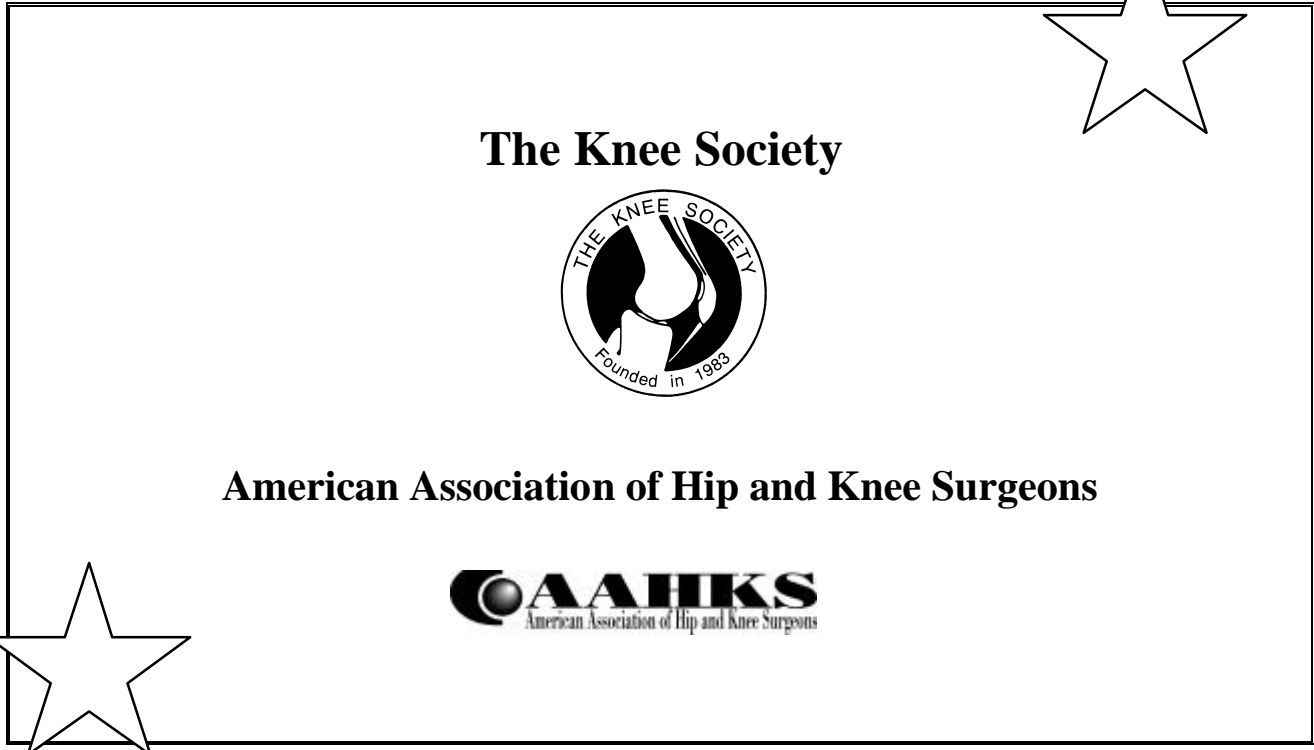



Welcome to Specialty Day

Table of Contents


Scientific ProgramPages 3-5
History of the Knee Society Award Papers.....Pages 6-8
Abstracts.....Pages 9-44
Abstract Forms.....Pages 45-48



The Knee Society

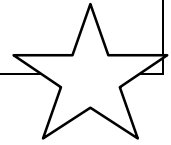


American Association of Hip and Knee Surgeons





**The Knee Society/American Association of Hip and Knee Surgeons
Combined Specialty Day Meeting
Saturday, March 3, 2001**



- 8:00 AM **Welcome**
Thomas S. Thornhill, MD/Cecil H. Rorabeck, MD/Richard B. Welch, MD
- 8:06 AM **Tribute to John N. Insall** – Thomas S. Thornhill, MD
- 8:16 AM **Symposia I: Tibial Modularity: The Cause of Premature Failure of TKR**
Moderator: James A. Rand, MD *
Keynote Speaker: Michael Mayor, MD *
- 8:31 AM An Analysis of Locking Mechanism - Gerard A. Engh, MD *
- 8:41 AM Cross Linked Poly is the Answer - Robert B. Bourne, MD *
- 8:51 AM Back Side Wear - The Achilles Heel of TKA – Ray C. Wasielewski, MD *
- 9:01 AM Modular Stems: A Problem? - Chitranjan S. Ranawat, MD *
- 9:11 AM **Discussion**
- 9:26 AM **Symposia II: Mobile Bearing Knees: What's All the Fuss About?**
Moderator: Lawrence D. Dorr, MD
Keynote Speaker: A. Seth Greenwald, D.Phil (Oxon)
- 9:41 AM Biomechanics/Mobile vs. Fixed Bearing - Douglas A. Dennis, MD *▲
- 9:51 AM Slide and Glide is Best - W. Norman Scott, MD *▲
- 10:01 AM Long Term Results LCS - Frederick F. Buechel, MD *▲
- 10:11 AM Clinical Results - John J. Callaghan, MD *
- 10: 21 AM **Discussion**
- 10:36-10:50 AM **Break**
- 10:51 AM **Symposia III: Unicompartamental TKR in the Millennium**
Moderator: Richard F. Santore, MD
Keynote Speaker: Richard S. Laskin, MD
- 11:06 AM Minimal Invasive Surgical Technique is Best – John Repicci, MD *▲
- 11:16 AM Uni TKA: Why I Prefer Instruments - Aaron G. Rosenberg, MD *▲
- 11:26 AM Results of Uni TKA – David Murray, FRCS *▲
- 11:36 AM Uni TKA: Long Term Results - Richard D. Scott, MD *
- 11:46 AM **Discussion**
- 12:00 – 1:00 PM **LUNCH (Business Meeting – Members Only)**

▲ indicates FDA disclosure, * indicates something of value received

- 1:01 PM **Award Presentations**
Moderator: Cecil Rorabeck, MD
- 1:01 PM **Insall Award** - Introduction – Robert E. Booth, Jr., MD
1:06 PM **Infection in Total Knee Replacement: A Retrospective Review of 6489 Total Knees**
Geert Peersman, MD, Richard Laskin, MD, John Davis, RN, M. Peterson, MD, PhD, New York, NY
- 1:16 PM **Coventry Award** - Introduction - Robert T. Trousdale, MD
1:21 PM **Multiple Surface Contact Stress and Motion Patterns in Mobile Bearing TKA: Experimental and Finite Element Characterizations**
Thomas D. Brown, PhD, Jason K. Otto, MS, John J. Callaghan, MD
Iowa City, IA
- 1:31 PM **Ranawat Award** - Introduction - Lawrence D. Dorr, MD
1:36 PM **A Rational for Using the Epicondylar Axis as the Reference for Femoral Component Rotation in Total Knee Arthroplasty**
Richard A. Berger, MD, Mark C. Miller, MD, Anthony J. Petrella, MD, Alexandros Karmas, MD, Harry E. Rubash, MD
Chicago, IL
- 1:46 PM **Scientific Paper Presentations**
Moderator: Aaron A. Hofmann, MD *
- 1:46 PM **Problems with Cementless Total Knee Arthroplasty at Eleven Years Follow-Up**
Paper #1
Richard A. Berger, MD, Chicago, IL
Aaron G. Rosenberg, MD, Joshua J. Jacobs, MD, Regina M. Barden, RN, Mitchell B. Sheinkop, MD, Jorge O. Galante, MD
- 1:56 PM **Simultaneous Bilateral Total Knee Arthroplasty - Who Decides?**
Paper #2
Adolph V. Lombardi, Jr., MD, FACS, Columbus, OH *
Thomas H. Mallory, MD, FACS, Robert A. Fada, MD, Jodi F. Hartman, MS, Kathleen Dodds, RN, Cheryl A. Kefauver, RN, Joanne B. Adams, BFA
- 2:06 PM **Comparison of Fixed Bearing and Mobile Bearing Total Knee Arthroplasty in Patients with Bilateral Simultaneous Total Knee Arthroplasty**
Paper #3
Young-Hoo Kim, MD, Seoul, Korea
Soon-Ho Cho, MD, Jun-Shik Kim, MD
- 2:16 PM **Is Obesity a Contraindication to Bilateral TKA Under a Single Anesthetic?**
Paper #4
James B. Benjamin, MD, Tucson, AZ *
Todd Tucker, MD, Paul Ballesteros, MD

▲ indicates FDA disclosure, * indicates something of value received

2:26 PM
Paper #5 **Results of Two-Stage Reimplantation with a Static Intervening Antibiotic Spacer for Salvage of Infected Total Knee Arthroplasties**
David G. Nazarian, MD, Philadelphia, PA *
Adam Klein, MD, Kevin Lutsky, BA, Robert E. Booth, Jr., MD

2:36 PM
Paper #6 **Early Failures in Total Knee Arthroplasty**
Thomas K. Fehring, MD, Charlotte, NC
Susan Odum, MEd, William L. Griffin, MD, J. Bohannon Mason, MD,
Matthew Nadaud, MD

2:46-3:00 PM **Break**

3:01 PM **Symposia IV: Hinges in Revision TKR - Back to the Future**
Moderator: Robert E. Booth, Jr., MD
Keynote Speaker: Robert Barrack, MD *

3:16 PM Constraint: How much is Enough - Giles R. Scuderi, MD *
3:26 PM Design of Hinges: What Works? - Russell E. Windsor, MD *
3:36 PM Modular Hinge - Richard E. Jones, MD *
3:46 PM Hinges: The Mayo Experience - Arlen D. Hanssen, MD

3:56 PM **Discussion**

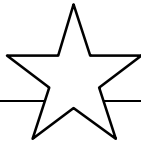
4:11 PM **Symposia V: DVT Prophylaxis: What's Hot and What's Not?**
Moderator: William L. Healy, MD
Keynote Speaker: Paul A. Lotke, MD *

4:26 PM Surveillance - What Should We Do? - Daniel J. Berry, MD
4:36PM The Place of Coumadin - Jay Lieberman, MD
4:46 PM Non-Chemical Prophylaxis is Best - Thomas P. Sculco, MD
4:56 PM L.M.W.H. - The Answer - Clifford W. Colwell, Jr., MD *

5:06 PM **Discussion**

5:20 PM Adjourn

▲ indicates FDA disclosure, * indicates something of value received



History of the Knee Society Awards



In October 1993, the Knee Society Board of Directors established an award program to recognize meritorious presentations at the annual Specialty Day meetings. In 1995, the Board designated three awards to be presented annually, in honor of Knee Society members' Mark Coventry (for the best Basic Science Paper), Chitranjan Ranawat (for the best work on a Surgical Technique) and John Insall (for the best work on a Clinical Subject or Outcomes Report).

