

The Knee Society
and the
American Association of Hip and Knee Surgeons



Combined Specialty Day Meeting
Saturday, March 13, 2004

Moscone Center Gateway Ballroom
San Francisco, California

Scientific Program

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Future Combined Specialty Day Meetings

Washington, DC	February 26, 2005
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San Diego, CA	February 17, 2007
San Francisco, CA	March 8, 2008
Washington, DC	February 21, 2009

2003-2004 Knee Society Education

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Abstract Applications for the 2004 Knee Society Interim Meeting and the 2005 Combined Specialty Day Meeting can be submitted on the Knee Society Website (www.kneesociety.org). The deadline for receipt of Abstracts is April 15, 2004.

**The Knee Society/AAHKS
Combined Specialty Day Meeting
Saturday, March 13, 2004**

- 8:00 AM **Welcome**
Cecil H. Rorabeck, MD, Knee Society President
Richard S. Laskin, MD, Knee Society Education Committee Co-Chair
Robert L. Barrack, MD, Knee Society Education Committee Co-Chair
Clifford W. Colwell, MD, AAHKS President
Thomas P.Vail, MD, AHHKS Education Committee Chair
- 8:10-9:15 AM **SYMPOSIUM I: UNICOMPARTMENTAL KNEE ARTHROPLASTY**
Moderator: John J. Callaghan, MD, Iowa City, IA
- 8:11-8:21 AM **Why Are We Seeing an Upsurge of Patients for UNIs?**
Gerard A. Engh*, MD, Alexandria, VA
- 8:22-8:32 AM **Indications and Contraindications: Medial vs. Lateral, Fixed vs. Mobile**
Thomas S. Thornhill,* MD, Boston, MA
- 8:33-8:43 AM **Solitary Tibial Resurfacing**
Richard D. Scott, MD, Boston, MA
- 8:44-8:55 AM **Unicondylar Knee Arthroplasty Compared to TKA in the Young
and the Elderly**
Alfred J. Tria,* MD, Somerset, NJ
- 8:56-9:15 AM **DISCUSSION**
- 9:16-10:30 AM **SYMPOSIUM II: MINIMALLY INVASIVE KNEE ARTHROPLASTY**
Moderator: Thomas P.Vail,* MD, Durham, NC
- 9:17-9:26 AM **Minimally Invasive TKR Can Improve Patient Function**
Richard S. Laskin,* MD, New York, NY
- 9:26-9:35 AM **Mini-Incision Total Knee Arthroplasty**
Giles R. Scuderi,* MD, New York, NY
- 9:35-9:44 AM **MIS TKR through a Mini-Mid Vastus Approach**
Steven B. Haas,* MD, New York, NY
- 9:44-9:53 AM **The Mini-Incision TKA: In Opposition**
David Hungerford,* MD, Baltimore, MD
- 9:53-10:10 AM **DISCUSSION**
- 10:10-10:25 AM **BREAK**

- 10:25-10:55 AM **DEBATE: Bilateral Simultaneous Knee Replacements**
Moderator: Douglas A. Dennis, MD, Denver, CO
- 10:26-10:34 AM **The Outcomes Justify Its Use**
Merrill A. Ritter,* MD, Mooresville, IN
- 10:35-10:42 AM **The Risks Do Not Justify Its Use**
Arlen Hanssen,* MD, Rochester, MN
- 10:43-10:58 AM **DISCUSSION**
- 10:59 AM - Noon **The Knee Society Award Presentations**
Richard Laskin, MD, New York, NY
- 10:59-11:01 AM **MARK COVENTRY AWARD**
Introduction: Arlen Hanssen, MD, Rochester, MN
- 11:02-11:10 AM **Factors Influencing Wear and Osteolysis in Press-Fit Condylar Modular Total Knees**
Thomas K. Fehring,* MD, Charlotte, NC
- 11:11-11:14 AM **DISCUSSION**
- 11:15-11:17 AM **CHITRANJAN RANAWAT AWARDS**
Introduction: Lawrence D. Dorr, MD, Inglewood, CA
- 11:18-11:26 AM **RANAWAT AWARD**
Tibial Component Failure Mechanisms in Total Knee Arthroplasty
Michael Berend,* MD, Mooresville, IN
- 11:27-11:30 AM **DISCUSSION**
- 11:31-11:39 AM **RANAWAT AWARD**
Long-Term Follow-up of Two-Stage Reimplantation for Infected Total Knee Arthroplasty
Abdul Haleem, MD, Rochester, MN
- 11:40-11:43 AM **DISCUSSION**
- 11:44-11:46 AM **JOHN INSALL AWARD**
Introduction: Michael A. Kelly, MD, New York, NY
- 11:47-11:55 AM **Patella Resurfacing/Non-resurfacing In TKA – Results of a Randomized Controlled Clinical Trial at a Minimum of 10 Years**
R. Stephen Burnett, MD, FRCSC, St. Louis, MO
- 11:56-11:59 AM **DISCUSSION**

Noon-1:00 PM	LUNCH BREAK (Knee Society Business Meeting - Members Only)
1:00-1:15 PM	Presidential Address Cecil H. Rorabeck, MD, FRCS, London, ON, Canada
1:16-2:29 PM	Scientific Paper Presentations Moderator: Paul A. Lotke,* MD, Philadelphia, PA
1:16-1:22 PM Paper #1	The Histologic Appearance of “Pristine” Articular Cartilage in Knees with Unicompartamental Osteoarthritis Jack M. Bert, MD, St. Paul, MN
1:23-1:26 PM	DISCUSSION
1:27-1:33 PM Paper #2	The Progression of Patellofemoral Arthrosis in Unicompartamental Knee Replacement at 11-15 Years Richard Berger,* MD, Chicago, IL
1:34-1:37 PM	DISCUSSION
1:38-1:44 PM Paper #3	Do Rotating Platform Knees Improve Patellar Tracking? A Prospective, Randomized Study of 240 Primary Total Knees Robert Trousdale,* MD, Rochester, MN
1:45-1:48 PM	DISCUSSION
1:49-1:55 PM Paper #4	Analysis of Early Revision in a Community Knee Implant Registry Terrence J. Gioe*, MD, St. Paul, MN
1:56-1:59 PM	DISCUSSION
2:00-2:07 PM Paper #5	Stability, Alignment, and Contact Stress in Two Techniques of Total Knee Arthroplasty Leo Whiteside,* MD, St. Louis, MO
2:07-2:10 PM	DISCUSSION
2:11-2:17 PM Paper #6	Early failure of Cementless Mobile Bearing TKA Robert Barrack,* MD, New Orleans, LA
2:18-2:21 PM	DISCUSSION
2:22-2:29 PM	BREAK
2:30-2:33 PM	Introduction to the 2003 John Insall Traveling Fellow W. Norman Scott, MD, New York, NY

- 2:33-2:45 PM **Report of the John Insall Traveling Fellows**
David Backstein MD, MEd, FRCS (C), Toronto, ON, Canada
- 2:45-3:30 PM **SYMPOSIUM III: CAN POLYETHYLENE WEAR BE DECREASED?**
Moderator: A. Seth Greenwald, DPhil, Cleveland, OH
- 2:46-2:53 PM **Knee Simulator Wear of Polyethylene Tibias Articulating Against Explanted Rough Femoral Components**
Orhun K. Muratoglu,* PhD, Boston, MA
- 2:54-3:01 PM **Wear Debris and Biological Activity of Crosslinked Polyethylene in the Knee: Benefits and Potential Concerns**
John Fisher,* BSc, PhD, DEng, CEng, FIMechE, FIPEM, Leeds, UK
- 3:02-3:09 PM **Diminished Polyethylene Wear through Use of a Metal-Ceramic Composite Femoral Component**
Clifford W. Colwell,* MD, La Jolla, CA
- 3:09-3:16 PM **Diminishing Backside Wear**
Timothy M. Wright* PhD, New York, NY
- 3:16-3:35 PM **DISCUSSION**
- 3:35-5:00 PM **SYMPOSIUM IV: NEW THOUGHTS FOR OLD PROBLEMS: BACK TO THE FUTURE?**
Moderator: Thomas S. Thornhill, MD, Boston, MA
- 3:36-3:43 PM **Patellofemoral Arthroplasty: Pros, Cons, Design Considerations**
Jess H. Lonner,* MD, Philadelphia, PA
- 3:44-3:51 PM **Patellar Bone Grafting in Preference to Patelloplasty**
Arlen D. Hanssen, MD, Rochester, MN
- 3:52-3:59 PM **Soft Tissue Local Anesthetic Injection to Reduce Pain after TKR**
Adolph V. Lombardi,* MD, Columbus, OH
- 4:00-4:07 PM **Computer Assisted Total Knee Arthroplasty: Results of a Prospective Randomized Study**
Jan Victor,* MD, Brugge, Belgium
- 4:08-4:15 PM **An Oral Anticoagulant that Does not Require Monitoring: Has an Optimal Answer for VTE Control Finally Arrived?**
Clifford W. Colwell,* MD, La Jolla, CA
- 4:16-4:23 PM **Mechanical Prophylaxis: The Safest Alternative for Thromboembolic Disease Control after TKR**
Paul Lachiewicz, MD, Chapel Hill, NC

4:24-4:31 PM **Is Two-Stage Revision Still the Gold Standard for Infected TKA?**
Daniel J. Berry,* MD, Rochester, MN

4:32-4:39 PM **Osteogenic Proteins in Knee Arthritis and Arthroplasty**
Robert Barrack,* MD, New Orleans, LA

4:40-5:00 PM **DISCUSSION**

5:00 PM **Adjourn**

(*) indicates something of value received from a commercial company or institution

Scientific Presentation Abstracts

Symposium I: Unicompartamental Knee Arthroplasty

Why Are We Seeing an Upsurge of Patients for UNIs?

