

THE KNEE SOCIETY

*2011 Specialty Day Meeting of
The Knee Society*



*In association with the
American Association of Hip and Knee Surgeons
(AAHKS)*



Final Scientific Program

Saturday, February 19, 2011
San Diego Marriott Hotel & Marina
Salon 4
San Diego, California



Schedule-at-a-Glance

San Diego Marriott Hotel & Marina
Salon 4

8:00 – 8:04 am	Opening Remarks
8:05 – 9:15 am	Symposium I: UNICOMPARTMENTAL KNEE ARTHRITIS
9:15 – 10:20 am	Symposium II: CONTROVERSIES IN PRIMARY TKA
10:20 – 10:45 am	<i>Break</i>
10:45 – 11:20 am	Symposium III: TKA PERIOPERATIVE MANAGEMENT
11:25 – 11:50 am	Symposium IV: LATEST KNOWLEDGE ON ALIGNMENT IN TKA
11:50 am – 12:00 pm	The Knee Society Lifetime Achievement Award – <i>Chitranjan S. Ranawat, MD</i>
12:00 – 1:00 pm	<i>Lunch (on your own)</i>
1:00 – 1:30 pm	Symposium V: PATIENT SPECIFIC INSTRUMENTATION FOR TKA
1:30 – 2:25 pm	Symposium VI: HOW I DO TKA IN 2011: VIDEO, PANEL DISCUSSION, AUDIENCE QUESTIONS
2:25 – 2:55 pm	The Knee Society Award Papers
2:55 – 3:10 pm	<i>Break</i>
3:10 – 3:45 pm	Symposium VII: THE INFECTED TKA
3:45 – 4:20 pm	Symposium VIII: SURGICAL TECHNIQUES FOR REOPERATIONS AND REVISIONS
4:20 – 5:00 pm	Symposium IX: ECONOMICS AND IMPLANT SELECTION
5:00 pm	Adjourn

(Full scientific program schedule on pages 5-10)

Welcome to the 2011 Specialty Day Meeting of The Knee Society

General Information

The Mission of The Knee Society is:

- To advance knowledge of the knee joint in health and disease.
- To provide an appropriate educational setting that will maintain the highest level of professional standards in order to promote continuous advancement in professional knowledge and improved treatment of disorders of the knee.
- To create an optimum environment to enhance education, research and treatment of arthritis of the knee joint.
- To promote and maintain professional standards to provide the best care to patients with arthritic disorders of the knee joint.

Meeting Objectives:

The Knee Society Specialty Day Meeting is designed to provide practicing orthopaedic surgeons with current information regarding disorders of the knee, surgical and non-surgical treatments for the knee, and emerging technology. Scientific papers and symposia will present information on total knee arthroplasty to enhance the care of patients with painful, arthritic knee joints.

CME Accreditation:

This activity has been planned and implemented in accordance with the policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint sponsorship of the American Academy of Orthopaedic Surgeons (AAOS) and The Knee Society. The AAOS is accredited by the ACCME to sponsor continuing medical education for physicians.

The AAOS designates this educational activity for a maximum of 7.25 *AMA PRA Category 1 Credits™*. Physicians should only claim credit commensurate with the extent of their participation in the activity.

Important



Please **complete and return your evaluation form** to The Hip Society registration table at the conclusion of the program.



Please **silence all your electronic devices** while inside the session room.

Thank you for your cooperation!

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Announcements

Future Specialty Day Meetings

2012: San Francisco, CA – February 11

2013: Chicago, IL – March 23

2014: New Orleans, LA – March 15

Abstracts for the 2011 Knee Society Members Meeting and the 2012 Knee Society Specialty Day Meeting Award papers can be submitted on the Knee Society website.

(<http://kneesoc.conference-services.net/directory.asp>)

The deadline for receipt of abstracts is June 1, 2011

Abstracts for the 2011 AAHKS Annual Meeting (papers and posters) can be submitted on the AAHKS website (www.aahks.org).

