



12TH ANNUAL MEETING

November 1-3, 2002

DFW Lakes Hilton

Executive Conference Center

Dallas, Texas

Final
Program

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Future Meetings

Combined Specialty Day
Knee Society/Hip Society/AAHKS
February 8, 2003
New Orleans, Louisiana

AAHKS 13th Annual Meeting
October 31-November 2, 2003
Dallas, Texas



American Association of Hip and Knee Surgeons

Twelfth Annual Fall Meeting

November 1-3, 2002

DFW Lakes Hilton Executive Conference Center

Dallas, TX

Goals and Objectives:

The American Association of Hip and Knee Surgeons Twelfth Annual Meeting is designed to provide orthopaedic surgeons with state-of-the-art information regarding the latest techniques and controversies in joint replacement surgery, as well as timely socioeconomic and legal issues of interest to our membership.

Two separate symposia will present the latest techniques and controversies regarding “Minimally Invasive Hip Replacement Surgery” and “Minimally Invasive Unicompartamental and Total Knee Replacement Surgery”. A third symposium will discuss “Socioeconomic Issues In Joint Replacement Surgery.” Ample discussion time is scheduled following each session.

Eleven sessions of paper presentations will cover: the In-Vivo Results of Highly Cross-Linked Polyethylene, Polyethylene Wear and Osteolysis, Revision Total Knee Replacement, Revision Total Hip Replacement, Long-Term Results of Hip and Knee Replacements, and the prevention and treatment of Complications related to joint replacement surgery. Forty-four free papers will be presented with an open discussion following each paper. Twenty scientific poster presentations will be on display throughout the annual meeting.

The program is designed for orthopaedic surgeons to attend and which meets the seven essentials of the Accreditation Council of Continuing Medical Education, and, as a result receives the highest quality education and category I CME credit for participation.

AAHKS 12th Annual Meeting

Scientific Program

(Note: all Sessions will be held in the Commerce Amphitheater unless otherwise noted)

Friday, November 1, 2002

- 1:00 – 2:50 pm **Practice Management Session I**
Practice Check-up: Is Your Practice Running Optimally?
Presenter: Karen Zupko, President, Karen Zupco & Associates
- 3:00 – 5:00 pm **Practice Management Session II**
Contracting Strategies That Can Make a Difference and 10 Ways to Boost Your Fiscal Fitness
Presenter: Karen Zupko, President, Karen Zupco & Associates
- 6:00 – 7:30 pm **Combined Hip/Knee Problem Case Sessions**
Moderators: *James Rand, MD*
Thomas Fehring, MD
Clifford Colwell, MD
Lawrence Dorr, MD
Charles A. Engh, MD
- 7:30 – 9:00 pm **Welcome Reception in Exhibition Hall**

Saturday, November 2, 2002

- 6:00 – 7:00 am **Breakfast in Windfall Restaurant**
- 7:00 – 7:55 am **Business Meeting (active members only) in Windfall Restaurant**
- 8:00 am **President's Welcome in Commerce Amphitheater**
Douglas A. Dennis, MD

SESSION ONE RESULTS: PRIMARY TOTAL HIP ARTHROPLASTY

- 8:05 – 8:48 am *Moderator: Richard Welch, MD*
- 8:05 am **Minimum 30-Year Follow-Up of Charnley Total Hip Arthroplasty:**
Paper #1 **A Standard for Future Arthroplasty**
Jesse E. Templeton, BA, Iowa City, Iowa*
- 8:10 am Discussion
- 8:16 am **Total Hip Arthroplasty in Patients 50 Years Old and Younger**
Paper #2 *James P. McAuley, MD*, Alexandria, VA*
- 8:21 am Discussion
- 8:27 am **20- to 26-Year Radiographic Review in Patients Less Than 50 Years**
Paper #3 **of Age with Cemented Charnley Low Friction Arthroplasty**
David K. Halley, MD, FACS, Columbus, OH*
- 8:32 am Discussion
- 8:38 am **THA Using a Tapered Titanium Femoral Component**
Paper #4 **Inserted without Cement in Type C Bone**
Richard D. Reitman, MD, Plano TX*
- 8:43 am Discussion

SESSION TWO PRIMARY TOTAL KNEE REPLACEMENT

- 8:49 – 9:32 am *Moderator: Thomas Fehring, MD*
- 8:49 am **Etiology of Failure with Posterior Stabilized TKA**
Paper #5 *Robert Trousdale, MD, Rochester, MN*
- 8:54 am Discussion
- 9:00 am **Does Practice Really Make Perfect? Provider Volume of TKA**
Paper #6 **and Patient Outcomes in a National Random Sample**
Sheleika L. Hervey, Durham, NC
- 9:05 am Discussion
- 9:11 am **Multicenter Survivorship Analysis of a Mobile Bearing TKA**
Paper #7 *James B. Stiehl, MD*, Milwaukee, WI*
- 9:16 am Discussion
- 9:22 am **Effect of Femoral Component Design on the Unresurfaced Patella in TKA**
Paper #8 *Leo A. Whiteside, MD*, St. Louis, MO*
- 9:27 am Discussion

SYMPOSIUM I SOCIOECONOMIC ISSUES IN TOTAL JOINT REPLACEMENT SURGERY

- 9:33 – 10:16 am *Moderator: Carlos Lavernia, MD*
- Introduction and Overview: The Healthcare System 2002: *Carlos Lavernia, MD*
- RUC & CPT: Understanding the Reimbursement Process: *Richard Wixson, MD*
- Private Insurance Systems in the US: *TBA*
- Medicare and Medicaid: *Brian Parsley, MD*
- Economics of Bilateral and Revision Joint Replacement: *William Hozack, MD*
- Economics of the Minimally Invasive Arthroplasty: *TBA*
- 10:06–10:16 am Panel Discussion
- 10:16 – 10:45 am **BREAK** in Exhibition Hall

10:45-11:30 am	KEYNOTE SPEAKER <i>Newt Gingrich, Public Policy Strategist</i> The Future of Medicare, Tort Reform and Professional Liability
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- 11:30 am–Noon Discussion
- 12:00 – 12:10 pm **Washington Update**
David Lovett, JD—Director, AAOS Washington office
- 12:11 – 12:21 pm **What Can a Political Action Committee Do for YOU?**
Paul Collins, MD—Chairman, Orthopaedic PAC
- 12:21 – 12:30 pm Discussion
- 12:30 – 1:25 pm **LUNCH** in the Exhibition Hall

SESSION THREE TOTAL HIP ARTHROPLASTY; CEMENTLESS ACETABULAR FIXATION

- 1:25 – 2:08 pm *Moderator: Clifford Colwell, MD*
- 1:25 pm **Primary Total Hip Arthroplasty with a Cementless Acetabular Component:**
Paper #9 **Evaluation at a Minimum of 15 Years**
Craig Della Valle, MD, Chicago, IL
- 1:30 pm Discussion

- 1:36 pm
Paper #10 **Radiographic Signs of Osseointegration in Porous Coated Acetabular Components**
James McAuley, MD, Alexandria, VA*
- 1:41 pm Discussion
- 1:47 pm
Paper # 11 **A Comparison of Cementless Acetabular Components of the Same Design: Spiked vs. Supplemental Screws**
Michael J. Archibeck, MD, Albuquerque, NM*
- 1:52 pm Discussion
- 1:58 pm
Paper #12 **Cementless Acetabular Fixation at 15 Years with the HGI Component: Comparison to the Gold Standard Charnley**
John J. Callaghan, MD, Iowa City, IA*
- 2:03–2:08 pm Discussion

SESSION FOUR CEMENTED FEMORAL STEMS

- 2:09 – 2:52 PM
Moderator: Richard White, MD
- 2:09 pm
Paper #13 **A Prospective Randomized Trial of Cemented Femoral Components with Polished vs. Grit Blasted Surface Finish and Identical Stem Geometry**
Thomas Parker Vail, MD, Durham, NC*
- 2:14 pm Discussion
- 2:20 pm
Paper #14 **Influence of Surface Finish in Total Hip Arthroplasty**
Bradley K. Vaughn, MD, Raleigh, NC*
- 2:25 pm Discussion
- 2:31 pm
Paper #15 **15-Year Survivorship of the Omnifit Femoral Stem in Primary Hybrid Total Hip Arthroplasty**
Vijay J. Rasquinha, MD, New York, NY*
- 2:36 pm Discussion
- 2:42 pm
Paper #16 **The Importance of Proximal Cement Filling of the Calcar Region: A Biomechanical Justification**
David C. Ayers, MD, Syracuse, NY
- 2:47–2:52 pm Discussion

SESSION FIVE REVISION TOTAL KNEE REPLACEMENT

- 2:52 – 3:35 pm
Moderator: Merrill Ritter, MD
- 2:52 pm
Paper #17 **Metaphyseal Only Engaging Stems in Revision TKA**
Thomas K. Fehring, MD, Charlotte, NC*
- 2:57 pm Discussion
- 3:03 pm
Paper #18 **Revision TKA with Cemented Components and Uncemented Intramedullary Stems**
Brian D Shannon, MD, Rochester, MN
- 3:08 pm Discussion
- 3:14 pm
Paper #19 **Mechanical Alignment of Cementless Stems in Revision Total Knee Arthroplasty**
Brian S. Parsley, MD, Houston, TX*
- 3:19 pm Discussion

3:25 pm Paper #20	Reoperations After 3200 Revision TKRs: Rate, Etiology and Lessons Learned <i>Rafael Sierra, MD, Rochester, MN</i>
3:30–3:35 pm	Discussion
3:35 – 4:00 pm	BREAK in Exhibition Hall
SESSION SIX	Highly Crosslinked Polyethylene
4:00 – 4:43 pm	<i>Moderator: Douglas Dennis, MD</i>
4:00 pm Paper #21	In-Vivo and In-Vitro Surface Changes in a Highly Crosslinked Polyethylene <i>Claude Reiker, PhD*, Winterthur, Switzerland</i>
4:05 pm	Discussion
4:11 pm Paper #22	Surface Damage of Short-Term Implanted Conventional and Highly Cross-linked Acetabular Components for THA <i>William Hozack, MD, Philadelphia, PA</i>
4:16 pm	Discussion
4:22 pm Paper #23	RSA Evaluation of Wear of Conventional vs. Highly Crosslinked Polyethylene Acetabular Component In-Vivo <i>Charles Bragdon, BS*, Boston, MA</i>
4:27 pm	Discussion
4:33 pm Paper #24	Clinical Performance of a Highly Crosslinked Polyethylene at Two Years in THA: A Randomized Prospective Study <i>John M. Martell, MD*, Chicago, IL</i>
4:38–4:43 pm	Discussion
SYMPOSIUM II	MINIMALLY INVASIVE UNICOMPARTMENTAL KNEE SURGERY
4:43 – 5:45 pm	<i>Moderator: Clifford Colwell, MD</i> <i>Panelists: Gerard Engh, MD and Chitranjan Ranawat, MD</i>
5:35–5:45 pm	Discussion
5:45 pm	ADJOURN

Sunday, November 3, 2002

- 6:15–7:00 am Breakfast in the Exhibition Hall
- 7:05–7:20 am **Research Committee Update** in Commerce Amphitheater
J. Wesley Mesko, MD and Steven Teeny, MD
- 7:20–7:30 am **TJR Documentary Project Update**
Clifford Colwell, MD

SESSION SEVEN REVISION TOTAL HIP ARTHROPLASTY

- 7:30 – 8:13 am *Moderator: Thomas Parker Vail, MD*
- 7:30 am **A Preliminary Report from an AAHKS/OREF Funded Grant:**
- Paper #25 **Prospective Matched-Pair Outcomes Analysis of Femoral Component Fixation in Revision THA Comparing Cementless, Modular Fixation with Cemented Femoral Fixation**
Richard Iorio, MD, Burlington, MA*
- 7:35 am Discussion
- 7:41 am **Constrained Osteonics Acetabular Liner: Average 10 Follow-up Study**
Paper #26 *John J. Callaghan, MD*, Iowa City, IA*
- 7:46 am Discussion
- 7:52 am **Fate of Cementless Acetabular Components Retained During Revision of a Femoral Component of a THA**
Paper #27 *Paul E. Beaulé MD*, Los Angeles, CA*
- 7:57 am Discussion
- 8:03 am **Cementation of an Acetabular Liner into a Well-Fixed Acetabular Shell during Revision Total Hip Arthroplasty**
Paper #28 *David Lewallen, MD*, Rochester, MN*
- 8:08–8:13 am Discussion

SESSION EIGHT POLYETHYLENE WEAR AND OSTEOLYSIS

- 8:14 – 8:57 am *Moderator: Daniel Berry, MD*
- 8:14 am **The Relationship Between Polyethylene Wear and Osteolysis in a Second Generation Porous-Coated Cementless Cup with Seven Years Follow-Up**
Paper #29 *Karl F. Orishimo, MS, Alexandria, VA*
- 8:19 am Discussion
- 8:25 am **Progression of Periacetabular Lysis Over Time: Serial Analysis Using Computed Tomography**
Paper #30 *Raju S. Ghate MD, Chicago, IL*
- 8:30 am Discussion
- 8:36 am **The Accuracy of Computed Tomography in Determining Location and Size of Pelvis Osteolysis Following THA: A Cadaver Study**
Paper #31 *Alexandra M. Claus, MD, PhD, Alexandria, VA*
- 8:41 am Discussion
- 8:47 am **Correlation Between Early and Late Wear Rates in THA with Application to the Performance of Highly Crosslinked Polyethylene Liners**
Paper #32 *Robert H. Hopper, Jr., PhD, Alexandria, VA*
- 8:52–8:57 am Discussion

SESSION NINE POLYETHYLENE WEAR AND INFECTION IN TKR

8:58 – 9:41 am *Moderator: David Lewallen, MD*

8:58 am **Wear of Retrieved Unicondylar Knee Arthroplasty Tibial Components**
Paper #33 *Gerard A. Engh, MD*, Alexandria, VA*

9:03 am Discussion

9:09 am **Early Ex-vivo Optical Analysis of Highly Crosslinked and Conventional**
Paper #34 **Polyethylene Tibial Inserts**
Orhun Muratoglu, PhD, Boston, MA*

9:14 am Discussion

9:20 am **A Two-stage Approach to Primary TKA in the Infected Arthritic Knee**
Paper #35 *David G. Nazarian, MD*, Philadelphia, PA*

