The Knee Society

and the

American Association of Hip and Knee Surgeons

Combined Specialty Day Meeting

Saturday, February 26, 2005

Grand Hyatt Washington Hotel, Constitution Ballroom
Washington, DC

Scientific Program

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Future Combined Specialty Day Meetings

New Orleans, LA	March 11, 2006
San Diego, CA	February 17, 2007
San Francisco, CA	March 8, 2008
Washington, DC	February 21, 2009

Abstract Applications for the 2005 Knee Society Interim Meeting, the 2006 Combined Specialty Day Meeting and the 2005 AAHKS Annual Meeting can be submitted on the Knee Society Website (www.kneesociety.org) or the AAHKS website (www.aahks.org). The deadline for receipt of Abstracts is April 15, 2005.

2005 Combined Specialty Day Scientific Program

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and
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Saturday, February 26, 2005
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ACCREDITATION
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. The American Academy of Orthopaedic Surgeons is accredited by the ACCME to provide continuing medical education for physicians.

CREDIT HOURS
The American Academy of Orthopaedic Surgeons designates this educational activity for maximum of 8 category 1 credits toward the AMA Physician's Recognition Award. Each physician should claim only those hours of credit that he/she actually spent in the activity.

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.

Please complete and return your Evaluation Form to the Knee Society table at the conclusion of the Meeting. Thank you!

Please turn off cell phone ringers while inside the Scientific Session rooms. Thank you.

The Knee Society/AAHKS
Combined Specialty Day Scientific Program
Saturday, February 26, 2005

8:00 AM	**WELCOME** Merrill A. Ritter, MD, Knee Society President E. Michael Keating, MD, Knee Society Education Committee Chair Richard F. Santore, MD, AAHKS President Mary I. O'Connor, MD, AAHKS Education Committee Chair
8:10-8:53 AM	**SYMPOSIUM I: NON-ARTHROPLASTY OPTIONS IN MEDIAL OA** Moderator: Arlen D. Hanssen, MD, Rochester, MN
8:11-8:21 AM	**Cartilage Replacement** * Thomas Minas, MD, MS, Chestnut Hill, MA
8:22-8:32 AM	**Osteotomies: Opening wedge or closing wedge** * Peter J. Fowler, MD, London, ON, Canada
8:33-8:53 AM	**DISCUSSION**
8:54-9:37 AM	**SYMPOSIUM II: UNI COMPARTMENTAL KNEES** Moderator: Richard D. Scott, MD, Boston, MA
8:55-9:05 AM	**Why I Think Uni's are a Good Option for Patients** * Gerard A. Engh, MD, Alexandria, VA
9:06-9:16 AM	**Early Failure of Minimally Invasive Unicompartmental Knee Arthroplasty is Associated with Obesity** * Adolph V. Lombardi, Jr., MD, Columbus, OH
9:17-9:37 AM	**DISCUSSION**
9:38-9:54 AM	**BREAK**
9:55–10:37 AM	**SYMPOSIUM III: COMPUTER ASSISTED SURGERY** Moderator: Daniel J. Berry, MD, Rochester, MN
9:55-10:05 AM	**This is The Future of Knee Surgery** * Aaron A. Hoffman, MD, Salt Lake City, UT
10:06-10:16 AM	**Computer Assisted Surgery in TKA: The Future is Not Now** John J. Callaghan, MD, Iowa City, IA
10:17-10:37 AM	**DISCUSSION**
10:38-10:58 AM	**PRESIDENTIAL ADDRESS** **Techniques in TKA: Thirty Years of Experience** * Merrill A. Ritter, MD, Mooresville, IN

The Knee Society Award Presentations

10:59-11:01AM **2005 Mark Coventry Award**
Introduction: Arlen D. Hanssen, MD, Rochester, MN

11:02-11:12 AM **Mark Coventry Award Paper**
WBC Gene Expression: A Novel Approach Toward the Diagnosis of Infection in Total Knee Arthroplasty
* Carl A. Deirmengian, MD, Philadelphia, PA

11:13-11:18 AM **DISCUSSION**

11:19-11:21 AM **2005 Chitranjan Ranawat Award**
Introduction: Paul A. Lotke, MD, Philadelphia, PA

11:22-11:32 AM **Chitranjan Ranawat Award Paper**
***In Vivo* Knee Forces after Total Knee Arthroplasty**
` Darryl D'Lima, MD, San Diego, CA

11:33-11:38 AM **DISCUSSION**

11:39-11:41 AM **2005 John Insall Award**
Introduction: W. Norman Scott, MD, Boston, MA

11:42-11:52 AM **John Insall Award Paper**
Unicompartmental Knee Replacement: A Minimum Twenty-One Year Follow-up End Result Study
* Michael R. O'Rourke, MD, Iowa City, IA

11:53-11:58 AM **DISCUSSION**

11:59 AM-12:10 PM **JOHN INSALL TRAVELING FELLOWSHIP REPORT**
Presenter: * Hong Zhang, MD, Beijing, China

12:10-1:13 PM **LUNCH BREAK**
(Knee Society Business Meeting - Members Only)

1:14-2:08 PM **Surgical Pearls and Video Vignettes**
Moderator: E. Michael Keating, MD, Mooresville, IN