2000 SPECIALTY DAY – ORLANDO, FLORIDA

Coventry Award

Author: Robert E. Booth, Jr., MD
Title: The Patellar Nose – An Anatomic Guide for Patellar Resurfacing

Ranawat Award

Author: Thomas K. Fehring, MD
Title: A Comparison of Articulating Versus Static Spacers in Revision Total Knee Arthroplasty for Sepsis

Insall Award

Author: Peter Thadani, MD
Title: Ten to Twelve Year Follow-Up of the Insall Burstein I Posterior Stabilized Total Knee Prosthesis: Wear in Molded Polyethylene and Nonmodular Components

1999 SPECIALTY DAY – ANAHEIM, CALIFORNIA

Coventry Award

Author: Jennifer R. Bohl, BA
Title: The Influence of Shelf-Storage Duration on Clinical Performance of UHMWPE Tibial Components Following Gamma Sterilization in Air

Ranawat Award

Author: Christopher W. Olcott, MD
Title: A Comparison of Four Intra-Operative Methods to Determine Femoral Component Rotation During Total Knee Arthroplasty

Insall Award

Author: Brian J. McGinley, MD
Title: Minimum Ten Year Follow-Up of the Efficacy of Arthroscopic Debridement in the Arthritic Knee

1998 SPECIALTY DAY – NEW ORLEANS, LOUISIANA

Coventry Award

Author: Nancy Parks, MS
Title: Modular Tibial Insert Micromotion: A Concern with Contemporary Knee Implants

Ranawat Award

Author: Robert L. Barrack, MD
Title: Comparison of Tibial Tubercle Osteotomy and Quadriceps Turndown in Revision TKA

Insall Award

Author: Gary Waslewski, MD
Title: Early, Incapacitating Instability of PCL Retaining TKA

1997 SPECIALTY DAY – SAN FRANCISCO, CALIFORNIA

Coventry Award

Author: Robert L. Barrack, MD
Title: The Value of Preoperative Aspiration Prior to Total Knee Revision

Ranawat Award

Author: Gerard A. Engh, MD
Title: The Histology of Nine Large Structural Bone Grafts Used in Total Knee Arthroplasty

Insall Award

Author: Richard S. Laskin, MD
Title: Total Knee Replacement with PCL Retention in Patients with Rheumatoid Arthritis

1996 SPECIALTY DAY – ATLANTA, GEORGIA

Coventry Award

Author: Robert E. Booth, Jr., MD
Title: Molecular Genetic Diagnosis of Infected Total Joint Arthroplasty: A Basic Science and Prospective Clinical Investigation

Ranawat Award

Author: Donald G. Eckhoff, MD
Title: Morphology of the Distal Femur and Femoral Component Rotation

Insall Award

Author: Richard S. Laskin, MD
Title: Long Term Results of TKR with PCL Retention in Patients with a Preoperative Fixed Varus Deformity

1995 SPECIALTY DAY – ORLANDO, FLORIDA

Author: Clifford Colwell, Jr., MD

Title: A Clinical Trial Comparing the Efficacy and Safety of Enoxaparin in Low Molecular Weight Heparin and Unfractionated Heparin for the Prevention of Deep Venous Thrombosis after Elective Knee Replacement Surgery

Author: Donald G. Eckhoff, MD

Title: Malrotation Associated with Implant Alignment Technique in Total Knee Arthroplasty

Author: Leo A. Whiteside, MD

Title: Total Knee Arthroplasty

1994 SPECIALTY DAY – NEW ORLEANS, LOUISIANA

Author: Timothy M. Wright, PhD

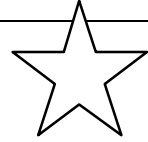
Title: Degradation in Polyethylene Total Knee Components as a Result of Sterilization, Shelf Storage and In-Vivo Use

Author: Profession Peter S. Walker

Title: Are Total Knee Overconstrained?

Author: Robert E. Booth, Jr., MD

Title: Computerized Bio-Sensor Analysis of Total Knee Arthroplasty



ABSTRACTS

Symposia I: Tibial Modularity: The Cause of Premature Failure of TKR
Speaker: Gerard A. Engh, MD

An Analysis of Locking Mechanism

The results of recent studies documenting backside wear on retrieved polyethylene inserts call into question the stability of locking mechanisms of modular tibial components. The purposes of our study were 1) to investigate the *in vivo* stability of modular tibial components and 2) to present a method for evaluating locking-mechanism stability.

We measured anteroposterior and mediolateral displacement between the polyethylene insert and tibial tray on nine types of modular total knee tibial components. Using a Materials Testing System, we measured stability on nine unimplanted components (the control group), seventeen implants obtained at revisions, and twelve postmortem-retrieved devices. We recorded total slack of the locking mechanism (the displacement between baseplate and insert with no or little resistance). From this, we obtained a micromotion index, a two-dimensional vector that represented the total motion in the transverse plane.

Micromotion was recorded in all implant designs and in all groups. For the control group, the micromotion index was a mean $70\mu\text{m} \pm 13\mu\text{m}$; for the revision group, it was $413\mu\text{m} \pm 55\mu\text{m}$; for the postmortem group, it was $420\mu\text{m} \pm 48\mu\text{m}$. The micromotion index for the control group was significantly less than for the revision and postmortem groups ($p < 0.001$).

Clinical Significance: The instability inherent with contemporary modular tibial tray locking mechanisms deteriorates with *in vivo* physiological loading. Debris from backside wear secondary to modular interface motion combined with wear from the articular side might account for the increasing incidence of osteolysis with the widespread use of modular components. Until manufacturers produce modular knee implants with documented stability that will not deteriorate *in vivo*, alternatives including one-piece tibial components should be considered to reduce wear-debris generation.

* Royalties and stock or stock options have been received by DePuy, and Johnson & Johnson Company.

Symposia I: Tibial Modularity: The Cause of Premature Failure of TKR
Speaker: Robert B. Bourne, MD

Cross Linked Polyethylene is the Answer?

Metal backing of tibial components has been implicated as a potential cause of premature wear-related failure of total knee arthroplasties (TKA's) due to thinner polyethylene, locking mechanisms of various efficacy and backside wear. Cross-linked polyethylene has been suggested as a potential alternative bearing surface for modular TKA's. Knee wear simulator evidence suggests that use of cross-linked polyethylene will significantly decrease volumetric wear in both fixed bearing and rotating platform TKA's.

Unfortunately, cross-linking has been associated with a reduction in mechanical properties and fatigue crack propagation resistance, factors which might affect modular TKA's locking mechanism and resistance to delamination. As a consequence, a cautious approach to the use of cross-linked polyethylene in TKA's is suggested, particularly in unconforming designs with high contact stresses and the risk of subsurface fatigue failure.

* Research or institutional support received and consultant or employee of DePuy.

Back Side Wear – The Achilles Heel of TKA

Metal-backed modular tibial implants are widely used in total knee arthroplasty. This modularity allows the surgeon to independently optimize the fit of the tibial and femoral implants while filling the flexion and extension gaps with the correct polyethylene thickness to provide knee function and stability. Additionally, tibial modularity allows the possibility for later revision of the polyethylene bearing alone. The tradeoff is that an interface is created between the insert back side and inner surface of the tibial tray. While a rigid mechanical lock between the tibial insert and metal backing can be manufactured, those assembled by the surgeon at arthroplasty must have some diathesis to relative micromotion.

We studied this back side articulation under cyclic axial physiologic loads (200-2500 N, 0.5 Hz) and found that all inserts tested moved 2–25 microns in the shear plane relative to the metal backing. This motion varied in magnitude and direction based on mechanical interlock design. But, all designs tested had this shear plane motion even under these conservative axial loading conditions.

Variables that influence load magnitude and direction at the main articulation can theoretically increase the likelihood of motion and subsequent wear at the back side articulation. Designs with a cam post mechanism that force rollback at a certain flexion angle create a significant force in this shear plane. The greater the insert constraint, the more likely forces at the main articulation are resisted and transferred to the other interfaces. Inserts with highly conforming sagittal geometries can have a similar affect if used to inhibit anteroposterior motion of the femur on the tibial insert. Therefore, the forces transmitted to the undersurface will probably be least in flat on flat designs and greatest in the highly congruent (sagittal plane) and highly constrained CCK-type designs. New mobile bearing knee designs with super-congruent articular geometries and purposeful motion at this undersurface articulation create an additional challenge to minimizing back-surface wear.

Surgical technique can intuitively result in increased or decreased articular stresses. Varying wear patterns seen on like insert retrievals and large kinematic variations noted in fluoroscopic studies of the same implant design suggest that surgical variables play an important role. These studies indirectly implicate alignment, gap balance and ligament balance as contributing causes of abnormal wear patterns and inconsistent fluoroscopic results. Surgical technique can be expected to similarly impact stresses at the back surface articulation in a given modular tibial design and type.

Insert type, articular design and surgical technique are important variables that can influence the forces to the tibial insert/metal backing articulation during in vivo physiologic loading. As these forces increase, so does the likelihood of relative micromotion and wear of the insert undersurface. To obtain the optimal longevities desired in our next generation TKA implants, back side wear will need to be better understood.

* Research or institutional support has been received from Johnson & Johnson and Zimmer. Consultant or employee of Johnson & Johnson.

Symposia I: Tibial Modularity: The Cause of Premature Failure of TKR
Speaker: Chitranjan S. Ranawat, MD

Modular Stems: A Problem?

There is general agreement that stems are essential to improve fixation and unload the condylar metaphyseal-implant interface especially in the face of proximal tibial cortical bone loss in revision total knee arthroplasty. The advantage of modern tibial base-plates is the modularity of the stem that allows the surgeon to select a suitable length of stem to enhance fixation of the tibial component. The controversy however is the optimal length and method of fixation of the stem. The options available are the ‘dangling’ loose intramedullary stem, the uncemented press-fit stem and the cemented stem.

