the OREF.

### Post-Discharge Costs in Arthroplasty Surgery

Carlos J Lavernia, MD, Michele R D'Apuzzo, MD, Victor H Hernandez, MD,  
Mark T Rossi, PT, PhD, David J Lee, PhD

**Introduction:** Previous research has documented increasing expenditures on primary hip and knee Arthroplasty surgeries. Post discharge costs associated with these procedures have received limited attention in the literature. Our objective was to assess costs incurred after discharge from an acute care setting in primary hip and knee arthroplasty and to use this information to estimate total United States (US) post-discharge expenditures.

**Methods:** 136 consecutive patients who underwent primary arthroplasty were studied. Costs from the comprehensive research unit (CRU), professional fees, and home care (HC) costs were obtained. The 2003 National Hospital Discharge Survey data (NHDS) was used to model national cost estimates. Quality of life was also monitored before and at 3-12 months following replacement surgery using the WOMAC, SF-36, and the Pain Visual Analog Scale.

**Results:** The average cost per case on CRU was \$10,751  $\pm$  SE \$598, payments made to HC averaged \$2,393  $\pm$  SE \$92 and the average total compensation in professional fees was \$345  $\pm$  SE \$19. Approximately \$3.4 billion is spent annually on post-surgical rehabilitation services.

Post-discharge costs were significantly lower in patients discharged directly to home versus patients who were sent to the CRU (\$13,435 vs. \$2,405,  $p < 0.001$ ). The magnitude of quality of life improvements following surgery were similar in both groups

**Discussion:** Cost utility and effectiveness of post discharge interventions has not been adequately assessed. Post-discharge costs are significantly higher for patients going to a CRU versus those discharged home yet both groups had similar short term outcomes. Prospective randomized studies are needed to assess the effectiveness of post-discharge interventions.

### Acetabular Component Deformation with Press-fit Fixation

Matthew Squire, MD, **William L. Griffin, MD**, J.B. Mason, MD,  
Rick D. Peindl, PhD, and Susan Odum, MEd, MA

Acetabular component deformation secondary to forces encountered during insertion is a potential consequence of the press-fit technique. This study characterized the stiffness of Pinnacle 100 cups via mechanical testing and used this information with intraoperative measurements of cup deformation to calculate the in vivo forces acting on cups inserted during hip arthroplasty in 21 patients. We found that 90.5% of cups had measurable compression deformity, averaging  $0.16 \pm 0.16$  mm. The corresponding forces acting on these cups averaged  $412 \pm 419$  N. Compressive force was not related to age, diagnosis, or gender, but was marginally related to bone type. Cups press-fit into harder, Type A bone experienced greater mean forces than cups press-fit into Type B bone. For hard-on-hard bearing surfaces, such in vivo deformation of acetabular shells may result in negative clinical consequences such as equatorial loading with increased wear and potential seizing of components, chipping of ceramic inserts, or locking mechanism damage.

### Long-Term Outcome and Risk Factors of Proximal Femoral Fracture in Uncemented and Cemented Total Hip Replacement in 3089 Hips

**Michael E Berend, MD**, Merrill A Ritter, MD, E Michael Keating, MD, John B Meding, MD, Philip M Faris, MD, Jeff L Pierson, MD, Asher Smith, MD, Tim Lynch, MD, Ken Davis, MD

Proximal femoral fracture is a relatively common occurrence during THR. The purpose of this study was to identify risk factors associated with proximal femoral fracture during THR and report the outcome of the femoral prosthesis in uncemented and cemented THR. Risk factors examined included surgical approach, patient demographics of age, sex, and body mass index, type of femoral component fixation, and types of fracture treatment. 3089 hips were examined with up to 14 year follow-up (mean 4.7 years). 2295 (74%) femoral stems were cemented and 794 (26%) were uncemented. 82 hips had a proximal femoral fracture for an incidence 2.7%. Uncemented stem insertion had a significantly higher fracture rate at 6.9% compared to cemented stems at 0.8% ( $p < 0.0001$ ). Risk factors for proximal femoral fractures include anterolateral approach ( $p < .0001$ ), uncemented femoral component fixation ( $p < .0001$ ), and female gender ( $p = 0.0016$ ). Treatment with cerclage wiring was the most common treatment and long term femoral component stability was unaffected by the fracture for uncemented hips with titanium circumferentially coated stems. For cemented femoral stems, the stem survival rate was significantly decreased in hips with a proximal fracture compared to those without (93.3% vs. 97.1%) at 7 years follow-up ( $p < 0.0001$ ). This study identifies an “at risk” population based on surgical approach, gender, and the use of uncemented components for proximal femoral fracture during THA. Treatment with cerclage wiring in combination with tapered titanium proximally circumferentially coated implants yielded excellent clinical and radiographic results at mean of 4.7-years (range 0.3-14 yrs) follow-up.

### Tapered Titanium Porous Plasma Sprayed Femoral Component in Patients Aged 40 Years and Younger

Brad Ellison, MD, **Keith R. Berend, MD**, Adolph V. Lombardi, Jr., MD, FACS,  
Thomas H. Mallory, MD, FACS

Total Hip Arthroplasty (THA) performed in patients aged 40 years and younger requires several decades of implant use under increased activity demands. Implant longevity and stable fixation is necessary for 30 or more years. The current study investigates the longevity of the Mallory-Head primary porous femoral stem in primary THA in patients aged 40 years and younger at the time of the THA. Between 1987 and 2000, 249 primary THA in patients 40 years of age or younger were performed with the Mallory-Head porous femoral component in one practice. The average age at the time of THA was 34.7 years (range 20-40). Average height, weight, and BMI were 67 inches, 187 pounds, and 29 kg/m<sup>2</sup>. Follow-up averaged 91 months with 125 hips having minimum 5-year follow-up and 51 THA having minimum 10 years. Harris hip score improved an average of 37 points. Four stems have failed for 98.2% overall survivorship at 5, 10, and 15 years. Only 2 stems were revised for loosening for a 99.2% (95% CI: 96.4-99.8) survivorship with aseptic loosening as the end-point at 5, 10, and 15 years. In young patients, this tapered titanium, proximally porous plasma-sprayed femoral component provides outstanding long-term fixation and function with significant pain relief into the second decade. Overall femoral stem survivorship is 98.2% at up to 18 years.

### Does Neck/Liner Impingement Increase Wear of UHMWPE Liners?

**Molly M. Usrey, BS**, Philip C. Noble, PhD, Lanny J. Rudner, BA, Michael A. Conditt, PhD,  
Michael V. Birman, BS, Richard F. Santore, MD, Kenneth B. Mathis, MD

Though impingement damage, backside wear, and damage to the femoral bearing surface are common observations of acetabular liners, they have traditionally been studied independently. In this study we explore the hypotheses that repetitive impingement increases wear of UHMWPE inserts at both the articular surface, and the backside surface, potentially compromising the durability and function of the hip replacement. One hundred and thirteen acetabular components were retrieved during revision total hip arthroplasty after an average time in situ of 84 months. Each acetabular liner was examined with incident light and inspected for presence, location, and severity of signs of impingement and back-side wear. The depth of penetration of the femoral head into the acetabular liner was also measured to calculate articular wear. Sixty percent (68/113) of acetabular liners examined showed evidence of prosthetic impingement, with moderate or severe damage to the rim in 32% (36/113) of components. Significant backside damage was present in 31% (34/109) of components. Moderate or greater backside wear was found in 61% (22/36) of liners exhibiting significant impingement damage, vs. 16% (12/73) of liners without impingement ( $p < .0001$ ). The average wear rate of liners with moderate or severe impingement damage was  $0.33 \pm 0.07$  mm/yr, compared to  $0.19 \pm 0.04$  mm/yr for liners with mild or no impingement damage ( $p = .03$ ). Repetitive impingement frequently occurs after THR and leads to a multitude of adverse events, including motion between the liner and the acetabular shell leading to backside wear, and accelerated wear of the articular surface.

### One-Stage Bilateral Total Hip Arthroplasty As Compared With Unilateral Total Hip Arthroplasty

Javad Parvizi, MD, Aidin Eslampour, MD, Peter F Sharkey, MD,  
William Hozack, MD, **Richard Rothman, MD**

**Introduction:** It is believed that patients undergoing bilateral joint arthroplasty are at higher risk for developing cardiopulmonary and possibly other complications. Patient request, convenience, and multiple other factors compel orthopedic surgeons to perform bilateral joint arthroplasties. The aim of this prospective nearly matched study was to evaluate and compare the morbidity and mortality of bilateral simultaneous uncemented THA versus unilateral uncemented THA.

**Methods:** 100 consecutive patients undergoing simultaneous bilateral THA (50 patients, 100 hips) and unilateral THA (50 patients) were prospectively followed. Detailed review of the clinical and radiographic data for all patients was carried out to record the outcome of THA and note the nature and circumstances surrounding any complications.

**Results:** Both groups had similar demographic distribution, comorbidities, and body mass indices. The mean ASA score was lower for the BTHA group at 1.9 vs. 2.1 for the UTHA group. There were no statistically significant differences in 90-day mortality, individual major (8% for both) or minor (BTHA = 36%, UTHA = 38%) complications between the two groups. BTHA patients required more autologous and homologous blood and had lower hemoglobin at discharge than UTHA patients. More BTHA patients needed rehab transfer than did UTHA patients (96% vs. 74%). There were no significant differences in average length of hospital stay (BTHA = 4.6 days, UTHA = 4.3 days) or rehabilitation stay (BTHA = 9.7 days, UTHA = 8.4 days).

**Discussion:** Bilateral uncemented THA has similar morbidity and mortality as unilateral THA in this patient population. Uncemented one-stage bilateral THA carried out in an expeditious manner may be considered in a carefully selected group of patients without cardiopulmonary conditions.

### Influences of Patient, Implant and Alignment Factors on Survival of Medial Unicondylar Arthroplasty

Matthew B. Collier MS, Thomas H. Eickmann MD, Fumio Sukezaki MD,  
James P. McAuley MD, Gerard A. Engh MD

**Introduction:** Our purpose was to identify factors associated with revision of medial unicondylar arthroplasty.

**Methods:** One surgeon performed 295 unicondylar arthroplasties for medial compartment osteoarthritis between 1988 and 1997. Of these, the 245 knees with a fixed-bearing metal-backed tibial component and gamma-irradiated-in-air polyethylene were selected for study inclusion. The mean patient age and weight were  $67 \pm 8$  years and  $84 \pm 16$  kg. Initial tibial component thickness averaged  $8.7 \pm 1.3$  mm. Polyethylene shelf age averaged  $1.4 \pm 1.1$  years. The mean postoperative hip-knee-ankle angle was  $2^\circ \pm 3^\circ$  varus. In 240/245 cases, the survival status of the arthroplasty had been confirmed within the past 3 years. Multivariate statistical analysis (Cox proportional hazards regression) was used to assess whether revision was significantly associated ( $p < 0.05$ ) with patient (gender, age, weight), preoperative radiographic (lateral tibial subluxation), implant-specific (unicondylar system name, tibial component initial thickness, polyethylene shelf age), and postoperative radiographic (hip-knee-ankle angle, tibial component varus angle, intraoperative angular change in medial tibial plateau varus, tibial component posterior slope angle, intraoperative angular change in medial tibial plateau posterior slope, lateral compartment joint space width) factors.

**Results:** Five factors were associated with revision: patient age, initial tibial component thickness, polyethylene shelf age, angular change in tibial plateau varus, postoperative hip-knee-ankle angle. The risk of revision increased roughly two-fold with any of the following: 10-year younger patient, 2mm thinner tibial component, 1-year longer shelf age,  $5^\circ$  less decrease in medial tibial plateau varus,  $8^\circ$  more varus hip-knee-ankle angle.