1:15-1:25 PM **Surgical Techniques to Customize the Knee to the Patient**
* Robert E. Booth, Jr., MD, Philadelphia, PA

1:26-1:32 PM **DISCUSSION**

1:33–1:43 PM **Balancing the Valgus Knee**
* Chitranjan S. Ranawat, MD, New York, NY

1:44-1:50 PM **DISCUSSION**

1:51-2:01 PM	**Revision Knee Balancing** * Leo A. Whiteside, MD, St. Louis, MO
2:02-2:08 PM	**DISCUSSION**
2:09-3:12 PM	**SYMPOSIUM IV: PATELLOFEMORAL JOINT** * Moderator: Mary I. O'Connor, MD, Jacksonville, FL
2:09–2:19 PM	**Arthroscopy & Osteotomy** * Michael A. Kelly, MD, New York, NY
2:20-2:30 PM	**Patellofemoral Replacement: Newer Prosthesis** * Jess H. Lonner, MD, Philadelphia, PA
2:31-2:41 PM	**Patellofemoral Replacement: Long Term Results** * Jean-Noël Argenson, MD, Marseille, France
2:42-2:52 PM	**Total Knee Replacement for Patellofemoral OA** * John Meding, MD, Mooresville, IN
2:52-3:12 PM	**DISCUSSION**
3:13-4:06 PM	**SYMPOSIUM V: POLYETHYLENE** * Moderator: Michael D. Ries, MD, San Francisco, CA
3:13-3:23 PM	**Alternative Bearings – Ceramic:** **Diminished Poly Wear Through Use Of A Metal-Ceramic Composite Femoral Component** * Clifford W. Colwell, Jr., MD, La Jolla, CA
3:24-3:34 PM	**Causes of Polyethylene Wear** * Gerard A. Engh, MD, Alexandria, VA
3:35-3:45 PM	**Knee Polyethylene: What is the Future** * Timothy M. Wright, PhD, New York, NY
3:46-4:06 PM	**DISCUSSION**
4:07-5:00 PM	**SYMPOSIUM VI: SMALL INCISION TOTAL KNEE REPLACEMENTS** Moderator: Thomas S. Thornhill, MD, Boston, MA
4:08-4:17 PM	**My Results Justify Routine Use** * Richard S. Laskin, MD, New York, NY
4:18-4:28 PM	**Why I Prefer Smaller Incisions** * Giles R. Scuderi, MD, New York, NY
4:29-4:39 PM	**MIS TKA-Is It for Everybody?** * Paolo Aglietti, MD, Florence, Italy
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: Non-Arthroplasty Options in Medial Osteoarthritis

Cartilage Replacement

Thomas Minas, MD, MS, *Cartilage Repair Center, Brigham & Women's Hospital*
Harvard Medical School, Chestnut Hill MA

There are several different treatment strategies when assessing articular cartilage injuries that are symptomatic. Cartilage repair techniques include symptom treatment via lavage and debridement, cell based therapies using either autologous marrow derived bone elements, autologous periosteal or perichondrial grafting or periosteum with autologous chondrocyte implantation. Mature cartilage via osteochondral grafting with autografts and allografts also offers successful treatment.

Prior to assessing the treatment most appropriate for management of the chondral defect an assessment of the patient factors and knee factors should be considered. Patient factors include desired activity level; low or high demand, B. M. I., addictive behavior patterns such as smoking, narcotic usage, alcohol usage should be considered. When assessing the knee, factors to consider include; mechanical axial alignment as noted on standing 54 inch radiographs, joint space on standing AP and PA Rosenberg views, ligament stability, presence or absence of the meniscus, and a predisposition for osteoarthritis.

The size of the chondral defect is the final factor to be considered when deciding on appropriate treatment option. Algorithms to assist in the management of articular chondral injuries have been published. There continues to the debate and overlap of treatments. The growing field of cartilage repair has allowed a group of patients not previously treated well by sports medicine techniques or prosthetic arthroplasty techniques to enjoy a continued active quality of life.

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Financial Disclosure: a,b – Genzyme Biosurgery

Symposium I: Non-Arthroplasty Options in Medial Osteoarthritis

Osteotomies: Opening Wedge or Closing Wedge

Peter J. Fowler, MD, *Fowler Kennedy Sport Medicine Clinic,*
The University of Western Ontario, London, ON, Canada

Why not high tibial osteotomy (HTO), a time-tested surgical option for treating medial compartment OA? The procedure has demonstrated a survivorship of 83% at 10 years (*Hutchison & Gross '98)* and success rates of 80-90% at 5 years and 60 - 70% at 10 years *(Insall 84; Rudan 91; Ivarsson '90; Coventry '93; Yasuda '92*). No intra-articular implants are required and there is a consistent decrease in adduction moment, suggesting improved alignment *(Goh '93; Prodromos '85; Wang '90; Chiang '03).*

Many patients with medial compartment OA need a biplanar correction necessitated by sagittal malalignment, cruciate deficiency and/or the particular site of the erosions. Although closing wedge osteotomy has produced decent results over the years, we prefer the opening wedge technique. This facilitates a biplanar correction to deal with anterior or posterior erosions, ACL or PCL deficiency, or a hyperextension thrust. It requires only a single cut, avoids the proximal tibiofibular joint and peroneal nerve, and does not violate the anterior compartment of the leg. The main disadvantage is the need for a graft (autograft, allograft or bone substitute), in most situations.