Gerard A. Engh, MD, *Alexandria, VA*

The application of minimally invasive surgery to unicondylar knee arthroplasty has spawned a resurgence of interest in this time proven operation. We live in a society that demands fast food, fast service, and cosmetic surgery. A unicondylar arthroplasty that quickly relieves pain, rapidly restores function, and can be performed as an outpatient procedure through a two-inch surgical incision has enormous appeal to prospective patients. Studies have documented the reduced morbidity and quicker recovery when unicondylar arthroplasty is performed using a minimally invasive technique. The relatively small size of the components makes unicondylar arthroplasty an operation that is easily adaptable to a small incision. Implant manufacturers, hospitals, and surgeons have realized these benefits and aggressively market this surgery directly to the consumer.

From a scientific standpoint, outcome studies with both fixed- and mobile-bearing unicondylar implants are equivalent to the best reported results with total knee arthroplasty. In studies comparing unicondylar arthroplasty to total knee arthroplasty in the same patient, patients have reported less pain, improved stair climbing abilities, and dominant function in the unicondylar side. Most often, patients preferred the knee with the unicondylar arthroplasty. For surgeons already performing unicondylar arthroplasty, these results provide confidence to expand their indications for this procedure. For other orthopaedic surgeons, these results have fostered trust in the procedure and they have elected to try this type of surgery.

In summary, the advantages and consumer appeal for this procedure far outweigh any disadvantages. The upsurge in unicondylar arthroplasty is the result of adapting minimally invasive surgical techniques to this procedure and responding to consumer demand through aggressive advertising for this type of surgery.

Financial Disclosure: a-Inova Health Care Services, c-DePuy

Symposium I: Unicompartamental Knee Arthroplasty

Indications and contraindications: Medial vs. Lateral, Fixed vs. Mobile

Thomas S. Thornhill, MD, Boston, MA

The indications and contraindications for unicompartamental knee arthroplasty (UKA) are similar for the medial or lateral side and for fixed bearing or mobile bearing. The strict contraindications to UKA include inflammatory arthritis, multi-compartmental disease, severe deformity and/or subluxation, and a significant non-articular deformity. Each of these has an exception relating to specific areas or severities that may create a variation to the rule. The relative contraindications include significant chondrocalcinosis in the articular cartilage (its presence tends to desiccate the cartilage and increased its propensity to wear), osteonecrosis if it involves both compartments, obesity and an anterior cruciate (ACL) deficient knee. The concern in obesity is the load placed across a small prosthetic surface. The concern in an ACL deficient knee is related to the pattern of gonarthrosis and the loss of the four-bar cruciate linkage.

The majority of UKAs are medial due to its prevalence in unicompartamental gonarthrosis. Lateral unicompartamental disease is frequently posttraumatic and studies have reported its efficacy as being better, similar and worse than medial UKA. The difficulty in lateral UKA is that the disease is frequently seen in association with patello-femoral arthrosis or inflammatory arthritis. The major differences; however, are related to variations in surgical experience, methods of exposure and component alignment. As the lateral patellar facet drapes over the lateral femoral condyle, anterior impingement on the femoral component is more likely to impinge anteriorly in lateral UKA. Moreover, component alignment in the medial lateral direction is more difficult in lateral UKA.

Most reports of UKA are with fixed bearing implants. It is clear that a conforming fixed bearing implant will be associated with a higher incidence of failure due to the unpredictable kinematics of the resurfaced compartment in UKA that leads to abnormal constraint. Mobile bearing UKAs clearly have a theoretical advantage and early reports from the Oxford experience are encouraging. It is essential; however, that a mobile bearing UKA be able to adapt to the kinematics of the resurfaced compartment, which vary in an unpredictable fashion.

Financial Disclosure: a, c – DePuy/Johnson & Johnson

Symposium I: Unicompartmental Knee Arthroplasty

Solitary Tibial Resurfacing

Richard D. Scott, MD, *Boston, MA*

McKeever and MacIntosh metallic hemi-arthroplasties have been available for more than fifty years. Two decades ago, published reports for patients with unicompartmental OA revealed good initial results in 85% of patients. This procedure is conservative and easily revised, if necessary, to any type of arthroplasty in the future. This author has continued to use McKeever metallic hemi-arthroplasty in highly selected patients over the past 30 years.

The UniSpacertm was introduced several years ago. It can be thought of as a mobile McKeever or MacIntosh metallic hemi-arthroplasty. Rather than attempting fixation to the tibial plateau via a keel or a roughened undersurface, it is designed to translate freely on the tibial plateau as determined by the conforming articulation of its top side surface with the femoral condyle. This mobility makes it inappropriate for use in the lateral compartment where the femoral roll-back could cause prosthetic dislocation, soft tissue impingement or both.

No long-term results are available for the UniSpacertm. At the present time, its role in arthroplasty surgery is uncertain. Its indication should be similar to those for McKeever arthroplasty: a patient with unicompartmental osteoarthritis in whom an osteotomy is contraindicated, but is considered too young, heavy or active for a metal-to-plastic arthroplasty.

Less than 1% of patients with OA should be appropriate candidates for any type of metallic hemi-arthroplasty.

Financial Disclosure: none

Symposium I: Unicompartamental Knee Arthroplasty

Unicondylar Knee Arthroplasty Compared to Total Knee Arthroplasty in the Young and the Elderly

Alfred J. Tria, Jr., MD, Somerset, NJ

Unicondylar knee arthroplasty (UKA) dates back to the 1980's. The initial results were not good. Many authors published data that was discouraging and the procedure fell out of favor in the 1990's. Repicci introduced the concept of minimally invasive surgery (MIS) for the UKA and this helped to rekindle interest in the procedure. The newer results for UKA have been very encouraging with survival rates greater than 90% at the ten-year mark.

Total knee arthroplasty (TKA) has continued to be successful and has shown survival rates of greater than 90% into the second decade of follow-up. The results of the two procedures are very similar during the first decade when either the young or the elderly results are compared. The newer results in the second decade for the UKA are just beginning to be reported and also appear to be comparable to the TKA counterparts.

UKA compares well to TKA in the young or elderly group as long as good surgical technique and patient selection are observed.

Financial Disclosure: e – Zimmer Orthopaedics, IMP

Symposium II: Minimally Invasive Knee Arthroplasty

Minimally Invasive TKR Can Improve Patient Function

Richard S. Laskin, MD, *New York, NY*

Our hypothesis was that by using an MIS approach without disruption of the suprapatellar pouch or patellar eversion, patient function after TKR would be improved. This is a matched study of patients who underwent surgery using a standard approach and comparing them with patients undergoing a MIS TKR approach. In the MIS group, the deep capsule was opened 1 cm medial to the patella and extended proximally approximately 2 cm into the VMO. The patella was displaced but not everted. Spinal-epidural anesthesia supplemented by a femoral nerve block was used and continued for 48 hours. Operative time, BMI, amount of analgesics via PCA epidural catheter, oral analgesics needed in the hospital, daily range of flexion, component position, and Knee Scores were measured.

In two heavily muscled males, the exposure was not sufficient for the arthroplasty and the incision was extended into a standard exposure. BMI *per se* was not a contraindication to the MIS approach. The mean surgical time was 63' in the MIS and 60' in the standard group. The patients in the MIS group used less epidural analgesia, used less overall analgesics throughout the hospital stay, had a more rapid regaining of flexion, and achieved milestones permitting discharge 18% faster than the standard incision patients.

The average MIS patient achieved 90 degrees of flexion within 3.2 days after surgery, and maintained a great flexion arc through the first 3 months post-op. X Ray position of the components was equal to that in the standard group. The average skin incision was 10cm in length.

The authors feel strongly that the length of the skin incision was NOT the crucial factor in achieving these goals, but rather the diminution of disruption to the deeper tissues that was performed.

Financial Disclosure: e-Smith & Nephew

Symposium II: Minimally Invasive Knee Arthroplasty

Mini-Incision Total Knee Arthroplasty

Giles R. Scuderi, MD, *New York, NY*

Total knee arthroplasty has been the standard of treatment for debilitating knee arthritis for over three decades. While there have been steady improvements in implant design, the surgical technique has centered on adequate exposure and soft tissue releases in order to correctly position the components.