**Discussion:** Five examined factors (patient age, tibial component initial thickness, polyethylene shelf age, postoperative coronal plane knee angle, intraoperative relative decrease/increase in medial tibial plateau varus) may explain the relative level of success achieved with unicondylar systems that featured metal-backed implants and gamma-irradiated-in-air polyethylene. Importance of the examined factors should be investigated with contemporary unicondylar systems, as manufacturers now employ alternative polyethylene sterilization practices and produce more all-polyethylene components.

### The Effect of the Insall-Salvati Ratio on Outcome after Total Knee Replacement

Jeffery L. Pierson, MD, R. Michael Meneghini, MD, Merrill A. Ritter, MD, John B. Meding, MD, E. Michael Keating, MD, Philip M. Faris, MD, Michael E. Berend, MD, Kenneth Davis, MD

**Purpose:** To evaluate the effect of total knee replacement (TKR) on patellar tendon length, as measured by the Insall-Salvati ratio (ISR), and the effect of the ISR on the outcome of TKR.

**Methods:** A retrospective review of 1055 primary TKRs performed in 1997-1998 was performed. Radiographic measurements were made of the patellar tendon length (PT) and patella (P) length pre- and postoperatively. From these measurements, the Insall-Salvati ratio was calculated (PT/P). Regression analysis was performed to determine the effects of these variables on range of motion (ROM), Knee Society Score (KSS), and stair, function and pain scores.

**Results:** TKR resulted in a decrease in the ISR in 50% of cases. Patella infera (ISR < 0.8) developed postoperatively in 9.8% of TKRs. A decrease in the ISR was associated with significantly worse stair and function scores (p= 0.0004 and 0.0081, respectively). There was no significant effect upon ROM, KSS, or pain scores. Optimal outcomes were observed in patients where the ISR was not decreased after TKR, with superior stair and function scores.

**Discussion:** TKR results in a decrease in patellar tendon length, as measured by the Insall-Salvati ratio, in 50% of patients. When this occurs, stair and function scores after TKR are adversely affected compared to patients in whom the ISR is not decreased. The overall KSS, pain score, and ROM are not affected by a change in the ISR. Patella infera develops in 9.8 % of knees after TKR and is twice as likely to occur in women as men.

### Correcting Lateral Patellar Tilt at the Time of TKA Can Result in Over-Utilization of Lateral Release

James Benjamin, MD, Margaret Chilvers, MD

Ninety-nine consecutive patients undergoing primary TKA with cruciate retaining prostheses over an 11-month period were prospectively examined. Intra-operative evaluation included measurement of pre and post-resurfacing patellar thickness and medial patellar lift off at 30° of flexion without any manual pressure on the patella. Regardless of medial patellar lift-off no lateral releases were performed. Tibio-femoral angles, patellar tilt and patellar congruence angles were measured pre and post-op. There were no patellar subluxations, dislocations or complications related to the patello-femoral joint in the post-operative period. Patellar tilt improved from a mean of 7.9° pre-op to 3.8° post-op and the congruence angle improved from 13.9° pre-op to 5.1° post-op. Seventeen patients had ≥10 mm of medial patellar lift off intra-operatively (mean 14 mm, range 10-22mm). Patients with ≥10mm of intra-operative lift off improved from 9.9° tilt pre-op to 6.6° post op. Patients with no intra-operative lift off changed from 6.3° to 2.9°. Although the two groups were statistically different, the amount of change from pre-op to post-op was not different between the groups. There was no difference in pre or post-op congruence angles between patients with or without intra-operative patellar lift off. There was no correlation between pre-op tibio-femoral alignment and patellar lift off intra-operatively. Based on the “rule of no thumb” the lateral release rate in this series would have been at least 18%. Patients with medial patellar lift off at the time of arthroplasty do not appear to require lateral release to yield acceptable post-operative patello-femoral alignment.

### PCL Substitution Is Not Essential for Excellent Post-Operative Outcomes in TKA

**Brian S. Parsley, MD**, Michael A. Conditt, PhD, Roberto Bertolusso, BS, Philip C. Noble, PhD

This study was performed to compare the post-operative range of knee motion and functional outcome of total knee replacements performed with a PCL-substituting knee prosthesis compared to an ultracongruent PCL-sacrificing design. 209 patients underwent primary total knee arthroplasties by the same surgeon utilizing the same surgical approach and a hyperflexion post-operative rehab protocol. 121 knees with a posterior stabilized (PS) design and 88 knees with a highly conforming, PCL-sacrificing, ultracongruent (UC) design were retrospectively reviewed with a minimum 2-year follow-up period. The age, sex, and pre-operative Knee Society scores were equivalent for both groups. There was a significant improvement in knee flexion, ROM, Knee Score and Function Score within each group. Comparatively, the post-operative mean total ROM was slightly higher with the PS design (PS=119.9±10.8°, UC=116.7±10.2°; p=0.04). However, the two patient groups were the same post-operatively in terms of the improvement in ROM, knee score, function score, satisfaction level, and several post-operative activity metrics. The slight improvement in post-operative knee flexion with the PCL substituting design may be attributed to the benefits of mechanical substitution of the function of the PCL or possibly by the slightly greater pre-operative range of motion. Surprisingly there was no clear categorical evidence proving superiority of posterior stabilization in PCL-sacrificing TKA.

### Design Specific Increase In Range Of Motion With PFC Sigma RP-F: A Matched Control Study

Chitranjan S. Ranawat, MD, **Sanjay K. Gupta, MD**, B. Zikria, MD, Joseph F. Zikria, BA,  
V. Shah, DO, Amar S. Ranawat, MD

**Introduction:** The new PFC Sigma RP-F knee is designed to provide ROM of 155° without increasing contact stresses in the polyethylene by providing a third articulating surface and simultaneously allowing for proper patellar tracking. The purpose of this prospective study was to explore the question whether design related ROM could be improved.

**Methods:** Between July '04 to March '05, 50 PFC RP-F were performed in 45 patients. This cohort was matched with 50 TKR in 45 patients who had PFC RP PS for age (mean 67), sex (M:F 10:35), BMI (mean 28), pre-operative diagnosis (50 DJD), duration of follow-up (mean 8 months) and pre-operative ROM (Mean 110°, range 60°-130°).

**Results:** The difference in the mean post-operative ROM in the RP-F cohort ( mean 121°, range 90°-150°) and in RP cohort (116°, range 90°-130°) was statistically insignificant (p=0.09). However, when the mean increase in active ROM in the two groups was compared in 42 knees in both the groups who had less than 120° of pre-operative ROM, in the RP-F group the mean increase was 15° and in the RP group was 7° which was statistically significant ( p = 0.0045).

**Discussion:** The most significant determinant of post-op ROM is pre-operative ROM. However, with the new PFC RP-F design, higher ROM can be achieved. This is more noticeable in knees which have less than 120° of flexion preoperatively than in knees which already have a high preoperative ROM. Future PS knee design with Primary TKA may need to consider design features of the RP-F knee to achieve increase ROM.

### Total Joint Arthroplasty: When Do Fatal or Near Fatal Complications Occur?

Javad Parvizi, MD, Alan Mui, MD, **William J Hozack, MD**, Richard H Rothman, MD, Peter F Sharkey, MD

**Introduction:** With the recent trend towards minimally invasive total joint arthroplasty (TJA) and increased emphasis for faster recovery and shorter hospital stays, it has become increasingly important to recognize the timing and severity of serious complications associated with elective TJA to ensure that early patient discharge is a safe practice.

**Methods:** This prospective study evaluated the intrahospital complications associated with TJA in 2411 patients (2631 joints). Of these, 998 were primary total hip arthroplasty (THA), 923 were primary total knee arthroplasty (TKA), 333 were revision THA, 311 were revision TKA, and 66 were hemiarthroplasty of the hip. All patients were followed closely during their hospital stay and a standardized complication form completed for all patients. The circumstances leading to the complications and the details of therapeutic intervention for each complication was recorded.

**Results:** We have so far completed the data analysis for 611 patients. 198 (32.4%) patients developed at least one complication, with some patients suffering multiple complications. The type of complications recorded range from the simple urinary tract infection to the life-threatening myocardial infarction and even death. Amongst all patients, a total of 227 complications were recorded during their hospital stay and they can be divided into major (47; 20.7%) and minor (180; 79.3%) groups. The major complications included arrhythmia (17; 7.5%), cardiopulmonary arrest (2; 0.9%), myocardial infarction (2; 0.9%), death (2; 0.9%), compartment syndrome (1; 0.4%), DVT (4; 1.8%), fracture (1; 0.4%), hypertensive urgency (1; 0.4%), neurologic injury (3; 1.3%), obstruction/perforation (1; 0.4%), PE (12; 5.3%), pneumonia (1; 0.4%), and pneumothorax (1; 0.4%).

**Discussions:** This prospective study evaluated the timing and severity of complications associated with TJA. A vast majority (76%) of these complications occurred within the typical hospital stay of three days. Given the serious nature of some of these complications our data cautions against early hospital discharge of patients after TJA.

### The Role of FDG-PET Imaging in Diagnosing Periprosthetic Infection after Total Hip Arthroplasty

Pill SG, MD, MSPT, **Parvizi J, MD**, Nelson CL, MD, Garino JP, MD, Garver J, BS, Zhuang H, MD, Alavi A MD

The accurate noninvasive diagnosis of periprosthetic joint infection remains a challenge. In recent years, fluorodeoxyglucose positron emission tomography (FDG-PET) imaging has shown great promise in delineating areas of infection. We aimed to determine the accuracy of FDG-PET in diagnosing periprosthetic infection as compared to conventional studies, such as Indium-111-labeled leukocyte scintigraphy.

**Methods:** Patients with painful hip prostheses were recruited prospectively and subjected to FDG-PET scanning. Two independent and trained observers interpreted FDG-PET images, and consensus interpretations were performed in cases of conflicting opinions. A specific pattern of increased activity at the bone-implant interface was deemed to represent periprosthetic infection. The diagnosis of periprosthetic infection or aseptic loosening of the hip was confirmed during surgical intervention and clinical follow-up.

**Results:** The cohort with complications consisted of 86 hips (83 patients). FDG-PET correctly diagnosed 21 of the 23 infected cases (sensitivity, 91.3%), and ruled out infection in 62 out of the 63 aseptic hips (specificity, 98.4%). FDG-PET imaging demonstrated a positive predictive value of 95.5% (21/22) and a negative predictive value of 96.9% (62/64). Scintigraphy correctly identified 10 of the 23 infected cases (sensitivity, 43.5%), and 32 of 35 aseptic cases (specificity, 91.4%). Scintigraphy was associated with positive and negative predictive values of 76.9% (10/13 cases) and 71.1% (32/45 cases), respectively.

**Conclusions:** FDG-PET exhibited substantially higher sensitivity and specificity than Indium-111-labeled leukocyte scintigraphy. Additionally, FDG-PET demonstrated a higher negative predictive value indicating that this imaging technique is more reliable in ruling out infection. Based on these preliminary results, FDG-PET appears to be a promising diagnostic tool for distinguishing septic from aseptic painful hip prostheses.

### The Impact of Infected Total Hip Arthroplasty on Hospital and Surgeon Resource Utilization and Patient Access to Care

Kevin J. Bozic, MD, MBA, Michael D. Ries, MD

**Introduction:** Deep infection following total hip arthroplasty (THA) is a devastating complication. This purpose of this study was to compare hospital and surgeon resource utilization among patients undergoing primary THA, aseptic revision, and septic revision THA.

**Methods:** Clinical and financial data were obtained for 25 consecutive patients who underwent two-stage revision THA for infection during an 18 month period at a single institution. Similar data were collected for a cohort of 25 patients who underwent revision of both components for a diagnosis of aseptic loosening, and 25 patients who underwent primary THA. Quantitative and categorical variables were compared among the groups. Referral patterns were examined by reviewing the primary diagnosis for all patients referred to our institution for revision THA during a five year period.