The deadline for receipt of abstracts is June 1, 2011

Scientific Program

PROGRAM CHAIR KNEE SOCIETY

Mark W. Pagnano, MD (Rochester, MN)

PROGRAM CHAIR AAHKS

Brian J. McGrory, MD (Portland, ME)

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Financial disclosures on pages 62-67

SCIENTIFIC ABSTRACTS

SYMPOSIUM I: UNICOMPARTMENTAL KNEE ARTHRITIS

8:05-8:17 am

DEBATE: UKA Should Often Be Used Instead of TKA Today

Agree: David F. Dalury, MD

Towson Orthopaedic Associates, Towson, MD

The concept of Unicompartmental Knee Replacement (UKR) is an old one. Its appeal is understandable: replace only the part of the knee which has worn out. There are several reasons that UKRs have had limited adoption: confusion regarding appropriate patient selection, a number of poorly designed instruments and devices and historically poorer outcomes when compared with TKR. However, a cautious expansion of the traditional patient selection criteria combined with lessons learned from the last two to three decades of implant and instrument design have led to the feeling that UKRs should be used often today.

The traditional ideal UKR candidate was felt to be elderly, slender, and relatively inactive with isolated compartment disease and with minimal deformity. Recently however, there are reports of using UKR successfully in heavier patients (1,2), as well as in patients with patella-femoral disease in addition to femoral-tibial disease (3). Several reports (4,5,6,7,8) have also documented successful use of these devices in younger patients. This is in part due to the fact that the other alternatives (arthroscopy, osteotomy and TKR) are also compromises in this patient population. This internet savvy group also likes the idea of “less invasive” approaches and are exposed to a good deal of DTC marketing.

The original unicompartmental devices consisted of a simple chrome cobalt wafer and many early implants were implanted without the benefit of any instrumentation. Newer devices have improved bone-implant interfaces, less edge loading and improved polyethylenes. Many UKR systems now have instrumentation that is on par with modern TKR systems. These advances have improved a surgeon’s ability to place better designed devices in more predictable positions. Surgeons as well as many patients understand the concept of limited resurfacing of the knee. Perceived advantages of UKRs include: less bone resection on both the femur and the tibia, smaller incisions, less pain, a more rapid return to function, an improved range of motion (compared to a TKR) and an easier revision in the event of a failure. There have been multiple publications comparing UKR to TKR and the majority of these studies show that patients prefer their UKR, and are functionally superior (6,9). In the event of a failure and need for revision to TKR, more recent publications report that these procedures (barring catastrophic bone loss) are relatively straight-forward revisions (10).

A review of the more recent publications on the outcomes of UKR is much more encouraging than the historical reports. There are multiple series of varying types of devices documenting successful outcomes at 10 years. (11,12,13,14,15) One recurring finding in these publications is the overwhelming importance of appropriate patient selection in determining long term success. UKR are more technically challenging procedures than TKR. Surgeons have been hesitant to endorse the concept. However great progress has been made in terms of implant and instrument design. We are seeing reports now of good outcomes in the second decade. This, combined with a

cautious expansion of the criteria for patient selection would suggest that there is an increased role for UKR in the treatment of isolated disease of the knee.

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DEBATE: *UKA Should Often Be Used Instead of TKA Today*

Disagree: Robert E. Booth, Jr., MD
Pennsylvania Hospital, Philadelphia, PA

The penetrance of UKA into the arthroplasty armamentarium hovered for years at about 4%, and then rose precipitously to almost 15% with the synergy of MIS techniques. But outcomes have recently reduced that popularity by almost half. Indications vary widely and continuously, but the optimal candidate is true uni-compartmental bone-on-bone arthrosis. The literature – pro and con – is overabundant, reflecting the vigor of the ongoing controversy; but the best overall data unquestionably reside in national joint registries. Results vary with design, technique, and analysis instruments – but also with geography and institutional influence. Putative improvements of UKA over TKA in length of stay, incisional length, pain levels, speed of recuperation, range of motion, natural “feel”, etc. are all trumped by the unarguable double-to-triple revision rate, most particularly in the young who are the posited optimal candidates for this procedure. UKA proponents who would excuse this radical difference by asserting that “more UKA revisions are performed because they are easier to do” must understand that that is why UKA’s were done in the first place. Revisional results are not optimal for biologic, technical, and psychological reasons. The reduced expense of UKA has become a popular recent defense; but high quality arthroplasty at any expense is always ultimately more economical than low-quality arthroplasty at any saving.