The minimal incision approach is less invasive, which minimizes soft tissue dissection, but can be converted to a standard approach if necessary. Critical to this minimally invasive approach is patient selection, since all cases may not be performed with limited dissection. The ideal patient should have a fixed angular deformity of < 10 degrees of varus or < 15 degrees of valgus; < 10 degree flexion contracture; and > 90 degrees arc of motion. Clinical observations relating to the length of the incision and arthrotomy include the size of the femur, length of the patellar tendon and body habitus. The wider the femur, as measured by the epicondylar width, the longer the incision. The lower the patellar, as measured by the Insall Salvati ratio, the longer the incision.

Therefore, a short patellar tendon means a longer incision. Recognizing that the goal is to obtain adequate exposure, the case can be started with a carefully placed 10 – 14 cm skin incision, which is extended gradually as needed. A limited medial parapatellar arthrotomy can be utilized and the patella subluxed laterally without eversion for joint exposure. A subvastus approach can also be used as a quadriceps sparing approach. Adequate exposure should be obtained since the surgical technique should not compromise the surgical result.

Financial Disclosure: a, c, d, e - Zimmer

Symposium II: Minimally Invasive Knee Arthroplasty

MIS TKR through a Mini-Mid Vastus Approach

Steven B. Haas, MD, *New York, NY*

PURPOSE: To evaluate the results of Total Knee Replacement (TKR) performed with a less invasive mid vastus approach without patella eversion (Mini-mid vastus), compared to TKR performed via a standard medial para-patellar approach.

METHODS: Between September 2001 and September 2002, forty consecutive minimally invasive TKRs (MIS-TKR) were performed. A modified mid vastus approach was utilized by sublaxing, but not evertting, the patella. We describe this modified approach as Mini-mid vastus. We also utilized a smaller skin incision. Skin incisions ranged from 8.7 – 12 cm (mean 10.3 cm). We compared the results of this group to an age- and sex-matched cohort of forty TKRs performed between September 2000 and September 2001 with a standard technique using a medial para-patella approach. The same Genesis II (Smith and Nephew, Memphis, TN) posterior stabilized knee was used in both the study patients and the control group. There was no significant difference in mean pre-operative height, weight or pre-operative motion between the MIS-TKR and control groups.

RESULTS: Patients achieved motion significantly faster in the MIS-TKR group. Mean flexion for MIS-TKR at 6 and 12 weeks was 113° (90-132°) and 122° (103-135°) respectively, compared to 95° (65-125°) and 110° (80-125°) for the control group. Improved ROM was also seen at 6 months and one year post-op. The average ROM at one year post-op in the MIS-TKR was 125° compared to 116° in the Control Group. There was no significant difference in X-ray alignment. Average postoperative tibio-femoral alignment in the MIS-TKR group was 6.4° valgus (1° – 10° valgus) vs. 6.6° valgus (3° - 12° valgus) in the control group. There were no infections, extensor mechanism or neurovascular complications. One patient in the MIS-TKR group with a prior menisectomy incision developed superficial wound necrosis that healed uneventfully. Postoperative Knee Society scores were also higher in the MIS-TKR group.

CONCLUSION: MIS-TKR using the Mini-mid vastus approach combined with a small incision was associated with a more rapid functional recovery and improved ROM in total knee replacement without compromising implant positioning.

Financial Disclosure: a, c – Smith & Nephew

Symposium II: Minimally Invasive Knee Arthroplasty

The Mini-Incision TKA: In Opposition

David Hungerford, MD, Baltimore, MD

In a review of 275 revision total knee replacements performed at my hospital between 1987 and 1997, from reviewing the pre-operative x-rays, it was determined that 75% had a technical failure that led directly to the failure. Many of the malalignments were deduced to have been caused by haste or lack of exposure. The cause was; however, surgeon error.

If the surgeon, with full exposure, cannot reproducibly and reliably align the knee, what will the outcome be with limited exposure? Worse, there is no convincing evidence that the patient will benefit in any meaningful way from limited exposure. Nonetheless, minimally invasive surgery (MIS) has become a buzz word, well on its way to becoming a mantra. Patients ask for it without knowing why, surgeons advertise it without knowing how. If MIS becomes widespread in total knee replacement, there will be a significant and predictable increase in the number of technical failures.

Moreover, even in those surgeries that are successful, there will not be a significant improvement in any of the parameters that patients and physicians should care about: decreased length of stay, improved range of motion, shorter recovery and less pain. If you are seeing good results from your total knee surgery now, I urge you not to be seduced by smaller incisions. If you are not seeing good results with your current techniques, MIS will not help you.

Financial Disclosure: a, c - Stryker

DEBATE: Bilateral Simultaneous Knee Replacements

The Outcomes Justify Its Use

Merrill A. Ritter, MD, Mooresville, IN, Leesa D. Harty, BA

The purpose of this paper is to assess the morbidity, mortality, and clinical outcome of simultaneous bilateral total knee arthroplasty. Forty-one hundred simultaneous bilateral total knee replacements were reviewed. The knees were subjected to two Kaplan-Meier survival analyses, with failure equal to revision for aseptic loosening and failure equal to patient death. Complications and Knee Society scores were also considered.

The average Knee Society knee score was 90 points three years postoperatively and 87 points 10 years postoperatively. The complication rates were as follows: deep infection 0.8%, superficial infection 0.3%, cardiac 1.5%, intestinal ileus 0.5%, gastrointestinal ulcer 0.4%, thrombophlebitis 0.9%, cerebrovascular accident 0.3%, and urinary 1.2%. The 10-year prosthesis survival probability was 98.3% (95% confidence interval: 97.5%-99.1%). The 10-year patient survival probability was 78.6% (95% confidence interval 75.0% – 82.1%). Twenty-five (1.2%) patients died within the first postoperative year. The patients who died within 1 year postoperatively were significantly older than the rest of the group (75 years vs. 70 years; $p=0.0023$). Higher age ($p<0.0001$) and male gender ($p<0.0001$) were significant factors related to increased mortality. The complication rates and clinical outcomes were similar to unilateral total knee arthroplasty.

With regard to death early in the postoperative course, simultaneous bilateral total knee arthroplasty may pose a greater risk to the patient than a unilateral procedure. However, the early deaths may be related to older age at the time of surgery.

Financial Disclosure: none

DEBATE: Bilateral Simultaneous Knee Replacements

The Risks Do Not Justify Its Use

Bilateral Total Knee Replacement in the Same Setting is Not Advisable

Arlen D. Hanssen, MD, Rochester, MN, Daniel A. Oakes, MD

The safety of performing simultaneous bilateral total knee replacement has been hotly debated for the past two decades. When performed in the elderly patient with cardiovascular comorbidities, there is general agreement that this procedure is associated with greater morbidity and mortality. An increased incidence of postoperative cardiac events, postoperative confusion, intestinal ileus, gastrointestinal bleeding, thromboembolic disease, loss of blood, stroke, and death have all been cited with simultaneous bilateral total knee replacement. In contrast, there are many studies that refute any difference in the rate of complications and there are ardent advocates of performing simultaneous bilateral knee replacement.

Although increasing age and medical illness are variables that linked with the onset of these complications, the actual definitions of age and extent of medical illness remains vague. There have been no true prospective randomized trials, and it is likely that this type of trial is not feasible for this area of study. Our premise is that the available literature regarding the safety and efficacy of simultaneous bilateral total knee replacement has significant selection bias and therefore the safety of this procedure has not been established. Although most of the reports suggest no difference in selection criteria between unilateral, staged, and simultaneous bilateral knee arthroplasty, it is rather obvious that selection bias has occurred in these reports. The recent article by Ritter *et al* (JBJS 85A: 1532, 2003) statistically proves that unknowingly, the authors exercised significant selection bias favoring the healthier patient for simultaneous knee surgery.

Although there are many patients who have safely and successfully undergone simultaneous bilateral knee replacement, until the specific variables which predispose the patient toward an increased risk of perioperative morbidity and mortality are known, the patient undergoing a simultaneous procedure incurs increased risk of perioperative morbidity and mortality on a random basis.

Financial Disclosure: none

The Knee Society Award Presentations

MARK COVENTRY AWARD for Best Basic Science Paper

Factors Influencing Wear & Osteolysis in Press-Fit Condylar Modular Total Knees

Thomas K. Fehring, MD, Charlotte, NC, Jeffrey A Murphy, MS, T. David Hayes, MD, Donald W. Roberts, MD, Donald L. Pomeroy, MD; William L. Griffin, MD

Background: The purpose of this study was to determine the factors influencing wear and osteolysis in patients who have undergone total knee arthroplasty with the Press-Fit Condylar (PFC) modular system.

Methods: 2091 primary total knees in 1737 patients were performed using the PFC system at three centers. Radiographic analysis was performed by an independent radiologist. Radiographic and manufacturing data was obtained for 2016 of 2091 (96.4 percent) of the implants. Evidence of major osteolysis or a wear-related revision in any patient was considered a positive event.

Results: Because osteolysis rarely occurs without a substantial in-service life, we chose a subset of cases with a minimum five-year follow-up to report the prevalence of wear-related failure. For the 1287 of 2016 knees (64 percent) with greater than a five-year follow-up, the prevalence of wear-related failure was 8.4 percent (108 of 1287). Wear-related failure appeared to be clustered. Implants produced before 1991 had a 2.8 percent prevalence of wear-related failure, while after 1991, it was 6.5%. The 13-year survivorship for all patients was 82.6 percent. Cox hazards analysis revealed five variables that were significantly correlated with wear-related failure: patient age, patient gender, polyethylene sheet vendor, polyethylene finishing method, and polyethylene shelf age.