**Results:** Revision THA procedures for sepsis were associated with longer operative time, more blood loss, and a higher number of complications, total hospitalizations, total hospital days, total operative episodes, total hospital costs, total outpatient encounters, and total outpatient charges during the 12 month period following the index procedure when compared with aseptic revisions or primary THA (all  $p < 0.0001$ ). Referral rates for septic revision THA increased significantly over a five year period ( $p = 0.0083$ ), while referral rates for aseptic revision THA remained unchanged ( $p = 0.3910$ ).

**Discussion:** Revision THA for sepsis is associated with significantly greater hospital and physician resource utilization than aseptic revision or primary THA. The lack of incremental reimbursement has created strong financial disincentives for hospitals and physicians to provide treatment for patients with infected THA.

### Prophylaxis with VenaFlow and Enoxaparin vs VenaFlow and Aspirin for Thromboembolic Disease Prevention in Total Knee Arthroplasty

Geoffrey H Westrich, MD, Friedrich Bottner, MD, Edwin Su, MD, Nicole Taveras, MD, Pamela Sanchez, MD, Russell Windsor, MD, Richard Laskin, MD, Steven Haas, MD, Thomas Sculco, MD

**Introduction:** Previous studies have shown the efficacy of intermittent pneumatic compression (IPC) or low-molecular-weight heparin (LMWH) in preventing deep venous thrombosis (DVT) following total knee arthroplasty (TKA). This exploratory study evaluated the safety and efficacy of DVT prophylaxis combining IPC plus LMWH (enoxaparin) compared to IPC *plus* aspirin in patients undergoing unilateral TKA.

**Methods:** In this study, patients were randomized to receive VenaFlow plus enoxaparin (30mg bid during hospitalization followed by 40mg qd for 3 weeks) or VenaFlow plus aspirin (325mg bid for 4 weeks). IPC was maintained until hospital discharge. Systematic ultrasound-screening tests were performed postoperatively to identify early (days 3-5) and late (weeks 4-6) DVT.

**Results:** This study included 275 patients; patient demographics were similar between groups. The overall DVT rate was 14.1% with VenaFlow and LMWH vs. 17.8% with VenaFlow and aspirin (p=ns). As with the overall efficacy, a nonsignificant trend towards lower incidence of DVT was observed with LMWH for both early (12.6% vs 14.0%, p=ns) and late (2.0% vs 5.4%, p=ns) DVT. No major bleeds were observed in either group.

**Discussion:** Prophylaxis with VenaFlow IPC *and* enoxaparin is safe and effective for preventing DVT in patients with TKA, with a trend towards improved efficacy compared to IPC and aspirin. As this study was not powered to demonstrate superiority, larger studies are warranted to confirm these findings. In spite of this, the rates of thrombosis noted in this study are among the lowest in the literature. We attribute this, in part, to the hemodynamic superiority of the VenaFlow compared to other IPC devices.

### Long Term Survivorship And Failure Modes Of 1000 Cemented Condylar Total Knee Arthroplasties

Michael B. Vessely, MD, Andrew L. Whaley, MD, W. Scott Harmsen, MS,  
Cathy D. Schleck, BS, Daniel J. Berry, MD

The purpose of this study was to examine the factors affecting survivorship and to analyze the reasons for reoperation and revision of a cemented modular condylar total knee arthroplasty (TKA). One thousand and eight consecutive primary cemented cruciate retaining total knee arthroplasties performed at one institution from 1987-1989 were studied. At the time of this study 411 patients (562 knees) had died, 43 patients (45 knees) had their knee components revised or removed, and 47 patients (62 knees) were lost to follow-up. Two hundred forty-four patients (331 knees) were alive and had not had their TKA components removed or revised at the time of latest follow-up. Mean follow-up of living patients with components in situ was 15.7 years (range, 14.5-17.9 years). Survivorship at 15 years for component removal for any reason, revision for any reason, revision for mechanical failure, and revision for aseptic loosening were 93.7%, 95.9%, 97.0%, 98.8%, respectively. Survivorship for the first three endpoints was significantly poorer among patients aged less than 60. Forty-five knees had components removed or revised: approximately one third were removed for infection (16 of 45), one third for aseptic loosening or tibial polyethylene wear (16 of 45), and one third for other causes. Twenty knees had reoperations that did not involve component removal or revision (mostly periprosthetic fracture or infection).

Mechanical implant failures accounted for less than half of the reoperations and revisions in the first 15 years after arthroplasty; while infection and periprosthetic fractures accounted for a substantial portion of revisions and reoperations. As mechanical arthroplasty failures have become less common other modes of complications related to the arthroplasty have become proportionately more frequent.

### High Incidence of Fractures of the Polyethylene Tibial Post in a Posterior Cruciate-Substituting Total Knee System

B Sonny Bal, MD, David Greenberg, Stephen Li, Kenneth Cherry

**Introduction:** An unusually high incidence of early catastrophic failures of the polyethylene tibial post in a consecutive series of total knee replacements (TKRs) is reported herein.

**Methods:** From 1997-2000, 564 consecutive TKRs were performed by a single surgeon using the Encore Foundation 100 Series PS Total Knee System. Mean patient age at surgery was 64 years (range 46-81 years), and mean body mass index was 31 (range 21-49). In each case, a medial parapatellar approach with sacrifice of the posterior cruciate ligament, and cemented components were used. The modular polyethylene insert had a central post that articulated with a cam on the femoral component at approximately 42 degrees flexion through the end point of flexion. The polyethylene had been sterilized with gamma radiation in an oxygen environment without a nitrogen flush. All procedures were performed by one surgeon who was experienced in TKRs. Standard rehabilitation protocols were used in all patients.

**Results:** At an average of 40 months after surgery (range 14-83 months), 70 TKRs in 62 patients (12 percent) had suffered a sudden rupture of the tibial post, usually in mid- to deep knee flexion. Common presenting symptoms were instability of the knee, with or without pain, with posterior subluxation of the tibia on a lateral radiograph of the knee joint. The knees in which a rupture of the post occurred did not differ significantly in terms of range of motion, patient BMI, or age compared to those without a rupture. Revision surgery to replace the broken liner was successful in relieving symptoms in each case. The post breakage was consistently at the base of the implant in each case.

**Conclusion:** Impingement of the polyethylene post in TKRs is a recognized phenomenon, and it can lead to polyethylene wear and failure of the post. While sporadic cases of tibial post rupture have been reported previously, this series provides detailed information on the incidence of this problem. The high incidence of post breakage in this study resulted from a combination of risk factors; namely, post impingement, suboptimal design, and polyethylene oxidation.

### Femoral Component Failure in Hybrid Total Knee Arthroplasty at 17 Years

Gavan P Duffy, MD, Elise B Murray, MD, Vicki S Baker, MD, Robert T Trousdale, MD

**Introduction:** Hybrid TKA was introduced in the 1980s in hopes of gaining the theoretical advantages of osseous ingrowth of the femoral component, while avoiding problematic tibial fixation seen in cementless systems. The purpose of the study was to evaluate the long-term results in a consecutive group of patients who underwent hybrid TKA.

**Methods & Materials:** From 1986 to 1991, 65 consecutive hybrid total knee arthroplasties (in 57 patients) of a single design were performed at the authors' institution. Two patients died with well functioning replacements during the surveillance period. There were 35 men and 22 women with an average age of 60 years (range 27-83 years) at the time of arthroplasty. The underlying diagnosis was osteoarthritis in 38 knees, rheumatoid arthritis in six knees, eleven post-traumatic, and two avascular necrosis.

**Results:** The average length of followup was 17 years (range, 14-19 years), and no patients were lost to followup. The Knee Society scores improved from an average of 37 preoperatively to 84 at latest followup. The functional score improved from 49 to 69 at latest followup. Eighteen (27.7%) knees required revision surgery. Eleven of the nine knees that were revised had femoral component problems, including a loose component in nine and a fractured component in two. Four patients had revision for patellofemoral complications and three had revisions for polyethylene wear. The implant survival to revision at 17 years was 58%.

**Conclusions:** Femoral component fixation in hybrid total knee arthroplasty is unreliable with this component design. In light of the excellent 15- year results of cemented condylar knee designs it is thought that hybrid fixation should be abandoned.

### Surgical Management of Symptomatic Instability Following Failed Primary Total Knee Arthroplasty

Theodore P. Firestone, MD, and Robert W. Eberle

The etiology of instability as a failure mode is multifactorial. In this study we attempt to identify those parameters with regards to the clinical history, physical exam and objective radiographic analyses which help identify the patient at risk. One hundred and nine (109) revision TKA procedures in 105 patients were performed for symptomatic instability as the primary diagnosis. The average time to follow-up was 4.2 years (2.0 years to 8.6 years). The average Knee Society Score improved from 43 to 87 with an improvement in the function score from 56 to 82. The total range of motion increased from 103 degrees to 115 degrees ( $p < 0.01$ ). The average intra-operative measured changes included an increase in the distal femoral condylar distance of -1mm and a concomitant change in the posterior femoral condylar distance of +4mm. Polyethylene thickness was increased by an average of 11mm. There were six reoperations; two for aseptic loosening of the tibial baseplate, two for recurrent instability requiring polyethylene insert exchange, one for infection requiring two-stage revision, and one for patellar tendon rupture requiring allograft reconstruction. In conclusion, good results can be achieved in this difficult patient population. Modular augments on the femoral side help restore the anatomic condylar profile while increasing polyethylene thickness corrects ligamentous laxity in flexion and extension.

## A Prospective Outcomes Analysis of Femoral Component Fixation in Revision Total Hip Arthroplasty Comparing Modular, Cementless Fixation with Cemented Femoral Fixation

Richard Iorio, MD, William L. Healy, MD, and Anthony H. Presutti, MD

- Purpose:** A prospective, surgeon randomized, matched cohort analysis of patient outcomes compared two types of femoral fixation utilized for revision total hip arthroplasty. A cementless, modular femoral stem was compared with cemented stems.
- Methods:** First time femoral revision operations (with and without acetabular revision) with Paprosky type I and II femoral bone stock were included. Exclusion criteria included re-revision femurs and Paprosky type IIIA, IIIB, or IV femoral bone stock. One surgeon performed all 43 cementless femoral revisions with a modular stem and another surgeon performed 43 consecutive cemented femoral revisions. This series of 86 patients was matched for age, weight, diagnosis, Charnley class, outcome measures, and femoral bone stock.
- Results:** Preoperatively, there were no significant differences between cohorts in age, weight, Charnley Class, Visual Analog Pain Scores (VAPS), Harris Hip Score (HHS), or bone stock deficiency. At 7-year average follow-up (3-13), there were no significant differences in VAPS, HHS, and SF-36 scores. Twenty-three (27%) patients died during the follow-up period (7(16%) cementless and 16 (37%) cemented). One (2.3%) femoral re-revision occurred in the cementless group, and two (4.6%) femoral re-revisions occurred in the cemented group ( $p=0.557$ ). There were 4 (9.3%) re-operations in the cementless group and 6 (14%) in the cemented group ( $p=0.291$ ).
- Conclusions:** In this study of femoral revision THA, cementless, modular fixation and cemented fixation were both successful in patients with Paprosky type I and II femoral bone stock. While the utilization of cementless femoral fixation is increasing, and it is the most common method of femoral revision in our practice, cemented femoral revision can achieve a good outcome in properly selected patients.

### Extra Large Uncemented Hemispherical Acetabular Components for Revision Total Hip Arthroplasty: Results at a Mean of 12 Years

Tarik Ait Si Selmi, MD, Daniel J. Berry, MD

**Methods:** Eighty-nine extra-large Harris Galante uncemented acetabular components were used to revise a failed total hip arthroplasty in 47 men and 42 women (mean age 59 years, range 30 to 83). Pre-revision acetabular bone deficiencies were categorized by the AAOS method as segmental in 5%, cavitory in 11%, and combined cavitory and segmental in 84%. Particulate bone graft was used in 54 hips and structural bulk bone graft in 9 hips.