9:25 am Discussion

9:31 am **Limited Success in Acute Staphylococcus Infection After TKA Treated with**
Paper #36 **Debridement and Retention of Components**
Carl Deirmengian, MD, Philadelphia, PA

9:36–9:41 am Discussion

9:41 – 10:05 am **BREAK** in Exhibition Hall

SYMPOSIUM III MINIMALLY INVASIVE TOTAL HIP REPLACEMENT

10:05 – 10:48 am *Moderator: Lawrence Dorr, MD*

Panelists: Richard Berger, MD and Thomas Sculco, MD: Why We Use Mini-Incision
Daniel Berry, MD: Why NOT to Do It

10:38–10:48 am Discussion

SESSION TEN TOTAL HIP REPLACEMENT COMPLICATIONS

10:49 – 11:32 am *Moderator: Mary O'Connor, MD*

10:49 am **The Long-Term Cumulative Risk of Dislocation After Primary THA:**
Paper #37 **Effect of Femoral Head Size and Operative Approach**
Daniel J. Berry, MD, Rochester, MN*

10:54 am Discussion

11:00 am **Long-term Clinical Consequences of Stress-Shielding After THA**
Paper #38 **Without Cement: A Follow-up Report**
C. Anderson Engh, Jr., MD, Alexandria, VA*

11:05 am Discussion

11:11 am **In-vivo Degradation of Mechanical Properties and Wear**
Paper #39 **Performance of UHMWPE Acetabular Liners**
William J. Hozack, MD, Philadelphia, PA

11:16 am Discussion

11:22 am **The Effect of Gas Plasma and Gamma-Irradiation Sterilization on the In**
Paper #40 **Vivo Wear Performance of Total Hip Arthroplasty Polyethylene Liners**
Robert H. Hopper, Jr., PhD, Alexandria, VA

11:27–11:32 am Discussion

SESSION ELEVEN POTPOURRI: TOTAL KNEE REPLACEMENT

- 11:33 am–12:16 pm *Moderator: David Ayers, MD*
- 11:33 am **Knee Implant Alignment: A Comparison of Minimally Invasive Unicompartamental, Open Unicompartamental and TKA**
Paper #41 *David A. Fisher, MD*, Indianapolis, IN*
- 11:38 am Discussion
- 11:44 am **Use of a Porous Metal Patella for Marked Patellar Bone Loss During Revision TKA**
Paper #42 *Charles L Nelson, MD*, Philadelphia, PA*
- 11:49 am Discussion
- 11:55 am **Corticosteroid vs. Synvisc (Hylan GF-20) Injections for Knee Osteoarthritis: A Prospective, Randomized Trial Demonstrating Similar Efficacy but Important Gender-Related Treatment Differences**
Paper #43 *Seth S Leopold, MD,* Seattle, WA*
- 12:00 Noon Discussion
- 12:06 pm **The Prevalence of Corporate Funding in Orthopaedic Lower Extremity Research and its Effect on the Reporting of Results**
Paper #44 *Kace A. Ezzet, MD,* LaJolla, CA*
- 12:11–12:16 pm Discussion
- 12:16 pm ADJOURN

**Please return your completed Evaluation Form to the
Registration Desk at the end of the Meeting.**

Thank you for your participation!

Minimum 30-Year Follow-up of Charnley Total Hip Arthroplasty: A Standard for Future Arthroplasty

John J. Callaghan, MD, Jesse E. Templeton, BA, *Iowa City, IA*, Steve S Liu, BS,
Devon D. Goetz, MD, Patrick M. Sullivan, MD, Richard C Johnston, MD

- Purpose:** The objective of this paper was to report on the long-term durability of cemented total hip arthroplasty. We evaluated the minimum 30-year follow-up of a consecutive series of Charnley total hip replacements performed by a single surgeon.
- Methods:** 330 Charnley total hip replacements were performed in 262 patients between 1970 and 1972. Living patients were evaluated clinically using a standard terminology questionnaire and WOMAC scores, and all hips were evaluated for the need of revision and radiographic loosening of the components.
- Results:** Only one hip has been lost to follow-up. The present status or the status at the time of patient death of all other hips was recorded. 80% of living patients had a minimum 30-year radiographic follow-up. The prevalence of revision was 13% for all hips, and 25 % for hips of patients living 30 years. 7.3% of all hips and 24% of living hips required a revision for aseptic loosening, and only 4% of living hips required more than one revision. In the evaluation of specific component revisions for loosening, 6.4% of all acetabular components and 24% of acetabular components in living patients have been revised. In regards to the femoral component, 1.2% of all femoral components and 8.8% of components in living patients have been revised.
- Discussion:** This study demonstrates the remarkable durability of cemented Charnley total hip replacement over a 30-year follow-up period. It should provide a comparison for long-term follow-up studies of total hip arthroplasty performed with other devices and techniques.

Total Hip Arthroplasty in Patients 50 Years Old and Younger

**James P. McAuley, MD, Alexandria, VA, Edward S. Szuszczewicz, MD,
Anthony M. Young, MSE, Charles A. Engh, Sr., MD**

Because the young total hip arthroplasty patient is presumed to place increased demands on a reconstruction for a longer period of time than the average hip replacement patient, long-term results are expected to be inferior. This study reviewed literature on total hip arthroplasty in younger patients and presented the long-term results of cementless total hip arthroplasty patients from the authors' institution who are 50 years old and younger, to determine the efficacy of total hip replacements in this population. The results were encouraging. Over the past 20 years, 561 hip replacements have been performed on patients in this age group, using extensively porous-coated cobalt-chromium stems matched with beaded, press-fit acetabular components of cobalt-chrome or titanium.

Using the Kaplan-Meier technique, it was determined that the 10- and 15-year survival rates for both femoral and acetabular components were 90%+ and 80%+, respectively. A subset of patients 40 years old and younger (256 hips) had similar results. A comprehensive literature review also showed that long-term success can be achieved with cemented or cementless total hip arthroplasties in young patients. Because some reconstructions exhibited inferior results in younger patients, the authors recommend that surgeons be much more critical of the components used in these patients, and allow long-term data to guide their decision making.

20- to 26-year Radiographic Review in Patients Less than 50 Years of Age with Cemented Charnley Low Friction Arthroplasty

David K. Halley, MD, FACS, Columbus, OH

Fifty-four patients had 68 low friction arthroplasties (L.F.As), with 14 patients having bilateral arthroplasties. At the time of surgery, the age range was 22-50 years, with more than 50% of patients aged 41 years or less. The most frequent diagnosis was avascular necrosis.

Since surgery, 10 patients (15 hips) have died. Fourteen hips have been lost to twenty or more years of radiographic study, but three of these hips are known to be functioning clinically without pain at greater than 20 years. Four hips were lost to follow-up because of revision surgery elsewhere, leaving 35 hips followed radiographically for longer than 20 years. The longest follow-up is just short of 27 years.

Fifteen out of 68 (22%) of acetabular components were either radiographically loose, but asymptomatic and not changed (5) or were revised for loosening (10). Four of the acetabular components were not changed until 20 years had elapsed.

Seven out of 68 (10%) of femoral stems were revised for loosening. Two additional stems were revised for fracture while two other stems were radiographically loose but not changed because they were asymptomatic at over 22 years.

The 22-year survival estimates and corresponding 95% confidence intervals for aseptic loosening of the acetabular component was 80.5%, and 85% for the femoral stem.

The wear rate of the acetabular components was low. Four hips had no measurable wear. The greatest wear in one patient weighing 250 pounds was 0.23mm per year requiring revision at 22 years. The average rate of wear for the entire group was 0.08mm per year. Lysis was extremely rare.

THA Using a Tapered Titanium Femoral Component Inserted Without Cement in Type C Bone

Richard D. Reitman, MD, *Plano, TX*, William Head, MD, Roger Emerson, MD, Linda Higgins, PhD

Introduction: Total hip arthroplasty using a plasma-spray, porous, coated, tapered titanium femoral component has proven extremely reliable. However, these studies involved young patients with good bone quality. The present study evaluates the results of THA using such a femoral component in patients with Type C femoral bone after a minimum follow-up of ten years.

Materials and Methods: Between 1985 and 1992, ninety-two hip arthroplasties were performed on 81 patients aged 65 years and older, using the Mallory-Head porous femoral component (Biomet – Warsaw, IN), inserted without cement. The average follow-up was 13.2 years. According to Door's criteria, 27 femora were classified as Type A, 25 as Type B and 40 as Type C.

Results: No stem was revised because of stem instability, thigh pain or osteolysis. One stem was removed due to sepsis. Six acetabula were revised because of polyethylene wear and periacetabular osteolysis. Four patients reported mild thigh pain. Seven stems subsided an average of 3.5 mm (2 mm – 5 mm). Two subsided stems were in Type C bone, two in Type B bone and one in Type A bone. All five subsided stems stabilized within six months and all five patients deny thigh pain at latest follow-up. The average Harris Hip Score improved from 53.7 preoperatively to 82.7 at latest follow-up.

Conclusion: This study demonstrates that a plasma-spray, porous, coated tapered titanium femoral component achieves highly reliable long-term fixation, even in patients with poor bone quality. Type C femora demonstrated adaptive metaphyseal cortical remodeling that was unrelated to thigh pain.

Etiology of Failure with Posterior Stabilized TKA

Robert T Trousdale, MD, Rochester, MN, Mark W Pagnano, MD, James A Rand, MD

Introduction: We recently reported a review of 11,606 primary total knee arthroplasties, and noted the 10-year implant survivorship was significantly worse for posterior cruciate substituting (PS) designs compared to posterior cruciate retaining designs (CR) (91% versus 76%, $p < 0.0001$). The purpose of this study was to document the mechanisms of failure in current design PS TKA.

Materials and Methods: From 1985 to 1999, 2994 PS TKAs were performed at our institution. The majority were male (58%) with an average age of 68 years at index arthroplasty. The diagnosis was osteoarthritis in the majority (87%).

Results: The implant survivorship was 92% at 5 years (CI 90-99%) and 76% at 10 years (CI 62-86%). The average time from index arthroplasty to revision was four years (range, 0-12 years). Reasons for revision were extensive mechanism problems in 36%, infection in 25%, aseptic loosening of the femur or tibia in 18%, polyethylene wear with or without instability in 10%, instability without wear in 3%, periprosthetic fracture in 2%, and combination of the above mechanisms in 6%.

Conclusions: The most common reason for reoperation after PS TKA were related to problems with the extensor mechanism and infection. Improvement in surgical technique may diminish the prevalence of knee reoperation after PS TKA.

Does Practice Really Make Perfect? Provide Volume of Total Knee Arthroplasty and Patient Outcomes in a National Random Sample

Sheleika L. Hervey, *Durham, NC*, Harriett R. Purves, Ulrich Guller,
Alison P. Toth, Thomas P. Vail, and Ricardo Pietrobon

Background: No previous investigation of the volume-outcome relationship in total knee arthroplasty procedures has evaluated a nationally representative sample.

Methods: The 1997 Health Care Utilization Project-National Inpatient Survey Release 6 provided discharge abstracts of patients undergoing total knee arthroplasty (TKA) from a national stratified probability sample. Logistic and multiple regression models were used to estimate the adjusted association of surgeon/hospital volume and in-hospital mortality, pulmonary thromboembolism, lower extremity deep venous thrombosis, post-operative wound infection, and hospital length of stay. Estimates were calculated for a target population of 319,000 patients. Models were adjusted for comorbidity, age, sex, race, household income, and procedure (primary vs. revision arthroplasty).

Results: Most patients were white (70.2%), female (62.7%), with a mean age of 68.9 years. The target population presented with an overall in-hospital mortality of 0.2% and an average length of stay of 4.6 days (95% CI 4.5-4.7) for primary TKA, and 4.9 days (95% CI 4.7-5.0) for revision TKA procedures. Low surgeon volumes were significantly associated with higher mortality ($p = 0.003$) and post-operative infection ($p < 0.001$) rates. Low hospital volumes were significantly associated with higher post-operative infection ($p < 0.0001$) and deep venous thrombosis ($p = 0.0020$) rates.

Conclusion: Patients treated by lower caseload volume providers presented higher rates of mortality, post-operative infection, and deep venous thrombosis following TKA in 1997. Proposing volume standards could decrease patient morbidity and mortality following TKA.

International Multicenter Survivorship Analysis of a Mobile Bearing Total Knee Arthroplasty

James B. Stiehl MD, *Milwaukee, WI*, Karel J Hamelynck, MD, PhD, Paul A Voorhorst, MS

This study evaluated the cumulative experience with a mobile bearing total knee arthroplasty in 4743 TKRs performed from 1981 to 1997. By implant type, the 14-year survivorship for bicruciate retaining implants was 79%; posterior cruciate retaining implants was 82%; and cruciate sacrificing was 87% ($p < .001$). The survivorship of the patella implants was 98% at 15 years. The most common cause of revision was bearing related issues including chronic instability, bearing subluxation, bearing dislocation, or bearing failure in 1.3% followed by implant loosening in 1.1%, wear related issues in 0.8%, chronic pain in 0.7%, sepsis in 0.5%, and patella related causes in 0.5% of cases.

Effect of Femoral Component Design on the Unresurfaced Patella in TKA

Leo A. Whiteside, MD, St. Louis, MO, Takashi Naskamura, MD, PhD

This clinical and laboratory study was conducted to test the hypothesis that reported differences in clinical results of unresurfaced patellae in total knee arthroplasty can be attributed to differences in femoral component design.

Thirty-eight knees had an Ortholoc II femoral component (shallow patellar groove, wide intercondylar notch, flat femoral surface). Thirteen knees had severe anterior knee pain and three knees had moderate anterior knee pain. Fifteen knees required patellar resurfacing at a later date. Two hundred twenty-two knees had Advantim femoral components (deepened and extended patellar groove, narrow intercondylar notch, rounded femoral surfaces). None had severe anterior knee pain. 18% had mild anterior knee pain on stairs postoperatively. Three hundred thirty knees had Profix femoral components (deepened and extended patellar groove, rounded femoral surfaces, extended lateral patellar support). 10% had mild anterior knee pain. This rate was statistically significantly less than that of the knees with Advantim femoral components ($p < 0.03$). None of the Advantim or Profix knees required patellar resurfacing. This was significantly lower than the revision rate of the Ortholoc group ($p < 0.002$). A pressure sensitive electronic transducer was used in cadaver knees to measure pressure on the patellar surface at various positions of knee flexion. Peak pressures were much higher with the Ortholoc II than with the other two designs, and slightly (but significantly) higher with the Advantim than with the Profix.