Conclusion: We were unable to identify one single factor as the defining reason for these wear-related failures. The multiple changes in manufacturing methods during the life of this implant such as changes in resin material, radiation dose, and finishing processes precluded such a determination. The reason for these wear-related failures is likely multifactorial.

Previous reports of excellent long-term survivorship with this prosthesis were experienced with implants produced before these manufacturing changes were initiated. This study emphasizes the potential deleterious effects that small changes in the manufacturing process may have on the outcome of a prosthesis with an initially favorable survivorship.

Level of Evidence: Level III-2 Retrospective Cohort Study

Financial Disclosure: a, e - DePuy

FIGURE 1

Mark Coventry, MD (dec.)
Born March 1913/Died July 1994
Mayo Clinic, Rochester, MN

CHITRANJAN RANAWAT AWARD for Best Work on a Surgical Technique

Tibial Component Failure Mechanisms in Total Knee Arthroplasty

Michael Berend, MD, Mooresville, IN, Merrill A. Ritter, MD, John B. Meding, MD, Philip M. Faris, MD, E. Michael Keating, MD, Ryan Redelman, Gregory W. Faris, BS, Kenneth E. Davis, MS

The purpose of this study was to examine the failure mechanisms and factors associated with failure of a non-modular metal backed cemented tibial component. Three thousand one hundred fifty two total knee replacements performed for osteoarthritis were reviewed and 41 tibial components had been revised (1.3%) for four distinct failure mechanisms. Twenty knees were revised for medial bone collapse, 13 for ligamentous imbalance, 6 for progressive radiolucencies, and 2 for pain. Factors associated with medial bone collapse were tibial component alignment greater than 3.0°, Body Mass Index (BMI) greater than 33.7, and overall varus limb alignment. Ligamentous imbalance was more prevalent in knees with pre-operative valgus deformity. No knees were revised for tibial component polyethylene wear or osteolysis. We conclude that the dominant failure mechanisms for this component design are related to preoperative deformity, technical factors of component alignment, overall limb alignment, and ligamentous imbalance.

Financial Disclosure: a - Biomet

FIGURE 2

Chitranjan S. Ranawat, MD
Lenox Hill Hospital
Cornell Medical College, New York, NY

CHITRANJAN RANAWAT AWARD for Best Work on a Surgical Technique

Long-Term Follow-up of Two-Stage Reimplantation for Infected TKA

Abdul A. Haleem, MD, Rochester, MN, Daniel J. Berry, MD, Arlen D. Hanssen, MD

Between January 1989 and December 1994, 94 patients (96 knees) underwent a two-stage reimplantation for treatment of an infected total knee arthroplasty. All patients were treated with an interval antibiotic-loaded static cement spacer and had antibiotic-loaded bone cement for prosthesis fixation at the time of reimplantation. The purpose of this study was to assess the long-term risk of reinfection and the mechanical durability of these reimplantation arthroplasties. Patients were followed for a median of 7.2 years (range, 2.5-13.2 years). At final follow-up, 15 knees (16%) had required reoperation. Nine knees (9%) had component removal for reinfection and six knees (6%) were revised for aseptic loosening. The median time to reoperation for reinfection was 1 year (range, 0.1-9.8 years). The risk of recurrent infection was not correlated with the type of organism, patient demographics, or method of prosthesis fixation at reimplantation. The survivorship free of implant removal for any reason was 90% (CI, 83.9%-96.4%) at 5 years and 77.3% (CI, 65.5%-89.6%) at 10 years. The survivorship free of implant removal for reinfection was 93.5% (CI, 88.5%-98.7%) at 5 years and 85% (CI, 73.8%-96.3%) at 10 years. Survival free of revision for mechanical failure (aseptic loosening or radiographic loosening) was 96.2% (CI, 92%-100%) at 5 years and 91% (CI, 80.8%-98.3%) at 10 years. This experience suggests that the high likelihood of early success following two-stage reimplantation of an infected total knee arthroplasty is well maintained over long-term follow-up with a modest rate of late recurrent infection or mechanical implant failure.

Financial Disclosure: none

INSERT FIGURE 2

Chitranjan S. Ranawat, MD
Lenox Hill Hospital
Cornell Medical College, New York, NY

JOHN INSALL AWARD

for Best Work on a Clinical Subject or Outcomes Report

Patella Resurfacing / Non-resurfacing In TKA – Results of a Randomized Controlled Clinical Trial at a minimum of 10 years

R. Stephen Burnett, MD, FRCSC, St. Louis, MO, Christopher M. Haydon, HBSc, Cecil H. Rorabeck, MD, FRCSC(C), R.B. Bourne, MD, FRCSC(C)

Introduction: Problem: Patellar resurfacing in TKA remains controversial. Purpose: To evaluate the results of resurfacing/non-resurfacing of the patella in a randomized controlled clinical trial at a minimum of 10 years.

Methods: One hundred knees (90 patients) with osteoarthritis were enrolled in a prospective randomized controlled double-blinded trial using the same posterior cruciate retaining total knee replacement. Patients were randomized to resurfacing or nonresurfacing of the patella. Evaluations were performed preoperatively and yearly to a minimum of 10 years (range, 10.1-11.5 years) postoperatively. Disease specific (Knee Society Clinical Rating System), functional (stair climbing, knee flexion/extension torques, patellar examination) outcomes were measured. Patient satisfaction, anterior knee pain, and patellofemoral questionnaires were completed. Intraoperative grading of the articular cartilage was performed.

Results: No patients were lost to follow-up; 46 knees remained alive. Nine revisions (9/90-10percent) were performed – 7/48(15 percent) in the nonresurfaced and 2/42(5percent) in the resurfaced group. Three knees in the nonresurfaced group were revised to a resurfaced patella for anterior knee pain. One resurfaced patella was complicated by AVN and fracture requiring revision. No significant difference was found between the groups regarding revision rates, KSCR score, functional, satisfaction, anterior knee pain, patellofemoral, and radiographic outcomes. Intraoperative cartilage quality was not a predictor of outcome.

Conclusions: This study represents the longest follow-up to date of a randomized controlled clinical trial to examine patellar resurfacing in TKA. The results showed no significant difference between the groups for all outcome measures at a minimum of 10 years.

Financial Disclosure: none

INSERT FIGURE 3

John N. Insall, MD (Dec.)
Born June, 1930/Died December, 2000
Insall, Scott Kelly Institute, New York, NY

SCIENTIFIC PAPER PRESENTATIONS

Paper #1

The Histologic Appearance of “Pristine” Articular Cartilage in Knees with Unicompartmental Osteoarthritis

Jack M. Bert, MD, St. Paul, MN, Joseph Leverone, MD

Specimens from the “unaffected” femoral condyle of 15 knees undergoing unicompartmental or tricompartmental TKA for unicompartmental osteoarthritis (Group A) were biopsied and reviewed histologically for signs of degenerative arthrosis. Surface cartilage was stained with safranin O and evaluated for the presence of proteoglycans (PG) content as well as chondrocyte structure and calcification. As a control, 15 biopsies were obtained from the intercondylar notch of knees in patients < 25 years of age (Group B) undergoing arthroscopy for a torn meniscus.

In all 15 Group A specimens, significant depletion of PG was noted when compared to normal biopsies. Group A specimens exhibited breakdown of calcification, “clonal grouping” of chondrocytes representing attempts at regeneration, and individual chondrocyte death indicating mild to moderate degenerative histologic changes.

Despite the pristine appearance of an intact cartilage surface on the contralateral “unaffected” compartment based upon clinical and radiological appearance and on visual appraisal of the articular surface, all 15 patients in Group A exhibited mild to moderate histologic degradation consistent with degenerative joint disease. This study contradicts the findings by Brockelhurst in 1984 where he noted a good correlation between the results of H&E staining and the visual appearance of human knee articular cartilage.

The clinical significance of this study may explain why patients develop lateral compartment pain subsequent to upper tibial osteotomy and unicompartmental arthroplasty due to the development of histologic arthrosis in the “unaffected” compartment despite a normal appearing lateral compartment at the time of surgery.

Financial Disclosure: none

Paper #2

The Progression of Patellofemoral Arthrosis in Unicompartmental Knee Replacement at 11-15 Years

Richard A. Berger, MD, *Chicago, IL*, R. Michael Meneghini, MD, Mitchell B. Sheinkop, MD, Craig Della Valle, MD, Joshua J. Jacobs, MD, Aaron G. Rosenberg, MD, Jorge O. Galante, MD

Introduction: There is a renewed interest in unicompartmental knee arthroplasty; however, the presence of preoperative patellofemoral arthrosis as a contraindication to unicompartmental arthroplasty is controversial. This study reports the 11- to 15-year results of unicompartmental knee arthroplasty with an emphasis on failure mechanisms and progression of patellofemoral arthrosis.