Seven patients were lost to follow-up and 20 patients died during the study period; the outcome of the reconstruction in each patient that died was known. For living, unrevised patients the mean follow-up was 12 years (range 10-15 years).

**Results:** Ten acetabular component metal shells were removed or revised: 5 for aseptic loosening, 4 for infection, and 1 for dislocation. Radiographically one unrevised socket had definite loosening. All 6 of the cups that developed aseptic loosening (5 revised -1 radiographic) had marked pre-revision combined cavitory and segmental bone loss.

In 10 other hips the acetabular polyethylene liner was exchanged but the metal shell was retained: 4 for recurrent instability, 2 for wear, and 4 incidentally at the time of femoral revision.

**Conclusions:** At a minimum of 10 years after revision with an extra-large uncemented cup, only 6 of 89 cups (6.7%) were known to have failed due to aseptic loosening.

### CT Follow-Up Evaluation of Operative Intervention for Peri-Acetabular Lysis

Bryan Lapinski, MD, **Lalit Puri, MD**, Richard Wixson, MD, Jamie Lynch, MS,  
Ronald Hendrix, MD, S. David Stulberg, MD, Margot MacDonald, BS

**Introduction:** The operative treatment of large, progressive peri-acetabular lytic lesions is frequently debridement and bone grafting of the lesions with modular exchange of the liner and head. Previous studies have demonstrated regression of lesions by plain radiography following liner exchange with grafting. Computed tomography has been shown to be more sensitive in analyzing the size and location of these defects. The purpose of this study is to determine the fate of osteolytic lesions in the pelvis after treatment with liner exchange and bone grafting, as determined by computed tomography.

**Methods:** Fifteen patients were identified who had undergone liner exchange with grafting for progressive lytic lesions, as demonstrated by pre-operative CT scans. Post-operative CT scans were performed in all fifteen patients, at a minimum of two years post-revision. The largest cross sectional lytic area, determined on pre-operative axial cuts, was recorded, and compared to the post-operative scan at the same depth to determine the fate of the lesion.

**Results:** The mean size of the measured lytic lesions pre-operatively was 6.38 cm<sup>2</sup> compared to persistent defects or voids on the post-operative CT scan with a mean size of 2.94 cm<sup>2</sup> (p=0.000). In 14 of 15 cases, the lesions did not progress and were reduced in size with bone graft incorporation. There was no significant change in the Harris Hip score.

**Discussion:** Modular liner exchange with debridement and grafting of lytic lesions is effective in treating osteolytic lesions in the pelvis, as demonstrated by computed tomography.

### The Use of a Trabecular Metal Acetabular Component And Trabecular Metal Augment For Severe Acetabular Defects

Scott M Sporer, MD, Wayne G Paprosky, MD

**Introduction:** Acetabular defects with severe bone loss cannot be reliably reconstructed with the use of a hemispherical acetabular component alone. The use of a trabecular metal acetabular component with a trabecular metal augmentation is an alternative to bulk allograft in the acetabular revision of patients with segmental bone loss of the superior dome.

**Materials & Methods:** All patients who had an acetabular reconstruction for a Paprosky Type IIIA acetabular defect between 2001 and 2003 were reviewed. A trabecular metal acetabular component supported with a modular, superiorly placed trabecular metal augment was used in the revision of all patients during this interval. Patients were followed semi annually with clinical and radiographic evaluation.

**Results:** At an average 3.1 year follow-up, 34 patients (34 hips) were treated for a Type IIIA acetabular defect. The indication for revision was aseptic loosening in 28 patients, infection in 5 patients, and a traumatic injury in one patient. One patient required re-revision with the placement of a constrained liner for recurrent instability. The remaining 33 hips remain radiographically stable. None of the stable acetabular implants demonstrate periacetabular radiolucenices or osteolysis. Clinically, patients Harris Hip Scores improved from 45 preoperatively to 91 postoperatively. 20 patients required no assistive devices for ambulation while 12 patients required a cane and two patients require a walker.

**Conclusion:** The use of a trabecular metal acetabular component with a superiorly placed trabecular metal augment can provide a reliable and reproducible method for reconstruction of Paprosky Type IIIA acetabular defects at early follow-up.

### Acetabular Revision Using A Trabecular Metal Acetabular Component For Severe Acetabular Bone Loss Associated With A Pelvic Discontinuity

Scott M Sporer, MD, Wayne G Paprosky, MD

**Introduction:** Pelvic discontinuity can be encountered during acetabular revision in patients with severe bone loss. The use of a trabecular metal acetabular component with or without an associated trabecular metal augment spanning the discontinuity is an alternative to plating the posterior column and using a hemispherical shell .

**Materials & Methods:** All patients who had an acetabular reconstruction for a Paprosky Type IIIB acetabular defect between 2001 and 2003 with an associated pelvic discontinuity were reviewed. A trabecular metal acetabular component with or without an acetabular augment, which placed the pelvic discontinuity in distraction, was used in the revision of all patients, except one, with a Type IIIB defect and associated discontinuity during this interval. Patients were followed semi annually with clinical and radiographic evaluation.

**Results:** At an average 2.6 year follow-up, 13 patients (13 hips) were treated for a Type IIIB acetabular defect. The indication for revision was aseptic loosening in 12 patients, and infection in one patients. One patient demonstrated possible radiographic loosening. The remaining 12 hips remain radiographically stable. None of the patients required repeat surgical intervention. Clinically, patients Harris Hip Scores improved from 41 preoperatively to 87 postoperatively. 9 patients required no assistive devices for ambulation while 2 patients required a cane and two patients require a walker.

**Conclusion:** The treatment of pelvic discontinuity during acetabular revision using a trabecular metal acetabular component with or without an associated trabecular metal augment can provide a reliable and reproducible method for reconstruction of Paprosky Type IIIB acetabular defects at early follow-up.

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\* indicates something of value has been received from a commercial company or institution

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\* indicates something of value has been received from a commercial company or institution

### Racial Differences in Hip and Knee Arthroplasty in the United States

Edmund Lau, MS, Steven Kurtz, MD, Fionna Mowat, MD, Kevin Ong, MD,  
Ke Zhao, MD, Michael Halpern, MD

**Introduction:** THA and TKA surgeries may not be performed equally across racial groups. This study quantifies racial disparities in arthroplasty rates, and their historical trends between 1990-2002, for the U.S. population.

**Methods:** Rates of primary THA and TKA were examined using the National Inpatient Sample (1990-2002). Population estimates were obtained from the Census Bureau. The rate of THA and TKA was calculated for white, black, Hispanic, Asian, and Native American populations. Regression models were used to compare differences in arthroplasty rates over time, controlling for differences in race, age, gender, and census region.

**Results:** Significant differences were found in the rates of surgery among racial groups. Average THA rates for whites were 72.2 (per 100K persons), followed by blacks (32.7), Hispanics (16.8), Asians (13.5), and Native Americans (8.7). Rates for TKA followed a similar trend. Overall, almost all racial groups experienced significant acceleration in rates of THA and TKA from 1990-2002. Relative changes in the rate of TKA among Asians, blacks, and Hispanics were all higher than among whites.

**Discussion:** Racial disparities we observed may be related to access to health care, availability of insurance, social economic differences, and perhaps a cultural barrier. The elderly Hispanic and Asian population ( $\geq 65y$ ) has been projected to grow by up to 7-fold in the next 50 years, compared to a 2-fold increase among elderly non-Hispanic whites. As the elderly minority population expands in the U.S., the unique challenges facing the delivery of health care to these population segments should be addressed.

### The Future Burden of Hip and Knee Revisions: U.S. Projections from 2005 to 2030

Steven Kurtz, MD, **Edmund Lau, MS**, Fionna Mowat, MD, Kevin Ong, MD,  
Ke Zhao, MD, Michael Halpurn, MD

**Introduction:** Little information is available to quantify the expected number of hip and knee revision arthroplasty surgeries in the future. The purpose of this study was to mathematically project the number of revisions in the U.S. through 2030.

**Methods:** The National Inpatient Sample (1990-2002) was used with Census data to quantify historical trends in primary and revision arthroplasty rates. Projections in hip and knee arthroplasty were estimated using a Poisson regression model incorporating the growth in population and rate of surgeries as a function of age, gender, race, and census region.

**Results:** The total number of arthroplasty procedures performed in 2005 is expected to double by the year 2026 for THA and by 2016 for TKA. THA revisions were projected to grow from 41,000 in 2005 to 98,000 in 2030 (237%). TKA revisions were projected to grow from 37,000 in 2005 to 195,000 in 2030 (522%). Primary hip arthroplasty was estimated to grow 226% from 201,000 in 2005 to 453,000 by 2030. If implantations continue at the current rates, primary TKA is projected to grow from 428,000 in 2005 to a staggering 2.16 million procedures by 2030.

**Discussion:** This study provides, for the first time, quantification of the future number of revisions in the U.S. through 2030. The projections demonstrate a massive expected demand for primary and revision surgeries in the next two decades, a demand that will need to be addressed with a combination of increased economic resources, operative efficiency, technical capacity (i.e., additional surgeons), and implant longevity.

### Backside Wear, Impingement and the Locking Mechanism of Contemporary Acetabular Cup Designs

Molly M. Usrey, MS

**Introduction:** In study of total hip arthroplasty retrievals, we examine the durability of a variety of modular cup designs, in terms of backside wear of the liner, and its relationship to prosthetic impingement.

**Materials & Methods:** 35 acetabular components were retrieved at revision surgery after an average of 64 months in situ. All cup designs were classified into three groups according to the type of locking mechanism. Neck impingement, backside wear, and locking mechanism damage of the liner/shell were evaluated on a 4-point scale.

**Results:** Damage to the backside surface was observed in 63% of all specimens, and rated as moderate or severe in 40%. Pitting ( $F=3.5$ ,  $p=0.04$ ) and burnishing ( $F=11.2$ ,  $p=0.0002$ ) were both more prevalent in group 2. 34% of liners showed evidence of impingement with the femoral component. There was a strong correlation between impingement and backside wear of the liner ( $p=0.006$ ).

**Conclusions:** The severity of backside wear is dependent upon the design of the locking mechanism. The correlation between rim impingement and backside wear demonstrates that the critical property of locking mechanisms is resistance to shell-liner motion during impingement.

### Do Hooded Acetabular Liners Increase the Incidence of Prosthetic Impingement after THR?

Molly M. Usrey, MS

**Introduction:** Hooded acetabular liners are frequently used to increase joint stability, but can potentially increase the probability of impingement if the liner is malpositioned.

**Materials/  
Methods:** 113 acetabular components were retrieved during revision total hip arthroplasty after an average time in situ of 84 months. Each acetabular liner was inspected for presence, location, and severity of signs of impingement. The presence of a liner hood along with angle, height, and type of hood were recorded.

**Results:** Approximately one-third (32%;36/113) of the liners examined had impingement damage graded as moderate or severe. Impingement was only slightly more prevalent in hooded liners compared to neutral liners (35% vs. 29%). In the hooded liners examined, the site of impingement was located on the elevated portion of the rim in 88% (45/51) of components, and was restricted to the neutral portion in only 8 of the liners examined (12%; 6/51).

**Conclusion:** Though it has been assumed that hooded liners increase head containment without neck/liner impingement, in practice, a far more common scenario is impingement of the neck on the elevated section of the liner leading to significant surface damage and reduced range-of-motion.