The drawbacks of closing wedge HTO include a resultant alteration in the shape of the upper tibia, which may have implications for future TKA, difficulty in controlling the tibial slope, and the necessary violation of the proximal tibiofibular joint. Huge corrections (<2cm) are better managed with osteotomies distal to the tibial tubercle and external fixation.

Financial Disclosure: a-Arthrex, Inc.

SYMPOSIUM II: UNI COMPARTMENTAL KNEES

Why I Think Uni's are a Good Option for Patients

Gerard A. Engh, MD, *Anderson Orthopaedic Research Institute, Alexandria, VA*

The benefits of unicondylar arthroplasty as compared to total knee arthroplasty are well documented in the literature - less blood loss, a quicker recovery, less chance of infection, higher patient satisfaction, better stair climbing ability, and an easier operation if a revision arthroplasty becomes necessary. The outcome is more predictable and the failure rates are lower than with high tibial osteotomy. The chances of developing debris-generated osteolysis, a major concern with total knee arthroplasty, have not been reported following unicondylar arthroplasty.

Studies that report a better survivorship with total knee arthroplasty fail to recognize the impact of shelf-age on wear related failures. Since unicondylar arthroplasties were performed in small numbers prior to the year 2000, inventory turnover was slower, resulting in a longer shelf age of unicondylar implants. The survivorship of 441 unicondylar arthroplasties from our institution was only 84% at a mean eight years. However, the survivorship of the implants with a shelf-age of less than one year was 95% and the survivorship of implants with a shelf-age less than six months was 98%. These results and those of Berger, Murray, Svard, and Pennington compare favorably with the very best results reported with total knee arthroplasty.

Financial Disclosure: c - DePuy

SYMPOSIUM II: UNI COMPARTMENTAL KNEES

Early Failure of Minimally Invasive Unicompartmental Knee Arthroplasty is Associated with Obesity

Adolph V. Lombardi, Jr., MD, *Joint Implant Surgeons, Inc., New Albany Surgical Hospital, Ohio State University, Columbus, OH*

There has been increasing utilization of and expanding indications for unicompartmental knee arthroplasty using minimally invasive techniques. We sought to define contraindications by examining failures. We reviewed the early results of a consecutive series of medial minimally invasive unicompartmental knee arthroplasty using two implant designs. Seventy-nine consecutive unicompartmental knee arthroplasty (48 instrumented and 31 non-instrumented) with potential 2-year follow-up were reviewed. Patients with radiographic involvement with or without pain referable to the lateral compartment or patellofemoral joint were not considered candidates. Failure was defined as revision or pending revision. The average follow-up was 38 months (6 patients had not returned for annual visits). There were 16 failures (6 tibial loosening, 3 plateau fracture, 4 persistent medial pain, 1 progressive arthritis, and 2 sepsis). Age, gender, and implant design were not predictive of failure. Body mass index over 32 was predictive of failure ($p<0.05$; chi-squared) and associated with a significant reduction in survivorship by log-rank and Wilcoxon analyses.

These results demonstrate reliable success if obesity is included as a contraindication and technical errors resulting in fracture are eliminated. Better defining the ideal candidate for unicompartmental knee arthroplasty, with obesity remaining a contraindication, will make this a more predictable and reliable procedure.

Financial Disclosure: a,b,c,d,e – Biomet Orthopaedics, Inc.

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Symposium III: Computer-Assisted Surgery

This is The Future of Knee Surgery

Aaron A. Hoffman, MD, *University of Utah Medical Center, Salt Lake City, UT*

Computer assisted surgery is the wave of the future. Computers have been paving the path from paper to electronic charting and signatures. The operative suite and patient monitoring has also begun to enter the computer age. Computer navigation has been introduced as an adjunct to total knee arthroplasty (TKA) to assure precision positioning, accurate bone resection, and optimal component alignment.

We have utilized the navigation system in 50 total knee arthroplasties. Ninety-eight percent (49/50) of all femoral components were placed within +/- 3 degrees of the radiographic and clinical goal position and 100% (50/50) of all tibial components were placed within +/- 3 degrees of their target. This is improved over excellent results by the same surgeon with standard instrumentation where 90% (45/50) of the femoral components and 92% (46/50) of the tibial components were within this same goal.

Computer assisted TKA demonstrates improved accuracy compared to standard instrumentation even in the hands of an experienced surgeon. This system affords the surgeon the potential to eliminate or significantly reduce outliers with regard to component position without adding significant time to the procedure. In addition, violation of the intramedullary canal is avoided using this instrumentation. This improved accuracy may translate into improved component survivorship in the long term and reduce outliers. Computer assisted surgery can make a good surgeon even better.

Financial Disclosure: e-Zimmer, Ortho Soft, Inc.

Symposium III: Computer-Assisted Surgery

Computer Assisted Surgery in TKA: The Future is Not Now

John J. Callaghan, MD, *University of Iowa, Iowa City, IA*

There is no question that all orthopaedic surgeons performing total knee replacement today have some outlier cases in axial alignment and sagittal plane alignment as well rotational alignment. Even if computer assisted surgery would decrease the outliers can we be sure that eliminating the outliers will decrease the need for revision or improve clinical results? I think these are the important questions that would need to be answered if computer assisted surgery could be made ready for prime time.