The 70mm dangling tibial stem has been shown to transmit up to 38% of axial load.¹ In addition the stress shielding of the proximal tibia is dependent on the length of the stem. Hybrid fixation of the proximal metaphyseal portion and a ‘dangling’ non-cemented diaphyseal fixation was the first to evolve and has been demonstrated to provide satisfactory results.²

The press-fit uncemented tibial stems employ endosteal contact and flutes or a slot to provide bony purchase and torque control. The technical problems with these stems involve anatomical axis mismatch of the diaphysis and metaphysis of the tibia. This phenomenon warrants off-center stems or downsizing of the tibial component to attain metaphyseal contact. In addition improper stress concentration at the tip of the stem results in tibial shaft pain in about 20% of cases. The advantages of the long press fit stems are more consistent alignment in the AP and lateral plane and easier revision should removal be needed.

The benefits of cemented modular tibial stems are improved load transfer, better fixation and less micromotion. In addition the advantage of antibiotic delivery in the cement is worth consideration in the setting of infection. However these benefits are offset by the occurrence of more extensive stress shielding and difficulty of component removal and bone damage should further revision be needed. However the Mayo Clinic’s experience with cemented long stemmed components³ is worth consideration in the revision total knee armentarium.

We have used hybrid fixation of the tibial component in 42 revision total knee arthroplasties performed between 1991-1995. At a mean follow-up of 6 years the average Knee Society clinical and functional scores respectively increased from 60 and 58 preoperatively to 94 and 93 postoperatively (p=0.04). The results were classified as good or excellent in 86% of patients. There were no failures and no further operations have been necessary. The mean knee flexion attained postoperatively was 100 degrees.

In summary, we advocate the hybrid method of revision tibial component fixation in most cases. In our judgement cemented modular tibial stems should be employed in cases of revision for infection, the presence of severe osteoporosis and reconstruction of extensive tibial metaphyseal bone loss with massive bulk allograft.

References:

1. Brooks PJ, Walker PS, Scott RD: Tibial component fixation in deficient tibial bone stock. Clin Orthop 184: 302-308, 1984
2. Haas SB, Insall JN, Montgomery W, Windsor RE: Revision total knee arthroplasty with use of modular components with stems inserted without cement. J Bone Joint Surg 77A: 1700-1707, 1995.
3. Murray PB, Rand JA, Hanssen AD: Cemented long-stem revision total knee arthroplasty, Clin Orthop 309: 116-123, 1994.

Symposia II: Mobile Bearing Knees: What's All the Fuss About?
Keynote Speaker: A. Seth Greenwald, D. Phil (Oxon)

Performance Characteristics of Mobile Bearing Knee Systems

Successful outcome in TKA is influenced by a complex interaction between implant design geometry and the active and passive soft tissue structures which surround the articulation. This, in turn, determines the stability, range of motion and interface stresses that develop. In fixed plateau designs, the extent of condylar conformity influences the degree of collateral and cruciate ligament involvement necessary to keep these parameters within normal limits. Less conforming geometries transfer reduced stresses to the tibial bone interface, but result in larger surface stresses at the tibial-femoral articulation due to diminished contact areas. The converse is also true.

Dual surface articulation between a polyethylene insert and metallic femoral and tibial tray components is a consequence of mobile bearing knee designs. These designs enjoy the advantage of conformal geometry and diminished surface stresses while the motion of the bearings serves to minimize the development of interfacial bone stresses. Currently, still a FDA-regulated imperative, the growing use of these systems outside the United States continues unabated. Their clinical performance will be influenced by the particular design kinematics of both proximal and distal surfaces as well as the distribution of contact stresses that act.

The volume and size of UHMWPE particulate produced by dual surface articulation will in turn be affected by polyethylene quality, precision manufacture of the articulating metallic component and the degree of conformity. Not all systems will perform similarly in these regards. A design-specific laboratory evaluation, using a joint simulator, quantified the generation of polyethylene wear debris as part of a required FDA trial, and supports the long-term efficacy of this concept.

Symposia II: Mobile Bearing Knees: What's All the Fuss About?
Speaker: Douglas A. Dennis, MD

Biomechanics: Mobile vs. Fixed Bearing TKA

Introduction: Presently, there are many different types of total knee arthroplasty (TKA); (1) posterior cruciate retaining (PCR) TKA, (2) posterior cruciate sacrificing (PCS) TKA, (3) posterior stabilized (PS) TKA, mobile bearing (MB) TKA, and (5) a combination of (1) through (4). Recently, interest in mobile bearing TKA has increased significantly. Therefore, the objective of this study is to determine the in vivo kinematics for the various TKA types to determine if there are any advantages for using a MB TKA.

Methods: Numerous studies were conducted on subjects, who have been implanted with various TKA types, using video fluoroscopy. While under fluoroscopic surveillance, subjects were asked to perform: (1) normal gait, (2) deep knee bend or (3) both activities. Femorotibial contact paths for the medial and lateral condyles were determined using a computer automated model-fitting technique. Axial rotation and femoral condylar lift-off were also assessed. Femorotibial contact anterior to the tibial midline in the sagittal plane was denoted as positive and contact posterior was denoted as negative.

Results: During a deep knee bend, subjects having a fixed bearing PCR TKA or mobile bearing PCS TKA experienced a paradoxical anterior slide, usually beginning at either 30 or 60 degrees of knee flexion. Subjects having a fixed or mobile bearing PS TKA routinely experienced posterior femoral rollback of their lateral condyle. Also, subjects having a PS TKA experienced more normal axial rotation patterns. During gait, subjects having a fixed bearing PCR or PS TKA experienced a paradoxical sliding motion. Subjects having a PCS TKA with sagittal conforming (LCS rotating platform) experienced a centrally located contact position. Subjects having a mobile bearing PCR TKA, where the polyethylene is free to rotate and translate, experienced a medial pivot motion with the lateral condyle translating more than the medial condyle. Condylar lift-off occurred with all TKA, routinely ranging from 1.0 to 3.5 mm, with the maximum amount of 8.0 mm occurring in deep flexion.

Discussion: Under in vivo conditions, subjects having a PS TKA (mobile or fixed bearing) achieved more normal and reproducible knee kinematics during a deep knee bend. During gait, subjects having a mobile bearing PCS TKA experienced more reproducible knee kinematics without paradoxical sliding. Overall, a mobile bearing PS TKA experienced better knee kinematics under gait and a deep knee bend.

- * Research or institutional support has been received from DePuy
- ▲ The FDA has not cleared the drug and/or medical device for the uses described in this presentation. (i.e., the drug or medical device being discussed for an “off label” use.) For full information, please refer to the inside back cover.

Symposia II: Mobile Bearing Knees: What's All the Fuss About?
Speaker: W. Norman Scott, MD

Slide and Glide is Best

The results of fixed bearing TKR over the past two decades have been very successful with long term prosthesis survival rates of approximately 95% at ten to fifteen years. However, with few exceptions these results have been obtained in older, less active patients. Despite the generally favorable outcomes, reservations still exist regarding the performance of fixed bearing devices in more active patients. In particular, the potential for polyethylene wear from both the bearing surface and the undersurface between the polyethylene insert and the tibial baseplate is concerning. In order to maximize contact area, thereby minimizing contact stresses and polyethylene wear, current knee prostheses have returned to the round on round geometry used in the designs of the 1970's. However, with a fixed bearing knee prosthesis there are limits to the femorotibial conformity that can be utilized, as there is a trade off between conformity and rotation/translation. Normal knee biomechanics require rotation and translation at the femorotibial interface and therefore, it seems desirable to allow for these motions. Without dramatic advances in material engineering, the only solution to this conflict is to design a mobile bearing knee prosthesis.

In a mobile bearing design, a highly conforming femorotibial articular surface can be utilized and still allow for rotation and translation to occur. This is because the motions of flexion-extension and rotation/translation have been uncoupled and occur at different interfaces. Flexion-extension occurs at the femorotibial interface, where the two components can act as a fully conforming hinge, while rotation and translation occur at the undersurface between the insert and the tibial baseplate. In addition to rotation, anteroposterior translation is required at the undersurface in order to facilitate knee flexion in a highly conforming prosthesis. In order to prevent posterior impingement that can limit flexion, the tibial insert must slide posteriorly on the baseplate as the knee flexes, effectively producing a posterior translation of the femorotibial contact point.

Short term experience in Europe, with a modern prosthesis that incorporates the design concepts reviewed above, have been encouraging. Aglietti has implanted >140 Zimmer MBK™ (Warsaw, Indiana) prostheses since December 1996. One to 3 year follow up on 100 patients is available. These prostheses were utilized in a typical population of patients requiring TKR, with a mean age of 71 and osteoarthritis in 94%. The mean Knee Society Knee Score at follow up was 92, with 70% excellent, 25% good, 3% fair and 2% poor results. Functional Scores were also favorable with 69% excellent, 16% good, 10% fair and 5% poor results. Average post-operative flexion was 110 degrees. In patients with pre-operative motion >120 degrees, the mean post-operative flexion was 124 degrees. This was the same as a control group in whom a modern design posterior stabilized knee was utilized. Radiographic follow-up did not reveal any progressive radiolucent lines. Currently, this prosthesis is undergoing IDE studies in the United States.

In summary, in order to allow for a fully conforming femorotibial articular surface with a large contact area, a knee prosthesis must incorporate a mobile bearing that allows for rotation and translation at the undersurface. Early results with a modern design, mobile bearing prosthesis that incorporates these features have been very favorable.

* Royalties have been received from Zimmer.

▲ The FDA has not cleared the drug and/or medical device for the uses described in this presentation. (i.e., the drug or medical device being discussed for an "off label" use.) For full information, please refer to the inside back cover.

Symposia II: Mobile Bearing Knees: What's All the Fuss About?
Speaker: Frederick F. Buechel, MD, FACS

Long Term Results LCS® Total Knee Replacement
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Clinical, radiographic and survivorship analysis was performed on the initial cementless series of 309 primary and multiply-operated PCR meniscal bearing and rotating platform New Jersey LCS® total knee replacements followed for a minimum of 10 to a maximum of 20 years.