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TKA vs UKA Outcomes: An Analysis using Prospectively Collected Clinical Patient Data

Steven J. MacDonald, MD

Lyndsay Somerville, PhD

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Introduction

Unicompartmental versus total knee arthroplasty has been a debated topic for decades. The purpose of this study was to compare the survivorship and clinical outcomes of a large primary total knee arthroplasty versus unicompartmental knee arthroplasty cohort.

Methods

A consecutive series of 6352 TKAs and 296 UKAs with a minimum of 1 year follow-up were evaluated. Pre-operative scores, latest scores, and change in clinical outcome scores (KSCRS, SF12, WOMAC) were compared and tested for significance using the students t-test.

Results

There were statistically significant differences in baseline demographics between the groups (followup 5.35 ± 4.04 vs 6.13 ± 4.57 , age 67.91 ± 9.52 vs 66.53 ± 8.46 , BMI 31.93 ± 6.81 vs 29.57 ± 5.67 in TKAs and UKAs respectively). UKA patients had significantly higher postoperative SF12 Mental Scores and KS scores ($p < .05$). However they also had significantly higher preoperative scores ($p < .05$) and it is the change scores that determine the efficacy of the intervention. The change scores for all WOMAC domains (stiffness, pain, function, total) were not different between the groups. The KS change scores were not different between the groups for total scores and favoured TKA over UKA for knee scores (48.9 vs 43.6 , $p < .0001$) and UKA over TKA for function scores (27.03 vs 22.6 , $p < .05$). The SF12 change scores demonstrated no differences between groups for Mental and Physical scores. Cumulative revision rates were 11.7% for UKAs and 7.3% for TKAs.

Discussion

In this cohort of patients undergoing TKA and UKA, there were significant differences in preoperative and postoperative outcome scores, but much fewer differences in change scores in most domains of WOMAC, SF12 and KSCRS. When comparing outcomes between these interventions it is critical to evaluate change scores and not raw postoperative scores alone.

Lateral Unicompartmental Knee Arthroplasty via a Lateral Parapatellar Approach

Keith R. Berend, MD^{1, 2}

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Background

Unicompartmental knee arthroplasty continues to raise interest and debate. However, there exists little data specifically examining the results of or indications lateral unicompartmental knee arthroplasty (LUKA).

Questions/purposes

The purpose of this study is to report the survivorship and clinical results of LUKA using a lateral parapatellar approach.

Patients and Methods

Retrospective review of electronic records from 2004 through 2008 revealed 132 consecutive LUKA. Indications for LUKA were complete lateral bone-on-bone arthrosis with a correctible deformity and maintenance of the medial joint space on varus stress radiographs or isolated lateral disease by diagnostic arthroscopy. A fixed bearing, metal-backed tibial component was used and all components were cemented. A lateral parapatellar approach was used in all cases and no case was aborted to total knee arthroplasty.

Results

109 LUKA were available for review. The average age was 69.5 years. 70% of patients were women. Follow-up averaged 29 months (12-70 months). Average knee scores at follow-up were: pain-46, clinical-94, functional-89 and range of motion 124 degrees. Two reoperations were performed: one open reduction and internal fixation for fracture at 2 years postoperatively, and one arthroscopy for medial meniscal tear. No knees are pending revision, for 100% implant survivorship.

Conclusions

The anatomic indications of complete cartilage loss laterally and correctible deformity with maintenance of the medial joint on varus stress radiographs appear valid for LUKA providing 91% good/excellent results. Implant survivorship was 100% survivorship using these inclusion criteria and a lateral approach. No knees required intraoperative conversion to total knee arthroplasty.

Level of evidence

Level IV, Case series (retrospective study) See the Guidelines for Authors for a complete description of levels of evidence"

DEBATE: *No Clinical Advantage of Mobile-Bearing over Fixed-Bearing UKA*

Agree: Craig J. Della Valle, MD
Midwest Orthopaedics at Rush, Chicago, IL

Fixed bearing unicompartmental knee arthroplasty (UKA) has a long history that extends back nearly as far as the first tricompartmental designs. While initial results were erratic, with a greater understanding of patient selection and surgical techniques, more consistent and favorable results have been reported with survivorship that rivals that of TKA. Despite the recent popularity of mobile bearing UKA, there are several compelling reasons to select a fixed bearing design.