### An Inter-Registry Comparison of Total Knee Arthroplasty in Sweden and Minnesota

Terence J. Gioe, MD, Otto Robertsson, MD, Katherine Grimm, MPH,  
Kathleen Killeen, MOT, Susan Mehle, BS

**Introduction:** We compared 12 years of data on the performance of one knee implant in two established total knee arthroplasty (TKA) registries, the national registry in Sweden (SW) and a community registry in Minnesota (MN).

**Materials and Methods:** All cruciate-retaining DePuy, PFC and PFC Sigma TKAs in SW and MN were followed prospectively between 9/91 and 12/2003. During this period, 2292 primary implants were captured in the MN registry and 9569 in the SW registry. The patella was resurfaced in 90% of the MN group versus 9% of the SW group. Both groups were two-thirds female. Mean age was 72 in SW and 69 in MN. Kaplan Meier survival statistics utilizing the Log Rank statistic for comparing survival curves and Cox regression for controlling for covariates were used to assess differences in revision rates.

**Results:** Kaplan Meier revealed that SW had a significantly higher 12 year cumulative revision rate (6.0%; CI = 4.5%, 7.5%) than MN (3.7%; CI = 2.5%, 4.9%). When age and gender were controlled, revision of the primary implant was two times more likely in the SW group. Patellar issues accounted for the greatest percentage of revisions in both groups (SW 41%, MN 31%).

**Discussion:** The revision rates for TKA are higher in SW than MN for this knee design. Numerous factors including differing classification schemes, surgical indications, or revisions performed elsewhere may explain this difference, and require further exploration. The limitations of implant registries are well-defined, but their potential remains great.

### Prevention of Readmission for Venous Thromboembolic Disease After Total Knee Arthroplasty

Christopher T. Donaldson, MD, Daniel Farber, MD, Erik B. Lehman, MS,  
C. McCollister Evarts, MD, Vincent D. Pellegrini, Jr., MD

**Introduction:** Venous thromboembolic disease is a life-threatening complication of TKA.

**Methods:** Venography as a predictive screening tool was prospectively studied after 1,321 TKA. Patients with venographic DVT received standard warfarin treatment, those with negative venograms received no post-discharge anticoagulation, and patients not completing venography received no further anticoagulation (1984-1992), or 6 weeks empiric warfarin (1993-2003). DVT, PE, or bleeding readmissions were recorded for 6 months postoperatively.

**Results:** The prevalence of venographic DVT was 42.3% (343/810); continuous epidural anesthesia/analgesia did not reduce DVT rates. Overall VTED readmission was 0.6% (8/1,321; 5 femoral DVT, 3 PE – 1 fatal). Readmission of patients discharged on warfarin was 0.21% (1/484) compared with 1.05% (5/477; 2 DVT, 3 PE;  $p=0.12$ ) in patients with negative venograms (no warfarin after discharge). One hematoma (anti-thrombin III) required operative drainage.

**Discussion:** Selective outpatient thromboprophylaxis based on routine screening risks readmission after TKA. Extended warfarin prophylaxis effectively prevents VTED readmission.

### The Value of Plain Radiographs for Evaluating Pelvic Osteolysis

Nobuto Kitamura, MD, Robert H. Hopper, Jr., PhD, **C. Anderson Engh, Jr., MD**,  
and Charles A. Engh, MD

This study evaluated the correlation between two-dimensional (2D) lesion area measured on anteroposterior (AP) pelvic x-rays and the three-dimensional (3D) volume based on computed tomography (CT) scans. With a computer-aided imaging program, we measured the volume of periacetabular osteolysis using minimum 5-year CT scans from 92 primary total hip arthroplasties (THAs) performed with a hemispheric, porous-coated cup (Duraloc 100, DePuy). The 2D size of the lesions was evaluated with Martell's Hip Analysis Suite using an AP pelvic x-ray taken within 3 months of the CT scan. Using CT, 94 acetabular lesions were detected among 63 THAs and 41 of these cases had osteolysis diagnosed on x-ray. While smaller lesions were often missed, osteolysis was diagnosed on x-ray in 91% (20/22) of THAs with lytic volumes of at least 10 cc. Because larger lesions were frequently identified, there was a strong statistical correlation between the 2D size and the 3D volume of osteolysis ( $r=0.80$ , Pearson's correlation). However, volume estimates based on the x-ray area were within 10 cc of the actual CT volume in only 50% of the cases when the correlation results were applied to the 22 THAs with pelvic osteolysis of at least 10 cc. While clinically important pelvic osteolysis can be identified on x-rays, computed tomography images are necessary to accurately measure lesion volumes. When osteolysis is identified on conventional x-rays during routine follow-up, we routinely obtain a CT image to confirm the lesion volume.

### The Use of a Hole Plug Does Not Prevent Retroacetabular Osteolysis

Nobuto Kitamura, MD, Robert H. Hopper, Jr., PhD, **C. Anderson Engh, Jr., MD**,  
and Charles A. Engh, MD

Although many modular acetabular cups offer an apex hole plug that can be inserted into the central dome hole, the clinical efficacy of these hole plugs has not been assessed. We identified 98 primary total hip arthroplasty (THA) patients who were implanted with a porous-coated Duraloc 100 cup (DePuy) featuring a single central dome hole and had a computed tomography (CT) scan at least 5 years (mean 8.5 years) after their THA. Twenty-one of the cups had no hole plug, 43 received a hole plug without a positive stop, and 34 had a hole plug with a positive stop. Among 68 THAs with acetabular osteolysis, 100% (15/15) of the cups without hole plugs, 91% (21/23) of the cups with a positive stop, and 83% (25/30) of the cups that had a hole plug without a stop demonstrated lesions communicating with the dome hole ( $p=0.21$ ). Hole plugs that are not watertight will not prevent acetabular osteolysis that communicates with the central dome hole.

### Treatment of septic prosthetic joints with a single-stage noncemented arthroplasty and intra-articular antibiotics

Tariq Nayef, MD, Leo A Whiteside, MD

- Introduction:** Infection is one of the most devastating complications following total joint arthroplasty. Fortunately, the incidence of infection is low after primary total joint arthroplasty, ranging from 1% to 13%. However, the treatment of these infections requires a significant expenditure for the patient. It often requires multiple surgical procedures, prolonged hospitalization, and long-term intravenous and oral antibiotic therapy. We have adopted a direct exchange method with antibiotics infused directly into the joint using Hickman catheters.
- Methods:** The treatment protocol includes a single-stage surgery in which the components are removed, the joint is debrided thoroughly, new components are implanted without cement or bone graft, and two indwelling Hickman catheters are placed. The patient then receives organism-specific intra-articular antibiotics through the Hickman catheters for 6 weeks.
- Results:** Since 1999 we have treated 31 patients with virulent organisms. We have had 2 failures with a 93% success rate. One of the failures occurred in a patient in whom we were unable to obtain an adequate closure for a large, soft tissue deficit with repeated attempts. The second failure occurred in a patient who was initially treated elsewhere and we were unable to identify the infecting organism.
- Conclusion:** This regimen appears to be as successful as the traditional two-stage treatment protocol with less morbidity and increased patient satisfaction.

### The Benefits of a Comprehensive Perioperative Protocol and Minimally Invasive Surgical Technique in Total Knee Arthroplasty

David J Covall, MD

**Introduction:** The study evaluated the impact of MIS and comprehensive perioperative protocols on TKA patients' length of stay (LOS) and outcomes.

**Methods:** Group I - traditional TKA and standard rehabilitation (56 pts); group II - traditional TKA but comprehensive perioperative protocol (50 pts); group III - "mini-TKA" with a comprehensive protocol (52 pts). Demographics, technique, outcomes, and LOS analysed.

**Results:** Groups similar: mean age, 61.3; 35% male, 65% female; BMI 33.2; preop Hgb 13.7, and TT 67 minutes. LOS differed significantly: group I, 3.5 days; group II 2.0; and group III 1.6 ( $p < 0.0001$ ). Transfusion rates lower for group III, 5.8% vs 9.5%. Also, decrease time to discontinuing walkers/canes, use of narcotics, and earlier return to driving, working and activities.

**Discussion:** Protocols impacted LOS and activities, but the addition of MIS had further beneficial effects on outcomes and patient satisfaction. Although both are evolving, the benefits of each should not be overlooked.

### Comparison of Unispacer Arthroplasty Functional Outcomes to Alternative Treatments for Unicompartmental Arthritis

Michael A. Conditt, PhD, Phillip C. Noble, PhD, Jason W. Pifer, BS, R. Bertolusso, BS,  
R. H. Hallock, MD, Brian S. Parsley, MD

**Introduction:** A new treatment of early osteoarthritis involves placement of an articulating discoid spacer (UniSpacer) in the medial compartment. This study evaluates the benefits of UniSpacer to improve knee function and provide pain relief.

**Methods:** 132 patients enrolled divided into 3 surgical and groups: UniSpacer (n=27), UKA (n=19), and TKA (n=21). A matched control group (n=65) was also enrolled. All subjects completed a self-administered, validated "Knee Function Questionnaire".

**Results:** Control group performed better in all activities than surgical groups. Surgical groups reported no significant differences in most functional activities including kneeling (p=0.38), squatting (p=0.25) and leg strengthening exercises (p=0.68), and similar levels of satisfaction (p=0.58). TKA patients were bothered significantly more (p=0.02) doing lateral movement. Activity participation frequency was equal in all groups (p=0.54). 44% of UniSpacer patients reported that were not as active as expected before the operation (compared to 33% for TKA patients and 11% for UKA patients, p=0.04) and 70% of UniSpacer patients reported that their knee kept them from doing things they wanted to do (compared to 60% for TKA patients and 50% for UKA patients, p=0.38).

**Discussion & Conclusion:** UniSpacer seems to restore a level of function on par with UKA and TKA. However, UniSpacer patients expressed higher surgical treatment expectations than the other groups.

### Range-of-Motion, Knee Function, and Patient Satisfaction after TKA

Michael A Conditt, PhD

**Introduction:** This study was performed to determine whether post-operative range of motion is a predictor of joint function and patients' level of satisfaction following TKA.

**Methods:** Enrolled patients (n=49) underwent TKA, by same surgeon. Each subject completed a self-administered, validated "Knee Function Questionnaire". ROM and Knee Society scores were measured at 1 year follow-up.

**Results:** Average post-operative ROM was  $122\pm 9^\circ$  and knee function score was  $92\pm 9$ . There were significant improvement in ROM and knee function scores with average improvements of  $15\pm 3^\circ$  ( $p<0.001$ ) and  $52\pm 7$  ( $p<0.001$ ), respectively. The majority of patients (70%) were satisfied with their knee function. There was no correlation between post-operative ROM ( $p=0.59$ ) or knee function score ( $p=0.39$ ) and satisfaction level.

**Discussion:** Clinical results, including knee function scores and post-operative ranges of motion, were excellent, but a substantial number of subjects were still not satisfied with their operated knee. Therefore, patient satisfaction will not necessarily follow restoration of excellent passive ROM in patients following TKA.

### Profiling the Dissatisfied Patient after Total Knee Replacement

Philip C. Noble, PhD

**Introduction:** The purpose of this study was to examine the demographic profiles of dissatisfied patients following TKA.

**Methods:** Two hundred eighty-four primary TKA patients were enrolled in this study with IRB approval. At a minimum follow-up of 1 year, each patient completed a self-administered, validated “Knee Function Questionnaire”.

**Results:** Seventy-five percent of the patients were either “satisfied” or “very satisfied” with their TKA, while 14% were either “dissatisfied” or “very dissatisfied”. There were no differences in gender ( $p=0.95$ ) or age ( $p=0.23$ ). Thirty-two percent of dissatisfied patients were less active following the knee operation compared to 14% for the satisfied group ( $p=0.0001$ ). Also, 50% of dissatisfied patients were not as active as they expected they would be before the operation compared to 14% for satisfied patients ( $p<0.0001$ ).