Although computer assisted surgery has the potential to make the total knee replacement operation more precise, it is not yet there. Even in experienced surgeons' hands with enthusiastic operating room crews the operation takes longer to do. In less optimal environments this approach can lead to CHAOS in the operating room with all the myriad of equipment, expensive hardware and software, and the expertise needed to run it, especially if there are computer glitches. Precise referencing points are needed otherwise there is huge potential for the "garbage in garbage out" phenomenon. Presently there are no manual overdrives for safety and there is danger of the surgeon opting out of the decision-making, a somewhat scary concept.

For the present time since the CAOS procedure doesn't simplify the operation and since it adds another layer of complexity, it should stay in the hands of the enthusiast.

Financial Disclosure: none

Presidential Address

Techniques in Total Knee Arthroplasty: Thirty Years of Experience

Merrill A. Ritter, MD, *Center for Hip and Knee Surgery, St. Francis Mooresville Hospital, Mooresville, IN*

Total knee arthroplasty is a soft tissue operation associated with instrumented bone resections. Correcting deformities requites soft tissue release and free hand bone cuts for the defects. Long term follow up of total knee replacements finds that the surgeon's understanding of how many variations there are in the bone resections and soft tissue releases that are acceptable to avoid failure.

Instruments and computers can accurately cut the bone but cannot determine the degree of soft tissue release necessary to position the knee replacement for long term success. It still requires a surgeon to select the appropriate prosthesis, release the appropriated soft tissues, correct and fill all defects and implant the prosthesis with or without cement.

Computer may well avoid bony outliers; however, they will never implant the prosthesis correctly without good soft tissue surgery.

Financial Disclosure: a, d, e - Biomet

The Knee Society Award Presentations

MARK COVENTRY AWARD
for Best Basic Science Paper

WBC Gene Expression:
A Novel Approach Toward the Study and Diagnosis of Infection

Carl Deirmengian, MD, Jess H. Lonner, MD**,** Robert E. Booth Jr, MD,
3B Orthopaedics, Pennsylvania Hospital, University of Pennsylvania Health System, Philadelphia, PA

Introduction: We introduce a novel molecular genetic approach toward the study and diagnosis of infection. The purpose of the study is to demonstrate that synovial fluid WBCs express a gene expression "signature" that differentiates septic from aseptic inflammation.

Methods: Synovial fluid was aspirated from patients with acute *S. aureus* infection or acute gout of the knee. Differential cell counts included predominantly neutrophils in all aspirates. RNA was isolated from the synovial fluid WBC and analyzed on the Affymetrix U133A Genechip.

Results: The neutrophils from a *S. aureus* infected knee can be distinguished from the neutrophils found in gout by nature of their differential gene expression. 1615 genes have an expression level that is significantly different ($p < 0.05$) between the groups. The 124 most significant ($.0000001 > p > .0001$) differences are in genes from immune pathways, including the interleukin pathway, the TNF pathway, and the antibacterial response.

Conclusions: The neutrophils at a site of infection (*S. aureus*) express different genes than the neutrophils at a site of aseptic inflammation (gout). To our knowledge, this is the first in-vivo demonstration of this principle. The differences in neutrophil gene expression may be utilized to develop simple laboratory tests that distinguish the causes of inflammation in a total joint arthroplasty.

Financial Disclosure: a - Zimmer

CHITRANJAN RANAWAT AWARD
for Best Work on a Surgical Technique

In Vivo Knee Forces after Total Knee Arthroplasty

Darryl D. D'Lima, MD; Shantanu Patil, MD; Nikolai Steklov, BS; John E. Slamin; Clifford W. Colwell Jr, MD, *Scripps Clinic Center for Orthopaedic Research & Education, La Jolla, CA*

The knee is complex and difficult to model accurately. Although advances in mathematical modeling have been significant, in vivo validation has not occurred. Direct measurement of knee forces could lead to better understanding the stresses seen in TKA.

An instrumented tibial prosthesis that measures forces at four corners of the tibial tray was implanted in an 80-year-old male. The patient walked approximately 1.6 million steps per year before surgery. Forces were measured postoperatively during passive and active knee flexion, rehabilitation, and various activities of daily living. Peak tibial forces were 1.2 times body weight (BW) while using a walker on postoperative day 3. By postoperative day 6 tibial forces during gait were 1.7 times BW; at 6 weeks the peak tibial forces were 2.2 times BW. Stair climbing increased from 1.9 times BW on day 6 to 2.5 times BW at 6 weeks.

This represents the first direct in vivo measurement of tibial forces. Data will be used to develop better biomechanical knee models and in vitro wear tests and to evaluate and improve implant design, bearing surfaces, rehabilitation protocols, and orthotics. Refining surgical techniques and enhancing prosthetic designs could be of great benefit to the longevity of TKA.