Among the primary advantages of a fixed bearing design is a surgical technique that is straightforward, familiar and forgiving. When a mobile bearing design is utilized, there is a risk of bearing dislocation unless the flexion and extension gaps are precisely balanced. Comparative studies of fixed and mobile bearing UKA show that mobile bearing UKA has a higher rate of early complications compared to a fixed bearing design. Further, in an effort to avoid bearing dislocation, the surgeon may be tempted to utilize a thicker bearing that can predispose to contralateral compartment arthritis. Finally, mobile bearing designs are not presently available for implantation on the lateral side of the knee as prior studies have shown an unacceptable risk of bearing dislocation.¹⁰

The theoretical advantages of a mobile bearing design include lower wear and a lower risk of loosening secondary to decreased stress at the implant interfaces. Interestingly, in most series of fixed bearing designs, wear is a relatively uncommon cause of failure while loosening is a not uncommonly reported mode of failure of mobile bearing designs. While both mobile bearing and fixed designs can be associated with excellent outcomes, the theoretical advantages of lower wear and implant stresses must be weighed against the relative complexity of the mobile bearing surgical technique and risk of bearing dislocation.

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DEBATE: *No Clinical Advantage of Mobile-Bearing over Fixed-Bearing UKA*

Disagree: Richard D. Scott, MD

Brigham and Women's Hospital Physician Organization, Boston, MA

For the first decade following surgery, reoperation rates for a UKA implanted in the 1970's remained competitive with those for TKA. Both procedures had a revision rate of approximately 1% per year. Long-term follow-up of UKAs done in the 1970s, however, showed an increasing incidence of the need for reoperation in the second decade compared to reports documenting reoperation rates for TKA¹. Modes of failure of UKA during this era were most frequently due to wear, loosening and degeneration of the opposite compartment. The metal-to-plastic articulation was often flat-on-flat and this highlighted the problem of edge-loading as a cause of wear. Some wear problems were also due to the use of metal-backed components that had only 2 mm of polyethylene in the anterior and posterior areas of the articulation. Retrievals of failures from this group of patients showed that the wear pattern of the polyethylene was anterior and peripheral². It soon became apparent that the prosthetic unicompartmental wear pattern replicated the preoperative articulating pattern of the arthritic knee as described by White and colleagues³. All fixed-bearing UKA designs are subject to this wear pattern.

Attempts were made to address the edge-loading issue and redirect the wear pattern by making the prosthetic articulation more conforming. These attempts to alter the wear pattern with a conforming fixed-bearing design, however, created a kinematic conflict that led to an increased incidence of femoral and/or tibial component loosening due to the increased force transmitted to the fixation interface. It became apparent that fixed-bearing UKA articulations must be non-conforming and remain round-on-relatively flat.

Here is where a clinical advantage of mobile bearing UKA can be demonstrated. A highly conforming UKA articulation must be mobile-bearing in order to eliminate the adverse effects of constraint on the fixation interface. A further advantage of a mobile-bearing articulation is the potential to provide a metal-backed component with a conservative composite thickness. Fixed-bearing metal-backed components are usually designed with a minimum of 6 mm of polyethylene. This mandates that the composite thickness with a 2 mm thickness of metal be a minimum of 8 mm and more often the metal backing is 3 mm increasing the composite thickness to 9. With the mobile-bearing knee, the FDA has approved a 3 mm polyethylene thickness because of the documented improved wear characteristics and long-term experience with this highly conforming articulation. The metal backing is 3 mm allowing a composite thickness as thin as 6 mm. One of the basic principles of unicompartmental arthroplasty is to perform an initial conservative tibial resection. This 6 mm composite allows this principle to be fulfilled. Until mobile-bearing knees were approved in the United States, the only way to achieve a conservative tibial resection was to use an all-polyethylene tibial component. Mobile-bearing UKA may also allow patient selection to become more liberal regarding age, weight and activity level.

Conclusions

UKA is an attractive alternative to osteotomy or total knee arthroplasty in selected osteoarthritic patients using either mobile-bearing or fixed-bearing technique. Both techniques appear to yield equivalent early results. Mobile-bearing articulations have the advantage of allowing a metal-backed component to be utilized with a composite thickness as thin as 6 mm. They also offer the potential for decreased long-term wear complications^{4,5,6}. The longevity of fixed-bearing components will likely be improved in the future with better prosthetic designs and improved polyethylene to minimize long-term wear complications.