**Conclusions:** There is no simple way to distinguish the dissatisfied from the satisfied patient on the basis of demographic variables. Dissatisfied patients expected to return to a higher level of activity and those higher expectations were met less frequently. This suggests that a key component to patient satisfaction with total knee replacement resides with reasonable pre-operative expectations concerning likely changes in lifestyle and an “abnormal” perception of the knee.

### A Prospective Randomized Trial of Fixed Verses Mobile Bearing Cruciate Retaining Knee Designs

Steven J. MacDonald, MD, Juliana T. Marr R.N., BScN, Robert Bourne, MD,  
Richard McCalden, MD, Cecil Rorabeck, MD

**Introduction:** The purpose of this study was to compare the results between a cruciate retaining mobile bearing total knee (SAL®, Sulzer) and two fixed bearings (AMK®, DePuy and Genesis II®, Smith and Nephew).

**Methods:** Ninety blinded patients were randomized. Patients were evaluated pre-operatively, 3 months and annually. Patient radiographs and multiple outcome were evaluated.

**Results:** 80 patients at an average follow-up of 4.52 years (range 3.09 – 5.61 years) were reviewed. There were no differences in radiographic findings or in KSCRS at latest follow-up,  $p=0.077$ ). A significant difference was noted in flexion at latest follow-up (SAL – 120°, AMK – 111°, GenesisII – 120°,  $p=0.001$ ).

**Discussion:** No differences in multiple outcome measures were seen between a cruciate retaining mobile and fixed bearing total knee prostheses. In this trial a significant difference was noted in flexion at latest follow-up between a mobile bearing and two fixed bearing designs at a minimum of 2 years follow-up.

## Large Diameter Femoral Heads for the Treatment of Recurrent Dislocation after Total Hip Arthroplasty

R Michael Meneghini, Michael E Berend, E Michael Keating, Philip M Faris,  
John B Meding, Merrill A Ritter, Jeffrey L Pierson

**Introduction:** The use of large diameter femoral heads has become a common method of treatment for recurrent dislocation following total hip arthroplasty (THA). Despite the reported biomechanical advantages, clinical evidence is lacking to support the use of large diameter heads to improve hip stability in this setting. The purpose of this study is to report a series of consecutive patients who underwent revision with a jumbo femoral head for the treatment of recurrent dislocation after THA.

**Materials & Methods:** 21 hips underwent revision with a large diameter femoral head for recurrent instability after THA. The average age of the 11 men and 10 women was 68 years (range, 45 to 83). The 21 patients had an average of 1.7 hip arthroplasty procedures (range 1 to 4) and 4 dislocations (range, 1 to 12) prior to the index revision hip arthroplasty. A modular, unipolar, large diameter femoral head (range, 36mm to 46mm) was used in every case.

**Results:** Two patients died of unrelated causes 6 and 12 months postoperatively and both remained stable without recurrent dislocation at the time of death. At a minimum of two-years follow-up (range, 2 to 8 years), no patients were lost to follow up and 18 of 19 hips remained stable without any episode of instability or dislocation. One patient developed recurrent instability (three posterior dislocations) at 22 months postoperatively and underwent revision for component malposition. Upon acetabular component reorientation, a 40mm modular head was replaced with an unconstrained jumbo femoral head and the patient has remained stable without recurrent instability. There were no other revisions or reoperations in the patient cohort.

**Discussion:** To our knowledge, this study represents the first reported series of modular, unipolar, large diameter femoral heads used for the treatment of recurrent instability after THA. This series demonstrates that large diameter femoral heads are clinically successful in restoring hip stability for recurrent dislocation. The authors believe for most situations, jumbo femoral heads are a superior alternative to constrained acetabular articulations for symptomatic hip instability after THA.

### Tissue Pressures and Skin Deformation During THR Performed via a Posterior Mini-Incision

Matthew T Thompson, MD

Twelve hip replacement procedures were performed in fresh cadavers via single 6cm posterior incisions by two experienced joint surgeons. During acetabular and femoral reaming, we measured the forces and contact pressures developed between each retractor and the wound edges. Following surgery, the incision was extended to 20cm and measurements were repeated with a self-retaining Charnley retractor. Peak wound pressures recorded with the Charnley retractor dropped by 47% with the increased incision length. Even specialized mini-incision retractors significantly increased the peak applied pressures to the 6cm incision over the Charnley and the 20cm incision (femoral reaming:  $4057 \pm 447$  mmHg and acetabular reaming:  $3009 \pm 284$  mmHg vs.  $2018 \pm 186$  mmHg for the Charnley). The acetabular reamer applied significantly more force than the other retractors (reamer:  $104\text{N} \pm 12\text{N}$ , retractor:  $40.2\text{N} \pm 8.2\text{N}$ ,  $p < 0.01$ ). The incision length increased  $1.4 \pm 0.1$  cm during surgery. The forces and strains developed during a single posterior mini-incision approach are significantly greater than those observed during traditional procedures.

### Femoral Neck Design Radically Alters the Range of Motion of Total Hip Replacement

Matthew T Thompson, MD

This study examines the effect of variations in femoral neck geometry on the range of motion before impingement of the prosthetic hip using 3D computer simulation. Computer models of an acetabular cup and several femoral necks with varying cross-sections were modelled (a circular 12mm diameter, a 10mm diameter, a reduced A/P “flats” design and a trapezoidal design). Three activities (2 posterior dislocation and 1 anterior dislocation) were simulated. Posterior dislocation: Using the 12mm diameter neck as a control, the ROM increased by 5°-6° for the 10mm neck, 7°-8° for the reduced A/P ‘flats’ design, and 10°-11° for the trapezoidal design. Anterior dislocation: ROM increased by 4° for the 10mm head, 7° for the reduced AP ‘flats’ design and 9° for the trapezoidal design. However, FEA analysis of each design under an applied “stair-climbing” load demonstrated that reducing the A/P width of the neck led to a substantial increase in neck stresses for minimal improvement in ROM.

### Resource Utilization After TKR Is Associated With Pre-op Physical and Emotional Health

Patricia Franklin, MD, Huang Wei, MD, Michael Kelly, MD, Fred Anderson, MD, David Ayers, MD

- Background:** One-third of primary total knee arthroplasty (TKA) patients report low pre-operative emotional health status (MCS<50; SF36) known to correlate with trait anxiety and mild depression. In medical patients, depression, anxiety, and physical co-morbid illness correlate with increased use of healthcare resources. It is unknown if inpatient length of stay (LOS) or discharge disposition (rehabilitation facility vs. home) following TKA correlates with pre-TKA MCS or physical co-morbid illness. The intent of this study is to investigate the association between resource utilization after TKR and the patients pre-op physical and emotional health
- Methods:** Demographic, clinical, and emotional (MCS) and physical functional status (PCS) (Short Form-8/SF-8) data were evaluated for 2220 primary TKA patients in 42 US orthopaedic practices between 2001 and 2004. Multivariate analysis was carried out to evaluate resource utilization.
- Results:** Initial and adjusted multivariate analyses found higher rates of hospital discharge to rehabilitation associated with older age (OR = 1.056,  $p < 0.0001$ ), female gender (OR = 1.877,  $p < 0.0001$ ), lower MCS (OR = 0.984,  $p = 0.0006$ ) and the presence of co-morbid diagnoses (OR = 1.830,  $p < 0.0001$ .) Longer inpatient hospital stay was associated with older age ( $p = 0.0017$ ) and shorter stays with the absence of co-morbidities ( $p = 0.0137$ .)
- Discussion:** Low preoperative MCS was not associated with a longer inpatient LOS and the clinical significance of the MCS association with discharge to rehabilitation facilities may not be clinically important ( $R = 0.984$ ). However, physical co-morbid illness was significantly associated with discharge disposition and LOS. Female gender and advanced age are correlated with higher resource use. Further research should and will adjust for reimbursement incentives before examining the role of emotional and physical health.

### Revision of the Polyethylene Component for Wear in Bone-Ingrowth Total Knee Arthroplasty

Tariq Nayfeh, MD, Leo A Whiteside, MD

**Introduction:** Revision of the polyethylene spacer for wear in TKA without removing osteointegrated components can minimize surgical trauma and preserve bone.

**Methods:** Forty-nine knees (29 Ortholoc I, eight Ortholoc II, five Advantim, five AMK, two MG II) failed due to wear, but maintained bone-ingrowth fixation of the femoral and tibial components. All had polyethylene component revision, curettage, and bone grafting of osteolytic cysts. The Ortholoc I did not have a modular polyethylene component. The AMK and MG II do not have adequate locking mechanisms for the polyethylene components, so a locking mechanism was fabricated using a carbide bit to create locking grooves and polymethylmethacrylate to secure fixation of the polyethylene to metal. The Ortholoc II and Advantim have competent locking mechanisms and allowed exchange of the polyethylene components without PMMA for fixation.

**Results:** Three failures occurred. A gamma-irradiated polyethylene component was inserted in an Ortholoc II tibial component, and failed 23 months later due to wear. It was revised to an ethylene-oxide sterilized component, and has functioned well with no signs of wear for 77 months. One Ortholoc II knee had the polyethylene component revised with an unconstrained component, avulsed the posterior cruciate ligament, and dislocated the tibia posteriorly. The femur fractured during reduction, and the knee was salvaged with a new femoral component and a conforming tibial polyethylene component. One Ortholoc II knee with massive tibial osteolysis sustained fracture of the tibial metaphyseal bone stock 2 months after revision, but healed in situ with 5° varus deformity. None of the knees with a fabricated locking mechanism has failed, and the remaining knees function well without evidence of wear or instability.

**Conclusion:** Knees with failure of the polyethylene component due to wear can be salvaged successfully when the new polyethylene component is made of modern wear-resistant material. A locking mechanism fabricated with a carbide bit and secured with polymethylmethacrylate can be effective in tibial polyethylene components with an inadequate locking mechanism.

### MIS TKR through a Mini Mid Vastus Approach

Richard S Laskin MD

This paper reports the results of 150 consecutive minimally invasive mini-mid vastus knee replacements followed for 2 years or more after surgery. Patients were operated upon under a combined epidural and femoral nerve block; continuous passive motion and pre-emptive analgesia was used post operatively. The mini mid vastus split extended 2 cm along the fibers of the VMO and the patella was subluxed but not everted. In 6 muscular male patients the mid vastus split had to be extended to 4 cm to allow patellar displacement.

The mean tourniquet time for the MIS group was 58 minutes. This was, on the average, 6-7 minutes longer than that for standard larger incision total knee procedures and is primarily related to positioning and repositioning of retractors and the leg, key components of the surgical technique. 88% of the patients had achieved 90° of flexion by the 3rd post operative day. 92% of the patients were able to ascend and descend stairs in a reciprocal manner by 4-6 weeks after surgery.

There were no outliers as related to tibial or femoral component positioning in either the sagittal or coronal planes as measured at the 4-6 week post operative films by an independent observer. The mean Knee Score at 4-6 weeks was 85, and at 3 months was 92.

One patient had a partial distal skin necrosis that healed spontaneously. Contraindications included patella baja, prior open intra-articular surgery, and a severe fixed valgus-flexion deformity. By the end of the first year the results are similar between standard incision and MIS incision patients, however the MMV MIS group achieved these goals more rapidly, had less pain, and a more rapid return of function and motion.

### Simultaneous Bilateral Total Knee Arthroplasty Using A Fixed Versus Mobile Bearing System

Theodore P Firestone, MD, Robert W Eberle, MD

**Introduction:** We report the prospective findings of simultaneous bilateral total knee arthroplasty (TKA) using a system of similar design but varying in bearing (Fixed [F] versus Rotating Platform [RP]).