Clinical results in patients surviving at least 10 years using a strict knee scoring scale were similar for PCL retaining and PCL sacrificing designs. Good to excellent results were seen in 97.7% of primary PCR meniscal bearing knees and in 97.9% of primary rotating-platform knees.

Radiographic analysis on minimum 10 year follow-up x-rays demonstrated stable fixation of all components, no gross migration but significant osteolysis requiring bearing exchange and bone grating in 3 multiply operated cementless rotating platform knees (1.8%) at an average of 10.2 years from their index surgery.

Survivorship of the primary cementless PCR meniscal bearing group with an endpoint of revision for any mechanical reason demonstrated 97.4% at 10 years and 83% at 16 years; using an endpoint of a poor clinical knee score the survivorship was 98.9% at 10 and 16 years, respectively. Survivorship of the primary cementless rotating platform group with endpoints of revision for any mechanical reason or a poor clinical knee score demonstrated 98.3% survivorship at 10 and 18 years, respectively.

No cementless rotating-bearing patella loosened, fractured or dissociated in this study, although one cementless rotating patella bearing (0.6%) in a multiply-operated patient wore through the inferior marker wire after 10.8 years causing metallosis, requiring revision.

* Consultant or employee of DePuy.

▲ The FDA has not cleared the drug and/or medical device for the uses described in this presentation. (i.e., the drug or medical device being discussed for an “off label” use.) For full information, please refer to the inside back cover.

Symposia II: Mobile Bearing Knees: What's All the Fuss About?
Speaker: John J. Callaghan

Clinical Results

Mobile bearing knee replacements have been implanted for over 20 years. The devices with the longest clinical follow-up are the Oxford unicompartmental replacement and LCS (low contact stress) total knee system.

Implant survival for the Oxford knee has been reported at ten years. The ten-year survival rate was 97% in the hands of the developer and 95% in the hands of an independent evaluator. Implant survivorship for the LCS meniscal-bearing knee was 98% for posterior-cruciate-retaining meniscal-bearing implants and 98% for rotating platform implants in the hands of the developer at six years. In the hands of independent examiners the survival rate of rotating platform implants at 8 to 12 years range from 95 to 100% and for meniscal bearing implants a survival rate of 94.6% at eight years has been reported.

Complications with these devices are similar to those of fixed bearing devices. However the same principles of soft tissue balancing and component alignment that are important in fixed bearing procedures are important in those where mobile bearing knee replacements are performed in order to avoid bearing dislocation.

* Research or institutional support, miscellaneous non-income support, commercially derived honoraria, or other non-research related funding, royalties, and consultant or employee of DePuy.

Symposia III: Unicompartmental TKR in the Millennium

Speaker: John Repicci, MD

Minimal Invasive Unicompartmental Arthroplasty is Best

Unicompartmental arthroplasty has been traditionally performed through a patellar dislocating surgical approach similar to that utilized for TKR. A mini-invasive, low morbidity, bone-sparing technique for Unicompartmental arthroplasty is described.

Unicompartmental implants are of significantly smaller size than TKR systems, arthroscopic visualization can provide all necessary diagnostic information, therefore maximum exposure is not mandatory. Avoiding patellar dislocation with its significant damage to the supra-patellar pouch dramatically reduces morbidity.

Exposure can be improved by distraction instrumentation while early ambulation facilitated by avoiding injectable narcotics and local anesthetic infiltration of all incised areas.

The minimally invasive surgical technique will be described.

The first 445 “mini-invasive” (10 cm incision technique) implants were reviewed: 86 outpatients, 353 one-day hospitalization, and 6 two-day hospitalizations. No re-admissions were required. At present all patients are outpatient or less than 23 hour stay.

References:

1. Repicci J and Eberle R (1999) Minimally invasive surgical technique for unicondylar knee arthroplasty J. Southern Orthopedic Association, Spring Vol. 8, No. 1: 20-27

* Royalties and stock or stock options received from Biomet.

▲ The FDA has not cleared the drug and/or medical device for the uses described in this presentation. (i.e., the drug or medical device being discussed for an “off label” use.) For full information, please refer to the inside back cover.

Symposia III: Unicompartmental TKR in the Millennium

Speaker: Aaron G. Rosenberg, MD

Unicompartmental Total Knee Arthroplasty: Why I Prefer Instruments

Many surgeons who attempted to use unicompartmental knee replacement in the past found an unfortunately high incidence of early failure. Much of this can be attributed to faulty implant design, fixation methods and patient selection; and some may be attributed to failure to understand the principles of limb alignment and component position that are different in unicompartmental as opposed to total knee replacement.

The history of total knee arthroplasty would suggest that the pioneering surgeons who developed this technology were able to perform much of their surgery without the use of instruments. Given the surgical skills and experience of these pioneers it would be foolish to suggest that they were not capable of implanting their total knees with precision and consistent accuracy. We know, however, from multiple studies in the literature, that limb malalignment and component malposition occurred occasionally in even these master surgeons' hands. Furthermore, almost all of these surgeons eventually developed instruments that allowed them to improve the consistency with which their knees were implanted and allowed other less experienced and or talented surgeons to implant total knee replacements with confidence and consistency. Is there any compelling reason why the same should not be true for unicompartmental replacement?

As this operation is even more demanding from the standpoint of component position and limb alignment, and is performed substantially less frequently by most orthopaedic surgeons performing knee arthroplasty, it is even more important for the surgeon to be guided by instruments in the accurate and consistent placement of this device.

- * Research or institutional support and royalties have been received by Zimmer.
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Symposia III: Unicompartmental TKR in the Millennium
Speaker: David G. Murray, FRCS

Results of Uni TKA

Unicompartmental knee replacements (UKR) have many advantages over total replacements (TKR), including better function and less morbidity. However, in general, they have a higher failure rate. To minimise the UKR failure rate it is essential that the implant should not wear out, and that the appropriate indications and surgical techniques are used. The Oxford UKR has a fully congruent mobile bearing and has been shown in a retrieval study to have minimal wear. The indications for the use of this device for medial compartment osteoarthritis are clearly defined. It is appropriate for about one in four osteoarthritic knees needing replacement.

The designer, Mr. Goodfellow, achieved a 98% (CI 93% to 100%) survival at 10 years, using the appropriate indications. However data from the designer is open to bias. An independent series of 420 Oxford UKR from Dr. Svard achieved a 94% (CI 86% to 100%) survival at 15 years, with no loss to follow-up.

In the Swedish National Arthroplasty Register the survival rate of the Oxford UKR at about 10 years was 85%. We have obtained data from 13 centers in Sweden and found that the failure rate in these centers varied from 0% to 30%. The poor results that occurred in a few centers were probably because of inappropriate indications or technique, and resulted in the relatively low overall survival. To address this problem of inconsistent results new simplified instrumentation (Phase 3) has recently been introduced. This instrumentation has been specifically designed for a minimally invasive approach.

Patients recover three times quicker after minimally invasive UKR than after TKR. A radiographic comparison demonstrated the Oxford UKR can be implanted as precisely through a short incision as through a standard incision. A fluoroscopic study demonstrated that knee kinematics after minimally invasive UKR are virtually normal and are substantially better than after TKR. At one year the first 58 minimally invasive Oxford (Phase 3) UKR implanted by a single surgeon had an average flexion of 135°, Knee Society knee score of 97 and function score of 92.

We conclude that UKR is the treatment of choice for medial compartment osteoarthritis provided appropriate implants, indications and surgical techniques are used.

- * Research of institutional support and royalties have been received from Biomet.
- ▲ The FDA has not cleared the drug and/or medical device for the uses described in this presentation. (i.e., the drug or medical device being discussed for an “off label” use.) For full information, please refer to the inside back cover.

Symposia III: Unicompartmental TKR in the Millennium
Speaker: Richard D. Scott, MD

Unicompartmental Knee Arthroplasty: Long Term Results

Unicompartmental knee arthroplasty (UKA) has been controversial since its introduction nearly 30 years ago in the early 1970's. Some initial results from that era suggested that medial compartment replacement did not yield good enough early results to be a viable long-term option, while lateral compartment replacement appeared to be promising.

By the early 1980's, however, good initial results were being published for both medial and lateral replacement and enthusiasm for the procedure began to rise. Refinements were made in patient selection, surgical technique, and prosthetic design. Ten year follow-up studies were reported that showed survivorship was slightly less than that reported for total knee arthroplasty (TKA) but acceptable considering the theoretically conservative nature of unicompartmental surgery. Some reports refuted this conservative argument while later reports confirmed it as long as conservative designs and techniques had been utilized.

Almost all 10 year-plus follow-up studies appear to show that UKA will have inferior survivorship to TKA in the second decade whether from loosening, prosthetic wear, or secondary degeneration of the opposite compartment.

We can now characterize UKA as a procedure with a reliable 8 to 10 year outcome in properly selected osteoarthritic patients with a skillfully implanted proper design. UKA can be an attractive alternative to osteotomy or TKA especially in the selected middle-aged female.

If second decade survivorship of UKA can become competitive with TKA, indications can be expanded. Ten-year results from one european center using a mobile-bearing design suggest that enhanced second decade survivorship is a possibility.

* Royalties have been received from DePuy, Inc.

Insall Award Paper

Geert Peersman, MD, Richard Laskin, MD, John Davis, RN, M. Peterson, MD, PhD, New York, NY

Infection in Total Knee Replacement: A Retrospective Review of 6489 Total Knees

Six thousand four hundred and eighty nine knee replacements were performed at the Hospital for Special Surgery between 1993 and 1999. Operations were performed in a theatre with vertical laminar flow, and with the operating team employing body exhaust suits. Of these, 116 knees became infected. Ninety-seven of these knees (86%) were deep periprosthetic infections with the remaining 16 knees being superficial wound infections. One third of the deep infections occurred within the first 3 months after surgery and the remaining 2/3 after three months. The overall early deep infection rate was 0.43%. A cohort of non-infected knees matched for gender, age and month of surgery was used as a control group.