The clinical study supports the hypothesis that femoral component design affects anterior knee pain after total knee arthroplasty. The laboratory study suggests that differences in articular surface pressure are responsible for differences in clinical performance.

Primary Total Hip Arthroplasty with a Cementless Acetabular Component:
Evaluation at a Minimum of 15 Years

Craig J. Della Valle, MD, Chicago, IL, Richard A. Berger, MD, Aaron G. Rosenberg, MD,
Joshua J. Jacobs, MD, Laura Quigley, RN, Jorge O. Galante, MD

Two hundred and four hip arthroplasties were performed in 184 patients with a porous coated acetabular component (HG-1, Zimmer). At a mean of 194 months, five well-fixed cups were revised and one cup was revised for loosening. An additional nine hips required reoperation for wear of the polyethylene liner/osteolysis. Three cups were radiographically unstable. The rate of failure of the component for aseptic loosening was thus 2% and the reoperation rate for a problem related to the acetabular component was 6.9%. Survivorship for the cup at 15 years was 98.7%. Cementless acetabular reconstruction provides excellent results at 15 years.

Radiographic Signs of Osseointegration in Porous-Coated Acetabular Components

Milan S. Moore, MD, MPH, Anthony M. Young, MSE,
James P. McAuley, MD, Alexandria, VA, Charles A. Engh, Sr., MD

Background: Radiographic signs of osseointegration have been established for cementless stems, but not for cementless cups. At our institution, we have observed repetitive radiographic signs of osseointegration of porous-coated cups. In this study we tested the hypothesis that these signs could be used to predict bone ingrowth of porous-coated cups.

Methods: In a series of 119 total hip arthroplasties with porous-coated cups, we reviewed post-primary and prerevision serial radiographs. We developed the definition of five radiographic signs for detecting osseointegration: the absence of radiolucent lines and the presence of a superolateral buttress, medial stress shielding, radial trabeculae, and an inferomedial buttress. We compared the predictability of each sign to intraoperative findings of cup stability and measured the sensitivity, specificity, and intra-observer agreement of each sign.

Results: Ninety-eight cups exhibited three to five signs. Of these, 97% (95 hips) were bone-ingrown at revision. Twelve cups had only one or no signs. Of these, 83% (10 hips) were unstable at revision. The presence of superolateral buttress and the presence of inferomedial buttress had excellent intra-observer agreement ($\kappa = 0.83$ and $\kappa = 0.88$, respectively). The other three signs had fair to good intra-observer agreement ($\kappa = 0.48, 0.62$ and 0.62).

Conclusions: The combination of these five signs of osseointegration is an excellent indicator of bone-ingrowth of a cup. Alternatively, the absence of these signs indicates that bone-ingrowth has not occurred. This information is useful for clinicians in clinical evaluation and in the planning of revision surgery.

A Comparison of Cementless Acetabular Components of the Same Design: Spiked Vs. Supplemental Screws

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The purpose of this report is to compare the results of a series of otherwise identical, cementless acetabular components with screws to a group with spikes in primary total hip replacement.

Materials and Methods: Between April 1993 and August 2002, 1,249 consecutive primary total hip arthroplasties were performed using a cementless acetabular component (Trilogy Acetabular System, Zimmer, USA). There were 545 acetabular components with screw holes and 704 hips with spikes only. All hips with a greater than two-year follow-up underwent radiographic evaluation (420 hips in 381 patients). The average follow-up in this group was 4.8 years (2 to 8.6 years).

Results: Of the 1,249 hips there were 10 acetabular revisions (0.8%). Two for early loosening (both spiked), five for instability, two for infection and one polyethylene exchange. Both spiked cups that experienced early loosening were used with an offset liner. In the 420 hips that underwent radiographic review there were no significant differences and no other cases of loosening.

Discussion: In this series there were two cases of aseptic loosening of a cementless acetabular component. Both were early (8 weeks and 8 months) and were spiked cups using extended offset liners ($p < 0.05$). Otherwise, radiographic results were excellent and comparable in both groups. This data would suggest that one should be wary of using extended offset liners and screwless acetabular fixation. Further follow-up is needed to determine if differences in the incidence and location of osteolysis will occur in these cup designs.

Cementless Acetabular Fixation at 15 Years with the HGI Component: Comparison to the Gold Standard Charnley

John J. Callaghan, MD, Iowa City, IA, John L. Gaffey, BS, Devon D. Goetz, MD, Patrick M. Sullivan, MD,
Douglas R. Pedersen, PhD, Richard C. Johnston, MD

- Purpose:** The recognition of acetabular loosening as a long-term problem associated with cemented total hip arthroplasty led orthopaedic surgeons to investigate the use of cementless acetabular fixation in the mid 1980's. The objective of this report was to evaluate the 13- to 15-year results of a cementless acetabular component fixed with screws, and to compare the results to the same surgeons' results using cemented acetabular fixation.
- Methods:** 120 consecutive non-selected primary total hip arthroplasties were performed on 108 patients using a Harris Galante I cementless acetabular component and an Iowa cemented femoral component. Hips were evaluated clinically for revision and radiographically for migration of the component, bone prosthesis radiolucencies, wear and osteolysis. Results were compared to the same surgeons' results at 15 years with Charnley (22 mm), TiBac (28 mm), and all polyethylene 28-millimeter inner diameter acetabular components.
- Results:** At 13- to 15-year follow-ups, 66 patients (72 hips) were living. 42 patients (48 hips) were deceased. No patients were lost to follow-up. No acetabular component was revised for aseptic loosening and no component had migrated. Three acetabular components were revised for pelvic osteolysis. Incomplete radiolucencies occurred around 35% of cases, but were non-progressive after two years. 5% of all hips and 6.9% of living patient hips exhibited pelvic osteolysis. The linear wear rate was .15 mm/yr. Acetabular revision rates were comparable to Charnley acetabular components at 15 years, and significantly better than TiBac and all polyethylene 28-millimeter components.
- Discussion:** The use of cementless acetabular components has produced comparable or better results in terms of fixation when compared to cemented components at 15 years. However wear rates are higher than those of cemented Charnley acetabular components.

A Prospective Randomized Trial of Cemented Femoral Components
with Polished Vs. Grit Blasted Surface Finish
and Identical Stem Geometry

Vail TP, Durham, NC, Goetz D, Tanzer M, Fisher DA, Callaghan JJ, Moehler CG

Seven surgeons implanted 226 hybrid Charnley-type total hips (113 polished, 113 grit blasted). Evaluation was performed at 4-7 years. Twenty-one patients died. Among the 204 eligible patients, 142 had adequate radiographs for review. One polished stem was revised due to infection. No stem in either group was loose or revised for aseptic loosening. The five-year survival rate was 99.5% (CI= 98.6% – 100%). The incidence of osteolysis and radiolucencies was not statistically different. Zone VII radiolucency was most frequent in both groups. There was no difference using Harris Hip (94.5 GB, 92.1 P), WOMAC, and SF-36 analysis.

Influence of Surface Finish in Total Hip Arthroplasty

**Bradley K. Vaughn, MD, Raleigh, NC, Elizabeth Fuller, PA,
Rebekah Peterson, RN, Susan G. Capps, PhD**

Femoral component surface finish influence was investigated by comparing two finishes, precoat and satin-finish, for one total hip arthroplasty (THA) system; consecutive series of a single surgeon using one acetabular cup design. Minimum two-year follow-up outcomes (36 precoat, 25 satin) were compared using Harris Hip Scores, radiographs and survivorships. The precoat population experienced significantly more radiographic and debonding failures than satin-finish, and significantly more pain ($p < 0.05$). Comparing failures and non-failures within the precoat population disclosed neither significant preoperative nor significant cement grade differences. This surgeon no longer implants precoat femoral components due to failure performance.

Fifteen-Year Survivorship of the Omnifit Femoral Stem in Primary Hybrid Total Hip Arthroplasty

V.J. Rasquinha, MD, *New York, NY*, V. Dua, MD, J.A. Rodriguez, MD, C.S. Ranawat, MD

- Purpose:** This prospective review aims to evaluate the 15-year survivorship of the collarless, cemented, Omnifit femoral stem with a surface roughness of 30-40 microinches implanted with modified third-generation cement technique in hybrid THA.
- Methods:** Between January 1986 and June 1990, a single surgeon prospectively implanted 250 consecutive hybrid THA's (215 patients) utilizing second-generation cement technique and a posterolateral exposure. The acetabular component was a Harris-Galante (I or II) cementless shell with modular polyethylene (4150 resin) liners, with calcium stearate and gamma sterilized in air. Two independent observers employing a patient administered questionnaire, HSS scores and established radiographic criteria performed clinical and radiographic evaluation.
- Results:** The demographics included a mean age of 60 years with 115 females and 100 males and a mean body weight of 165 lbs. The preoperative diagnosis was osteoarthritis in 220 hips, rheumatoid arthritis in 15, fracture in 8, AVN in 4, and hip dysplasia in 3. The mean HSS score was 37 out of 40 at last follow-up. The cement mantle was grades A or B in 90% and grade C1 in 10%. Femoral stem alignment was neutral in 53%, valgus in 31% and varus in 16%. Revision THA was performed in 4 hips – 2 for recurrent dislocation and 1 for infection. Wear couple exchange and retroacetabular bone grafting was performed in 1 case (0.4%) for progressive osteolysis. No femoral component was revised due to aseptic loosening. Kaplan-Meir survivorship with mechanical failure (revision for aseptic loosening) as the endpoint was 100%+0% at 15 years.
- Discussion:** Meticulous technique in the attainment of a centralized femoral stem with a good cement mantle provides a reproducibility, high quality of function and durability of hybrid THA at 15-year survivorship.

The Importance of Proximal Cement Filling of the Calcar Region: A Biomechanical Justification

David C. Ayers, MD, Syracuse, NY, Kenneth A. Mann, PhD

- Purpose:** Removal of trabecular bone in the calcar region resulting in thicker proximal-medial cement mantles has been shown to improve long-term outcomes of cemented femoral components. A biomechanical justification for this common surgical technique has not been established. The purpose of this study was to determine the effect of the replacement of proximal medial trabecular bone with cement.
- Methods:** A three dimensional finite element model of a Versys-CT cemented stem was created with a consistent 3mm cement mantle and placed in a CT based bone model. The bone material properties were assigned based on the QCT density of the individual bone elements and the model consisted of 3400 elements and 14247 nodes. The polished stem-cement interface was modeled as frictional (not bonded) whereas the bone was bonded to simulate good cement-bone interdigitation. Stair climbing loads were applied with a substantial out-of-plane loading component. Following the initial (index) analysis, trabecular bone elements in the calcar region were replaced with cement to simulate bone removal and increased medial cement mantle. This was done in a step-wise fashion with 10 to 40 mm of trabecular bone replaced with cement. In another set of runs, trabecular bone in a circumferential ring around the cement mantle was replaced with cement.
- Results:** Maximum principal stresses (tensile) in the proximal cement mantle decreased from 24.3 MPa (index) to 20.3 MPa after removal of trabecular bone from the calcar. The decrease was non-linear; peak stresses were 23.3, 20.6, 20.3, and 20.3 MPa for 10, 20, 30, and 40mm of bone removal, respectively. Circumferential addition of cement further decreased peak tensile stresses to 15.0 MPa.
- Conclusions:** Peak cement mantle stresses were reduced 20% by removal of proximal-medial trabecular bone. Under fatigue loading, this could increase the number of loading cycles to failure by a factor of ten. These finding supports removal of proximal medial trabecular bone in the calcar region to improve long-term performance of cemented femoral components.

Metaphyseal Only Engaging Stems in Revision Total Knee Arthroplasty

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William L. Griffin, MD, J. Bohannon Mason, MD, Thomas H. McCoy, MD

Introduction: The length and method of fixation of stems in revision TKA is controversial. The purpose of this paper is to review our experiences with metaphyseal only engaging stems in revision TKA.

Methods: Between 1986 and 2000, 475 revision knee arthroplasties were performed in 419 patients. Of the 475 TKAs, 393 full component revisions in 279 patients were performed using 484 stems. The remaining 82 revisions were performed without the use of stems. Of these 279 patients, 85 patients with 131 stems were deceased, re-revised within two years or revised with diaphyseal engaging stems. 87 patients with 151 stems had less than a two-year follow-up. The final data set is 113 patients with 202 metaphyseal engaging stems implanted at the time of full component revision. Radiographic analysis was performed utilizing the Knee Society Radiographic Scoring System. According to this system, implants were categorized as stable with insignificant radiolucencies, possibly loose needing close follow-up or loose. Implants with cemented stems were compared with cementless stem fixation.

Results: Of the 202 metaphyseal only engaging stems, 107 were cemented and 95 were cementless. The average follow-up was 57 months. Of the 107 implants with cemented stems, 100 (93%) were categorized as stable, 7 (7%) require close follow-up, and none were loose. Of the 95 implants placed with cementless stems, only 67 (71%) were categorized as stable, 18 (19%) require close follow-up, and 10 (10%) were loose. Components with cemented stems and components implanted with cementless stems were compared using a 3 by 2 c2 at the .05 level. Implants placed with cemented stems were significantly more radiographically stable than those implanted with cementless stems, $c2(2) = 19.92$. This difference was significant at the $p = .0001$ level.

**Discussion/
Conclusion:** We have shown that cemented metaphyseal engaging stems work well in the majority of revision total knees at midterm follow-up. We are also concerned about the radiographic appearance of implants placed with cementless stems at similar follow-up.

Revision Total Knee Arthroplasty with Cemented Components and Uncemented Intramedullary Stems

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Introduction: Cemented and uncemented stems have been advocated to augment component fixation during revision total knee arthroplasty (TKA).

Purpose: To evaluate results of revision TKA using cemented component fixation with uncemented intramedullary stems.

Materials & Methods: Sixty-three revision TKA in 60 patients (27 females, 33 males; average age 66 years) treated consecutively with cemented component fixation and an uncemented stem were reviewed. Two patients died within 2 years of surgery leaving 61 knees for review. No patients were lost to follow-up. The mean follow-up time was 5.75 years (range 2-10).