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The Outcome of Fixed and Mobile-Bearing Unicompartmental Arthroplasty at a Minimum Fifteen-year Follow-up

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Sebastien Parratte, MD
Jean-Manuel Aubaniac, MD
The Aix-Marseille University, Marseille, France

Introduction

There is still controversy whether there is a clinical difference between fixed or mobile bearing unicompartmental arthroplasty (UKA). The objective of this study was to compare the clinical and radiological long-term outcome and the survivorship of fixed and mobile metal-backed cemented UKA.

Methods

The study included 156 knees in 147 patients operated on by the same surgeon following the same selection protocol between 1989 and 1992 in the same center. Seventy-nine knees received a fixed-bearing UKA (FB group) and 77 patients a mobile-bearing (MB group) UKA. All implants were cemented in both groups. Mean age of the patients (63 years-old), gender and BMI (26Kg/m²) were comparable in the two groups.

Results

At a minimum of fifteen-year follow-up, the mean KS function and knee scores were respectively 82 and 88 points in the FB group and 81 and 89 points in MB group (NS). Radiographically, the number of radiolucencies was statistically higher in the MB group (69% vs 24%, $p < 0.001$). At final follow-up, considering revision for any reason, 12/77(15%) MB UKA were revised (for aseptic loosening, dislocation, and arthritis progression) and 10/79(12%) FB UKA (for wear and arthritis progression) ($p = 0.44$). In the FB group 4 out of the 7 presenting for wear have been treated with a direct liner exchange without implant removal.

Conclusion

According to these results, no statistical differences were observed in terms of clinical results and survivorship. However specific complications and modes of failure were observed in each group.

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The Impact of Body Mass Index on the Outcome of the Unicompartmental Knee Replacements

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Previous studies have suggested that unicompartmental knee replacements (UKR) tend to have high failure rates when used in obese patients. These failures are commonly due to loosening and wear. Mobile bearing UKR have large contact areas and low levels of shear stress at the bone implant interface so have low rates of loosening and wear. The aim of this study was to investigate the impact of BMI on the failure rate of mobile bearing UKR.

A consecutive series of 2465 knees from two centres in two countries treated with the Oxford Phase 3 medial UKR were studied prospectively. The maximum follow up was 12 years. Patients were divided into the following groups: BMI <25 (Normal body weight, n= 380), BMI 25-30 (overweight n= 869), BMI 30-35 (Obese class I, n= 722), BMI 35-40 (obese class II, n=290), and BMI more than 40 (morbidly obese, n= 204). The 7 year survival rate in the various groups was: BMI <25, 97%; BMI 25-30, 95%; BMI 30-35, 91%; BMI 35-40, 94%; and BMI more than 40, 98%. There was no significant difference in the survival between the groups (p=0.51).

In this large two centre series of Oxford UKR the failure rate did not increase with increasing BMI. This suggests that it is safe to use mobile bearing UKR in the Obese and therefore that obesity should not be considered to be a contra-indication to mobile bearing UKR.

SYMPOSIUM II: CONTROVERSIES IN PRIMARY TKA

9:15-9:27 am

DEBATE: *A Minimally Invasive Approach is Best for Most Patients Today*

Agree: Peter M. Bonutti, MD

Bonutti Orthopaedic Clinic, Effingham, Illinois

Minimally invasive approaches for total knee arthroplasty refer to techniques that reduce soft tissue exposure. Numerous surgeons have defined features of MIS as they relate to the length of the incision, quadriceps muscle exposure, capsular disruption, patellar eversion, and rapid recovery. Others have challenged the terminology of MIS and suggested less invasive approaches should be described as reduced tissue trauma¹. It has been suggested that MIS is really an evolutionary approach involving gradually reducing the incision, soft tissue, and muscle exposure based on the surgeon's skills and technique as well as the patient's size and deformity². The term "mobile window" has been used to describe the gradually changing position of the knee during the surgical procedure to facilitate exposure³. Surgical technique is enhanced by down-sized soft tissue friendly instrumentation, appropriate retractors, adjustable leg holders, and foremost surgical experiences. The learning curve can vary substantially with different techniques and has been quoted as high as 60 cases with some surgical approaches⁴.