Financial Disclosure: None

JOHN INSALL AWARD
for Best Work on a Clinical Subject or Outcomes Report

Unicompartmental Knee Replacement:
A Minimum Twenty-One Year Follow-up, End Result Study

Michael R. O'Rourke, MD; Jeremy J. Gardner, BA; John J. Callaghan, MD; Steve S. Liu, MD; Devon D. Goetz, MD; David A. Vittetoe, MD.; Patrick M. Sullivan, MD; and Richard C. Johnston, MD, *Department of Orthopaedics and Rehabilitation, University of Iowa Hospitals and Clinics, Iowa City, IA*

Introduction: The purpose of this study is to report the results of a consecutive series of Marmor cemented unicompartmental knee replacements performed between 1975 and 1982 and followed for a minimum of 21 years.

Methods: 136 unicompartmental knee replacements were inserted in 103 patients. Clinical evaluation included HSS knee rating, Knee Society scores and the need for revision. Radiographs were evaluated for loosening as well as disease progression.

Results: At final follow-up 14 patients with 19 knee replacements were living, 87 patients with 115 knees were deceased, and only 2 patients with 2 knees were lost. The average age at surgery was 70.9 years. The average preoperative and final follow-up HSS knee score was 58 and 74 points, respectively. The average Knee Society final follow-up clinical and functional score averaged 72 and 53 points, respectfully. 19 knees (14%) were revised during the 21-year follow up, 9 knees for progression of disease, 8 for loosening, and 2 for pain, at an average 10.6 years (range, 1 to 22 years). Of the 19 knees in living patients, 7 knees (37%) were revised, 2 knees for tibial loosening, 4 knees for disease progression, and 1 for pain.

Discussion: Unicompartmental knee replacement in this relatively older age group of patients performed well at minimum 21-year follow-up. Although we are encouraged by these results, only 22% were performed in patients who were under age 65 at the time of surgery. The knees in this age group required significantly more revisions (p=0.005) during the follow-up interval.

Financial Disclosure: a, e - DePuy

JOHN INSALL TRAVELING FELLOWSHIP REPORT

Presenter: Hong Zhang, MD, *Dept. of Adult Joint Reconstructive Surgery, Beijing Jishuitan Hospital, Beijing, P R of China*

2004 Insall Traveling Fellows
Hong Zhang, MD
Michael Berend, MD, Center for Hip & Knee Surgery, Mooresville, IN
J. Bohannon Mason, MD, Charlotte Hip & Knee Center, Charlotte, NC
Henry Clarke, MD, Mayo Clinic Scottsdale, Scottsdale, AZ

The annual John Insall Traveling Knee Fellowship took place from September 28 to October 30, 2004. The four fellows visited 13 knee centers across the United States and Canada. At each center the Knee Society members hosted didactic sessions and surgical observation; four Knee Society topics noted below were also discussed.

Computer navigation was discussed from both a practical and economic point of view. At approximately half of the centers computer navigation was used by select surgeons. Without exception, the need to use standard checks to verify the computer's analysis was noted; the increased expenses were also discussed. Most surgeons believe that computer navigation is promising technology that requires further development.

All-poly tibial components were used at some centers, primarily in older, less active patients. Support for these non-modular components included long-term data demonstrating good results in select patients, reduced costs, and avoidance of modularity. The importance of specific prosthesis design was emphasized.

Most centers acknowledged the importance of peri-operative analgesia in improving immediate recovery but comprehensive programs emphasizing pre-emptive measures were the exception. Modalities included pre-operative narcotics & COXII inhibitors, local anesthetic injections, epidural, femoral and sciatic blocks and routine post-operative oral anesthesia.

The importance of the design changes to TKA prosthesis to reduce PF complications was discussed. However, the multi-factorial nature of PF problems after TKA was emphasized, especially noting the importance of surgical technique. Most members believed that there is limited role for isolated PF replacement. The lack of understanding about the underlying pathology of PF pain, patient selection, and the limitations of current PR replacement designs were recurrent concerns.

Financial Disclosure: Zimmer China (travel expenses)

SURGICAL PEARLS & VIDEO VIGNETTES

Surgical Techniques to Customize the Knee to the Patient

Robert E. Booth, Jr., MD, *3B Orthopaedics, Pennsylvania Hospital, University of Pennsylvania Health System, Philadephila, PA*

Contemporary techniques of total knee arthroplasty necessarily aim at averages. To accommodate the wide Gaussian distribution of clinical pathology and surgical skill, standardized approaches to knee replacement pick fixed numbers based off bony reference points. Increased surgical sophistication, however, allows preoperative identification of pathologic variants and deviations from the mean which can be accommodated to improve the ultimate outcome.

Customized techniques for problems such as patellar subluxation, excess tibial slope, variable femoral axis, patella baja, MCL fibrosis, and patient gender for example, can offset the difficulties created by a rigid "cookbook" approach. Even in total knee revision, where the most common error is to undercorrect the flaws that produced failure in the index arthroplasty, one must address the special needs of each knee from the outset of the procedure.

Financial Disclosure: c - Zimmer

SURGICAL PEARLS & VIDEO VIGNETTES

Balancing the Valgus Knee: Total Knee Arthroplasty for Severe Valgus Deformity: Five to 14 Year Follow-up

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

Background: In 1985, the senior author (CSR) developed a soft tissue release technique to balance severe valgus knees to reduce instability and the need for primary constrained implants. This report describes the soft-tissue release technique and its long-term results.