Results: There were twelve (19%) re-revisions: Six (10%) were revised for aseptic loosening, 4 (6%) for recurrent infection, and 2 (3%) instability. For the retained 49 knees (48 patients), Knee Society Pain Scores improved from 56 to 81 and function scores improved from 49 to 62.

Radiographs at last exam showed none with definite femoral loosening, but 4 with tibial loosening. None of these 4 patients had more than mild pain. Incomplete parallel sclerotic lines less than 2 mm from the uncemented stems were seen in 90% of stable knees. Combining those revised for aseptic loosening and radiographic aseptic loosening, mechanical failure occurred in 10 patients (16%).

Conclusion: The mid-term clinical results of this method were favorable with a mechanical failure rate of 16% at a mean of about 6 years. Incomplete radiodense sclerotic parallel lines around uncemented stems were common and appear to be consistent with stable implants. Ongoing critical appraisal of the pros and cons of this method of reconstruction is recommended.

Mechanical Alignment of Cementless Stems in Revision Total Knee Arthroplasty

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This multicenter study evaluated the radiographic results of achieving optimal tibial alignment in revision knee arthroplasty using a single modular CoCr cemented or cementless stemmed implant design. Stem size and length were also evaluated. 257 revision TKR were performed between December 1993 and December 1996 by 23 surgeons. The patients were subdivided into five comparative groups: 1) cemented stems, 2) 95 mm length canal filling stems, 3) 95 mm length non-canal filling stems, 4) 140 mm length canal filling stems and 5) 140 length non-canal filling stems. The AP & LAT tibial alignment angles were measured and ANOVA analysis was utilized. The canal filling ratio (CFR) was determined by dividing the stem diameter by the endosteal diameter. Overall, the ability to achieve tibial alignment in the AP and lateral planes was more predictable when canal filling (CFR \geq .85) cementless stems were utilized. This was further enhanced when long canal filling cementless stems were selected. The least predictable results were achieved with cemented stems.

Reoperations After 3200 Revision Total Knee Replacements:
Rate, Etiology and Lessons Learned

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Introduction: The purpose of this study was to evaluate the prevalence, etiology, and evolution over time of re-operations done after revision total knee replacement (TKA).

Methods: Excluding previously infected knees, those with previous revisions done elsewhere and those in which custom or non-condylar prostheses were used. 1893 revision knees were performed between 1970-2000. 287 knees (15.1%) subsequently have been re-operated on one or more times.

Results: The total number of reoperations was 392. From the 1970s to the 1990s, the prevalence of reoperations has remained unchanged at 15%. Removal of all components for aseptic reasons and resection arthroplasties after revision TKA decreased from 7.5% to 2.4% and 3.1 to 1.6%, respectively.

Discussion: The prevalence of reoperation in this large series of revision TKA was surprisingly high. Despite substantial improvements, patients who have a revision TKA are at substantial risk of developing one or more subsequent problems that result in a re-operation.

In-Vivo and In-Vitro Surface Changes in a Highly Crosslinked Polyethylene

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Rolf Schön, MS, Werner Schneider, MS , Niels A. Abt, MS

Highly crosslinked UHMWPEs were developed to reduce UHMWPE wear in arthroplasty. These UHMWPEs have manifested an improvement in the wear resistance. Examination of the first retrievals revealed surface features not usually observed on conventional retrievals. A flattening of the machining marks is evident, together with the presence of ripples/micro-cracks. These ripples/micro-cracks were investigated in-vitro and on retrievals had a follow-up of up to 15 months. The examinations of all specimens showed that the ripples may be described as folds. The depth of these folds extended to a maximum of 5 μm . These depths were independent of the mode of loading (up to 27 million cycles). Due to the extreme wear resistance of these UHMWPEs, the folds accumulate on the surface of components.

The FDA has not cleared the following medical device for the use described in this presentation.

(Centerpulse Orthopaedics: Durasul for mobile knee prostheses)

Surface Damage of Short-term Implanted Conventional and Highly Crosslinked Acetabular Components for THA

Steven M. Kurtz, PhD, **William Hozack, MD**, *Philadelphia, PA*, Joseph Turner, MS, Clare Rimnac, PhD, Matthew Kraay, MD, Victor Goldberg, MD, Av Edidin, PhD

Highly crosslinked UHMWPE acetabular liners have been developed to reduce wear in THA and hence reduce periprosthetic osteolysis. The purpose of this study was to evaluate the surface damage of highly crosslinked acetabular components after short-term implantation for comparison with conventional liners. Nineteen conventional and highly crosslinked acetabular components were revised for reasons other than wear (e.g., instability, infection) after less than 24 months of implantation. The conventional components (n=10) were gamma irradiated in nitrogen, and the crosslinked components were fabricated from Crossfire (n=5) and Durasul (n=4).

Surface damage was assessed under optical microscopy using the method of Hood. The retrievals were also examined under scanning electron microscopy (SEM). Out of a maximum score of 84, the total damage score was 15 ± 5 for the conventional liners, 17 ± 2 for the Crossfire, and 11 ± 2 for the Durasul liners. The differences between groups were not significant ($p > 0.05$). Multidirectional scratching was found to be the most prevalent mode of surface damage for both the conventional and highly crosslinked components. SEM examination of the crosslinked retrievals revealed evidence of microscopic plastic deformation and, in some cases, microcracking of machining marks. These clinical retrievals challenge the concept, introduced by previous hip simulator studies, that certain crosslinked UHMWPE materials exhibit “undetectable wear.” The wear and surface damage observed in the highly crosslinked acetabular components was consistent with short-term implantation. Continued surveillance of crosslinked acetabular components is warranted, as no inference of long term performance can be gleaned from these short-term retrievals.

RSA Evaluation of Wear of Conventional Vs. Highly Crosslinked Polyethylene Acetabular Component In-vivo

Bragdon, C R, Boston, MA, Digas, G; Karrholm, J; Malchau, H;
Herberts, P; Thanner, J; Estok, D; Plank, G; Harris, W H

A randomized, prospective RSA study compared the femoral head penetration into highly crosslinked vs. conventional polyethylene acetabular components. Forty three hips with two-year follow-up are reported in this preliminary report. Also, laboratory studies of creep characteristics of each material were performed.

Although the average femoral head penetration was lower in the highly crosslinked group, there was no significant difference between the two groups. The magnitudes of the head penetration resulting from creep were similar, ~0.1mm. The two-year clinical data for the Durasul were excellent. No significant difference in femoral head penetration could be demonstrated, as predicted by the creep data.

Clinical Performance of a Highly Crosslinked Polyethylene
at Two Years in Total Hip Arthroplasty;
A Randomized Prospective Trial

Martell, J. , Chicago, IL, M.; Verner, J.J.; and Incavo, S. J.

Introduction: Highly crosslinked polyethylene demonstrates 80-90% wear reduction by hip simulator testing, however clinical data on this new polyethylene has been unavailable. We report the two-year results for a prospective randomized trial comparing highly crosslinked to standard polyethylene.

Methods: 45 hips were available for radiographic analysis at two to three years follow-up. All cases were performed using the Secur-Fit™ HA acetabular component and the Secur-Fit™ or Secur-Fit™ Plus HA femoral components (Stryker/Howmedica/ Osteonics). Femoral bearings were 28 mm cobalt chrome with low friction ion treatment (L-Fit). The polyethylene insert was randomized at the time of implantation to highly crosslinked polyethylene (Crossfire™), or standard polyethylene that was gamma sterilized and packaged in nitrogen (N2/Vac™). Polyethylene wear rates were measured based on AP and lateral pelvis radiographs at six weeks and yearly intervals using a validated computer assisted edge detection method. Wear rates between the two groups were compared using the non-parametric Mann-Whitney U-test at the 95% level.

Results: There were no device related failures in this group. The highly crosslinked group showed significant 38%-65% reductions in wear as follows: two-dimensional linear = 65% (p=0.002, power=80%), three-dimensional linear = 54% (p = 0.021, power = 75%), and two-dimensional volume = 38% (p = 0.021, power = 78%).

Conclusions: This early follow-up on highly crosslinked polyethylene shows no device related failures and significant wear reduction compared to standard (N2-Vac) polyethylene. This data includes early bedding-in, and further follow-up is needed to assess the wear reduction after bedding-in is complete. Nevertheless, these clinical results are encouraging given the decrease in wear debris that can be anticipated with a 65% reduction in wear.

A Preliminary Report from an AAHKS/OREF Funded Grant:
A Prospective Matched-Pair Outcomes Analysis of Femoral Component Fixation
in Revision THA Comparing Modular, Cementless, Femoral Fixation with
Cemented Femoral Fixation

Richard Iorio, MD, Burlington, MA, William L. Healy, MD, David Appleby, MPH

- Purpose:** This study prospectively analyzes outcomes of patients with cemented and cementless femoral fixation in revision THA. This project is funded by OREF and AAHKS. Preliminary data are reported at 2- to 8-year follow-ups as an update for the Research Committee.
- Methods:** During the study, all femoral revision THA operations were included except AAOS Grade III reconstructions. One surgeon performed all 50 cementless reconstructions and 23 cemented revisions. Another surgeon performed 27 consecutive cemented revisions. This series of 100 patients is being followed as 50 pairs matched for age, weight, diagnosis, Charnley Class, duration of follow-up and femoral grade. Only first femoral revision, non-septic operations were included in the cohort. SF-36, HHS, and MMDP scores, radiographic analysis, and patient derived outcome data will be recorded prospectively.
- Results:** Preoperatively, the two groups had no significant differences in age, weight, Charnley Classification, VAP scores, SF-36 scores or Bone Stock deficiencies. At 4-year average follow-up, VAP scores, HHS, and SF-36 scores were not significantly different among the two groups. There was one femoral revision for aseptic loosening (5 years) in the cemented group and one femoral revision for instability and loss of distal fixation in the cementless group (18 months). There were four other re-operations in the cemented group: three for subsequent acetabular revisions and one for a periprosthetic femur fracture. There were three other re-operations in the cementless group, one for subsequent acetabular revision and two for periprosthetic femur fractures.
- Conclusions:** This is a preliminary report of a prospectively followed revision THA cohort using clinical, radiographic and outcome instruments.

Constrained Osteonics Acetabular Liner: Average 10-Year Follow-up Study

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- Purpose:** Five-year follow-up studies evaluating the use of a constrained tripolar device (Osteonics) for recurrent dislocations and intraoperative instability have demonstrated low rates of recurrent dislocation. The objective of this study was to evaluate the durability of this device in terms of dislocation, component loosening, and osteolysis prevalence at 10-year average follow-up.
- Methods:** 101 Osteonics constrained tripolar devices were inserted for recurrent dislocation of a total hip replacement (56 hips) or intraoperative instability (45 hips) between 1988 and 1993. Components were evaluated at an average 10-year follow-up (range 8 to 14 years). Patients were evaluated for recurrent dislocation, component loosening and osteolysis.
- Results:** At average 10-year follow-up, 5% of hips had redislocated at an average of 4 years (range 3 months to 8 years) following surgery. All were treated successfully with another constrained liner. Including some of these failures, 5% of acetabular components required a revision for loosening and 7% including those revised were radiographically loose. On the femoral side, 3% of the components were revised for loosening and 7% including those revised were radiographically loose. Only 2% of acetabular components had osteolysis in the surrounding bone.
- Discussion:** The Osteonics tripolar constrained liner has markedly reduced dislocation and instability (95% success) in most of these complex cases. The component loosening and osteolysis prevalence is similar to the rates reported for complex revisions at this length of follow-up.

Fate of Cementless Acetabular Components Retained During Revision of a Femoral Component of a Total Hip Arthroplasty

Paul E. Beaulé, MD, Los Angeles, CA, Michel LeDuff, MA, Frederic Dorey, PhD, Harlan C. Amstutz, MD

Introduction: Removal of a well fixed cementless acetabular component can result in an increased operative morbidity.

Methods: 85 consecutive patients (92 hips) with a retained cementless socket during revision of a femoral component were reviewed. Average age at the time of revision was 54. 33% of the patients had acetabular osteolysis of which 52% were grafted.

Results: Mean follow up 9.6 years (5.5 to 15.9). Average time in situ of socket 14.7 years (7.1 to 20.2). 7 sockets were revised at a mean of 6.3 (2.1-12.4) years post revision and 12.7 years in situ with only one for loosening. Dislocation rate was 14% with 54% occurring in the first 6 months post revision. No recurrence or expansion of pelvic osteolysis was observed at last follow-up.

Discussion: Revision of a cementless socket on the basis of the duration in vivo, presence of osteolysis does not appear to be warranted. Because of the high risk of dislocation off set liners/stems and larger femoral head sizes should be considered.

Cementation of an Acetabular Liner into a Well-Fixed Acetabular Shell during Revision Total Hip Arthroplasty

Bryan D. Springer, M., Arlen D. Hanssen, MD, **David G. Lewallen, MD**, Rochester, MN

- Purpose:** To assess the clinical indication, results and complications of cementing a polyethylene liner into a well-fixed acetabular shell during revision Total hip arthroplasty.
- Methods:** Sixteen patients with greater than 2 year follow-up and those with any complications less than two years from surgery were reviewed (one patient). There were 10 females and 7 males with an average age at revision of 69.8 years. Indications for cementing a polyethylene liner into a metal shell included: Failure of the locking/capture mechanism in seven, significant polyethylene wear in five, malposition of the acetabular shell in four, and a previous resection arthroplasty with a retained acetabular shell in one patient. Acetabular shells in place at time of revision included a titanium cup in eleven, cobalt chrome in five and cemented metal backed cup in one patient. Average follow-up after cementation of a polyethylene liner was 32.1 months (range 24-62 months).
- Results:** One acetabular shell had been revised at 13 months for instability and multiple dislocations. No other acetabular components were revised. Hip Scores improved an average of 24.2 points ($p=0.001$). Radiographs revealed no polyethylene dissociation or acetabular loosening. Complications occurred in seven patients. Dislocation was the most common and was recurrent in two patients. Femoral revision for aseptic loosening was performed in one patient. Wound healing problems, heterotopic ossification and a postoperative femoral stress fracture occurred in one patient each.
- Discussion/Conclusions:** Initial results of cemented polyethylene liner exchange into a well-fixed acetabular shell during revision THA appear successful at providing secure fixation, while preventing the bone loss that might occur with removal of a well fixed component.