Those co-morbidities which were statistically significant in increasing the risk of infection were prior open surgical procedures, immunosuppressive therapy, poor nutrition, hypokalemia, diabetes mellitus, obesity and history of smoking. Revision procedures had a statistically higher risk of infection than did primary surgeries. If the surgery took longer than 2 ½ hours to perform the risk of infection was significantly increased ($p < .001$). There was no change in the infection rate when the peri-operative antibiotic prophylaxis was decreased from 48 hours to 24 hours after surgery. The predominant infectious organisms were gram positive (staphylococcus aureus, staphylococcus epidermidis, and streptococcus group B). Twenty percent of the knees that were clinically infected had no organisms that could be identified. In each case, the patient had been treated empirically at another institution with antibiotics prior to obtaining a culture of the joint.

Coventry Award Paper

Thomas D. Brown, PhD, Jason K. Otto, MS, John J. Callaghan, MD, Iowa City, IA

Multiple Surface Contact Stress and Motion Patterns in Mobile Bearing TKA: Experimental and Finite Element Characterizations

The contact stress and motion patterns of the femoral-tibial articulating surface of fixed bearing total knee arthroplasty have been characterized by multiple investigators. With the development and use of mobile bearing and modular fixed bearing total knee replacements, there is a need for the development of valid models to characterize multiple surface contact stresses and motion patterns. In this study the authors have performed an experimental and finite element analysis of the contact stresses and motions at multiple bearing surfaces of a rotating platform total knee arthroplasty.

The mobility of a widely used rotating platform total knee was investigated through mechanical testing on a servohydraulic machine, and through a nonlinear finite element model. Parameters varied were axial load, condylar load allocation, flexion angle, and static vs. dynamic loading. Similar results of the physical model and finite model in areas common to both lend credence to the validity of the findings. The relationship between resisting torque and axial load was approximately linear. The amount of torque required to initiate rotation (static torque) was greater than the amount to sustain rotation (dynamic torque). Peak values measured were 9.47 ± 0.61 and 5.51 ± 0.38 N-m, for static and dynamic torque, respectively. A 60-40 condylar load allocation produced slightly less resisting torque than the 50-50 load case. For all practical purposes, the polyethylene insert rotated simultaneously with the femoral component, especially at flexion angles of 15 degrees or less. Insert rotation consonant with femoral rotation led to maintenance of high contact area, desirable behavior clinically. Apparent static and dynamic friction coefficients were 0.154 and 0.089, respectively.

By use of a combined approach (experimental and finite element analysis), the authors have demonstrated the contributions of the tibial-femoral “bearing” surface and the “mobile” polyethylene-tibial tray surface to contact motion in a specific mobile bearing knee replacement, in addition to characterizing contact stresses at those two interfaces.

Clinical Relevance: The high frictional torques observed at the “mobile” interface in this experimental and finite element analysis may explain why a percentage of these mobile bearing knee devices are not moving under routine functional load. This model should enable investigators to better characterize the “stress conditions” occurring at the backside of fixed bearing knees, as well as the various other surfaces of the newer mobile bearing knee replacement designs, as they are developed.

Ranawat Award Paper

Richard A. Berger, MD, Mark C. Miller, MD, Anthony J. Petrella, MD, Alexandros Karmas, MD, Harry E. Rubash, MD, Chicago, IL

A Rational for Using the Epicondylar Axis as the Reference for Femoral Component Rotation in Total Knee Arthroplasty

Introduction: Femoral component rotation is important in total knee arthroplasty to minimize both patellofemoral and tibiofemoral complications. More recently, the epicondylar axis has been cited as the definitive landmark for femoral component rotation. However, there is little data to support the validity of this rotational landmark and its effect on the patellofemoral and tibiofemoral articulations.

Methods: A total knee arthroplasty was performed in 11 cadaveric knees. The knees were tested with various femoral component rotations from 5° of internal rotation to 5° of external rotation referenced to the epicondylar axis and to the posterior femoral condyles. Each knee acted as its own internal control. The knees were actively ranged from 0-110° by a force on the quadriceps tendon in an Oxford knee simulator. 3-D kinematics of all three components were measured while a multiaxial transducer imbedded in the patella measured patellofemoral forces.

Results: Femoral component rotation parallel to the epicondylar axis resulted in the most normal patellar tracking and minimized patellofemoral shear forces early in flexion. This optimal rotation also resulted in the most normal tibiofemoral wear motions. These beneficial effects of femoral rotation were less reproducibly related to the posterior condyles. Rotating the femoral component either internal or external to the epicondylar axis worsened knee function by increasing tibiofemoral wear motions causing rotational instability and significantly worsening patellar tracking with increased shear forces early in flexion.

Conclusion: Aligning the femoral component parallel to the epicondylar axis resulted in optimum patellofemoral tracking, and minimized tibiofemoral wear motion and instability. The posterior condyles were a less reproducible landmark. In conclusion, the femoral component should be rotational aligned parallel to epicondylar axis to avoid patellofemoral and tibiofemoral complications.

Scientific Paper Presentation #1

Richard A. Berger, MD, Chicago, IL

John Lyon, MD, Regina M. Barden, MD, Joshua Jacobs, MD, Aaron Rosenberg, MD,
Jorge O. Galante, MD

Problems with Cementless Total Knee Arthroplasty at Eleven Years Follow-Up

Introduction: Cementless fixation may provide added longevity in knee arthroplasty; however, it may be less predictable than cemented fixation and may predispose the periarticular bone to osteolysis.

Methods: One hundred twenty-nine consecutive cementless total knee arthroplasties that retained the posterior cruciate ligament (MG-1, Zimmer) were prospectively followed. The mean follow-up was 12 years (9-15 yrs). The average age was 58 years (32-75 y.o.). The patellar component was metal-backed.

Results: The average pre-operative HSS knee score of 51 points improved to 90 (22-100) at follow-up. Seventeen knees (13%) had a fair or poor result. Of these, 15 (12%) were related to their knee and have been revised, while two were unrelated to their knee.

- Patella:** Forty-four (34%) of the metal-backed patellae failed and were revised; nine were loose and 35 wore through the polyethylene.
- Femur:** Thirteen (10%) required revision due to galling from a failed metal-backed patellar component. No other femoral component was revised, loose, or developed osteolysis.
- Tibia:** Seven tibial components (5%) were revised; five for loosening and two for fracture. Two additional components are radiographically loose but not revised. Over 50% of the tibiae developed radiolucencies beneath the component or around the screws. Thirteen (10%) small osteolytic lesions developed; all around screws or screw holes in the tibial components.

Conclusion: At an average of 12 years follow-up, cementless fixation yielded mixed results: cementless femoral fixation was excellent while metal-backed patellar components led to a 34% revision rate. Cementless tibial components led to a 5% aseptic loosening rate. In addition, over 50% of the tibiae developed radiolucencies and thirteen cases (10%) demonstrated small osteolytic lesions adjacent to screws or screw holes. Based on these results we have abandoned cementless fixation in total knee arthroplasty.

Scientific Paper Presentation #2

Adolph V. Lombardi, Jr., MD, FACS, Columbus, OH

Thomas H. Mallory, MD, FACS, Robert A. Fada, MD, Jodi F. Hartman, MS, Kathleen Dodds, RN, Cheryl A. Kefauver, RN, Joanne B. Adams, BFA

Simultaneous Bilateral Total Knee Arthroplasty – Who Decides?

Introduction: The decision of whether to treat patients presenting with severe end-stage degenerative joint disease (DJD) of both knees necessitating bilateral total knee arthroplasty (TKA) in a simultaneous (at one surgical setting) versus staged (at two different and distinct times) fashion is often debated. The ability to accomplish the basic goals of TKA, namely, pain relief, restoration of function, stability, and durability, with either approach is well established in the literature and not disputed. However, controversy exists regarding the safety and relative risk of simultaneous bilateral TKA. The purpose of this retrospective review is to compare the results of all simultaneous bilateral and unilateral TKAs performed in a three-year period, focusing on perioperative complications, length of stay, and discharge disposition.

Materials and Methods: Between March 1997 and March 2000, three surgeons at a single institution performed 2048 TKAs in 1498 patients. Bilateral simultaneous TKA was performed in 1090 cases, while unilateral TKA was carried out in 958 cases. All procedures followed a standard operative protocol. The postoperative physiotherapy and rehabilitation for both groups of patients was identical. All patients were evaluated perioperatively for any variances by the same internal medicine group, utilizing standardized and established management protocols.

Demographics were similar between the groups. In addition, the following sets of comparisons were performed between the unilateral and simultaneous bilateral patients: 1) overall unilateral patients versus overall simultaneous bilateral patients; 2) unilateral patients 80 years of age or greater versus simultaneous bilateral patients 80 years of age or greater; 3) unilateral patients less than 80 years of age versus simultaneous bilateral patients less than 80 years of age; 4) unilateral patients 80 years or greater versus unilateral patients less than 80 years of age; and 5) simultaneous bilateral patients 80 years of age or greater versus simultaneous bilateral patients less than 80 years of age.

Results: Summarizing the operative results, the difference in blood loss, number of patients receiving blood, and the average number of blood units received were statistically significant between each comparison ($p = 0.0000$ in all cases), indicating greater blood loss in the simultaneous bilateral and/or elderly patients. A significantly higher incidence of gastrointestinal variances ($p < 0.0001$), primarily ileus, was reported in the overall simultaneous bilateral group compared to the overall unilateral group. When age comparisons between the two groups were analyzed, the simultaneous bilateral patients 80 years of age or greater had a significantly higher pulmonary incidence ($p = 0.0428$), while the simultaneous bilateral patients less than 80 years of age had a significantly higher incidence in gastrointestinal incidence ($p < 0.0001$). Comparing age subgroups within the unilateral group revealed significantly higher pulmonary ($p = 0.0024$), neurological ($p < 0.0001$), cardiac ($p < 0.0001$), and genitourinary ($p = 0.0497$) incidences among the patients greater or equal to 80 years of age versus those patients less than 80 years of age. The simultaneous bilateral patients greater or equal to 80 years of age had significantly higher pulmonary ($p = 0.0349$), neurological ($p = 0.0016$), and cardiac ($p = 0.0002$) incidences than patients less than 80 years of age in that same group. The average acute length of stay in the simultaneous bilateral and unilateral groups was 3.65 days and 3.42 days, respectively. The total discharge disposition between all study group comparisons was statistically significant ($p < 0.0001$ in all cases), with a significantly higher number of simultaneous bilateral patients discharged to a post-hospitalization care facility.