Methods: Four hundred and ninety consecutive total knee arthroplasties were performed by one surgeon between January 1988 and December 1992. In this group, seventy-one patients (eighty-five knees) had a valgus deformity of $\geq 10°$. Thirty-two patients (thirty-six knees) died, and four patients (seven knees) were lost to follow-up, leaving thirty-five patients (forty-two knees) followed for a minimum of five years. These twenty-seven women and eight men had a mean age of sixty-seven years. The technique included an inside-out soft-tissue release of the posterolateral aspect of the capsule with pie-crusting of the iliotibial band and resection of the proximal part of the tibia and distal part of the femur to provide a balanced, rectangular space. Cemented, posterior-stabilized implants were used in all knees. Clinical and radiographic evaluations were performed at one, five, and ten years postoperatively.

Results: The mean modified Knee Society clinical score improved from 30 points preoperatively to 93 points postoperatively, and the mean functional score improved from 34 to 81. The mean coronal alignment was corrected from 15° preoperatively to 5° postoperatively. Three patients underwent revision surgery for delayed infection, premature polyethylene wear, and patellar loosening in one patient each. There were no cases of delayed instability.

Conclusions: The inside-out release technique to correct a fixed valgus deformity in patients undergoing primary total knee arthroplasty is reproducible and provides excellent long-term results.

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Financial Disclosure: c - DePuy

SURGICAL PEARLS & VIDEO VIGNETTES

Revision Knee Balancing

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Ligament balancing in revision total knee arthroplasty begins with exposure of the knee and implant removal. Minimal soft tissue should be stripped from bone even in cases of difficult exposure. Tibial tubercle osteotomy technique should be used to expose these cases and preserve the capsular attachments to bone. Minimal bone should be resected to leave the bone-soft tissue envelope intact. Alignment in flexion and extension must be established early in the case so that the articular surface is parallel to the epicondylar axis in flexion, and perpendicular to the mechanical axis in extension.

The joint surface then is positioned in flexion and extension to correctly tension the soft-tissue envelope. This is done with sizing of the femoral component and with augments on the femur and tibia to stabilize the knee in flexion and extension. Finally, tight ligaments are released to achieve correct balance. This simple plan will stabilize almost every revision knee, and should be used regardless of the type of implants the surgeon chooses.

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

SYMPOSIUM IV: PATELLOFEMORAL JOINT

Arthroscopy & Osteotomy

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The surgical management of isolated patella femoral arthritis remains controversial. Needless to say, the vast majority of these patients have failed a well outlined, non-operative treatment regiment for greater than six months. Multiple factors are involved in surgical decision-making including the age and activity level of the patient, obesity and the presence of bilateral disease. Early patella femoral degenerative joint disease is typically associated with a lateral patella femoral malallignment with lateral tilt of the patella. Surgical arthroscopy for osteoarthritis of the knee is unpredictable and this is no different in isolated patella femoral arthritis.

Arthroscopic debridement with or without lateral release does have a role in the younger active patient with severe limitations in their daily activities and realistic activity goals. Limited lateral release is utilized in the surgical arthroscopy when lateral malalignment is present on x-ray or CT Scan. Post-operative rehabilitation is critical. In this particular patient population we have experienced approximately 75 percent success at two years.

Osteotomy of the tibial tubercle was initially advocated by Bandi & Maquet. This was based on the biomechanics that elevation of the tibial tubercle by approximately 2 cm. would decrease the patella femoral contact forces by 50 percent. Although this procedure popularized by Maquet was useful in relieving painful symptoms it had a very high complication rate. Significant problems included skin necrosis locally, infection and fracture. In 1983 Fulkerson popularized a variation of this osteotomy known as anteromedialization. This technique both anteriorized and medialized the tibial tubercle using no bone graft. Early results reported by Fulkerson were encouraging and there were no significant wound problems similar to the Maquet procedure.

The initial problems of stiffness and later tibial fracture have been largely managed by rigid internal fixation of the osteotomy allowing immediate range of motion and CPM and limited weight bearing until the osteotomy has fully healed. The indication for tibial tubercle osteotomy in patella femoral arthritis is not clearly delineated today. Additionally, there has been some enthusiasm for cartilage re-surfacing techniques such as micro fracture and carticel in conjunction with these osteotomies. It is difficult to interpret the clinical results due to the variation and diagnosis.

Financial Disclosure: a, c, e - Zimmer

SYMPOSIUM IV: PATELLOFEMORAL JOINT

Patellofemoral Replacement: Newer Prosthesis

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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 still it is 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.

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Financial Disclosure: a, c, e - Zimmer

SYMPOSIUM IV: PATELLOFEMORAL JOINT

Patellofemoral Replacement: Long Term Results

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Introduction: The purpose of the study is to present an updated evaluation of patellofemoral arthroplasty (PFA) in a group of patients presented ten years ago and also to determine the in vivo kinematic patterns for subjects implanted with a PFA.

Methods: Of the original group of 66 patients, nine had died, leaving 57 cases to study with a minimum followup of ten years. The mean age at the time of surgery was 57 years. Preoperative diagnoses included instability, fracture, and primary arthritis. All patients received a metallic femoral component and a cemented polyethylene patella. Twenty recent subjects having a PFA were studied under fluoroscopic surveillance to determine patellofemoral contact positions and medial-lateral translation.