The Relationship Between Polyethylene Wear and Osteolysis in a Second-generation Porous-Coated Cementless Cup with Seven Years Follow-Up

**Karl F. Orishimo, MS, Alexandria, VA, Alexandra M. Claus, MD, PhD,
Christi J. Sychterz, MS, Charles A. Engh, MD**

The goals of this study were to quantify the relationship between the incidence of osteolysis and linear and volumetric wear, and to evaluate the risk of developing osteolysis as a function of wear in a current porous-coated cup design. We examined polyethylene wear and osteolysis in 56 hips (55 patients) implanted with Duraloc 100 acetabular cups articulating with 28-mm femoral heads. Linear and volumetric wear rates were calculated from anteroposterior pelvic radiographs of each patient using a validated computer-assisted technique. A logistic regression analysis was performed to determine the increase in risk of developing osteolysis associated with a given change in linear or volumetric wear rate.

Osteolysis was found in 23 of the 56 hips. The cases with osteolysis had significantly higher linear and volumetric wear rates than those without osteolysis. The logistic regression revealed that a 0.1 mm/year increase in the linear wear rate increased the likelihood of developing osteolysis by a factor of four in comparison to cases without wear. In comparison to no wear, a 40-mm³/year increase in volumetric wear raised the risk of developing osteolysis by about three times. The results of our analysis give quantitative support to the observation that a wear rate of 0.2 mm per year seems to represent a “critical threshold” for the development of osteolysis. Close radiographic monitoring with the determination of linear wear rates is recommended for all total hip arthroplasties to assess each patient’s risk of developing osteolysis.

Progression of Periacetabular Lysis Over Time: Serial Analysis Using Computed Tomography

**Raju S. Ghate, MD, Chicago, IL, Richard L. Wixson, MD,
S. David Stulberg, MD, Ronald W. Hendrix, MD**

Background: Since acetabular osteolytic lesions following total hip arthroplasty (THA) may be asymptomatic until extensive bone loss occurs, early detection and monitoring the progression of these lesions is important. The purpose of this study was to use high resolution helical CT to determine the progression of the osteolytic lesions over time by comparing serial studies.

Methods: Fifty-two hips with primary, cementless THAs completed between 1984-1996 were evaluated as part of an ongoing prospective study. These patients had a history of a high level of activity. This was believed to place them at increased risk for accelerated polyethylene wear. The mean age was 51 yrs, 55% male: 45% female. The average time from date of surgery to initial scan was 7.4 years (4.7-16.6). If an acetabular lytic lesion was identified, the patients were offered Alendronate for potential suppression of bone resorption with a repeat CT scan for follow-up. The area of the maximum size osteolytic lesions on axial images were measured on the initial scan and compared at the same level on the subsequent study.

Results: Seventy percent of the hips demonstrated some lysis at the initial index scan with a mean of 325 mm² (40-1184) with a mean follow-up area of 394 mm² (45-1344). The mean progression rate was 15%/year. The interval between scans averaged 15 months (6 – 38).

Conclusions: Once established, periacetabular lysis appears to be a slowly progressive, relentless process. Analyzing changes on serial CT, along with assessment of the degree and location of lysis, provides an additional important tool to evaluate the need for surgical intervention.

The Accuracy of Computer Tomography in Determining
Location and Size of Pelvic Osteolytic Lesions
Following Total Hip Arthroplasty: A Cadaver Study

Alexandra M. Claus, MD, PhD, Alexandria, VA, Saara M. Totterman, MD, PhD,
Christi J. Sychterz, MS, Charles A. Engh, Sr., MD

- Purpose:** We hypothesized that the location and volume of periacetabular osteolysis could be determined accurately with a computer-assisted computed tomography (CT) imaging program that suppresses streak artifacts from metal implants.
- Methods:** To assess the computer-assisted CT program, we created periacetabular bone defects in 4 cadaveric pelvises. After implanting THA components in 8 hips, we removed the cups, created two bone defects per hip in the ilium, ischium, pubis, or acetabular rim, and measured the volume of each defect. The cups were reimplanted and a helical CT scan acquired with both hips reduced. Each defect was enlarged twice (N=48 lesions) and then measured, scanned, and processed with the computer-assisted CT program. A muscular-skeleton radiologist analyzed the CT images for the location and volume of osteolysis. We compared actual lesion locations and volumes to those determined from the CTs.
- Results:** The reviewer correctly identified 81% (39/48) of the lesions. Detection was location dependent: 100% were detected in the ilium, 89% at the rim, 78% in the ischium, and 50% in the pubis (50%). Lesion volume was overestimated from the CTs by a mean of $5.6\% \pm 24.8\%$. Volumetric error was unrelated to lesion location but dependent on lesion size, decreasing to $1.8\% \pm 18.1\%$ for lesions greater than 10 cm³.
- Discussion:** This computer-assisted CT imaging analysis had an overall high detection rate for pelvic osteolysis and was very accurate in the ilium and rim.
- Conclusion:** This CT process could be useful in monitoring pelvic osteolysis associated with stable implants and investigating treatment strategies.

Correlation Between Early and Late Wear Rates in Total Hip Arthroplasty with Application to the Performance of Highly Crosslinked Polyethylene Liners

Robert H. Hopper, Jr., PhD, Alexandria, VA, Anthony M. Young, MS,
Karl F. Orishimo, MS, James P. McAuley, MD

Introduction: Historically, the clinical performance of new bearing surfaces for total hip arthroplasty has been extrapolated from laboratory simulations. However, the ability of in- vitro studies to accurately predict intermediate and long-term clinical wear performance remains uncertain. This study investigates the use of short-term clinical wear data to predict long-term wear performance.

Methods: Using computer-assisted methods, we measured femoral head penetration on serial x-rays for 261 hips implanted with porous-coated cups to investigate the temporal nature of the head penetration patterns. Using regression techniques, we evaluated the relationship between early and late wear rates. We subsequently compared the early wear rates from 35 highly-crosslinked polyethylene liners and 44 conventional liners of a single design.

Results: While the mean wear rate based on two-year follow-up was not significantly different than the mean long-term rate (0.12 ± 0.21 mm/year versus 0.11 ± 0.12 mm/year, $p=0.74$), the correlation between early and late wear rates was weak ($r^2=0.11$). Using three-year follow-up to calculate the early wear rates marginally improved the correlation with long-term wear rates ($r^2=0.21$). Based on mean 2.6-year follow-up, highly-crosslinked liners wore 57% less than conventional, gas-plasma-sterilized liners (0.09 ± 0.35 mm/year versus 0.21 ± 0.22 mm/year, $p=0.07$).

**Discussion/
Conclusion:** Using computer-assisted measurement techniques, wear rate data based on early clinical follow-up can predict the average long-term wear rate for a population. However, the early wear rate is not suitable for accurately predicting the long-term wear rate for an individual hip. Our results indicate that short-term clinical wear data can be used to validate hip simulator studies.

Wear of Retrieved Unicondylar Knee Arthroplasty Tibial Components

Gerard A. Engh, MD, Alexandria VA, Anand R. Rao, BS; Matthew B. Collier, MS

Introduction: Few studies have assessed polyethylene wear in unicondylar knee arthroplasty (UKA). Here, we graded wear of failed UKA and evaluated contributions of factors specific to the polyethylene bearings.

Methods: 68 tibial components spanning 7 designs were examined. All but 2 had metal backings. Minimum polyethylene thicknesses at implantation ranged from 3.5mm-9.0mm (mean:5.2mm). Mean years in situ were 6.4 (standard deviation:3.7, range:0.8-14.7). Polyethylene shelf lives were computed for 47 components as years from sterilization to implantation (mean±standard deviation:1.6±1.4, maximum:5.3). Polyethylene ages at revision were computed as years from sterilization to explantation (mean±standard deviation:7.8±3.3, maximum:14.9, n=47).

Polyethylene wear that occurred via 7 modes (abrasion, burnishing, delamination, embedded debris, pitting, scratching, surface deformation) was graded in 3 zones (anterior, central, posterior) on a 0-3 point severity scale (0=none, 1=mild, 2=moderate, 3=severe). The maximum possible wear score was 63.

Results: Mean wear score was 40 (standard deviation:14, range:12-63). Fatigue modes were common: 97%(66/68) showed pitting and 77%(53/68) displayed delamination.

The wear score had significant correlations ($p < 0.01$) with time in situ (correlation=+0.63) and polyethylene age at revision (correlation=+0.75). The wear score was not correlated with polyethylene shelf life ($p = 0.27$, correlation=+0.17) or initial polyethylene thickness ($p = 0.91$, correlation=-0.01).

Discussion: Polyethylene wear has been the leading cause of UKA failure at our institution. Fatigue wear modes were common and not restricted to thin polyethylene bearings or those having long shelf lives. The sum of shelf life and in situ duration predicted the severity of polyethylene damage better than did either parameter independently.

Early Ex-vivo Optical Analysis of Highly Crosslinked and Conventional Polyethylene Tibial Inserts

Orhun K. Muratoglu, PhD, *Boston, MA*, Jeff Ruberti, PhD, Suzi Melotti, BS,
Stephen Speigelberg, PhD, Evan S. Greenbaum, BA, William H. Harris, MD, DsC

Surgically explanted highly crosslinked (n=8) and conventional polyethylene (n=71) tibial inserts were studied for polyethylene damage. Average total damage score was 47.3 and 58.6 for the highly crosslinked and conventional inserts, respectively. The loss of machining marks on the articular surfaces were significantly lower with the highly crosslinked inserts (8.3) than conventional inserts (13.4) (p-value=0.003). No significant difference was found in the backside surface damage. Melt-recovery analysis of one of the highly crosslinked inserts showed healing of nearly all surface damage and recovery of original machining marks, indicating that the early damage of the highly crosslinked material may primarily represent plastic deformation rather than material removal through wear.

A Two-Stage Approach to Primary Knee Arthroplasty in the Infected Arthritic Knee

David G. Nazarian, MD, *Philadelphia, PA*, Francis Mcguigan, MD,
Barbara Bowen, CRNFA, Robert E. Booth, Jr., MD

Introduction: Septic arthritis or chronic osteomyelitis of the knee has traditionally been considered a contraindication to total knee arthroplasty. This study is a review of a consecutive series of infected native knees which were treated with primary total knee arthroplasty after placement of an interval antibiotic impregnated cement spacer.

Materials & Methods: Fourteen knees were treated by the senior author between 1989 and 1996 for recurrent septic arthritis or chronic osteomyelitis. All patients underwent a radical soft tissue debridement. Bone cuts were made in preparation for a primary total knee arthroplasty with the placement of an antibiotic impregnated cement spacer block. Patients were treated with IV antibiotics for 6 weeks and were implanted no less than 2 months after the index procedure. Patients were evaluated clinically and radiographically using a modified Knee Society rating system.

Results: All patients had severe pain and disability prior to the index procedure. The average Knee Society score was 89 at an average follow-up of 4.5 years (range 2-9). All patients had good or excellent pain relief with no evidence of recurrent infection. Seven patients had a flexion contracture with an average range of motion from 10 to 100 degrees. Two of these patients required manipulation under anesthesia. There were non-progressive radiolucent lines in 6 (43%) knees and no cases of loosening.

Discussion/ Conclusion: Treatment alternatives for recurrent septic arthritis or chronic osteomyelitis of the knee have been generally unsatisfying. Arthroscopy or open debridement have limited curative potential in the chronically infected knee. Arthrodesis and amputation may be curative but present significant functional limitations. Although primary knee arthroplasty is contraindicated in the actively infected knee, this study reports on a successful treatment protocol which provides excellent functional results.

Limited Success in the Treatment of
Acute Gram Positive Infections After Total Knee Arthroplasty
with Open Debridement and Retention of Components

Deirmengian C.A., Philadelphia, PA, Greenbaum J.N., Stern J., Braffman M., Lotke P, Lonner J.H.

Thirty-one total knee arthroplasties with acute gram-positive infections were seen at our institution over a ten-year period, and were treated with open debridement and component retention. Only patients who underwent debridement from 1990-2000 and had gross purulence, or two positive bacterial cultures were included in this study group.

Thirteen (42%) *S. aureus*, fifteen (48%) *Streptococcus*, and three (10%) *S. epidermidis* infections were treated. The index procedure was a primary arthroplasty in twenty-two patients, and revision arthroplasty in nine patients. The average time from index arthroplasty to debridement was two years (range, 16 days-7 years). The average duration of symptoms before debridement was 9 days (range, 1-40 days). All patients received appropriately directed intravenous antibiotics for six weeks.

Eleven (35%) of the thirty-one patients retained their components at most recent follow-up (mean, 4 years; range, 2-10 years). Only one (8%) of the thirteen patients infected with *S. aureus* had retained components. In contrast, ten (56%) of eighteen patients with either *S. epidermidis* or a streptococcal species had retained components. The difference between these groups is statistically significant ($p = 0.007$).

The success rate of debridement with component retention for the treatment of acute infections in knee arthroplasty varies significantly depending on the involved pathogen. The high failure rate of debridement and component retention suggests that immediate component removal should be considered in the presence of acute *S. aureus* infection in total knee arthroplasty.

The Long-term Cumulative of Dislocation After Primary Total Hip Arthroplasty:
Effect of Femoral Head Size and Operative Approach

Daniel J. Berry, MD, Rochester, MN, William S. Harmsen, MS

- Purpose:** To determine the effect of femoral head size and operative approach on long-term cumulative risk of dislocation after primary THA.
- Materials/ Methods:** From 1969-1999, 22,174 primary THAs were performed on a single institution. Patients were routinely followed at defined intervals and specifically queried about dislocation. Survivorship free of first time dislocation was estimated using the Kaplan-Meier method.
- Results:** The prevalence of dislocation was 918/22,174 (4.1%). The cumulative risk of any dislocation was 2.2% at one year, 3.0% at five years, 3.8% at 10 years and 6% at 20 years. The cumulative 10-year risk of dislocation was 3.2% for anterolateral, 6.8% for posterolateral, and 3.4% for transtrochanteric approach ($p<0.0001$). The cumulative 10-year risk for 32 mm heads was 2.6%, for 28 mm 3.0%, and 22 mm 3.9% for patients treated with an anterolateral approach. In a multivariate model, the relative risk of dislocation compared to 32 mm head size was 1.7 for 22 mm ($p<0.0001$); 1.8 for 26 mm ($p=0.006$) and 1.3 for 28 mm ($p=0.02$).
- Conclusions:** This study confirms that the posterior approach—previously shown to be a risk factor for early dislocation—is also a long-term risk factor. Importantly, this paper demonstrates a statistically significantly lower clinical risk of long-term dislocation associated with a larger femoral head size.