Discussion: In conclusion, patients continue to present with bilateral end-stage DJD requiring TKA of both knees. The analysis of the operative and postoperative variance variables suggests that age, not procedure, plays a more significant role in the perioperative morbidity of TKA. Based on the results from this study and previous literature documenting patient choice and satisfaction with simultaneous bilateral TKA, literature suggesting comparable efficacy and outcomes between simultaneous bilateral and unilateral TKA procedures, and professional experience with minimal associated perioperative complications, this orthopaedic practice continues to offer bilateral simultaneous TKA. However, the authors caution that each orthopaedic surgeon must evaluate the literature closely and, more specifically, his/her own practice with respect to perioperative complications to decide if bilateral TKA may be performed in a safe fashion. Therefore, while it is the patient who decides to proceed with bilateral simultaneous TKA, the surgeon must ultimately decide if this is feasible in his/her own practice.

* Research or institutional support has been received, miscellaneous non-income support, commercially derived honoraria, or other non-research related funding, royalties, and consultant or employee of Biomet, Inc.

Scientific Paper Presentation #3

Young-Hoo Kim, MD, Seoul, Korea

Soon-Ho Cho, MD, Jun-Shik Kim, MD

Comparison of Fixed Bearing and Mobile Bearing Total Knee Arthroplasty in Patients with Bilateral Simultaneous Total Knee Arthroplasty

To compare results critically of fixed bearing and mobile bearing total knee arthroplasty (TKA), a prospective and randomized study was performed in patients who underwent bilateral simultaneous primary TKA with cemented Anatomic Modular Knee (AMK) (DePuy, Warsaw, IN.) and Low Contact Stress (LCS) knee (DePuy, Warsaw, IN.). 116 patients (232 knees) were enrolled in this study. 80 were female and 36 were male. Average age of patients was 65 years (33 to 70). AMK (fixed bearing) prostheses were implanted in one side and LCS meniscal bearing (mobile bearing) in opposite side of 116 patients' knees. All polyethylene patellar prostheses were used in AMK and mobile bearing metal backed patellar prostheses were used in LCS knees. All surgeries were performed under epidural anesthesia by one surgeon (YHK). 110 patients had osteoarthritis of both knees and 6 patients had rheumatoid arthritis. Subvastus approaches were used in all knees. The average follow-up was 6.4 years (5 – 7 years). Clinical (HSS knee score) and x-ray follow-up was performed at 6 week, 3 mos, 6 mos, 1 year and then annually. There was no aseptic loosening or subsidence of femoral, tibial or patellar components in both groups. In AMK group, preop. knee score was 47.4 (12 – 71) points and the score at final F.U. was 91.1 (59 – 99) points. In LCS group, preop. knee score was 47.1 (13 – 69) points and the score at final F.U. was 92.8 (61 – 99) points. One knee in each group had poor result due to unknown origin of persistent pain in the knee. R-O-M of both knees were comparable. Average R-O-M in AMK group was 120.9° (85° - 140°) and 123.2° (85° - 140°) in LCS group. Alignment in AMK group was 4.2° valgus (5° varus - 10° valgus) and 5.3° valgus (0° - 10° valgus) in LCS group. Femoral angle (A-P) was 94.7° (89° - 103°) in AMK group and 94.4° (81° - 100°) in LCS group. Femoral angle (lateral) was 7.6° (0° - 14°) in AMK group and 10.5° (0° - 20°) in LCS group. Tibial angle (A-P) was 89.5° (85° - 102°) in AMK group and 89.6° (85° - 95°) in LCS group. Tibial angle (lateral) was 86.3° (81° - 92°) in AMK group and 84.8° (80° - 91°) in LCS group. The percentage of area of tibial surface covered by implant was comparable in both groups. 4 knees (3.4%) with AMK and 8 knees (6.8%) with LCS had radiolucent line (RLL) less than 1 mm in zone 1 of femoral cement-bone interface (lateral) and 112 knees (96.6%) with AMK and 108 knees (93%) with LCS had no RLL. 34 knees (29%) with AMK and 20 knees (17%) with LCS had RLL less than 1 mm in zone 1 of tibial bone-cement interface, 1 knee (0.9%) with AMK had RLL less than 1 mm in zones 1 and 2 and 1 knee (0.9%) with LCS had RLL less than 1 mm in zone 4 of tibial bone-cement interface. 16 knees (14%) with AMK and 20 knees (17%) with LCS had lateral patellar subluxation. No knee had patellar dislocation. No gross polyethylene liner wear or osteolysis was identified in any knees in both groups. All results were similar in both groups except AMK group tended to have higher incidence of RLL in the medial tibial plateau.

Scientific Paper Presentation #4

James B. Benjamin, MD, Tucson, AZ

Todd Tucker, MD, Paul Ballesteros, MD

Is Obesity a Contraindication to Bilateral TKA Under a Single Anesthetic?

Methods: Patients undergoing primary TKA between 1/94 and 6/99 were reviewed for the incidence of local wound and systemic complications following unilateral and simultaneous bilateral TKA. Body mass index of ≥ 30 was used to define obesity. Wound complications were calculated based on the number of knees performed and systemic complications based on patient numbers. Knee society scores were calculated pre-op and a minimum of 6 months post op.

Results: During the study period 316 patients underwent 405 primary knee replacements. One hundred and twenty-eight patients were classified as obese based on BMI. The mean BMI in the obese group was 35.6 with a range of 30 to 46.7. One hundred eighty-eight patients with a BMI < 30 underwent TKA during the same period. In the non-obese group there were 19 local wound complications including 2 wound dehiscences and one deep infection. In the obese group there were 14 wound complications included 2 dehiscences and 4 deep infections. Local and systemic complications for all 4 groups are summarized in table:

	THIN UNI	OBESE UNI	THIN BILAT	OBESE BILAT
PATIENTS / KNEES	137/137	90/90	51/102	38/76
WOUND COMPS	7%	10%	10%	7%
SYSTEMIC COMPS	3%	10%	10%	8%
PRE-OP SCORES	47/46	46/42	49/42	48/40
POST-OP SCORES	83/73	84/71	85/80	87/81

Discussion: Non-obese patients undergoing unilateral TKA demonstrated lower systemic complications than the other groups however there was no significant difference in complication rates between obese patients undergoing unilateral or simultaneous bilateral TKA. Local wound complication rates did not differ between any of the study groups although there were more deep infections in the obese group. Knee score improvements were comparable for all patients. Based on local and systemic complication rates obesity does not appear to be a contraindication to bilateral TKA under a single anesthetic.

* Consultant or employee of Johnson & Johnson/DePuy.

Scientific Paper Presentation #5

David G. Nazarian, MD, Philadelphia, PA

Adam Klein, MD, Kevin Lutsky, BA, Robert E. Booth, Jr., MD

Results of Two-Stage Reimplantation with a Static Intervening Antibiotic Spacer for Salvage of Infected Total Knee Arthroplasties

Introduction: Infection in total knee arthroplasty is a devastating complication. The management of chronic infections usually involves either immediate or delayed reimplantation. One previous study with two-stage reimplantation reported successful eradication of the original infection in 37 of 38 total knees. Other authors have advocated the use of an articulating spacer rather than a static spacer. This study reports the results at one institution with two-staged reimplantation using a static spacer block.

Methods: This study included a retrospective review of 124 knees with an average follow-up of 4.5 years (range 2-11 years). Two-stage reimplantation consisted of an initial radical debridement with removal of all prosthetic components and insertion of a molded monolithic antibiotic impregnated cement spacer followed by a six-week course of parenteral antibiotics. Reimplantation was performed at an average of 3.9 months (range 2-9) following explanation. All patients were evaluated clinically and radiographically with a modified Knee Society rating system.

Results: The infection was successfully eradicated with this protocol in 112 of 124 knees. The average knee score went from 46 preoperatively to 84 postoperatively. The average range of postoperative motion was 3 (range 0-15) to 95 (range 85-125). Results were good or excellent in 66%, fair in 24%, and poor in 10%. Allograft was used in only 4 knees with severe bone loss which was noted at explantation. Complications included 7 superficial wound problems, 3 patellar fractures, and 4 extensor ruptures. Recrudescence of infection occurred in 12 of 124 knees requiring staged reimplantation in nine, amputation in 2, and chronic oral suppression in 1.

Discussion and Conclusion: The use of an articulating spacer has observed increasing popularity because of previous reports showing a reduction in bone loss and ease of reimplantation compared to the use of static spacer. In contrast, excellent results have been observed in this study with the use of a static spacer. This method is felt to provide more satisfactory bone and soft tissue preservation than an articulating spacer which may cause abrasive wear of the surrounding tissues. This static construct has not been shown to significantly reduce eventual knee motion and may have the additional advantage of improved local angiogenesis with more successful eradication of infection because of the extended period of joint immobility.

* Consultant or employee of Zimmer

Scientific Paper Presentation #6

Thomas K. Fehring, MD, Charlotte, NC

Susan Odum, MEd, William L. Griffin, MD, J. Bohannon Mason, MD, Matthew Nadaud, MD

Early Failures in Total Knee Arthroplasty

Introduction: Total knee arthroplasty is a predictable operation. Published long-term studies cite greater than 90% success at > 10 year follow-up. Unfortunately, there is a subset of patients who do not do well requiring revision within the first five years. Both patient and surgeon alike have come to expect results far superior to this. The purpose of this study was to analyze the mechanisms of failure in those patients revised within five years of their index arthroplasty.

Materials and Methods: Between 1986 and 1999, 440 total knees were referred for revision surgery. An analysis of patients failing within 5 years of their index arthroplasty was performed. Reasons for early failure were documented.

Results: Of the 440 patients revised, 281 (64%) were revised within five years of their index arthroplasty. 105 of the 281 early failures (37%) were revised for infection. 74 of the 281 early failures (26%) were revised for instability. 37 of the 281 early failures (13%) were revised for failure of ingrowth of a porous coated implant. 22 of the 281 early failures (8%) were revised for patellofemoral problems, and 21 of the 281 early failures (7%) were revised for wear or osteolysis. Only 8 of the 281 early failures (3%) were revised for aseptic loosening of a cemented implant. The remaining 12 patients were revised for miscellaneous problems.