Results: At the most recent evaluation, 14 knees were revised for femorotibial osteoarthritis, 11 for femoral loosening and 4 for stiffness. Survivorship was 58% at 16 years. The knee function score improved from 40 points preoperatively to 81 points at last follow-up. Kinematic evaluation showed high individual variability with an average of 11.9 mm of craniopodal translation and 3.8 mm of medial-lateral translation.

Discussion: The best results were found in subjects with preoperative instability with corrected alignment of the extensor mechanism. Stiffness occurred only in those with osteoarthritis from previous fracture. The kinematic evaluation confirms the importance of femoral positioning, particularly avoiding implantation in flexion and internal rotation. This long term evaluation of PFA demonstrates the importance of careful preoperative selection and avoidance of preoperative femorotibial deformity.

Financial Disclosure: a - DePuy

SYMPOSIUM IV: PATELLOFEMORAL JOINT

Total Knee Replacement for Patellofemoral OA

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Patients with patellofemoral osteoarthritis represent a relatively small subgroup of patients (two to five percent) presenting for knee arthroplasty. Treatment options may include patellectomy, pateollofemoral arthroplasty, and total knee replacement.

After total knee replacement, patients eventually achieve the same level of function and pain relief as patients with isolated tibiofemoral arthrosis. When as subgroup of patients with isolated patellofemoral arthrosis was compared to a group of over 3,000 total knee replacements performed for severe medial and lateral arthrosis we found no difference in Knee Society knee scores or pain scores at an average follow-up of over five years.

Function scores, including stair-climbing score, were significantly lower at six months and one year ($p<0.05$). With longer follow-up, however, function scores were similar. This delay in the early post-operative period is, likely due to the quadriceps weakness that exists pre-operatively.

Furthermore, when compared to the results of isolated patellofemoral arthroplasty, the most reliable, predictable, and durable treatment in patients with patellofemoral arthritis is total knee replacement.

Financial Disclosure: a - Biomet

SYMPOSIUM V: POLYETHYLENE

UHMWPE in Total Knee Arthroplasty

Sympoisum Moderator: Michael D. Ries, MD, *University of California-San Francisco Medical Center, San Francisco, CA*

Failures of fixed bearing total knee tibial components have usually resulted from fatigue wear mechanisms which were associated with gamma irradiated in air UHMWPE.[1] However, gamma irradiation in air sterilization has not been used by most manufactures for nearly 10 years and the typical failure mechanisms previously observed do not appear to be continuing.

Crosslinking reduces wear of UHMWPE but also reduces the static mechanical properties such as tensile and yield strength as well as fatigue crack propagation resistance.[2,3] In a highly conforming joint such as the hip where contact stresses are relatively low, surface wear mechanisms (abrasion and adhesion) predominate while in a less conforming joint such as a fixed bearing knee replacement, where contact stresses are high, fatigue wear mechanisms occur more typically (delamination and pitting). Therefore, modifications to UHMWPE which improve wear resistance by crosslinking but also reduce mechanical properties may not be more appropriate for fixed bearing knee replacements.

Abrasive wear in total knee replacements can occur in association with in vivo roughening of the femoral component. Although non gamma irradiation sterilization techniques have improved the wear and fatigue behavior of UHMWPE compared to gamma irradiated in air UHMWPE, further improvement in wear may be achieved with counterface hardening.

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Financial Disclosure: e – Smith & Nephew

SYMPOSIUM V: POLYETHYLENE

Alternative Bearings – Ceramic: Diminished Poly Wear Through Use Of A Metal-Ceramic Composite Femoral Component

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Composite bearing materials consisting of a (non-oxidized) metal zirconium core with oxidized zirconia surface have recently become available. Wear properties of this material in total knee arthroplasty (TKA) are under investigation. Three oxidized zirconium femoral components (OxZirc) were mounted in a knee wear simulator coupled to standard tibial polyethylene inserts and modular tibial base-plates. Three femoral components of identical geometry made of conventional cobalt-chrome (CoCr) were tested as controls. Knees were taken through 5 million cycles of normal gait and stair-climbing simulation. Polyethylene insert wear 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 to simulate an athletically active patient with non-optimal component alignment. 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 found in inserts worn against OxZirc femoral components when tested under conditions of increased varus moments and increased dynamic tibial rotation. Tibial polyethylene wear can be substantially reduced through the use of oxidized zirconium femoral 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*

SYMPOSIUM V: POLYETHYLENE

Causes of Polyethylene Wear

Gerard A. Engh, MD, *Anderson Orthopaedic Research Institute, Alexandria, VA*

Polyethylene wear and osteolysis were not reported as complications with total knee arthroplasties performed in the 1970s and early 1980s. Over the past decade increasing numbers of failures have been reported secondary to wear. Recent studies by Sharkey (2002) and Fehring (2003) report wear and osteolysis as two of the most common causes of knee implant failure.

Analysis of retrieved implants provides valuable information as to variables that contribute to wear. At our institution, Collier et al used multiple regression analysis to determine the relative contributions of different patient, surgical technique, and implant factors on the wear of almost 2000 total knee implants and over 440 unicondylar implants. The three variables that consistently correlated with wear were patient age, mechanical axis alignment, and the shelf-age of the component. In fact, over 50% of wear could be attributed to shelf-age alone. Although changes to sterilization methods have reduced the risk of wear and osteolysis, backside wear as well as component and extremity alignment continue to correlate with the development of osteolysis following total knee arthroplasty.