**Methods:** The component side was randomly chosen for all patients at the time of surgery and the patients were blinded as to the component type by knee. Patients with pre-disposing adverse medical conditions, (e.g. moderate to severe varus / valgus deformity, or gross soft-tissue instability or insufficiency in one knee versus the other) were not offered the opportunity to participate in this study. Prospective clinical and radiographic information was collected including a modified Knee Society rating scale. The average follow-up was  $26 \pm 14.6$  (18–39) months.

**Results:** Seventy-two knees in 36 patients were included in this study. Nine patients have scheduled but not yet returned for their 2-year follow-up and are not included. One patient was excluded from this study because of a progressively worsening Parkinson's syndrome. Fifty-two knees in 26 patients were available for study. The average patient age was  $72.3 \pm 6.5$  years (58–86) and there were 12 males and 14 females. Pre-operative diagnoses included OA in 25 knees (96%) and RA in 1 knee (4%). The average pre-operative range of motion (ROM) was [F]  $113 \pm 12$  degrees (80 – 130), [RP]  $114 \pm 11$  degrees (85 – 130) and improved post-operatively to [F]  $122 \pm 8$  degrees (98–140), [RP]  $119 \pm 12$  degrees (90– 140). The modified Knee Society rating scale pre-operatively was [F]  $45.4 \pm 9.7$  (33–58), [RP]  $47.4 \pm 14.6$  (32–99) and improved to [F]  $98.9 \pm 2.0$  (94–100), [RP]  $98.2 \pm 2.6$  (93–100) at the most recent follow-up. There were no statistically significant differences between study groups and measured outcomes. Radiographically, both groups had well positioned components, optimum patello-femoral alignment and no evidence of adverse radiographic events.

**Discussion:** From these findings, the reported bearing systems within similar component design work equally well. Further intermediate follow-up is necessary for determining component composite durability. Patient satisfaction and knee preference is being evaluated.

### A Randomized, Prospective Trial to Determine the Hemostatic Efficacy of a Bipolar Sealing Device in Total Knee Arthroplasty

Philip H. Ireland, MD, Jeffery L. Pierson MD, Edward J. Hellman, MD, Donald R. Earles, MS

**Introduction:** This study was designed to evaluate the hemostatic efficacy of a bipolar sealing device designed to coagulate and seal the likely sources of bleeding after total knee arthroplasty (TKA). Minimizing blood loss associated with TKA, thereby maximizing postoperative hemoglobin levels and reducing the need for transfusions, is an appealing concept.

**Materials & Methods:** Ninety patients undergoing unilateral primary TKA were randomized into two groups. Conventional wound treatment was used for one group, and the bipolar device was used as an adjunct to conventional wound management for the other group.

**Results:** Preoperative hemoglobin levels were similar in both groups. The mean decline in hemoglobin was significantly lower for the treatment group compared to the control group (a 13% reduction).

**Discussion:** The use of this bipolar sealing device resulted in a significant reduction in blood loss compared to conventionally performed TKA.

### Prevalence of Dislocation In Rotating Platform Total Knee Arthroplasty

John B. Chiavetta, MD, **Thomas K. Fehring, MD**, Susan Odum MEd, MA,  
William L. Griffin, MD, J. Bohannon Mason, MD

**Introduction:** Rotating platform (RP) total knees allow the use of a highly conforming polyethylene with reduced contact pressures and potentially reduced wear. The mobile nature of the rotating platform, however, can lead to insert spin out. The purpose of this study was to determine the prevalence of spin out in a series of knees using a specific implant and surgical technique.

**Methods:** 540 rotating platform TKA's were performed in 500 patients. All knees were implanted using a balance gap technique. All knees were initially balanced in extension after cutting the distal femur and the proximal tibia perpendicular to their mechanical axis. The knee was then tensed in flexion and an AP femoral cut parallel to the tibia was made. The flexion and extension gaps were then equalized. Of the 500 patients, 13 were deceased and 94 were lost to follow up. 393 patients with 426 knees were included in the study. The average follow up was 3.2 years.

**Results:** There were no cases of bearing spin out.

**Conclusion:** The balanced gap technique reliably produces knees well balanced in both flexion and extension. This implantation technique allows one to take advantage of the potential wear benefits of the rotating platform design with a nominal rate of bearing spin out.

**Level of Evidence:** Level III, retrospective comparative study

## Surgical Treatment of Femoroacetabular Impingement by Means of an Anterior Minimal-Invasive Approach

Manuel Ribas, MD, Paul E Beaulé, MD, Jose M Vilarrubias, MD

**Introduction:** Femoroacetabular Impingement had been until now an unknown pathology. It causes pain in the movements of flexion-adduction-internal rotation, due to a bump effect between the head-neck surface of the femur and the anterior acetabular rim. This effect can be produced either by a retroverted acetabulum or lesser femoral neck-offset, or by combination of both phenomena. This process is more often observed in hips of sportsactive patients.

**Methods:** We analysed our 14 first patients, 3 operated bilaterally with 2 years F.U.. In these later the elapsed time between both operations ranged from 5 to 8 weeks. Mean Age: 36 years (27 to 48), all sportsactive patients.. The technique that we used was through a modified Hueter approach. The superoanterior rim of the acetabulum was excised as well as the deformity at the femoral side that causes a lesser femoral neck-offset. For that purpose we have developed special surgical instruments, that provide an accurate contouring.

**Results:** Pain relief was obtained 4 weeks after surgery in 13 from 14 patients. Mean hospitalization time was 2,6 days (2 – 5). Improvement in ROM was significant ( $p=0,006$ ): from  $-17^\circ$  mean internal rotation ( $-14^\circ$  to  $-28^\circ$ ) at  $80^\circ$  flexion to  $+23^\circ$  mean one month postop internal rotation ( $14^\circ$  to  $32^\circ$ ). There was a significant improvement of hip score according to Merle d'Aubigne evaluation ( $p=0,017$ ): 13,8 points preop (13 to 15) to 16,9 at 2 years F.U. (16-18). Neither Trendelenburg nor osteonecrosis was observed in any patient, as eventual complication related to the approach. Mean time of rehabilitation was 3,8 weeks (3 – 5). All patients returned to their respective sportactivities.

**Discussion:** This new approach for Femoroacetabular Osteoplasty provides rapid improvement of the normal hip motion, relatively short rehabilitation time and sports resume compared to other current approaches, that require trochanter osteotomy and hip dislocation. However midterm new osteoarthritic changes need to be assessed, although clinical and functional improvement has been evident. This surgical procedure makes us think about other alternatives to hip endoprosthesis in young sportsactive adults.

### The “Banana Peel” Method of Exposure in Revision Total Knee Arthroplasty

Amit Lahav, MD, Aaron A. Hofmann, MD, Tanya Hanberg, BS, **Shawn Hocker, MD**

**Introduction:** We present a technique referred to as the “Banana Peel” and has been used exclusively for revision knee replacement for over 20 years.

**Materials & Methods:** A retrospective review of 102 consecutive patients, with an average age 62 (range 41-92), underwent tibial-femoral stemmed revision total knee surgery using the “Banana Peel” method of exposure. There were five deaths leaving 98 knees in 97 patients for the study. The technique involves peeling the patella tendon as a sleeve off the tibia leaving the extensor mechanism intact with a lateral hinge of soft tissue. A quadriceps snip is also done proximally. Patients with minimum 24 months follow-up were included. Telephone interview, chart review, and Knee Society scores were obtained.

**Results:** The average follow-up was 39 months (range 24-56). There were no patients who reported disruption of their extensor mechanism or decreased ability to extend their operative knee. Average knee society score was 176 (range 95-200). Average motion postoperative was 106 degrees. No pain over the tibial tubercle was reported.

**Discussion/ Conclusion:** The “Banana Peel” technique for exposure of the knee during total knee arthroplasty revision is a safe method that can be used along with a proximal quadriceps snip that does not violate the extensor mechanism maintaining continuity of the knee extensors.

### Effect of Celecoxib on Bone Ingrowth in Humans

Shawn Hocker, MD

The effect of Celecoxib (Celebrex) on bone ingrowth into porous coated devices has not been studied in humans. The bone ingrowth was measured into titanium and tantalum plugs in nine patients taking Celebrex as part of a perioperative pain relief protocol who underwent bilateral total knee arthroplasty (TKA). Patients were given tetracycline to measure the mineral apposition rate (MAR) before and after Celebrex administration. Time zero plugs were implanted and retrieved during the first TKA, while 12 weeks later the contralateral implanted plugs were retrieved at second TKA. Bone ingrowth was 21% for the titanium and 12% for the tantalum plugs ( $p=0.144$ ). The MAR was  $0.97\mu\text{m}/\text{day}$  for the titanium and  $1.15\mu\text{m}/\text{day}$  for the tantalum plugs ( $p=0.331$ ). Celebrex may provide postoperative pain relief, while not appearing to inhibit bone ingrowth or bone formation at the interface.

### Periprosthetic Femoral Fracture Fixation with a Locking Plate

Craig J. Della Valle, MD, Todd Schubkegal, MD, Walter V Virkus, MD,  
Scott M Sporer, MD, Wayne G Paprosky, MD

**Introduction:** Periprosthetic femoral fractures are difficult entities to treat. Challenges encountered include gaining adequate fixation around well-fixed implants and poor quality bone. Locking plates represent an attractive option for fixation however few studies are available documenting the performance of these devices around periprosthetic fractures.

**Materials & Methods:** Fifteen consecutive patients managed by two surgeons with a locking plate for the treatment of a periprosthetic femoral fracture were reviewed. The mean age of patients in the cohort was 76 years (range, 59 to 88 years) and twelve of the patients were female (80%). Seven fractures were interprosthetic, 5 were associated with total knees and 4 were associated with total hips; 5 of these fractures had failed prior attempts at fixation. All patients were managed with a locking plate and all were associated with well-fixed implants (Vancouver Class B-1 or C and Rorabeck classification type II). Fresh frozen allograft was used in 10 cases and augmentation with a femoral strut was used in two. Patients were followed until union (defined as radiographic evidence of healing and the ability to bear full weight on the extremity) or failure.

**Results:** All of the fractures healed by a mean of 13 weeks postoperatively (range 10 to 29 weeks). One fracture above a total knee healed in twenty degrees of flexion; all other fractures healed with less than 5 degrees of deformity. All patients regained their pre-fracture ambulatory capacity.

**Conclusion:** Locking plates are an excellent option for managing periprosthetic femoral fractures around well fixed implants.

### Single Dose Intrathecal Morphine Verses Indwelling Epidural for Post Operative Pain Control in Arthroplasty Patients

Vincent J. Williams, MD, Michele M. Hughes, RN, ACNP, Phyllis B. Daniel, RN, CNS,  
James J. Crawford, MD, and Joseph T. Moskal, MD

A retrospective review comparing patients receiving single dose intrathecal narcotics (n=38) to indwelling epidural catheters (n=34) was conducted. The average pain scores were found to be equivalent POD's 0, 1 and 3. Epidural patients had significantly improved pain scores POD 2. The level of ambulation and range of motion were similar in both treatment groups. Respiratory depression and hypotension were found more frequently in the intrathecal narcotic group. Significant numbness and weakness occurred more frequently in the epidural patients. The incidence of nausea, pruritis and average daily sedation scores were equivalent. Neither group had a significant complication from the regional anesthetic technique.

The use of intrathecal narcotics placed at the time of surgery provided nearly equivalent postoperative pain control compared to indwelling epidural catheters. This single dose technique reduces the risk associated with an indwelling catheter in anticoagulated patients, reduces costs and simplifies post operative pain control in arthroplasty patients.

### Surgical Accuracy with the Mini-Subvastus Total Knee Arthroplasty: A CT Scan Analysis of Post-Operative Implant Alignment

William C Schroer, MD, Paul J Diesfeld, PA-C, Angela R LeMarr, RN, Mary E Reedy, RN

A primary concern of Minimally Invasive (MIS) TKA is that limited visibility, smaller instrumentation and unfamiliar surgical techniques will lead to inaccurate implant alignment. Implant malalignment is a leading cause of TKA failure. CT scans have been shown to be accurate and reproducible in determining implant position following TKA. In this study, CT scans of traditional and MIS TKA were compared to determine if a loss of accuracy occurred when a surgeon switched from the traditional medial parapatellar arthrotomy to a mini-subvastus surgical technique.