In comparison studies on quadriceps exposure, midvastus, subvastus and quadriceps sparing (QS) approach, no one exposure has been defined as superior^{5, 6, 7}. For most, the QS approach has the largest learning curve and risk for implant outliers.

In a prospective, randomized, double-blind comparison of midvastus versus median parapatellar the midvastus had less blood loss, low risk of lateral release, earlier straight leg raise, and early range of motion at 45 days (all statistically significant)⁸.

In another comparison study, with different proposed features of MIS exposure including patellar subluxation versus eversion, the literature is conflicting. A prospective, randomized study with simultaneous bilateral knees found no difference in results of patellar eversion versus subluxation⁹, yet both randomized studies found that patellar eversion improves range of motion, has less pain, and decreases the rate of manipulation^{10, 11, 12}.

In a recent, prospective, randomized study no significant difference in minimally invasive versus more traditional total knee arthroplasty procedures was found¹³. Radiographic measurements demonstrated reliable implant positioning in both groups.

If the results are comparable, why would a surgeon want to use a traditional approach if a minimally invasive or less invasive approach may improve short term recovery? If there are comparable radiographic results, why should surgeons use a more traditional approach? MIS is not purely about cosmetics of the incision. Cosmetics might relate to the closure, such as subcuticular versus a staple closure. The length of the incision can have functional implications including paresthesia lateral to the incision and discomfort, with clothing wear and kneeling. An incision appropriately placed with reduced soft tissue trauma is best for most patients today. Our clinical experience suggests that with adequate training and working through an appropriate learning curve, the majority of patients can have total knee arthroplasties performed through a minimally invasive surgical approach with the goal of reducing the overall soft tissue disruption.

There may be limited short-term improvement in terms of rapid recovery in the first few weeks. Longer-term data does not suggest substantial clinical improvements.

Many surgeons have been evolving their instruments and their technique to try to reduce the overall incision length and reduce the soft tissue trauma in an evolutionary approach as prospective data suggest the results of MIS surgery are at least as good as traditional total knee arthroplasty and may have improved short term recovery.

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9:15-9:27 am

DEBATE: *A Minimally Invasive Approach is Best for Most Patients Today*

Disagree: William J. Maloney, III, MD

Elsbach-Richards Professor and Chair

Department of Orthopaedic Surgery

Stanford University School of Medicine, Redwood City, CA

Total knee replacement has been a reliable procedure for decreasing pain and increasing function in patients with end stage arthritis for more than three decades. Minimally invasive total knee arthroplasty was advocated with little evidence to support its use. We performed a study evaluating a consecutive series of revision total knee replacements over a three year period. 18.6% of the revisions were done in patients who had a minimally invasive total knee done as the index procedure. In contrast to standard incision surgery, those requiring revision after MIS surgery were significantly young and had revision done at a significantly earlier time period (14.8 v 80.0 months). Several studies have demonstrated the importance of getting the parts in right. Minimal exposure surgery can compromise this goal and lead to early failure.

DEBATE: *Local Anesthetic Injections vs. Peripheral Nerve Blocks for Postop Pain*

Local Injection: Robert B. Bourne, MD, FRCSC

Division of Orthopaedic Surgery, University of Western Ontario, London, ON, Canada

Pain immediately after surgery has been identified as the number one concern of preoperative TKA patients and as a result, the focus of intense research (1). Although no universal pain management protocol has been established, preoperative patient education, preemptive analgesia, regional anaesthesia, the use of peripheral nerve blocks or periarticular injections and multimodal postoperative pain control, monitored by an acute pain service, are commonly used approaches. The purpose of this debate is to compare the efficacy and safety of two effective strategies in reducing postoperative TKA patient pain, namely peripheral nerve blocks versus periarticular injections.

While peripheral nerve blocks are effective in reducing pain after TKA, there are drawbacks with this approach. First, the establishment of a "block room" requires considerable organization and specialized anaesthesiologists. Second, many patients experience discomfort during insertion of the peripheral nerve blocks. Third, there is a risk for surgical delay, if the blocks do not go well. Fourth, significant complications have been reported with peripheral nerve blocks (ie. infection, hematoma, nerve damage, organ perforation and postoperative falls).