Discussion: Early failure of TKA is disappointing for patient and surgeon alike. Steps to prevent such early failure should be taken at index arthroplasty. Infection appears to be an unavoidable reason for early failure. Meticulous sterile technique coupled with prophylactic antibiotics should keep this to a minimum. Host factors, however, will prevent this from ever being eradicated. Many of the other reasons for early failure were related to poor surgical judgment or poor surgical technique. 2 patterns of failure dominated this series – failure of cementless fixation and instability. 13% of our early failures and 8% of our revisions overall were revisions for lack of bony ingrowth. Since the long-term results of cementless fixation have never been reported superior to cemented fixation, the wisdom of choosing this type of fixation must be questioned. Instability was the other preventable mechanism of failure leading to early failure. 26% of our early failures and 17% of our revisions overall were revisions for instability. Care in ligamentous balancing and equalization of flexion extension gaps cannot be over-emphasized during primary surgery. Total knee arthroplasty is not an exercise in bony carpentry. Special care must be given to the soft tissue part of the procedure to avoid early revision for instability. If all of the patients in this early failure group would have been routinely cemented and carefully balanced, our total number of early revisions would have decreased by 40% and our overall failures would have been reduced by 25%.

Symposia III: Unicompartamental TKR in the Millennium
Keynote Speaker: Robert L. Barrack, MD

Evolution of the Rotating Hinge for Complex TKA

The fixed hinged knee prosthesis was introduced by Walldius in the 1950's. The high failure rate of the original hinged devices was due to the lack of normal kinematics resulting in abnormally high stresses transmitted to the metal articulation and the bone cement interface. The rotating hinge was introduced in an attempt to improve the suboptimal clinical performance. The clinical result of early generation rotating hinges had a number of problems of their own including excessive bone removal at the time of implantation, inconsistent alignment, a suboptimal patellofemoral joint, and a high incidence of tibial component loosening particularly when malalignment occurred. Because of the variable results of the early generation rotating hinges, this design concept was largely abandoned by most American arthroplasty surgeons. Rotating hinges continued to be used by orthopaedic oncologists as well as by a number of centers in Europe, notably the Endo Klinik. A small group of surgeons continued to use rotating hinges for complex knee arthroplasties especially in salvage revision procedures. A number of design improvements have occurred in the last ten years including improved kinematics and contact area of the rotating hinge articulation, improvement in the conformity and contact area of the patellofemoral articulation, improved instrumentation to achieve more consistent alignment, the use of modular canal filling stems to improve alignment and fixation, the addition of metal augments for both the femoral and tibial sides to assist in more accurately restoring the joint line, and the use of modular metaphyseal components to avoid excessively thick cement mantle and improve cement fixation. Good results are now being reported from a number of American centers of intermediate term results of second generation rotating hinge devices that incorporate these design improvements. Non-oncology indications for the use of a rotating hinge that have been suggested include absence of the MCL especially in an elderly or low demand patient, revision of a previous hinged component with a substantial ligamentous laxity and bone loss, when the femoral peel is used and an extreme flexion-extension gap balance is encountered, when distal femoral structural grafts or proximal tibial grafts that include the collateral ligament origin or insertion are utilized, and in conjunction with extensor mechanism reconstruction in unstable knees. The major alternative to the use of the rotating hinge in these difficult cases is the use of a highly constrained tibial insert with a high degree of varus/valgus constraint to substitute for the absence or insufficient collateral ligaments. These tibial inserts frequently have only 1 to 2 degrees of rotation before impingement of the post in the box occurs. Excessive loading of the post leads to polyethylene wear as well as high forces transmitted to the modular interface with the base plate which can result in polyethylene and metal debris generation. The rotating hinge may, in fact, represent a less constrained alternative since these devices allow in excess of 30° of internal and external rotation and movement that is occurring is between the polished cobalt-chrome surface and a polyethylene. The number and complexity of revision knee replacements is increasing rapidly and it is likely that the rotating hinge will continue to have a role. The indications for the use of a rotating hinge in complex TKA will be more clearly established in the future.

* Research or institutional support has been received by Johnson & Johnson. Consultant or employee of DePuy.

Symposia III: Unicompartamental TKR in the Millennium
Speaker: Giles R. Scuderi, MD

Constraint: How Much is Enough?

The goal of total knee replacement is to relieve pain, restore function and provide stability. This is achieved by implanting a durable and predictable prosthetic design with anticipated long-term success. It is preferable to use the least constraint possible when trying to achieve these goals, since constraint has been implicated with polyethylene damage and component loosening.

Total knee replacement is a balance between conformity and constraint, which relies on the simultaneous interaction of the supporting soft tissues and the contoured prosthetic surface. Often constraint and conformity are used interchangeably, but this is not correct. Conformity relates to shape of the corresponding articular surfaces. The most conforming articulation would have similar radii of curvature and the radius ratio would be one. Conforming articulations minimize contact stress by maximizing the surface area. Constraint implies a restriction of rotational or translational movement in an implant design. This can be achieved with a linked or non-linked implant design. There are times when the pre-operative pathology dictates the use of a constrained implant.

Constrained implants, such as the constrained condylar knee, are non-linked devices that provide varus-valgus, as well as anterior-posterior stability. Indications include medial collateral insufficiency, inability to balance the flexion and extension spaces and, at times, the valgus knee.

Symposia III: Unicompartamental TKR in the Millennium
Speaker: Richard E. Jones, MD

Modular Hinge

First generation, highly constrained hinged total knees had high rates of loosening and complications with direct metal on metal load transmission and excessive stresses across bone - cement - implant interfaces. Newer designs of hinge knees based on increasing conformity and decreasing stresses by recognizing the link between gait kinematics which require rotation at the knee and long term function have been used clinically over the last decade. Only recently have published clinical results been available for such knees. These linked, mobile knee systems allow modular construction of an implant that can provide restoration and stability to those most difficult revisions which have significant hard or soft tissue deficiencies.

Recent reports of Barrack, et. al. (mean 51-month follow-up) and Jones, et. al. (mean 47 month follow-up) uniformly document statistically significant improvement in function with a modular, linked, mobile bearing total knee system (S-ROM mobile-bearing hinge knee system, DePuy, Inc., Warsaw, IN). This system provides intramedullary mounted alignment instruments and modular diaphyseal stems, metaphyseal sleeves and augments.

Intramedullary fixation is obtained with press-fit, slotted and splined stems while the modular, metaphyseal sleeves both fill and load the large Engh type II and III bony deficiencies often encountered in salvage revision knee surgery. In this system with press-fit sleeves and stems there were no significant radiologic changes demonstrating that the mobile hinge concept did provide excellent restoration of function. In the two studies of patients remarkable for their severe deficiencies, both Barrack and Jones cited positive and significant improvements in Knee Society scores and function.

Similar results have recently been reported by Westrich, et. al. (mean 33-month follow-up) with another modular, mobile hinge knee system (Finn rotating hinge knee, Biomet, Inc., Warsaw, IN). No mechanical failures were reported in any of the three series.

Significant clinical improvement and radiographic evidence of bone maintenance and apposition suggests that a high percentage of satisfactory results can be successfully obtained with modular, mobile-bearing hinge knees in salvage revision knee arthroplasty.

* Royalties, and consultant or employee of DePuy, a Johnson & Johnson Co.

Symposia III: Unicompartamental TKR in the Millennium
Speaker: Arlen D. Hanssen, MD

Hinges: The Mayo Experience

Between January 1980 and July 1998, 188 Kinematic Rotating Hinged TKA (KRH-TKA) were implanted at our institution. The majority of KRH-TKA were performed for the management of neoplastic disease reconstruction. A subset of 67 patients (77 KRH-TKA) were treated for non-neoplastic etiologies. Of these 77 implants, 8 KRH-TKA (8 patients) were omitted from the present study and the remaining 69 KRH-TKA (59 patients) constitute the basis of this report.

At the time of KRH-TKA implantation, patient age averaged 72 years (range, 46-89 years). There were 12 primary and 57 revision TKA and of the revision procedures, the number of prior TKA averaged 2.1 procedures (range, 1-4). The indications for use of the KRH-TKA included combined severe bone loss and collateral ligamentous instability (17), failure of a prior hinged TKA (15), nonunion of a periprosthetic fracture (12), acute periprosthetic fracture (10), reimplantation for infection (7), severe ligamentous instability (6), and congenital dislocation of the knee (2). Preoperatively knee joint extension averaged 1.5 degrees (range, -40 to 30 degrees) and flexion averaged 81 degrees (range, 15 to 120 degrees). The preoperative Knee Society Knee Score averaged 29 points (range, 3 to 93 points). At final follow-up, knee extension averaged 1.25 degrees (range, -5 to 25 degrees), flexion averaged 94 degrees (range, 5 to 120 degrees) and the Knee Score improved to 76 points (range, 44 to 97 points). Follow-up averaged 6 years (range, 2 to 16.6 years).

Complications were numerous and required reoperation in 20 knees (29 percent). The incidence of deep periprosthetic infection was 13 percent (9 knees). These were managed with an above knee amputation (5) and debridement with prosthesis retention and chronic antibiotic suppression (4). Additional reoperations included skin grafting or local muscle transposition for soft-tissue loss (6), revision for aseptic loosening of femoral or tibial loosening (5), repair of extensor mechanism instability or patellar component loosening (4), replacement of a fractured axis bushing (2), and evacuation of an acute postoperative hematoma (1).

During the time period of this study, there were 15,798 primary TKA and 2673 revision TKA performed at our institution. The patients receiving a KRH-TKA represent a highly complex and small subset of the overall population undergoing TKA. Although the use of the KRH-TKA for these limited indications has been useful in our hands, the incidence of complications and the poor outcome of these complications is sobering. We believe that the use of a hinged TKA should be reserved for the final salvage option of the treatment options available when performing complex revision TKA.

Symposia V: DVT Prophylaxis: What's Hot and What's Not?
Keynote Speaker: Paul A. Lotke, MD

DVT Prophylaxis: What's Hot and What's Not?

Methods for prophylaxis against thromboembolic disease (TED) have been investigated intensely for the past 50 years. Yet, there is still very little consensus as to which is the safest and most effective regimen. The reasons for the divergence in opinion can be attributed in part to the large volume of information that is poorly defined or incompletely reported. In order to determine the best prophylaxis, we must balance the risks and benefits associated with our choices. This requires accurate data, which is clearly reported.