Methods: In a prospective study of 513 consecutive potential knee replacement candidates, 59 patients (12%) underwent medial unicompartmental arthroplasty of the knee. All 59 patients had isolated unicompartmental disease without clinical symptoms or radiographic evidence of patellofemoral arthritis; intraoperatively no patient had more than Outerbridge class 2 chondromalacia. No patient was lost to follow-up. The average follow-up was 13 years (range, 11 to 15 years).

Results: The pre-operative HSS knee score of 55 points (range, 30-79 points) improved to a mean of 90 points (range, 60-100 points) at final follow-up. Patellofemoral symptoms were present in only 1.6% of patients at 10-years; this increased markedly to 10% of patients at 15 years. Radiographically, progressive patellofemoral joint space loss, present in 6% of patients at 10-years, increased to 26% at 15 years. Four patients (10%) had moderate or severe patellofemoral symptoms at final follow-up; two were revised to a primary total knee replacement at 7 and 11 years for progressive patellofemoral degeneration. No component was radiographically loose and no osteolysis was seen. The Kaplan-Meier survival with loosening or revision for any reason was 98.0% \pm 2.0% at 10 years and 95.7% \pm 4.3% at 15 years.

Conclusion: At up to 15 years, unicompartmental knee arthroplasty yielded good clinical results; however, progressive patellofemoral arthritis was the primary mode of failure. Progression of patellofemoral arthrosis occurred despite the lack of patellofemoral symptoms or radiographic evidence of patellofemoral arthritis preoperatively. Patients with preoperative clinical or radiographic evidence of patellofemoral arthritis should not be considered as acceptable candidates for unicompartmental replacement as progressive patellofemoral arthritis is the main mode of failure with increasing time of follow-up.

Financial Disclosure: a, e - Zimmer

Paper #3

Do Rotating Platform Knees Improve Patellar Tracking? A Prospective, Randomized Study of 240 Primary Total Knees

**Mark Pagnano, MD, Rochester, MN, Robert T. Trousdale, MD, Michael J. Stuart, MD,
David Jacofsky, MD, Arlen D. Hanssen, MD**

Renewed interest in mobile bearing total knee designs has been generated by the concept of self-alignment and the suggestion that those designs can accommodate small mismatches in the rotational position of the tibial and femoral components. Self-alignment might improve patellar tracking, decrease the prevalence of lateral retinacular release, decrease the prevalence of post-operative patellar tilt or subluxation, improve knee flexion and improve patellofemoral function during daily activities such as stair climbing. This prospective randomized study of 240 patients used a single posterior-stabilized femoral component and included three groups of 80 patients: all-polyethylene, modular metal-backed and rotating platform tibia.

The prevalence of lateral retinacular release was 3.8% in each group. The prevalence of patellar tilt was 5 % (all-polyethylene), 7 % (modular metal backed) and 11 % (rotating platform). Preoperative motion was not different, and both the 3-month flexion (112, 110 and 108 degrees) and 1-year flexion (116,117, and 115 degrees) were not different amongst the all-polyethylene, modular metal backed and rotating platform groups. Preoperative stair climbing scores were not different and both the 3-month (38, 41 and 35 points) and 1-year (44, 46, and 42 points) scores were not different. In this prospective randomized study, the rotating platform knee design did not decrease the prevalence of lateral retinacular release, did not decrease the prevalence of patellar tilt or subluxation and did not increase knee flexion nor improve stair climbing ability at 3 months or 1 year postoperatively when compared to a posterior-stabilized fixed bearing knee.

Financial Disclosure: c - Zimmer

Paper #4

Analysis of Early Revision in a Community Knee Implant Registry

Terrence J. Gioe, MD, *St. Paul, MN*, Kathleen Killeen, MOT, Susan Mehle, BS,
Karen Scheltema, MS, Katherine Grimm, MPH

Since 1991, 5760 knee arthroplasty procedures performed by 53 surgeons have been registered in a community joint implant registry and were reviewed concerning initial revision performed within the health care system. The 168 revisions performed represented 2.9% of the knee arthroplasties between September 1991 and December 2002. Survival was defined as the absence of revision surgery. Death was considered a censored event. Cumulative survival rates for the different TKA configurations were: cemented TKA with all-polyethylene tibia (APT) – 99.2% (98.2%, 100%); cemented TKA with metal-backed tibia (MBT) – 96.3% (95.3%, 97.3%); hybrid TKA – 89.3% (83.9%, 94.6%); and unicondylar knee (UKA) – 87.2% (82.8%, 91.6%).

Cemented TKA with MBT had significantly better survival than hybrid TKA ($p=.031$, $OR=1.56$), ingrowth TKA ($p=.005$, $OR=2.31$), and UKA ($p<.001$, $OR=3.06$). Cemented TKA with MBT did not have significantly better survival than cemented TKA with APT ($p=.220$, $OR=.412$). Gender was not significantly related to survival ($p=.680$). Age was significantly related to survival, with older patients' knees surviving longer ($p<.001$). Aseptic loosening or wear was the cause of revision in 40.8% of TKA and 46.6% of UKA, while progression of arthritis necessitated UKA revision in 51.2%. A total of 37.1% of all revisions took place within 2 years, with instability representing the primary cause for TKA revision in this timeframe. This study presents further evidence of the value of and ongoing need for total joint registries. Cemented TKA with APT and with MBT showed greater than 95% ten-year cumulative survival. Hybrid TKA, ingrowth TKA and UKA fared less well.

Financial Disclosure: a-DePuy

Paper #5

Stability, Alignment, and Contact Stress in Two Techniques of Total Knee Arthroplasty

Hirofumi Hanada, MD, **Leo A. Whiteside, MD**, *St. Louis, MO*, Jerry Steiger, Paul Dyer, Masatoshi Naito, MD

This study evaluated alignment and stability characteristics of knees aligned and resected using the tensioned gap technique (dependent cut technique) and the measured resection technique (independent cut technique) in total knee arthroplasty (TKA). Twelve normal cadaveric knees were tested for stability, alignment, and load-bearing stress-transfer characteristics after TKA. The tensioned gap technique was used in 6 knees, and the measured resection technique was used in another 6 knees, aligning the anterior and posterior femoral cuts perpendicular to the median sagittal plane as defined by the anterior-posterior (AP) axis. Alignment and stability were tested at 0°, 30°, 60°, 90°, and 120° flexion under 50N axial load, 10N-m varus and valgus torque, and 10N-m internal and external rotational torque. Load-bearing stress and transfer characteristics were tested with a digital electronic pressure sensor at 0°, 45°, and 90° flexion. All knees prepared using the tensioned gap technique shifted toward varus in flexion, but maintained stability. The patellar groove shifted laterally relative to the neutral position. Load-bearing stress in the femoral surface shifted markedly medially in flexion. All knees prepared with the measured resection technique had near-normal varus and valgus and rotational stability tests, and alignment, patellar groove position, and load-transfer characteristics remained near normal throughout the flexion arc.

Financial Disclosure: a, b, c – Smith & Nephew

Paper #6

Early Failure of Cementless Mobile Bearing TKA

Robert Barrack, MD, *New Orleans, LA*, Shawn J. Nakamura, MD, Shelby G. Hopkins, BS, Seth Rosenzweig, MD

A consecutive series of 82 cementless mobile bearing total knee arthroplasties performed was studied. The indications for surgery in all cases was osteoarthritis with only mild or moderate deformity. The evaluation consisted of a Knee Society clinical score (KSCS) and radiographic evaluation pre-operatively and at annual follow-up. A minimum two-year follow-up was obtained in 73 of 82 knees (89%). The results were compared to those of a subsequent consecutive series of 76 knees (66 with 2-year follow-up) performed with a mobile-bearing TKA with cemented components and the same indications, implant, technique, and length of follow-up. Six of 73 cementless mobile-bearing TKAs (8%) underwent tibial component revision for symptomatic subsidence and failure of ingrowth compared to 0/66 revisions in the cemented group ($p < .05$). Patients with cementless mobile bearing TKA also had a significantly lower KSCS (161 vs. 184, $p < .05$), significantly higher incidence of pain rated more than mild (23% vs. 7%, $p < .01$) and a trend toward less arc of motion (106° vs. 115° , $p < 0.2$).

Summary: The results do not support the hypothesis that mobile-bearing TKA imparts the advantage of reliable tibial bone ingrowth.

Financial Disclosure: e - DePuy

Report of the 2003 Insall Fellows

David Backstein, MD, MED, FRCSC, *Mt. Sinai Hospital, Univ. of Toronto, Toronto, ON, Canada*

Christophe Hulet, MD, *Caen Univ. Hospital, Caen, France*

Shuichi Matsuda, MD, *Kyushu Univ., Fukuoka, Japan*

Thomas Muellner, MD, PhD, *Donauklinikum Dept for Orthopaedic Surgery, Tulln, Austria Univ. of Technology Institute for Strength of Materials, Vienna, Austria*

The Insall Traveling Knee Fellowship took place from Oct. 1 - 31, 2003. Thirteen American centers were visited by four fellows, originating from Austria, Canada, France and Japan. Visits consisted of didactic sessions, surgical observation and two scheduled cadaver labs. Topics highlighted for discussion included the following: unicompartmental knee arthroplasty (UKA), thromboembolic (TE) prophylaxis, arthroscopic debridement for arthritis and minimally invasive (MIS) total knee arthroplasty (MIS TKA).