Long-term Clinical Consequences of Stress-Shielding After Total Hip Arthroplasty Without Cement

C. Anderson Engh, Jr., MD, Alexandria, VA, Anthony M. Young, MSE, Charles A. Engh, Sr., MD

From a series of 223 extensively porous-coated total hip arthroplasties (THAs) at mean 14.8-year follow-up, we compared the outcome 45 THAs that had stress shielding on two-year postoperative radiographs to 178 THAs that did not. Stress shielding was more likely in females ($p=0.003$) and patients with larger stems ($p=0.001$). Patients with stress shielding had a lower mean walking score than those without stress shielding ($p=0.008$) and less osteolysis ($p=0.009$). No cases with stress shielding involved femoral loosening, implant fractures, or loss of porous coating. The revision rate was 13% (6 hips) among hips with stress shielding and 19% (34 hips) among hips without stress shielding ($p=0.51$). Fifteen-year survivorship was 93% among hips without stress shielding and 77% among hips with stress shielding ($p=0.177$). Stress shielding did not produce adverse consequences in these extensively porous-coated THAs.

In-Vivo Degradation of Mechanical Properties and Wear Performance of UHMWPE Acetabular Liners

Steven M. Kurtz, PhD, **William Hozack, MD**, Philadelphia, PA, Joseph Turner, MS,
Clare Rimnac, PhD, Matthew Kraay, MD, Victor Goldberg, MD, Av Edidin, PhD

In this study, we tested the hypothesis that mechanical and oxidative behavior of gamma radiation sterilized UHMWPE changes after implantation. We also sought to address whether in-vivo changes in mechanical behavior, provided that they could be measured, might also influence the clinical wear rate of contemporary hip replacement components. Shelf aging time (average: 0.5 years), implantation time (average: 8.2 years), and ex-vivo time (average: 0.6 years), defined as the interval between retrieval and component testing, were determined for 30 inserts. Overall, the retrieved liners exhibited significant mechanical degradation which increased with increasing implantation time. The average mechanical properties of the 30 liners were estimated to degrade at a rate of 2.0 to 4.7% per year of implantation.

FTIR analysis confirmed that the in-vivo degradation mechanism stemmed from polymer oxidation. The implants with the highest wear rates were also associated with a significantly degraded peak load ($\rho = -0.43$, $p = 0.04$) and degraded ultimate load of the UHMWPE ($\rho = -0.48$, $p = 0.02$). Due to the short shelf aging and ex-vivo times of the retrieved liners (on average 6 months), the significant changes in the mechanical properties after long-term implantation of up to 13.5 years were attributed primarily to changes that took place in-vivo. Therefore, the results of this study support the hypothesis that mechanical degradation of gamma-radiation sterilized UHMWPE acetabular components occurs in-vivo, via an oxidative mechanism. Our data further suggest that in-vivo degradation may influence the wear rate of the acetabular components.

The Effect of Gas-Plasma and Gamma-Irradiation Sterilization
on the In-Vivo Wear Performance of
Total Hip Arthroplasty Polyethylene Liners

Robert H. Hopper, Jr, PhD, Alexandria, VA, Anthony M. Young, MS,
Karl F. Orishimo, MS, C. Anderson Engh, Jr., MD

Introduction: Terminal sterilization of conventional total hip arthroplasty polyethylene liners with gamma-irradiation-in-air promotes crosslinking, which improves wear resistance, but also results in free radicals, which can oxidize and degrade the polyethylene properties. Owing to the possibility of oxidation, some manufacturers switched from gamma-irradiation to terminal sterilization with gas-plasma, a non-crosslinking chemical surface treatment. We hypothesized that conventional polyethylene liners crosslinked by sterilization with gamma-irradiation-in-air had better in-vivo wear performance than non-crosslinked liners sterilized with gas-plasma.

Methods: We retrospectively evaluated the clinical wear rates for 124 hips implanted with a Duraloc 100 cup, a 28-mm femoral head, and an Enduron (DePuy) liner that had been sterilized with gamma-irradiation-in-air (61 hips) or gas-plasma (63 hips). The gamma-irradiated liners had been stored an average of 1.0 (range, 0.05 - 5.72) years prior to implantation. The mean follow-up was 5.2 (range, 3.1-7.4) years for the gamma-irradiated liners, and 3.9 (range, 3.0-5.8) years for the gas-plasma-sterilized liners. Multiple linear regression was used to assess the effect of sterilization method on wear rate while accounting for the possible influence of liner geometry, head material, patient gender, cup abduction angle, and age at surgery.

Results: Gamma-irradiated-in-air polyethylene liners wore at a significantly lower mean rate than gas-plasma-sterilized liners (0.097 versus 0.19 mm/year, $p < 0.001$). Sterilization method ($p < 0.001$) and age at surgery ($p = 0.001$) were the only factors significantly correlated with wear rate.

Discussion/Conclusion: Using a single cup design, conventional polyethylene liners sterilized with gamma-irradiation-in-air demonstrated 50% less in-vivo wear, on average, than gas-plasma-sterilized liners. At intermediate follow-up, these gamma-irradiated-in-air components with relatively short shelf lives had lower wear rates than gas-plasma-sterilized liners.

Knee Implant Alignment: A Comparison of Minimally Invasive Unicompartamental, Open Unicompartamental, and Total Knee Arthroplasty

David A. Fisher, MD, Indianapolis, IN, Melanie R. Watts, ATC/L, CSCS, Kenneth E. Davis, MS

This is a retrospective radiographic analysis of implant position in three groups of knee arthroplasty patients performed by a single surgeon. These groups included minimally invasive (88 knees), open unicompartamental (64 knees), and total knee arthroplasty (54 knees). In addition to pre- and postoperative limb alignment, femoral and tibial implant positions were recorded in the AP and lateral planes. The groups were compared statistically with Two Sample T-test and Equality of Variances F-test.

For the minimally invasive (MIU) and open unicompartamental knee groups, there were significant differences in postoperative alignment (MIU 3.5 degrees valgus, open uni 4.3 degrees valgus $P < .006$) and AP tibial position (MIU 84.6 degrees varus, open uni 85.9 degrees varus $P = .001$) with higher standard deviations in the minimally invasive group.

When comparing the uni knee groups to the total knee group, significant differences were noted in all parameters except preoperative alignment. Furthermore, there were wider ranges and greater standard deviations in the uni knee groups.

Of the three groups evaluated, the total knee group had the least variation and greatest accuracy of implant placement. Using contemporary instrumentation, unicompartamental replacement is less accurate in implant positioning and limb alignment than TKA. Minimally invasive unicompartamental replacement by the technique used in this study was as accurate as the open technique with regard to AP/ lateral femoral position and lateral tibial position, but not in AP tibial placement or overall alignment. Concerns are raised for accuracy of implant placement with minimally invasive procedures.

Use of a Porous Metal Patella for Marked Patella Bone Loss During Revision TKA

Charles L Nelson, MD, Philadelphia, PA, Ashkan Lahiji, MD, Jess H. Lonner, MD, Jane Kim, BS, Paul A Lotke, MD

Introduction: Treatment options for severe patellar bone loss during revision total knee arthroplasty are limited. A new porous tantalum metal shell has been developed to compensate for patellar bone loss. This study compares clinical outcomes using a trabecular metal [TM] shell to the results of a standard patelloplasty with no patellar button.

Methods: Sixteen consecutive patients with severe patellar bone loss, with or without patellar fragmentation precluding fixation with standard cemented patellar designs, were managed with a porous tantalum patellar shell (Group A). These patients were compared with 9 consecutive prior revision TKA procedures in which a patelloplasty was performed for similar bone loss (Group B). All patients were followed prospectively with Knee Society knee scores (KSS), function scores (FS) and radiographic evaluation. Patients were also assessed for anterior knee pain and function.

Results: The mean KSS were 89.5 [64-100] (Group A) and 87.8 [45-100] (Group B). The mean FS were 54.1 [15-80] (Group A) and 57.5 [30-80] (Group B). Average ROM was 110 degrees [75-125] for Group A and 115 degrees [90-120] for Group B. Results were good or excellent for 13 out of 16 patients in Group A and in 8 out of 9 for Group B at average 20-month follow-up for both groups. There was no displacement of any porous tantalum patellar shells. Three patients in Group A underwent another surgical procedure for fracture of the patellar pole. The porous tantalum patellar shell was solidly fixed to the patellar remnant in both of these patients. One patient in Group B developed comminution of the remaining patellar remnant and was converted to a TM patella. There was diminished anterior knee pain, and improved anterior knee function in Group A compared with Group B.

Discussion: Short-term results of patellar resurfacing with a porous tantalum patellar shell compared favorably with our prior patelloplasty procedures. No objective difference in Knee Society scores was found to exist between the two groups. Qualitative advantages of patellar resurfacing included decreased anterior knee pain and improved extensor mechanism function. There was no displacement of any porous tantalum patellar shells, and fixation of the porous surface appears excellent despite the poor quality bone remaining. We feel this is an important new device, which may help solve the problem of deficient patellar bone during revision total knee arthroplasty.

The FDA has not cleared the following medical device for the use described in this presentation. (Zimmer: trabecular metal patella shell. FDA cleared only for use with cement)

Corticosteroid Vs. Synvisc (HYLAN GF-20) Injections for Knee Osteoarthritis:
A Prospective, Randomized Trial Demonstrating Similar Efficacy
But Important Gender-Related Treatment Differences

Seth S. Leopold, MD; *Seattle, WA*, Brigham B. Redd, MD, Winston J. Warme, MD,
Paul A. Wehrle, MD, Patrick D. Pettis, LVN, Susan Shott, Ph D

Background: The present report tests the hypothesis that there are no significant differences between hylan GF-20 (Synvisc) and the corticosteroid betamethasone sodium phosphate/betamethasone acetate (Celestone-Soluspan) in terms of pain relief or improvement in function, as determined by validated scoring instruments.

Methods: One hundred patients with knee osteoarthritis were randomized to receive either intra-articular Synvisc or Celestone-Soluspan (CS), and were followed for six months. Synvisc patients received one course of three weekly injections. CS patients received one injection at study enrollment, and could request one more injection any time during the study. An independent, blinded evaluator assessed patients with the WOMAC index, the Modified Knee Society Score (KSS), and the visual-analog pain scale (VAS).

Results: Both CS and Synvisc patients demonstrated improvements from baseline WOMAC scores (55 to 40 points, $p < 0.01$; and 54 to 44 points, $p < 0.01$, respectively). Scores on the KSS did not show statistically significant improvement for CS patients, or Synvisc patients (58 to 70 points, $p = 0.06$; and 58 to 68, $p = 0.15$, respectively). VAS scores improved for Synvisc patients, but not for CS patients (70 to 52 mm, $p < 0.01$; vs. 64 to 52 mm, $p = 0.28$). However, there were no significant differences in WOMAC, KSS, or VAS results between the two treatment groups, despite 80 percent power to detect clinically relevant differences. Women demonstrated a statistically significant improvement in only one of the six possible outcomes/treatment combinations (the WOMAC scale for female Synvisc patients), while men demonstrated significant improvements in five of six (all measures except the KSS for male Synvisc patients). The gender-related differences could not be explained by differences in age or disease severity.

Conclusions: No differences in pain or function were detected between intra-articular injections with Synvisc or CS at six months' follow-up. To our knowledge, this is the first trial to compare CS and any viscosupplement that was not funded by the manufacturer of the hyaluronic acid product in question. The difference in pharmacy cost between the two treatments is over 100-fold at our institution. Women demonstrated significantly less response to treatment than did men for both CS and Synvisc on all three outcome scales. Such significant gender-related differences warrant further investigation.

The Prevalence of Corporate Funding in Orthopaedic Lower Extremity Research and its Effect on the Reporting of Results

Kace A. Ezzet, MD, La Jolla, CA, Clifford W Colwell, MD

Introduction: As federal funding for reconstructive orthopaedic research has dwindled, investigators have become increasingly dependent on corporate sponsorship for funding. This study investigates the prevalence of commercial sponsorship in orthopaedic research, and its impact on the reporting of results.

Methods: All volumes of the 2001 Journal of Arthroplasty and JBJS (American and British) were reviewed for articles relating to adult lower extremity reconstruction (LER). All papers, posters, scientific exhibits, and symposia pertaining to LER from the 2001 AAOS and AAHKS meetings were reviewed. In total, 568 presentations were reviewed. Studies were reviewed for the presence of commercial sponsorship, type of financial relationship, country of origin, nature of study, and conclusion.

Results: 47% of research was commercially sponsored. Studies with commercial sponsors reported good results in 87%; mediocre/bad results in 3%, and 10% “neutral”. Studies without commercial sponsorship reported good results in only 35%, mediocre/bad results in 34%, and 30% “neutral”. Studies published in JBJS and Journal of Arthroplasty with commercial funding reported bad results in 0%, (non-funded studies reported bad results in 37%). Among clinical reports of hip implant performance in the USA, 73% were commercially funded. Commercially funded reports on total hip devices in the USA reported good results in 94% and bad results in 2%, as contrasted to non-funded studies which reported 47% good results and 53% bad.

Conclusions: Commercial funding is extremely prevalent in scientific LER research, and substantially affects reported outcomes. Tragically, there is virtually no independent outcome data on specific implants used in the USA.