Fifty TKA patients, 25 traditional and 25 MIS, underwent CT scans. All patients had the same PS cemented TKA placed by a single surgeon with a surgical goal of placing the femoral component at 5° valgus and the tibial component at 0° varus and 0° posterior slope. CT images were manipulated in the axial plane to determine the optimal AP and lateral views. Surgical accuracy was determined by measuring the femoral anatomic axis, the tibia varus angle, and the posterior tibial slope. All scans were read in a blinded manner. Outliers were defined by variances greater than 3°.

The mean variance for the tibia varus alignment was 1.03° for the traditional TKA and 1.00° for the MIS TKA,  $p=0.183$ . There were no outliers. The mean variance for the posterior tibial slope was 2.09° and 1.50° for the traditional and MIS TKA respectively,  $p=0.054$ . There were three traditional and one MIS outliers. The mean variance for the femoral anatomic axis was 1.04° and 1.71° for the traditional and MIS TKA respectively. This was statistically significant,  $p=0.045$ . There were two MIS outliers and no traditional outliers.

This study demonstrated no loss in accuracy in the implantation of the tibial component with the mini-subvastus technique. Although not statistically significant, the tibia varus and posterior slope trended better with the MIS technique ( $p=.183$  and  $.054$  respectively). Femoral alignment was significantly less accurate with the MIS procedure. As new MIS instrumentation is designed, diligence must be maintained to ensure accurate alignment.

### Evaluation of a Tripolar Constrained Acetabular Component in Complex Revision THR

Joseph C. McCarthy, MD, Jo-Ann Lee

**Introduction:** This study examines the outcome of acetabular fixation and stability utilizing a tripolar constrained acetabular component at 2 - 5 year follow-up.

**Materials & Methods:** This study retrospectively examined 28 hips using a tripolar acetabular component with follow-up of 2 to 5 years (mean 3 years). Preoperative indications included recurrent dislocation 5, loose acetabular component with instability 13, migrated bipolar 6, 2 girdlestone conversions, and 2 primary arthroplasties (1 patient with Down's syndrome and 1 post pelvic radiation). Postoperative radiographs were reviewed for radiolucencies, loosening, migration or breakage. Fourteen of the revision arthroplasties included the femoral component revision.

**Results:** Twenty-five of the 28 acetabular components (89%) are well-fixed and bony ingrown. There have been no dislocations. One patient was involved in an MVA 1 year after the surgery and sustained a fracture of the ilium and a 2 mm radiolucency about the component which is now stable. One patient who had multiple hip surgeries for massive trauma was revised for a loose cup. One patient had early failure with cup displacement. The two latter hips have been revised to a tripolar cemented into a cage which is doing well. One additional patient required reoperation for avulsion of the trochanter following a MVA, the cup remained well fixed. The mean preoperative Harris Hip score was 46 (range, 25 – 69), and postoperative was mean 73 (range, 48 – 97).

**Discussion:** This component has resulted in reliable fixation and joint stability in those patients at high risk for dislocation.

### Rotational Malalignment of the Femoral Component: A Cause of Lift Off and Overload

Murali Jasty, MD, Guoan Li, PhD

Femoral component lift-off during knee flexion creates abnormal kinematics and excessive loads. We investigated the effect of femoral component rotational malalignment on lift off and on polyethylene stresses using contemporary computer knee simulation models (explicit FEA). A PS femoral component was aligned with transepicondylar axis, 15° of internal or external rotation and stairclimbing loads and kinematics from in vivo data simulated.

While medial and lateral femoral-tibial liner contact was maintained through out stairclimbing with anatomically placed femur, lift off occurred with both of the malrotated components starting at around 30 degrees of knee flexion. By 50 degrees of flexion there was complete lift off and the polyethylene stresses on the opposite compartment were greater than 35MPa. Thus, rotational malalignment of the femoral component is also to femoral-tibial articulation.

## **On-site Registration Hours**

Friday, November 4 . . . . . 2:00 – 9:00 pm

Saturday, November 5 . . . . . 6:00 am – 6:00 pm

Sunday, November 6 . . . . . 5:30 – 10:00 am

All on-site registrants must provide payment (cash, credit card or check) at time of registration.

## **CME Credit**

These activities have been planned and implemented in accordance with the Essential Areas and policies of the Accreditation Council for Continuing Medical Education (AACME) through the joint sponsorship of the American Academy of Orthopaedic Surgeons (AAOS) and the American Association of Hip and Knee Surgeons (AAHKS). The AAOS is accredited by the AACME to provide continuing medical education for physicians.

The AAOS designates this educational activity for a maximum of 13 hours in category 1 credits toward the AMA Physician's Recognition Award. Each physician should claim only those credits that he/she actually spent in the activity.

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# Additional Information

## Financial Disclosure

Each participant in the Annual Meeting has been asked to disclose if he or she has a financial interest or other relationship with a commercial company related directly or indirectly with the AAHKS Meeting to the subject of their presentation.

The American Association of Hip and Knee Surgeons has identified the options to disclose as follows:

- A. Research or institutional support has been received;
- B. Miscellaneous non-income support (e.g., equipment or services), commercially derived honoraria, or other non-research related funding (e.g., paid travel);
- C. Royalties;
- D. Stock or stock options; or
- E. Consultant or employee

If a participant has received something of value from a commercial company, an asterisk will appear next to their name in the Program outline. The AAHKS does not view the existence of these disclosed interests or commitments as necessarily implying bias or decreasing the value of the author's participation in the Annual Meeting.

<b>MODERATOR</b>	<b>RELATIONSHIP DISCLOSED</b>	<b>PAPER PRESENTER</b>	<b>RELATIONSHIP DISCLOSED</b>
Thomas Schmalzried, MD	a,c,e – Depuy, Stryker; a – Wright Medical	Javad Parvizi, MD	none
Steven Incavo, MD	a,e - Stryker	Rodrigo M. Mardones, MD	none reported
John J. Callaghan, MD	none reported	David G. Lewallen, MD	none reported
Steven MacDonald, MD	none reported	Carl A. Deirmengian, MD	none reported
Seth Greenwald, DPhil (Oxon)	none reported	Richard W. McCalden, MD	none reported
Joseph C. McCarthy, MD	none reported	Joshua J. Jacobs, MD	a,e – Wright Medical, Zimmer, Medtronics
William J. Robb, Jr., MD	a – Smith & Nephew; BrainLab	John M. Martell, MD	none reported
Lawrence D. Dorr, MD	none reported	Vijay J. Rasquinha, MD	none reported
Daniel J. Berry, MD	a,c – DePuy; a – Zimmer, Stryker	Christopher J. Doro, MD	none
Mary I. O'Connor, MD	a,c – DePuy; c - Zimmer	C.Anderson Engh, Jr., MD	a – Inova Health Systems; c,e – DePuy
Kevin J. Bozic, MD	none reported	James A. D'Antonio, MD	a,c,e – Stryker
James B. Benjamin, MD	none reported	Lawrence D. Dorr, MD	a,c – Zimmer
William J. Hozack, MD	e - Stryker	Daniel J. Berry, MD	a,c – DePuy; a – Zimmer, Stryker
Thomas K. Fehring, MD	none reported	Douglas A. Dennis, MD	none reported
Brian S. Parsley, MD	none reported	Paul F. Lachiewicz, MD	a – Aircast a,e – Zimmer; Aircast
Douglas A. Dennis, MD	none	David G. Lewallen, MD	none reported
Michael E. Berend, MD	none reported	William Rogers, MD, FACEP	none reported
Carlos J. Lavernia, MD	a – Zimmer, Mercy Hospital c,e – Zimmer	The Hon. Thomas E. Price, MD	none reported
David C. Ayers, MD	none reported	Stuart L. Weinstein, MD	none reported
Brian J. McGrory, MD	none reported	Richard F. Kyle, MD	none reported
Adolph V. Lombardi, Jr., MD	none reported	Karen Hackett	none reported
David G. Lewallen, MD	none reported	Robert Jasak	none reported
		Steven M. Teeny, MD	none reported

# Additional Information

<b>PAPER PRESENTER</b>	<b>RELATIONSHIP DISCLOSED</b>	<b>POSTER PRESENTER</b>	<b>RELATIONSHIP DISCLOSED</b>
William G. Hamilton, MD	none reported	Edmund Lau, MS	none
Mark W. Pagnano, MD	c - Zimmer	Molly M. Usrey, MS	none reported
Robert T. Trousdale, MD	none reported	Terence J. Gioe, MD	none reported
Peter F. Sharkey, MD	a,c,e – Stryker Orthopaedics	Christopher T. Donaldson, MD	none
William J. Hozack, MD	e - Stryker	C. Anderson Engh, Jr., MD	a – Inova Health Systems; c,e – DePuy, a Johnson & Johnson Co.
Thomas P. Vail, MD	a,c,e – DePuy; a,e – Wright; a,c – Zimmer; a – Smith & Nephew, Stryker	Tariq Nayfeh, MD	none reported
Richard S. Laskin, MD	none reported	David J. Covall, MD	a,e - Zimmer
David F. Dalury, MD	none reported	Michael A. Conditt, PhD	a,c,e – Zimmer; a,c – Stryker; a,e – Plus Orthopedics
Steven J. MacDonald, MD	none reported	Philip C. Noble, PhD	a,c,e – Zimmer; a,c – Stryker; a,e – Plus Orthopedics
Amanda Marshall, MD	none	Steven J. MacDonald, MD	none reported
Brayton R. Shirley, MD	none	R. Michael Meneghini, MD	none
David C. Ayers, MD	none reported	Matthew T. Thompson, MD	none reported
William L. Griffin, MD	none reported	David C. Ayers, MD	a – Zimmer, Inc., OREF
Michael E. Berend, MD	a,b,c,e - Biomet	Tariq Nayfeh, MD	none reported
Keith R. Berend, MD	b,d,e – Biomet, Inc.	Richard S. Laskin, MD	none reported
Molly M. Usrey, MS	none reported	Theodore P. Firestone, MD	none reported
Richard H. Rothman, MD	none reported	Philip H. Ireland, MD	a,e - TissueLink
Carlos J. Lavernia, MD	a – Zimmer; Mercy Hospital c,e – Zimmer	Thomas K. Fehring, MD	none reported
Brian S. Parsley, MD	none reported	Manuel Ribas, MD	none
Thomas K. Fehring, MD	none reported	Shawn Hocker, MD	none
Richard D. Coutts, MD	none reported	Craig J. Della Valle, MD	a,b,e - Zimmer
Matthew B. Collier, MS	none	Vincent J. Williams, MD	none
Jeffery L. Pierson, MD	e - Zimmer	William C. Schroer, MD	a,e - Biomet
James B. Benjamin, MD	e – DePuy, Smith & Nephew	Joseph C. McCarthy, MD	a – Stryker Orthopaedics
Sanjay K. Gupta, MD	none	Murali Jasty, MD	none
Javad Parvizi, MD	none		
Kevin J. Bozic, MD	none		
Geoffrey H. Westrich, MD	none reported		
Michael B. Vessely, MD	a – DePuy		
B. Sonny Bal, MD	none reported		
Gavan P. Duffy, MD	c,e – DePuy Orthopaedics		
Theodore P. Firestone, MD	a,e – DePuy		
Richard Iorio, MD	a – DePuy Orthopaedics		
Lalit Puri, MD	none		
Scott M. Sporer, MD	a,e - Zimmer		
Wayne G. Paprosky, MD	none reported		