Regarding UKA, considerable uncertainty remains regarding the ideal indications and preoperative evaluation. Despite very positive published UKA results, many find the outcomes of TKA difficult to improve upon. Most UKA surgeons avoid overcorrection and preserve maximal tibial bone. There was wide agreement that revision from UKA to TKA is more complex than primary TKA.

TE prophylaxis was utilized in all centers but with highly disparate protocols, including aspirin, compression stockings, LMWH or Warfarin. The duration of prophylaxis was 7-10 days with no routine screening in the first post-operative month. Arthroscopic debridement of arthritic knees was found to be particularly contentious as a result of a recently published article. While all surgeons agree that it is at best a temporizing measure, many feel that a role exists for arthroscopic debridement of arthritic knees, particularly in young patients.

MIS TKA was discussed and observed. Techniques involve parapatellar subvastus and midvastus approaches through smaller incisions and utilizing low profile instrumentation. Concerns were raised about the adequacy of visualization for soft tissue releases and the potential for major wound problems. It was generally felt that MIS TKA will have a significant role in the future as instrumentation continues to be perfected and ideal indications clarified.

Financial Disclosure: none

SYMPOSIUM III: Can polyethylene wear be decreased?

Moderator - A. Seth Greenwald, D.Phil. (Oxon)

The enduring success of the low friction arthroplasty advanced by Sir John Charnley as a solution for hip arthrosis can be appreciated by the fact that almost 700,000 primary and revision hip and knee arthroplasties were performed in 2002 in the United States. Despite this success, the advent of wear debris generation leading to osteolysis and fixation failure is a growing concern with the increased graying and activity levels of our society. Alternative bearing materials have had a checkered past as they moved from the laboratory to clinical application. Contemporarily highly crosslinked polyethylenes and altered bearing surfaces have been introduced with the approval of the Food and Drug Administration, but this was done in the absence of clinical data supporting their safety and effectiveness.

It is no small coincidence that nearly 62% of all polyethylene acetabular components sold in the United States are constituted of highly crosslinked polyethylenes in their various formulations. Their proclaimed advantage lies in the reduction of wear debris generation through enhanced crosslinking of the polymer chains and elimination of oxidation through the manufacturing process. The introduction of femoral material alternatives further reduces the prospect of surface wear in knee components. All lead to the promise of articulation longevity. Cost concerns, as well as patient selection and the unknown clinical realities of long-term series reporting, will only be elucidated over time. This symposium deals with the hopes, promises and caveats that these emerging materials offer in the treatment of the arthroplasty patient.

SYMPOSIUM III: Can polyethylene wear be decreased?

Knee Simulator Wear of Polyethylene Tibias Articulating Against Explanted Rough Femoral Components

Orhun K. Muratoglu, PhD, *Boston, MA*, Brian R. Burroughs, PhD, Charles R. Bragdon, BS, Steven Christensen, BS, Andrew Lozynsky, BS, William H. Harris, MD

Highly crosslinked and melted polyethylene tibial inserts have recently been introduced for clinical use to reduce fatigue damage and adhesive wear in tibial inserts. Others have studied the effect of counterface roughness on the wear behavior of polyethylene tibial inserts in knee simulators using femoral components that were roughened artificially. They reported a higher wear rate with highly crosslinked polyethylene than with unirradiated polyethylene tibial inserts.

Artificial roughening of femoral components may not be clinically relevant. To evaluate this concern, we studied the wear behavior of highly crosslinked and conventional polyethylene tibial inserts when articulating in vitro against surgically retrieved femoral components that had become roughened in vivo. The wear rate of the highly crosslinked polyethylene (5.9 mg/million-cycles) was 82% lower than that of the conventional polyethylene (33.5 mg/million-cycles) tibial inserts after two million cycles of simulated gait.

This study suggests that during the in vivo use, those scratches which are generated on the femoral components are likely to produce a higher wear rate of both polyethylenes than a smooth femoral component but that this increase is likely to be higher with conventional polyethylene than highly crosslinked polyethylene tibial inserts.

Financial Disclosure: a, c, d, e - Centerpulse

SYMPOSIUM III: Can polyethylene wear be decreased?

Wear Debris and Biological Activity of Crosslinked Polyethylene in the Knee: Benefits and Potential Concerns

J Fisher, Leeds, UK, HMJ McEwen, JL Tipper, A Galvin, J Ingram, A Kamali, MH Stone, E Ingham

Crosslinked polyethylene is now being introduced for use in knee prostheses. The wear rates, wear debris and biological reactivity of non, moderately and highly crosslinked polyethylene were compared in multidirectional wear and knee joint simulators.

Multidirectional pin-on-plate wear studies of non, moderately 5 MRad, and highly crosslinked 10 MRad polyethylene showed a 75% fold reduction in wear with the highly crosslinked material under kinematics found in the hip, but only a 50% reduction in wear under kinematics representative of the knee. In knee simulator studies, with the fixed bearing PFC SIGMA ligament retaining knee under high kinematic input conditions, the wear of Marathon 5 MRad moderately crosslinked polyethylene was $13 \pm 4 \text{ mm}^3/\text{million cycles}$. This was significantly lower than that of clinically used GVF GUR1020 polyethylene $23 \pm 6 \text{ mm}^3/\text{million cycles}$. For the LCS mobile bearing knee, the wear of Marathon polyethylene was $2 \pm 1 \text{ mm}^3/\text{million cycles}$, which was significantly lower than GVF GUR1020 polyethylene $5 \pm 2 \text{ mm}^3/\text{million cycles}$. The wear debris isolated from the fixed bearing knees showed the Marathon material to have a larger percentage volume of particles smaller than one micrometer in size, as compared to GVF GUR1020 polyethylene. Direct cell culture studies of wear debris generated in sterile wear simulators using multidirectional motion showed a significant increase in cytokine levels and reactivity for GUR1050 crosslinked polyethylene, compared to an equivalent volume of non crosslinked GUR1050 polyethylene. The use of crosslinked polyethylene in the knee reduces volumetric wear rate; however, the clinical significance of reduced fracture toughness, elevated wear under abrasive conditions, and elevated cytokine release from smaller more reactive particles, warrant further investigation.

Financial Disclosure: a- DePuy

SYMPOSIUM III: Can Polyethylene Wear Be Decreased?

Diminished Poly Wear through Use of a Metal-Ceramic Composite Femoral Component

Juan Hermida, MD; Shantanu Patil, MD, **Clifford W. Colwell, Jr., MD**, *La Jolla, CA*,
Darryl D. D'Lima, MD; Kace A. Ezzet, MD

Introduction: Composite bearing materials consisting of a (non-oxidized) metal zirconium core with an oxidized zirconia surface have recently become available. Wear properties of this material in total knee arthroplasty (TKA) are under investigation.

Methods: Three oxidized zirconium femoral components (OxZirc) were mounted in a knee wear simulator coupled to standard tibial polyethylene inserts and to modular tibial base-plates. Three femoral components of identical geometry made of conventional cobalt-chrome (CoCr) components were also tested as controls. Knees were taken through 5 million cycles of normal gait and stair-climbing simulation. Wear in polyethylene inserts was quantified by gravimetric measurement. In a second experiment, the same femoral components were tested under conditions of increased varus moments, and increased dynamic tibial rotation. This was to simulate an athletically active patient with non-optimal component alignment.

Results: The use of oxidized zirconium reduced polyethylene wear by 44% under optimal alignment. Mean polyethylene wear rate was 19.99 (± 2.1) mg/million cycles for the CoCr group and 11.6 (± 1.3) mg/million cycles for the OxZirc group ($p < 0.001$). A similar reduction in polyethylene wear (by approximately 40%) was also found in the inserts worn against OxZirc femoral components when tested under conditions of increased varus moments and increased dynamic tibial rotation.

Discussion and Conclusion: Tibial polyethylene wear can be substantially reduced through the use of oxidized zirconium femoral components. There is an increased potential for damage and fatigue failure in highly crosslinked polyethylene, and a risk of fracture in ceramic knee components. "Metal-ceramic composites" represent promising alternative bearing surfaces for TKA prostheses. Wear was significantly lower in polyethylene inserts tested against metal-ceramic composite femoral components compared to cobalt-chrome alloy components.

Financial Disclosure: a – Smith & Nephew, Stryker, Zimmer; b - Stryker, DePuy

SYMPOSIUM III: Can Polyethylene Wear Be Decreased?

Diminishing Backside Wear

Timothy M. Wright, PhD, *New York, NY*

Recent reports showed the interface between the inferior surface of the tibial insert and the superior surface of the metallic tibial tray as a source of significant submicron-sized wear debris, commonly referred to as backside wear. A number of design, manufacturing, and patient factors can be implicated in the problem. Design factors include the shape of the tibial insert, additional constraint between the articular surfaces, and the locking mechanism used to secure the insert to the tray. Manufacturing factors include the surface finish on the superior surface of the metallic tray, the tolerances on both the insert and tray, and the type of polyethylene used to fabricate the insert. Patient factors include the applied loads, kinematics, and duty cycles.