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Poster Presentations

- 1. Efficacy of Bone Morphogenic Protein-2 to Promote Gap filling and Ingrowth Across the Gap in a Canine Total hip Replacement Model**
Charles Bragdon, BS, Shannon Larson, BS, Murali Jasty, MD, Harry Rubash, MD, William H. Harris, MD
- 2. Underestimation of Osteolysis in Posterior Stabilized Total Knee Arthroplasty**
Matthew C. Nadaud, MD, Thomas K. Fehring, MD, Keith Fehring
- 3. Press-fit Intramedullary Stems in Revision TKA: Is Thigh and Leg Pain an Issue?**
Christopher L. Peters, MD, Robert Klopper, MD, Alexander Mohr, MD
- 4. Effect of Total Hip Component Design and Placement on Range of Motion**
William P. Barrett MD, Richard M. Harrington, Randal P. Ching
- 5. Comparison of Cemented Femoral Components with Identical Geometry but Different Surface Finishes: A 13 to 15 Year Follow-up Study**
John J Callaghan, MD, Steve S Liu, BS, Devon D Goetz, MD, Patrick M Sullivan, MD, Richard C Johnston, MD
- 6. Non-Response Bias in Mail Surveys for Follow-up Total Knee Patients**
Jane Kim, Paul A. Lotke, MD, Charles Nelson, MD, Jess H. Lonner
- 7. Second Generation Uncemented Total Hip Arthroplasty: Minimum Five-Year Results With a Fully Porous Coated Stem and Hemispheric Porous Coated Cup**
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- 8. Clinical Wear Performance of Alumina vs. Cobalt Chrome 28mm Femoral Bearings in the HGP Acetabular Component**
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- 9. Knee Fusion Conversions with No Extensor Mechanism: Is It Worthwhile?**
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- 10. Clinical assessment of the tibial polyethylene insert: evaluating the accuracy of radiographic thickness measurements**
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- 11. Rotational Stress and Relative Motion in Modular Total Knee Replacements**
Thomas P. Schmalzried, MD, Lou Serpe, MS, Mark A. Kester, PhD, Ormonde M. Mahoney, MD, Donald T. Reilly, MD,
- 12. The Application of Impaction Bone Grafting for Periprosthetic Femur Fractures Following Total Hip Arthroplasty: Minimum 2-year follow-up**
Charles L Nelson Jonathan P Garino, Justin Hawes, Daniel Lamar
- 13. Acetabular Component Removal—A New Technique**
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- 14. The Porous Coated Anatomic Total Hip Prosthesis: Prospective 11-13 Year Clinical and Radiographic Results**
Joseph Moskal, MD, Louis Jordan, MD, Thomas Brown, MD
- 15. Early Experience with Lateralized Modular Acetabular Liners**
Matthew Dobzyniak, MD, Thomas K. Fehring, MD, Thomas H. McCoy, MD, William L. Griffin, MD, J. Bohannon Mason, MD
- 16. 100 Consecutive Unicondylar Arthroplasties Featuring Gamma-Sterilized-in-Air Polyethylene Inserts: Shelf Life of the Insert and its Impact on Clinical Outcomes, Symptomatology, and Follow-up Patterns at 6 Years**
Matthew B. Collier, MS, Gerard A. Engh, MD, C. Anderson Engh, Jr., MD
- 17. Rotational Mal-Alignment as a Mechanism of Wear in Conventional UHMPWPE and Highly Crosslinked Polyethylene Patellar Components**
David C Markel, MD Mark Kester, PhD, Robert Klein, Michael Bushelow
- 18. Periprosthetic Fractures Around a Total Knee Replacement: Treatment with Revision To Another TKR**
Gwo Chin-Lee, MD, Mark W Pagnano, MD, Robert T Trousdale, MD
- 19. Simultaneously Infected Bilateral Total Knee Arthroplasty**
Luther H Wolff, III, MD, J Parvizi, MD, MW Pagnano, MD, RT Trousdale, MD, DR Osmon, MD, GJ Haidukewych, MD

Efficacy of Bone Morphogenic Protein-2
to Promote Gap Filling and Ingrowth Across the Gap
in a Canine Total Hip Replacement Model

Charles Bragdon, BS, Arin Dorherty, BS, Murali Jasty, MD,
Howard Seeherman, Harry Urbash, MD, William H. Harris, MD

We studied BMP-2 for enhancement of bone ingrowth into porous canine total hip replacement implants, both with intimate contact and across a gap. A hemispherical gap was created behind the cup. The gap with no treatment, with the carrier, and carrier with BMP-2 were evaluated.

Gap filling with bone occurred in the BSM/BMP-2 treated components and less so without BMP-2. The occurrence of bone ingrowth under the gap without BMP-2 was 2.2%, while with BSM/BMP-2 it averaged 7.0%. Similar amounts of bone ingrowth occurred in areas of the porous surface in direct contact with host bone.

This study has demonstrated the ability of a biological agent to promote bone bridging across a periprosthetic gap with bone ingrowth into the porous surface.

Use of Osteolysis in Posterior Stabilized Total Knee Arthroplasty

Matthew Nadaud, MD, Thomas K. Fehring, MD; Keith Fehring

- Purpose:** Periprosthetic osteolysis in total knee arthroplasty (TKA) has become a significant problem. Routine surveillance is warranted to detect problems that may not be symptomatic. The goal of these radiographs is to detect arthroplasty-related bone loss at an early stage to implement strategies to limit its extension. In a posterior cruciate-retaining (PCR) implant, anteroposterior (AP) and lateral radiographs usually suffice. However, in a posterior stabilized (PS) implant, the condylar pillars of bone are obscured on routine views. The purpose of this study was to show the extent to which condylar osteolysis can be underestimated on routine radiographs.
- Methods:** To evaluate the value of routine radiographs and the utility of including oblique radiographs, a model for osteolysis was used. Two cadaveric femurs were prepared to receive a PS femoral component. Initial baseline radiographs were obtained, which included four views, AP, lateral and medial and lateral obliques. A simulated “osteolytic lesion” was created utilizing acetabular reamers.
- Results:** Lesions of 36 mm. not discernible on standard AP and lateral images were easily recognized on oblique films. The 38 and 40 mm. lesions were noted on the AP and lateral films. However, their extent was more easily appreciated on the oblique films.
- Discussion/
Conclusion:** Osteolysis in TKA is an emerging problem. Neglected asymptomatic osteolysis can slowly progress to the point of catastrophic failure. The oblique radiographs described here can help with the early recognition of retro-femoral osteolysis about a posterior stabilized implant. In evaluating a patient with a PS knee, oblique radiographs are mandatory in the following situations:
1. Eccentric poly wear;
 2. Chronic synovitis with recurrent effusions;
 3. Recognized osteolysis on AP and lateral radiographs;
 4. Defining a lesion prior to surgical intervention for wear-related problems.

Press-fit Intramedullary Stems in Revision TKA: Is Thigh and Leg Pain an Issue?

C. Peters, R. Kloepper, R. Mohr, J. Erickson

The clinical and radiographic outcomes of 56 consecutive revision total knee arthroplasties placed with surface cemented femoral and tibial components with press-fit cementless stems were reviewed. Follow-up averaged 58 months (range 36-84). At revision, the average age was 70 years (range 35-90) and knees averaged 2.1 prior operations. Revision knees was performed for aseptic loosening in 18 knees (32%), infection in 19 knees (34%), periprosthetic fracture in six knees (11%), component failure in five knees (9%), and other in eight knees (14%). The press-fit cementless stems were 80-160mm in length exclusive of the femoral and tibial component stem housings. Two knees were re-revised for infection. No knees were revised for aseptic loosening.

The average modified Hospital for Special Surgery score improved from 34 to 80 ($p < 0.001$). Flexion improved from 64.5 to 104.5 ($p < 0.001$). One patient (2%) reported thigh pain associated with a femoral stem and one patient (2%) reported leg pain associated with a tibial stem. Incomplete non-progressive radiolucent lines (RRL) were visualized in 6% of femurs and 11% of tibias. The percent AP and lateral canal filling for the femoral and tibial stems averaged 93% and 96% for the femora and 98% and 99% for the tibiae. Surface cemented revision total knee components with press-fit cementless femoral and tibial stems of this design are not associated with significant thigh and leg pain. Component stability is confirmed by the low incidence of component failure, radiolucent lines, and improvement in clinical function.

The Effect of Total Hip Prosthesis Component Design and Placement on Range of Motion

William P. Barrett, MD, R. M. Harrington, MD, P. P. Lewis, MD, R. P. Chang, MD

This project examined the effect of component design and placement on range of motion of total hip prostheses using a three-dimensional computer model. The design elements investigated for their effect on range of motion were femoral component head diameter and liner edge shape. The placement of the femoral and acetabular components determines the total range of motion in each of three anatomic planes.

An inverse relationship between total flexion/extension and internal/external range of motion was noted. Greater range of motion until impingement was obtained with 36 mm heads when compared with 28 mm heads. Modification of the liner edge geometry revealed improved range of motion with the metal-on-metal articulation when compared to the metal-on-polyethylene. Hooded liners did not improve range of motion, and in fact, decreased range of motion in the direction away from the buildup.

The effect of increasing combined anteversion on external rotation is a linear relationship. The effect of increasing combined anteversion on flexion reveals increase in flexion, up to 30 to 50 degrees of combined anteversion, after which flexion range of motion decreases, secondary to bone and soft tissue impingement.

COMPARISON OF CEMENTED FEMORAL COMPONENTS
WITH IDENTICAL GEOMETRY BUT DIFFERENT SURFACE FINISHES:
A 13 TO 15 YEAR FOLLOW-UP STUDY

Steve S. Liu, B.S., **John J. Callaghan, M.D.**, Iowa City, IA, Jesse E. Templeton, B.S., Devon D. Goetz, M.D., Patrick M. Sullivan, M.D., Richard C. Johnston, M.D.

- Purpose:** The objective of this study was to evaluate the results of two cemented femoral components with identical stem geometry but different surface finishes (30 to 80 microinch Ra) at 13 to 15 year follow-up to determine if there were differences in stem construct durability.
- Methods:** Two consecutive non-selective cohorts of hips performed by a single surgeon sequentially (Group I 1984-1985 304 hips, Group II 1986 120 hips) were evaluated for femoral revision for aseptic loosening and radiographic loosening and osteolysis. Group I had a TiBac cemented acetabular and 20-30 microinch surface roughness cemented femoral component and Group II had a cementless HG I acetabular and 80 microinch surface roughness femoral component of identical geometry. The average age at surgery was 67 years for both groups and both groups had 60% females and 70% of patients with osteoarthritis.
- Results:** No patient was lost to follow-up. Hips with the smoother femoral component were followed for 14 to 15 years and those with a rougher femoral component were followed for 13 to 15 years. In Group I 2% of hips required a femoral revision and in Group II 10% of hips required a revision. In Group I the radiographic loosening rate was 3.6% and in Group II 13.3%. The difference between groups was significant for all three parameters ($p = .001$).
- Discussion:** This study supports the use of femoral components with smoother surface roughness in cemented total hip arthroplasty. The smoother stem performed as well as any other cemented femoral component that has 15-year follow-up reports.

Non-Response Bias in Mail Surveys for Follow-up Total Knee Patients

Jane Kim, Paul A. Lotke, Charles Nelson, Jess H. Lonner

Introduction: Mail survey questionnaires are increasingly being used for follow-up evaluation of patient satisfaction and performance after total joint surgery. The literature identifies a variety of possible questionnaire response biases. Some past studies suggest that the validity of mail surveys may be compromised by non-response bias. This paper defines the non-response bias in a mail survey sent to patients following their total knee arthroplasty.

Method/Materials: 472 patients who had primary TKA between 1996-1998 were mailed a ten-question survey that scored the following parameters: Satisfaction, general health, pain, motion, stability function and Knee Society rating. 83% responded after 1 or 2 mailings. The remaining 17% who failed to respond after two mailings were considered “non-respondents”. These non-respondents were sent up to four repeat mailings within a one-year period, or interviewed by telephone. 100% of the non-respondents were eventually contacted. Survey scores of the respondents versus non-respondents were statistically compared by the following methods: A non-parametric analogue to Anova, the Kruskal-Wallis test, a series of 2-sample t-tests, the Wilcoxon rank sum tests, Chi-square tests and Fisher’s exact tests. Additionally, non-respondent survey scores received by mail were compared to those received by telephone interview.

Results: Non-respondents had significantly lower scores in satisfaction, general health, pain, motion, stability, function and Knee Society scores (all $p < 0.001$). There was no statistically significant difference in survey scores between the non-respondents who were contacted by mail versus telephone, except in satisfaction score.

Discussion: The results indicate that in the mail survey follow-up evaluations, the non-respondents have significantly worse outcomes than respondents. Therefore, the assessment of patients lost to follow-up is an important and necessary component to accurate outcome analysis. It is suggested that this response bias be considered in all follow-up analyses. In the absence of a complete response, a conservative approach would be to consider both best case and worst case scenarios, to take into account the potentially inferior outcomes of those patients “lost to follow-up”.

Second Generation Uncemented Total Hip Arthroplasty:
Minimum Five-Year Results With a Fully Porous Coated Stem
and Hemispheric Porous Coated Cup

Christopher J. Chen, MD, John S. Xenos, MD, James P. McAuley, MD,
Anthony M. Young, MSE, Charles A. Engh, Sr., MD

- Purpose:** The authors evaluated the five-year results of a series of consecutive total hip arthroplasties performed with Prodigy stems and Duraloc cups. We hypothesized that these components would provide better outcome than preceding porous-coated cementless stems and cups.
- Methods:** Of 157 THAs performed at our institution, twelve were lost to follow-up. We evaluated the average 6.7 year results of the remaining 145 hips. We obtained clinical outcomes and reviewed radiographs to evaluate bone ingrowth, osteolysis, and polyethylene wear.
- Results:** Survivorship at five years with component revision as an endpoint was 99.4%. Ninety-eight percent of patients reported satisfaction, 7% reported activity-limiting pain. Among the unrevised arthroplasties, 99% were bone-ingrown, one stem loosened. Acetabular osteolysis was observed in 2% and femoral osteolysis in 5% of the hips. The mean true wear rate was 0.10 ± 0.14 mm/year.
- Discussion/
Conclusion:** This second-generation fully porous-coated hip system yields excellent clinical and radiological results at early follow-up.

Clinical Wear Performance of Alumina Vs. Cobalt Chrome 28mm Femoral Bearings in the HGP Acetabular Component

Martell, J.M., *Chicago, IL*, Roller, C., Goebel, S., Galante, J, Henrich, C.

Patients underwent primary cementless hip replacement using 28 mm bearings and conventional ultra high molecular weight polyethylene (UHMWPE) liners. 109 implants received cobalt-chrome bearings, while 100 received alumina (BioloX) bearings. 2D linear polyethylene wear rates were calculated using a computer assisted edge detection technique. The metal bearings demonstrated a mean linear wear rate of 0.14 mm/yr. compared to 0.13 mm/yr. for alumina. This difference was not significant using the Mann-Whitney test ($p= 0.46$), with 80% power to detect a (28%) difference in wear rates. This series shows no clinical advantage in wear performance for alumina on conventional UHMWPE.