Financial Disclosure: c - DePuy

SYMPOSIUM V: POLYETHYLENE

Knee Polyethylene: What is the Future?

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Wear of the ultra high molecular weight polyethylene bearing surfaces in total knee replacements is inevitable. The large sliding distances between the bearing surfaces and the high stresses created in the material by the joint contact loads are sufficient to cause wear damage even in highly conforming designs. The questions become, therefore, how to minimize wear and how to demonstrate that wear reductions equate to clinically relevant reductions in osteolysis.

Efforts to reduce pitting and delamination from occurring in knee components have focused on reducing the propensity for oxidative degradation through the use of new sterilization techniques. Most techniques maintain the benefit of cross-linking provided by exposure to radiation. Pitting and delamination can also be minimized by lowering the elastic modulus of the polyethylene, thus lowering the contact stresses. Lower modulus can be achieved through molding the material, but is also a byproduct of thermal treatments that elevated cross-linked polyethylenes undergo to quench free radicals.

The opposing bearing surface also affects wear. Introduction of ceramic bearing surface, for example, can be expected to lower abrasive and adhesive wear. The clinical relevance of lower wear rates is difficult to determine with the short term follow-ups available thus far. This same problem complicates the introduction of elevated cross-linked polyethylenes, which show resistance to pitting and delamination, improved resistance to abrasive and adhesive wear, but increased susceptibility to crack propagation.

Nonetheless, improvements to polyethylene portend the possibility for new designs aimed at providing more functional bearing surfaces without compromising wear resistance.

Financial Disclosure: a – Zimmer,Inc., NIH Grant #AP049793

SYMPOSIUM VI: Small Incision Total Knee Replacements

MIS TKR: My Results Justify its Use

Richard S. Laskin MD, *Hospital for Special Surgery, New York, NY*

This paper reports the results of 150 consecutive minimally invasive (MIS) mini mid vastus (MMV) knee replacements followed for two years or more after surgery. Patients were operated upon under a combined epidural and femoral nerve block, continuous passive motion and pre-emptive analgesia was used post operatively. The mini mid vastus split extended 2 cm along the fibers of the VMO and the patella was subluxed but not everted. All x-rays were evaluated for component position and clinical evaluation was performed using the Knee Society rating system.

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

There were no outliers as related to tibial or femoral component positioning as measured at the 4-6 week post-operative films.

One patient had a partial distal skin necrosis that healed spontaneously. In six muscular male patients, the mid vastus split had to be extended to 4 cm to allow patellar displacement.

By the end of the first year, the results are similar between standard incision and MIS incision patients; however, the MMV MIS group achieved these goals more rapidly and with less pain.

Financial Disclosure: c, e – Smith & Nephew

SYMPOSIUM VI: Small Incision Total Knee Replacements

Why I Prefer Smaller Incisions

Giles R. Scuderi, MD, *Insall, Scott, Kelly Institute for Orthopaedics and Sports Medicine, New York, NY*

Minimally invasive total knee arthroplasty has been introduced in an effort to reduce surgical morbidity and facilitate an early functional recovery. Early clinical studies are reporting less blood loss, earlier gains in motion and shortened hospital stays.

When considering minimally invasive TKA, surgeons should be comfortable operating with limited visualization and recognize the anatomic landmarks in order to accurately perform the procedure and position the components. Modified instruments have made it easier to perform the procedure through either a limited medial parapatellar arthrotomy, subvastus approach, midvastus approach or the quadriceps sparing approach. The utility of these minimally invasive approaches is that they can easily be converted to a standard extensile approach when indicated.

Minimally invasive total knee arthroplasty is proving to be a viable technique, but it is important is to remember that the surgical approach should be performed safely and not compromise the clinical outcome. Large patients, especially muscular males, with limited motion, significant fixed deformities and prior surgical procedures should be considered for a more traditional approach.

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

SYMPOSIUM VI: Small Incision Total Knee Replacements

MIS TKA-Is It for Everybody?

Paolo Aglietti, MD, *First Orthopaedic Clinic of the University of Florence, Firenze, Italy*

With the ever increasing use of MIS TKA it becomes mandatory to clearly define relative and absolute contraindications for it's use in order to minimize the risk of complications. Factors to be considered are the patients knee, the surgeon ability and the environment in which the operation takes place.
We have compared MIS TKA with standard TKA and sub-vastus MIS with quad-sparing MIS. Based on our studies and on the available literature we have identified the following patient related factors which may pose limitations on the use of MIS TKA. Previous surgery, scarring with adhesion, previous high tibial osteotomy, loss of range of motion, severe deformity, bone fragility due to osteoporosis, inflammatory arthritis, bone loss, the very obese and the very muscular leg. Depending on the relevant significant of these factors on their own or in combination a decision for or against MIS TKA can be made.

Conclusion: Most patients are suitable for MIS TKA. The operation should be reserved for knee surgeons who are supported by a well trained and dedicated theatre team. The hospital management must make provisions for the longer duration of surgery and extra training of OR personnel. Adherence to correct indications and technique will provide satisfactory results with clear advantages of MIS TKA over standard TKA.

Financial Disclosure: e - Zimmer

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.

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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.

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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:

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