The relative influences of these factors can be understood by considering the way in which they influence the joint contact problem itself, by retrieval studies and laboratory experiments aimed at correlating one or more of the factors to subjective and quantitative evidence of backside wear, or by theoretical considerations based on principles of tribology. Diminishing backside wear should be achievable by managing those factors under the control of the designer and manufacturer. The fact remains; however, that the clinical relevance of backside wear and the ability to accurately measure backside wear in vivo, or to simulate it in the laboratory, limit our capacity for establishing the importance of both the problem itself and possible solutions.

Financial Disclosure: a – Zimmer, Exactech, Wright Medical Technologies

SYMPOSIUM IV: New thoughts for old problems: Back to the future?

Patellofemoral Arthroplasty: Pros, Cons, Design Considerations

Jess H. Lonner, MD, Philadelphia, PA

Patellofemoral arthroplasty is a worthy alternative to total knee arthroplasty or patellectomy in those patients with arthritis localized to the anterior compartment of the knee, particularly when there is no considerable patellar malalignment or maltracking. The results can be optimized by accurately aligning the prosthesis and balancing the soft tissues to enhance patellar tracking, but it is still vulnerable to patellofemoral complications with particular designs.

Postoperative patellofemoral dysfunction should be reduced by using a trochlear component that engages the patella within the trochlear groove and articulates with the patella completely in extension, but which is relatively unconstrained in extension and has a sagittal radius of curvature that mates well with the native distal femur. The incidence of patellofemoral complications was reduced in this author's series from 17% with a first generation implant to 4% with a 2nd generation implant.

Evolving designs will likely eliminate many of the complications of early generation implants, leaving tibiofemoral degeneration the major source of "failure" of patellofemoral arthroplasties.

Financial Disclosure: a, c, e - Zimmer

SYMPOSIUM IV: New Thoughts for Old Problems: Back to the Future?

Patellar Bone Grafting in Preference to Patelloplasty

Arlen D. Hanssen, MD, Rochester, MN

Retention of the patellar shell, patellar resection arthroplasty or patelloplasty, has been a traditional method of treatment for many patients with severe patellar bone loss, which precludes fixation of another patellar implant. Typically this technique consists of contouring the patellar remnant to remove eccentric or sharp bone edges and to facilitate central patellar tracking within the femoral trochlea. Although this alternative is attractive because of its simplicity, the clinical results are inferior and are commonly associated with fragmentation and lateral subluxation of the patellar remnant.

The “Gull-Wing” osteotomy is essentially a variation of the patellar resection arthroplasty except that the patellar remnant is purposely fractured with a central longitudinal osteotomy to create medial and lateral “wings”. The purpose of this technique is to create patellar fragments that are oriented so that the undersurface of the fragments are opposed against the sides of the femoral trochlea which theoretically facilitates central patellar tracking. To date, there have been only anecdotal case presentations and there are no published results detailing this procedure.

Patellar bone grafting procedures are distinctly different from the other salvage revision treatment options of the patella in that the use of bone graft in this setting imparts the potential for restoration of patellar bone stock. A tissue flap is sewn to the peripheral patellar rim with multiple sutures to provide a watertight closure. Cancellous bone graft, either locally harvested autograft or morseled allograft, is tightly impacted into the patellar defect. The tissue flap contains the bone graft and serves as an interposition between the femoral trochlea and bone graft. The patellar shell-bone graft construct undergoes remodeling against the trochlea and the retropatellar surface assumes the shape of the prosthetic trochlear groove.

This procedure uniquely imparts the potential for restoration of bone stock and may improve the functional outcome in these patients by facilitating patellar tracking and improving quadriceps leverage.

Financial Disclosure: none

SYMPOSIUM IV: New Thoughts for Old Problems: Back to the Future?

Soft-Tissue Local Anesthetic Injection to Reduce Pain after Total Knee Replacement

Adolph V. Lombardi, Jr., MD, Columbus, OH, Keith R. Berend, MD, Thomas H. Mallory, MD, Kathleen L. Dodds, RN, Joanne B. Adams, BFA

We examine the effectiveness of intra-operative injection of bupivacaine with epinephrine and morphine to control pain and blood loss and improve ROM in primary total knee arthroplasty. A control group of 138 patients (181 knees) received no intra-operative injection. The study group of 171 patients (197 knees) received intra-operative injection of 0.25% bupivacaine with epinephrine and morphine divided two-thirds soft-tissue and one-third intra-articular. Patients undergoing bilateral simultaneous procedures received a divided dose. The pain management protocol was otherwise identical.

In the post anesthesia care unit, 84% of control patients versus 74% of study patients required breakthrough narcotic dosing ($P=0.0278$). Twice as many control patients required narcotic reversal. In the study group, ROM was greater at discharge and incidence of manipulation decreased. Bleeding index ($P=0.0065$) and rate of blood loss ($P<0.0001$) were significantly lower for the study group. Transfusion rate was slightly lower for the study group, but not significantly different. Preemptive analgesia with soft-tissue and intra-articular injection of long-acting local anesthetic with epinephrine and morphine decreases the need for rescue narcotics and reversal agents. Pain levels during the immediate postoperative period, blood loss and bleeding indices were significantly reduced.

This simple, inexpensive method provides an effective adjunct to a multimodal approach in improving the post-operative course of primary total knee arthroplasty.

Financial Disclosure: c, e - Biomet

SYMPOSIUM IV: New Thoughts for Old Problems: Back to the Future?

Computer Assisted Total Knee Arthroplasty: Results of a Prospective Randomized Study

Jan Victor, MD, Brugge, Belgium, D. Hoste, MD

A prospective, randomized and controlled trial was undertaken to evaluate image-based computer assisted surgery (CAS) in TKA. The aim of the study was to determine the *feasibility* to work with the system, to assess the *accuracy* of the kinematical determination of the centre of rotation of the hip, and to compare the *outcome* of the CAS group versus a control group of patients with conventionally instrumented TKA. Randomization was performed on a consecutive group of 100 primary TKAs without exclusion criteria. The randomization was carried out in permutation blocks of 4.

1. Feasibility to work with the system was evaluated for every single step in the procedure. Despite two software crashes that needed recovery of the images, all navigation cases except one were successfully finished.
2. All computed kinematical centres of rotation of the hip were compared to the anatomic fluoroscopic images. The difference between the kinematical centre of rotation and the anatomic centre of the femoral head was measured in the frontal plane. The mean deviation between the two points was 1.6 mm (range 0-5mm).
3. The outcome analysis showed significant ($p < 0.005$) differences in tourniquet time and operative time. No significant differences in blood loss, patellar alignment, tibial slope, and post-operative scores were noted. Coronal alignment was measured on full leg standing films. Validation of this technique was carried out in comparing the pre-operative measured angle and the computed deformity angle at the beginning of the surgery. Variance in post-operative coronal alignment between conventional and CAS was highly significant ($p < 0.0001$) with all CAS knees displaying neutral mechanical alignment.

Financial Disclosure: a, e-Smith & Nephew

SYMPOSIUM IV: New Thoughts for Old Problems: Back to the Future?

An Oral Anticoagulant That Does Not Require Monitoring: Has An Optimal Answer For VTE Control Finally Arrived?

CW Colwell, MD, La Jolla, CA, S.D. Berkowitz, MD, P.C. Comp, MD, PhD, J.R. Lieberman, MD, J.S. Ginsberg, MD, G. Paiement, MD, J.L. McElhattan, MS, A.W. Roth, MS, C.W. Francis, MD and EXULTA and B Investigators

Introduction: Without prophylaxis, 2/3 of TKR patients develop deep venous thrombosis (DVT) as detected by venography. Warfarin is the only oral anticoagulant in North America approved for prophylaxis of VTE (DVT and/or pulmonary embolism [PE]), but is associated with total DVT rates of 36-55%, and requires routine coagulation monitoring. Ximelagatran (Exanta™, AstraZeneca), a novel oral direct thrombin inhibitor, is converted to the active form, melagatran, which selectively inhibits free and clot-bound thrombin.

Objective: Phase I: To optimize the dose of ximelagatran and compare the efficacy and safety of ximelagatran with warfarin for prevention of VTE in TKR patients. Phase II: To confirm the safety and superior efficacy of ximelagatran over warfarin for prevention of VTE in TKR patients.

Methods: Multicenter, randomized, double-blind, double-dummy phase III trial conducted in two phases at 116 sites in 5 countries. Fixed-dose (no coagulation monitoring or dose adjustment) oral ximelagatran, 24 or 36 mg bid (in Phase I) and oral ximelagatran 36 mg bid (in Phase II), compared with warfarin (target INR 2.5; range 1.8-3.0) and matched placebo were continued for 7-12 days. Warfarin was initiated the evening of the day of surgery and the first dose of ximelagatran, the morning after surgery.

Measurements included VTE rates determined by mandatory bilateral venography, and symptomatic VTE confirmed by objective means, up to day 14 postop; all-cause mortality; and bleeding rates. The occurrence of VTE, major and minor bleeding events, and death were judged by an independent central adjudication committee. In both phases, efficacy was assessed by the number of subjects with confirmed VTE and/or all-cause mortality. Safety was assessed by rates of major and any (major + minor) bleeding and by wound assessment.