Knee Fusion Conversion with No Extensor Mechanism:
Is It Worthwhile?

Todd D. Sekundiak, MD, Seattle, WA

- Purpose:** Knee fusion conversion to a total knee arthroplasty has had equivocal, if not poor results. Residual pain and dysfunction are the main concerns. The success of knee fusion conversion to total knee arthroplasty needs to be determined.
- Method:** A prospective follow-up of 7 consecutive knee fusion takedowns (4 females, 3 males) (average age 58.1 years) was performed. Fusion conversions were performed for disability and cosmesis and only after thorough counseling. A minimum follow-up of 38 months (average 52 months) was performed clinically and radiographically. No patients had a patellar ligament or patella. All approaches were performed with a "V-Y subperiosteal peel," which is described and which was performed to obviate the need for extensor mechanism reconstruction.
- Results:** Six of the seven patients had an extensor lag less than 10 degrees with an average ROM of 75 degrees. One patient required a late extensor mechanism reconstruction. One patient required revision of his femoral component for aseptic loosening. Knee society scores only averaged 71/100 with pain scores averaging 31/50 from a preoperative score 46/50. Functional scores improved from 39/100 to 81/100. WOMAC pain scores showed similar deterioration with moderate improvement in the functional scores. All patients considered the procedure worthwhile.
- Discussion / Conclusion:** Although scores were much lower than for primary arthroplasty procedures, knee fusion conversions were satisfactory. All patients must be counseled of the probability compromised function, if the extensor mechanism is not satisfactory, and of the probability of residual pain.

Clinical Assessment of the Tibial Polyethylene Insert:
Evaluating the Accuracy of Radiographic Thickness Measurements

Matthew B. Collier, MS, Brian A. Jewett, MD, **C. Anderson Engh, Jr., MD**

For 66 PCL-retaining Anatomic Modular Knee inserts revised due to wear or osteolysis, polyethylene thicknesses were measured from standard AP radiographs by two practical methods and compared to original or final insert thicknesses. Measuring the distance from each femoral component condyle to a transverse line through the middle of the baseplate's superior surface proved the better method. For radiographs acquired six weeks after primary TKA, this method's mean error (after magnification adjustment) was -0.1mm (underestimate) $\pm 0.6\text{mm}$ (mean \pm SD, 72% and 87% of measurements within 0.5mm and 1.0mm of original thickness, respectively).

Wear compromised the method's accuracy – errors from pre-revision radiographs averaged $+0.6\text{mm}$ (overestimate) $\pm 1.0\text{mm}$ (41% and 70% within 0.5mm and 1.0mm of final thickness, respectively). Method two required measuring the minimum distance between the baseplate and each condyle – its 6-week and pre-revision errors averaged $-1.6\text{ mm} \pm 1.1\text{mm}$ and $-0.6\text{ mm} \pm 1.4\text{mm}$, respectively. The former method proved significantly more accurate than the latter, save lateral compartment measurements preceding revision.

Rotational Stress and Relative Motion
in Modular Total Knee Replacements

R. Klein, MS, L. Serpe, MS, M.A. Kester, PhD, O.M. Mahoney, MD, **T.P. Schmalzried**

Longitudinal rotation is a normal component of knee motion. Based on recent retrieval analyses, a bench model was constructed to assess the forces generated by tibio-femoral rotation and the amount of relative motion induced at the modular interface. Tibio-femoral conformity is the primary source of rotational constraint. Box-post impingement can be a source of additional rotational constraint. Depending on specific design features, small changes in relative tibio-femoral component rotation can more than double the generated torque and nearly triple the amount of relative motion between the insert and the baseplate. A reduction in rotational constraint is desirable, especially for modular implants.

The Application of Impaction Bone Grafting for
Periprosthetic Femur Fractures Following Total Hip Arthroplasty:
Minimum 2-year follow-up

Charles L. Nelson, MD, Justin Garino

Introduction: The purpose of this study is to evaluate the short- to intermediate-term results of impaction grafting with long stem femoral revision in the management of a subset of periprosthetic femur fractures in which bone loss precluded cementless femoral fixation.

Methods: Over the past five years, we have surgically treated 22 patients with periprosthetic femur fractures of the hip. Among these, eight patients had extensive osteolysis, bone loss or comminution extending distal to the isthmus, precluding stable fixation with a cementless implant, and were treated with impaction bone grafting. A minimum two-year follow-up was available for seven of these eight individuals. Clinical results were evaluated using Harris Hip Scores. These eight patients were evaluated with serial radiographs and clinical evaluation.

Results: At mean 38-month follow-up (range 30-50 months), all fractures had healed radiographically. The clinical results were good and excellent for six out of seven patients. Mean Harris Hip score was 82 (range 51-92). No patients had been revised, and no components were radiographically loose.

**Discussion/
Conclusion:** The short-term results of impaction grafting and long-stem femoral revision for periprosthetic femur fractures with significant bone loss compares favorably with previously published results using other techniques. Potential advantages of impaction bone grafting in this setting compared with cemented femoral revision include better cement interdigitation for prosthetic fixation, supply of osteoconductive substrate to the fracture site, decreased cement extrusion and restoration of bone stock in osteopenic patients.

Acetabular Component Removal—A New Technique

Randall J. Lewis, MD, Washington, DC

A new technique for removal of a well-fixed acetabular component has been employed in 31 patients over the past three years. A modified femoral head, positioned in the acetabulum, guides a short, stiff blade, which passes around the component, but preserves the rim. A longer blade then divides the deeper bony attachments and allows the component to be lifted out. The path of the blade is controlled by the ball rotating in the socket.

A well-fixed acetabulum can typically be removed in three to five minutes. Difficulty in removing the component usually signifies failure to identify and remove a fixation screw. Twenty-six of 30 acetabulae were reconstructed with a standard monobloc cup, 0-6mm larger in diameter than the component removed, generally without supplemental screw fixation. The technique is applicable for both cemented and uncemented cups.

Because the amount of bone destruction beneath the cup is invariably greater than can be appreciated on radiographs, and the ease and rapidity of acetabular component removal with this technique, we no longer leave a modular shell in place and attempt to curette and graft through the screw holes.

The Porous Coated Anatomic Total Hip Prosthesis:
Prospective 11-13 Year Clinical and Radiographic Results

Joseph T. Moskal, MD, FACS, Louis Jordan, MD, Thomas E. Brown, MD.

Introduction: We are reporting the clinical and radiographic results on 107 consecutive Porous Coated Anatomic total hip arthroplasties at eleven to thirteen years follow-up.

Methods: One hundred thirty seven consecutive primary Porous Coated Anatomic arthroplasties were performed. Complete data was available on 107 hips in 93 patients at an average 12.4 year follow-up. Eighty-two circumferential proximally porous coated femoral stems were inserted without cement, and 25 with cement. All patients received a cementless porous ingrowth acetabular component.

Results: The average Harris hip score improved from 44 to 85 at final follow up. Seventy-eight percent had a good or excellent result. Nine percent of patients (8/93) experienced thigh pain. Thirteen percent (14/107) of acetabular components were deemed failures. Four porous ingrowth stems required revision for failure to achieve bony ingrowth. Osteolytic lesions were seen in 7.5% (8/107) of acetabular components. Survivorship of the PCA prosthesis as a whole, with revision, pending revision, or mechanical failure as the endpoint was 83% at 12.4 years.

Discussion / Conclusion: An incongruent fit of the polyethylene liner with the metal shell and a poor locking mechanism resulted in excessive backside wear, the development of particulate debris and subsequent osteolysis. The use of 32 mm heads in conjunction with cups less than or equal to 55mm in diameter resulted in the use of thin polyethylene liners which further compounded the problem. The four femoral failures occurred in patients with AVN. Unrecognized pathologic changes in the meta-diaphyseal region of the proximal femur may have inhibited bone ingrowth.

Early Experience with Lateralized Modular Acetabular Liners

Matthew Dobzyniak, MD, Troy, MI, Thomas K. Fehring, MD, Thomas H. McCoy, MD,
William L. Griffin, MD, J Bohannon Mason, MD

- Purpose:** Modular total hip components address the anatomic variation encountered in hip arthroplasty. Lateralized acetabular liners increase polyethylene thickness and have the ability to improve stability by increasing offset. The purpose of this study was to determine if lateralized acetabular liners adversely affect the osseous integration of cementless acetabular components.
- Methods:** 34 primary cementless acetabular components with lateralized liners were implanted from 1993 to 2000. Eight hips were lost to follow-up. Of the remaining 26 hips, 20 were implanted without screws and 6 were placed with screw fixation. The average follow-up was 4.6 years. Radiographic analysis was performed using the method of DeLee to determine radiolucencies and the method of Massin to detect migration.
- Results:** Of the 26 patients available, one patient failed. This patient had a cup placed without screws in the presence of a significant posterior deficiency. This was an error in judgment. The remaining 25 patients had evidence of osseous integration. No new radiolucency, measurable migration or change in abduction angle was noted.
- Discussion / Conclusion:** The advantages of lateralized acetabular components include increased polyethylene thickness and improved offset. They allow maximal range of motion by eliminating the need for skirted femoral heads. Our study shows that lateralized acetabular liners do not affect the osseous integration of cementless acetabular components even when placed in cementless acetabular components without supplemental screw fixation. Lateralized liners can be used to safely increase polyethylene thickness without resorting to smaller femoral heads and their inherent disadvantages. Our experience with these components supports their use as a viable means of eliminating the need for skirted heads and their inherent range of motion limitations.

100 Consecutive Unicondylar Arthroplasties Featuring Gamma-Sterilized Polyethylene Inserts: Impact of Insert Shelf Life on Six-year Clinical Outcomes

Matthew B. Collier, MS, Alexandria, VA, Gerard A. Engh, MD, C. Anderson Engh, Jr., MD

One hundred consecutive cemented Osteonics Single Compartment Replacement UKAs performed before May 1996 were reviewed. The median insert shelf life was 1.7 years (range: 0.1-5.3). By 6 years post-UKA, 12/48(25%) UKA having an insert shelf life above the median had failed (10 revised, 2 lost to dissatisfaction with knee; all seven inserts revised here showed pitting-type subsurface fatigue wear, as did one lost-to-dissatisfaction insert arthroscoped here). 2/50(4%) UKA having an insert shelf life below the median failed by 6 years post-UKA (tibial components placed in $>14^\circ$ varus and loosened after <3 years, both inserts showed abrasive scuffing consistent with malalignment but no subsurface fatigue failure). At 4- to 6-years' follow-up, Knee Society Knee Scores (KS) and Function Scores (FS) were poorer when insert shelf life exceeded the median (KS: 29 UKA below median shelf life = 93 ± 8 , 20 UKA above median shelf life = 80 ± 20 , $p = 0.02$; FS: 29 UKA below median = 85 ± 17 , 20 UKA above median = 73 ± 21 , $p = 0.06$).

Rotational Mal-Alignment as a Mechanism of Wear
in Conventional UHMWPE and
Highly Crosslinked Polyethylene Patellar Components

D.C. Markel, MD, R. Klein, MS, M. Bushelow, MD, M. Kester, PhD

Hypothesis: Rotational mal-alignment results in increased wear. Highly crosslinked polyethylene decreases wear even if mal-aligned.

**Materials/
Methods:** A high load-flexion test model was used to measure wear of rotationally aligned and mal-aligned all-polyethylene patellae (conventional or highly crosslinked).

Results: **Conventional:**
All demonstrated articular damage (burnishing, scratching). Mal-aligned patella demonstrated increased wear ($p < .05$).

Highly crosslinked:
All components fractured when mal-aligned (gamma irradiated remelted $n=6$, gamma irradiated annealed $n=2$). The failure occurred at the cement interface rather than at the posts.

Conclusions: Wear of UHMWPE patellae is increased by rotational mal-alignment. Highly crosslinked components were a poor solution to the wear problem and resulted in component fracture.

Periprosthetic Fractures Around A Total Knee Replacement:
Treatment with Revision to Another TKR

Gwo-Chin Lee, MD, Rochester MN, Bryan D. Springer MD, Mark W. Pagnano MD, Robert T. Trousdale MD

Introduction: This study evaluated the outcome of periprosthetic fractures around a TKR treated with revision to another TKR.

Materials / Methods: Between 1986 and 1999, 30 total knee replacements were revised to a new implant after a periprosthetic fracture. The mean time from injury to revision TKR was 22 months. The revision implant was a hinge in 17, a modular revision knee in 10 and an allograft prosthetic composite in 3.

Results: The mean follow-up was six years. Intraoperative technical challenges were common. Before the periprosthetic fracture, the Knee Society Clinical and Functional scores averaged 91 and 69 points and after revision were a mean of 80 and 35, respectively. Substantial surgical complications occurred in five patients and required another operation in four patients.

Conclusions: Periprosthetic fractures around a TKR that is loose, or in which there is markedly poor bone quality can be treated successfully with revision to another TKR.

Simultaneous Infected Bilateral Total Knee Arthroplasty

Luther H. Wolff III, M D, J. Parvizi, MD, **Robert T. Trousdale, MD**, Mark W. Pagnano, MD,
Douglas R. Osmon, MD, George J. Haidukewych, MD

Between 1976 and 1999, 21 patients with a mean age of 71 years (range 60-78) were treated at our institution for bilateral simultaneously infected TKAs. Two patients died within two years, and one patient was lost to follow-up. The mean follow-up for the remaining 19 patients was five years. Resection arthroplasty was performed in 10 patients. Eleven patients had prosthetic salvage with surgical debridement and suppressive antibiotics. Nineteen substantial complications occurred in 11 patients.

Of the ten patients treated with initial resection, seven patients underwent subsequent reimplantation. All were functioning well at follow-up and none had been revised. Nine of the 11 patients (81%) treated with attempted prosthetic salvage failed treatment due to persistent infection, and eight patients had subsequent resections at a mean of 15 months (range one month to 60 months). This data suggests that these patients are treated best with bilateral resection arthroplasty with planned delayed reimplantation.

On-site Registration Hours:	Friday, November 1	3:00 – 9:00 pm
	Saturday, November 2	6:30 am – 5:00 pm
	Sunday, November 3	6:30 – 10:00 am

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This continuing medical education activity has been submitted for review by the AAOS for up to 14 hours in category 1 credit of the Physician's Recognition Award of the American Medical Association.

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