The risk of fatal PE is frequently misrepresented in the literature. Within the introduction of many recent well-controlled studies on TED, it is inappropriately reported that the death rate from pulmonary emboli after total joint surgery is between 1-7%. In reality, the current death rate from PE in the past decade is between 0.1 and 0.2%, and this defines the major risk.

The literature frequently equates the presence of a DVT with a pulmonary embolism. They are combined and equated for statistical purposes. This is misleading. The significance of a DVT after TKA is undetermined and may not be clinically important. Even after the most aggressive prophylactic regimens, DVT may be reduced in number, but still exists in 10-30% of our patients. They are three times more common after TKA than after THA, yet we do not see an associated three-fold incidence in PE. In addition, there has not been a drop in fatal PE proportional to the reduction in calf DVT. After TKA, DVT may not be an accurate surrogate marker for patients at risk for PE.

The risk from bleeding is a significant potential morbidity from anticoagulation. Patients with past history of DVT or GI bleed are excluded from most sponsored studies and thereby skew the entry population. In general a major bleed is defined as one that requires reoperation, bleeding into an organ, or death from hemorrhage. Other bleeds may be considered "not significant." The risk from bleeding requires careful assessment and is frequently understated in the literature.

Preconceptions of effectiveness prevail. For instance, aspirin is perceived not to be effective. Yet several large studies have shown that with the use of aspirin the death rate is the same as with more aggressive chemoprophylactic regimens without the increase risk from bleeding. Since it is safe and as effective against fatal PE as other agents, it is my preference at this time.

In order to determine "the best" regimen, we must balance the risks and benefits of our choices. Also, we must be aware of the limitations of the current reporting and look for unbiased accurate data in order to decide which is best for our patients.

Symposia V: DVT Prophylaxis: What's Hot and What's Not?
Speaker: Daniel J. Berry, MD

Surveillance – What Should We Do?

The role of routine screening for deep venous thrombosis after total knee arthroplasty is controversial. Different screening methods have a range of levels of sensitivity and specificity for proximal and distal clots, and accuracy also varies with the experience of the technician performing the test. Advantages of screening include: (1) detection and treatment of asymptomatic but potentially life-threatening clots, (2) potential to reduce the morbidity, inconvenience, and expenses associated with treating many patients with venous thromboembolism prophylaxis after hospital discharge. Disadvantages of screening include: (1) imperfect accuracy of screening tests, (2) the potential of screening to lead to over-treatment and excess morbidity in otherwise asymptomatic patients, (3) potential under treatment of patients with clots that escape detection, and (4) cost associated with routine screening.

The central question regarding screening remains: With modern screening methods, does routine screening lead to a reduction in venous thromboembolism related morbidity and mortality after total hip arthroplasty? The relative benefit of screening probably is influenced by (1) the type—and efficacy—of the venous thromboembolism prophylaxis being used, (2) the treatment algorithm used when asymptomatic clots are detected, and (3) whether screening is used for all patients or exclusively high risk patients.

A summary and analysis of the literature to date will be presented to provide insight into this important subject.

Symposia V: DVT Prophylaxis: What's Hot and What's Not?
Speaker: Jay Lieberman, MD

The Place of Coumadin

There is significant risk of the development venous thromboembolic disease (TED) in patients undergoing total knee arthroplasty (TKA). The ideal agent for prophylaxis is yet to be determined. The selection of a prophylaxis regimen is not only influenced by its efficacy and safety, but also by pressures of cost containment and decreased duration of hospital stay. Despite a number of well-designed clinical studies assessing the efficacy and safety of variety of modalities for prophylaxis against TED, the prevention of this complication with respect to major knee surgery remains problematic.

There is a long history of successful use of warfarin prophylaxis to prevent symptomatic pulmonary embolism (PE) and deep vein thrombosis (DVT) after TKA. However, there are concerns about the high rates of asymptomatic thrombi that have been reported in clinical trials. Low-dose warfarin prophylaxis has been used successfully at the UCLA Medical Center for the past three decades. In a study of a consecutive series of 815 primary and revision TKA patients that received low-dose warfarin prophylaxis, there were only three symptomatic PE's (0.3%:95% confidence intervals, 0.08%-1.1%) and eight (1%) symptomatic distal DVTs. Two patients (0.3%) died, but neither deaths were secondary to PE. Hematomas developed after surgery in 17 knees (2.5%) and two of these patients required drainage of the knee.

There are four recently published randomized trials that compared the efficacy of adjusted dose warfarin prophylaxis (INR=2.0-3.0) and different low molecular heparins (LMWHs) as prophylactic agents after total knee arthroplasty. The data is listed in the table below.

Study	Study Population	Successful Venography	DVT(%) Overall	DVT(%) Proximal	Pulmonary Embolism (%)	Bleeding (%)
Hull et al Warfarin	324	277	54.9	12.3	0	2.4
Logiparin	317	258	45.0	7.8	0	4.4
RD Heparin Warfarin	147	147	41.0	10.0	0	NA
RD Heparin (twice daily)	150	150	25.0	6.0	0	NA
LeClerc et al Warfarin	334	211	51.7	10.4	0.9	1.8
Enoxaparin	336	206	36.9	11.7	0.3	2.1
Heit et al' Warfarin	279	222	38.0	7.0	0.04	4.4
Ardeparin	277	232	27.0	6.0	0.0	7.9

In all of these trials, the data demonstrated a significantly increased risk of overall asymptomatic DVT formation when comparing warfarin prophylaxis to LMWH. However, there was no statistically significant difference in proximal clot or symptomatic PE rates between warfarin and the LMWHs. In addition, there were significantly higher bleeding rates noted with some of the LMWHs compared to low-dose warfarin. The clinical significance of the DVTs that were noted in these studies is difficult to ascertain since almost all of these clots were asymptomatic. These asymptomatic clots could be associated with the development of chronic venous stasis disease, but this has not been documented.

There have been no randomized trials comparing pneumatic compression devices with warfarin. There is clear evidence that pneumatic compression devices do provide effective DVT prophylaxis after total knee

arthroplasty. There are concerns about compliance and limited duration of the use of these devices with shorter hospital stays.

In summary, low dose warfarin prophylaxis has been found to provide safe and effective prophylaxis after total knee arthroplasty. However, low molecular heparins and pneumatic devices also provide effective prophylaxis. The advantage of warfarin prophylaxis is that it can be administered orally, however, careful monitoring of the INR level is required. There are also concerns that TKA patients may be relatively unprotected during the early perioperative period. The appropriate duration of prophylaxis has not been established, but it is recommended that prophylaxis be continued post discharge. Routine screening with ultrasonography is not recommended at this time.

Symposia V: DVT Prophylaxis: What's Hot and What's Not?
Speaker: Thomas P. Sculco, MD

Non-Chemical Prophylaxis is Best

Inciting events leading to deep vein thrombosis occur primarily intraoperatively. Therefore if at all possible intervention should be performed at the time of the operative procedure. It has been demonstrated in hip replacement surgery that DVT is significantly reduced with epidural hypotensive anesthesia which may or not be augmented with intraoperative small doses of heparin (500-1000 units). Reduction of extreme limb position with occlusion of the femoral vein during hip replacement surgery reduces the stasis effect which promotes clotting. In the hip overall DVT rates have been reduced to 7% and proximal DVT rates to 2% using these intraoperative techniques.

Mechanical devices work by a myriad of mechanisms: (1) venous turbulence is created in valve pocket areas and this reduces clot formation; (2) there is an increase release of endothelial relaxing factor (EDRF) which inhibits platelet aggregation; (3) intermittent compression stimulates fibrinolysis by inducing release of urokinase and tissue plasminogen from the venous endothelium. Randomized trials have demonstrated a reduction in DVT to levels similar to pharmacologic agents (20-27%) without the risk of postoperative hemorrhage. However, compliance with use of these devices is crucial, as a positive relationship has been demonstrated between time of use and DVT rates. Although plantar pump devices tend to be well tolerated with occasional complaints of foot and skin irritation, calf compression devices with or without sequential foot compression applying at least 50mm Hg of external pressure at a frequency of at least once per minute and an inflation rate of less than 1 second tend to be the ideal device for DVT prophylaxis.

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Symposia V: DVT Prophylaxis: What's Hot and What's Not?
Speaker: Clifford W. Colwell, Jr., MD

L.M.W.H. – The Answer

Venous thrombosis continues to be a major risk after total knee arthroplasty. Without prophylaxis, the prevalence of total deep vein thrombosis is as high as 84%, with proximal occurrence as high as 20%. Of more concern is the occurrence of pulmonary embolism as high as 7%, with fatal pulmonary embolism as high as 0.7%. This high prevalence mandates that prophylaxis for thromboembolic disease be utilized for patients having total knee arthroplasty.

Low-molecular-weight heparins (LMWH) have a predictable dose response, offer high bioavailability at low doses, and produce linear pharmacokinetics. LMWH has no significant influence on the prothrombin time or partial prothrombin time. It has a half-life of approximately 4½ hours providing effective dosing every 12 to 24 hours with rapid antithrombotic action.

Routine pharmacological prophylaxis with low-molecular-weight heparin appears to be effective in decreasing the occurrence of venous thromboembolism. Venographic prevalence of DVT among TKA patients receiving LMWH prophylaxis remains substantial at 25-45%. In a cohort study of 842 TKA patients receiving LMWH prophylaxis for a mean duration of 9 days, the overall 84-day incidence of symptomatic VTE and fatal PE was only 3.9% and 0.4%, respectively.¹ Prophylaxis with LMWH beyond hospitalization may be indicated with decreased hospital stays, though studies have not been convincing that extended outpatient prophylaxis for more than seven to ten days is necessary.

Low-molecular-weight heparin has been studied extensively and is safe and effective prophylaxis after total knee arthroplasty.

1. Leclerc JR, Gent M, Hirsh J, Geerts WH, Ginsberg JS. The incidence of symptomatic venous thromboembolism during and after prophylaxis with enoxaparin: a multi-institutional cohort study of patients who underwent hip or knee arthroplasty. Canadian Collaborative Group. *Arch Intern Med* 1998 Apr 27;158(8):873-8.

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Notes