Results: Phase I: 2301 patients randomized; 2285 received ≥ 1 dose of study drug (safety population), and 1851 had adequate venography or symptomatic VTE (evaluatable population). The efficacy of ximelagatran 24 mg po bid was 24.9%, similar to warfarin (27.6%) and ximelagatran 36 mg po bid was superior (20.3% vs. 27.6%, $p = 0.003$) to warfarin for total VTE. Phase II: 2303 patients randomized; 2299 received $=1$ dose of study drug (safety population), and of these, 1949 (84.8%) had venography adequate for evaluation, or confirmed symptomatic events (efficacy population). The efficacy of ximelagatran 36 mg po bid (22.5%) was superior ($p < 0.001$) to that of warfarin (31.9%) for the composite endpoint of total DVT/PE. There were no statistically significant differences in either phase between treatments for proximal DVT, PE, or death, or for major or any (major + minor) bleeding, or wound drainage or appearance.

Conclusions: Ximelagatran 36 mg po bid initiated the day after TKR for prophylaxis of VTE provides superior efficacy and no increase in bleeding or wound complications compared with warfarin (target INR 2.5), with no routine coagulation monitoring or dose adjustment required.

Financial Disclosure: a – AstraZenica, Aventis, Pharmacia, Organon Sanofi Synthelabo, Wyeth Ayerst; b - AstraZenica, Aventis, Pharmacia, Organon Sanofi Synthelabo

The FDA has NOT cleared the following pharmaceuticals for the use described in this presentation. The following pharmaceuticals are being discussed for an off-label use. (Ximelagatran (Exanta™))

SYMPOSIUM IV: New Thoughts for Old Problems: Back to the Future?

Mechanical Prophylaxis: The Safest Alternative for Thromboembolic Disease Control after Total Knee Replacement

Paul F. Lachiewicz, MD, Chapel Hill, NC

Mechanical pneumatic compression devices have been shown to be efficacious for the prophylaxis of venous thromboembolic disease after total knee arthroplasty; however, prior clinical studies have included only small numbers of patients with a variety of devices. The optimal characteristics for pneumatic compression devices for prophylaxis after total knee arthroplasty are not known. In vivo ultrasound studies of 7 different pneumatic devices have shown variable increases in peak venous velocity. A prospective, randomized study was designed to compare a rapid inflation asymmetric calf compression device (V) to a circumferential calf compression device (S). Both groups also received aspirin. The hypothesis was that the device that provided for a larger increase in peak venous velocity would have a lower prevalence of thromboembolism. The study included 423 patients (472 knees) who had primary or revision total knee arthroplasty. Patients were randomized by sealed envelopes. Duplex ultrasonography was performed by experienced technologists who were unaware of the device used.

Overall, 206 patients (232 knees) had device V and 217 patients (240 knees) had device S. There was one death (0.2%) from myocardial infarction and one nonfatal, symptomatic pulmonary embolism (0.2%), both in patients with device S. The overall prevalence of thromboembolism was 6.9% with device V and 15% with device C ($p=.007$). The prevalence of thrombi was significantly lower with device V for unilateral primary knees ($p=.032$) and for bilateral primary knees ($p=.05$). There were no bleeding complications.

There is a low prevalence of death and symptomatic pulmonary embolism using mechanical calf compression and aspirin. Pneumatic devices using rapid inflation, asymmetric compression provide for the greatest increase in peak venous velocity, which may be the optimum characteristic for the prevention of venous thromboembolism after total knee arthroplasty.

Financial Disclosure:

SYMPOSIUM IV: New Thoughts for Old Problems: Back to the Future?

Is Two-Stage Revision Still the Gold Standard for Infected Total Knee Arthroplasty?

Daniel J. Berry, MD, Rochester, MN

The main controversy in the treatment of chronically infected total knee arthroplasty is whether the best form of management is one- or two-stage reimplantation. The main advantage of one-stage treatment is a single operation, which if successful, is easier for the patient and surgeon and is less costly. The advantage of two-stage treatment is that the infected field is sterilized by surgical debridement and prolonged antibiotic treatment prior to prosthesis reimplantation and hence may be associated with a higher rate of successful infection eradication.

This paper will evaluate the success rate of one- versus two-stage prosthesis reimplantation of a chronically infected total knee arthroplasty using an evidence-based approach. Computerized search methods were used to gather articles published in English on the topic of infected total knee arthroplasty management. To qualify for inclusion, the article had to contain the results of treating at least 20 infected total knee arthroplasties, and have a minimum follow-up time of two years. Reinfection with any organism was considered an endpoint of failure due to infection.

A recognized drawback of this analysis methodology is that infected total knee arthroplasties represents a wide spectrum of problems with respect to host status, preoperative functional level, infecting organism, and bone loss. Nevertheless, data will be presented on the combined rate of success of one- versus two-stage reimplantation based on a review of the combined modern literature on the subject.

Financial Disclosure: c - DePuy

SYMPOSIUM IV: New Thoughts for Old Problems: Back to the Future?

Osteogenic Proteins in Knee Arthritis and Arthroplasty

Stephen D. Cook, PhD, *New Orleans, LA*

The use of graft materials to restore bone stock and promote healing and implant stabilization is a crucial part of total knee arthroplasty, especially in the revision situation. Recent research has centered on the use of osteoinductive materials to promote bone formation. Osteogenic proteins are members of the transforming growth factor-beta superfamily of proteins that alone, or in combination with other regulatory molecules, induce new bone formation.

The cloning and genetic expression of recombinant human osteogenic proteins has led to production of quantities sufficient for their clinical use. Recombinant human osteogenic protein-1 (OP-1) has been combined with bone derived Type I collagen for delivery to an implant site. Preclinical studies have shown that the osteoinductive capacity of autograft and allograft bone as well as bone graft substitute materials can be significantly improved with the addition of OP-1. The use of this protein consistently improved the amount and rate of new bone formation compared with graft alone resulting in earlier graft incorporation and consolidation.

In addition, since osteogenic proteins are chondrogenic they may also have a role in the treatment of cartilage injury and degeneration. OP-1 has been shown to induce hyaline-like cartilage repair of full thickness osteochondral defects in animal models with no degradation of the tissue over time.

Although no detailed clinical studies in knee surgery have been reported with the use of OP-1, in anecdotal cases, its use alone and with bone graft materials indicate results consistent with those obtained in preclinical studies.

Financial Disclosure: a, e – Stryker Biotech

The FDA has not cleared the following drug/medical device for the use described in this presentation. The following drug/medical device is discussed for an off-label use: OP-1 Implant

CME Accreditation Statement

This activity has been planned and implemented in accordance with the Essential Areas and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint sponsorship of the American Academy of Orthopaedic Surgeons and the Knee Society/AAHKS. The American Academy of Orthopaedic Surgeons is accredited by the ACCME to sponsor continuing medical education for physicians. The American Academy of Orthopaedic Surgeons designates this continuing medical education activity as meeting the criteria for up to 8.0 Category 1 credits of the Physician's Recognition Award of the American Medical Association. Each physician should claim only those credits that he/she actually spent in the activity.

Goals and Objectives

The Knee Society/AAHKS Specialty Day program is designed to provide practicing orthopaedic surgeons with current information regarding surgical techniques, emerging technology and symposia discussions on managing total knee arthroplasty, and to enhance the care of patients with arthritis and degenerative diseases of the knee joint. 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 eight hours of Category 1 CME credit.

Upon completion of this activity, participants will be able to:

- Critique presentations of surgical techniques and demonstrations of treatment options.
- Discuss management of patients who present with musculoskeletal injuries and conditions related to the knee joint.
- Determine indications and complications in TKA and other surgical interventions.
- Update basic knowledge and skills through clinical research findings and biomechanical studies.

Disclaimer

The material presented at this continuing medical education activity has been made available by the Knee Society/AAHKS for educational purposes only. This material is not intended to represent the only, nor necessarily best, methods or procedures appropriate for the medical situations discussed, but rather is intended to present an approach, view, statement of opinion of the faculty, which may be helpful to others who face similar situations.

The Knee Society/AAHKS disclaims any and all liability for injury or other damages resulting to any individuals attending a session, and for all claims which may arise out of the use of the techniques demonstrated therein by such individuals, whether these claims shall be asserted by a physician or any other party.

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Each participant in the Specialty Day Meeting has been asked to disclose if he or she has received something of value (any item, payment, or service valued in excess of \$500) from a commercial company or institution which relates directly or indirectly to the subject of their presentation.

The options are 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)
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at the conclusion of the Meeting. Thank you!**



The Knee Society

704 Florence Drive
Park Ridge, IL 60068-2104
Phone: 847-698-1200
Fax: 847-825-9294
Email: Priscilla@thekneesociety.org
Web site: www.kneesociety.org



American Association of Hip and Knee Surgeons

704 Florence Drive
Park Ridge, IL 60068-2104
Phone: 847-698-1200
Fax: 847-825-9294
Email: helpdesk@aahks.org
Website: www.aahks.org