Over the past decade, periarticular injections have been employed safely in over 10,000 TKAs and THAs at our center. We have published two randomized controlled trials on the safety and efficacy of this technique (2,3). Periarticular injections have proven to be not only effective, but also an inexpensive alternative to peripheral nerve blocks with no systemic effects and no interference with other medications. A combination of 1% ropivacaine (400 mg), 1:1000 epinephrine (0.6 ml), preservative-free morphine (5 mg) and ketorolac (30 mg), mixed with sterile saline to make up a combined volume of 100 ml, and injected into the surrounding tissues at the time of surgery have significantly reduced patient pain, improved patient satisfaction and reduced the need for patient-controlled analgesia with no apparent risks following TKA and THA surgery.

In conclusion, the use of periarticular injections remain a cornerstone of pain management following TJA at our institution. Many other centers have adopted this technique and report similar results. Indeed, many have stated that the use of periarticular injections have been one of the most significant improvements in their TJA surgical practices!

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DEBATE: *Tourniquet Use: During Cementing Only, if at All*

Agree: Robert T. Trousdale, MD

Professor of Orthopedics
Mayo Clinic, Rochester, MN

Pros of Tourniquet Use in TKA

- drier surgical field
- ? better cement interdigitation (no good data to support)
- ? ↓ transfusion requirement (data is controversial on blood loss)

Negatives of Tourniquet Use in TKA

- local trauma to thigh muscles
- local trauma to thigh nerves
- local trauma to blood vessels
- metabolic issues related to ischemia
- hyperemia after release
- miss large bleeding vessels
- embolic load to heart and lungs after release
- difficulty in early postoperative rehabilitation
- affects assessment of patellar tracking
- negative affects of wound hypoxia

Best of Both Worlds – Tourniquet Only During Cementation

- minimize known negatives of tourniquet (above)
- maximize cement interdigitation
- optimize coagulation of big vessels (lateral inferior geniculate, middle geniculate)
- minimize metabolic ischemic issues
- minimize local trauma to muscles, nerves, blood vessels

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9:39-9:51 am

DEBATE: *Tourniquet Use: During Cementing Only, if at All*

Disagree: Thomas S. Thornhill, MD

John B. and Buckminster Brown

Professor of Orthopedic Surgery

Harvard Medical School

Chairman, Department of Orthopedics

Brigham and Women's Hospital, Boston, MA

One problem of a debate forum is that each participant is expected to defend a specific point of view. I will choose to define the debate as to whether there is ever an indication for using a tourniquet in total knee arthroplasty as; in fact, I frequently use a tourniquet in TKR only for cementation.

The advantages of using a tourniquet are that exposure is quicker and easier. Visualization, especially posterior ally is better under tourniquet. The preparation of the bony bed for cementation is better when a tourniquet is used (even better than when the tourniquet is used only for cementation). It is unclear as to whether this makes a better mechanical interlock or improves the long-term support at the bone cement interface.

There are physiological data suggesting that a tourniquet time under 2 hours does not create irreversible tissue harm. Operating room engineering systems monitor the accuracy of the tourniquet boxes and systems are in place to assure tourniquet times are not excessive.

I currently do not use a tourniquet except for cementing in approximately 30% of cases. The selection is based on a variety of local and systemic issues. Obese patients and patients with calcific arteritis will oftentimes make it impossible to achieve an arterial tourniquet. Moreover, there is concern of distal embolization of damage calcific debris at high tourniquet pressures. Tourniquets are not used in people with severe peripheral vascular disease or in patients where a vascular graft would cross the tourniquet area. Tourniquets are restricted for cementing only in patients with a significant history of pulmonary embolism and recurrent deep venous thrombosis. This is to prevent elevation of tissue thromboplastin and other prothrombotic agents.

Tourniquets are not used in patients with a history of patent foramen ovale as it has been recorded by transesophageal echo that there is, upon tourniquet deflation, a shower of fat, marrow elements and clot to the right side of the heart that could paradoxically embolize to the arterial side. Finally, patients with an increased risk for hematoma (those requiring Plavix, low molecular weight heparin bridging and with certain coagulopathies) undergo knee replacements where the tourniquet is used only during the cementing.

In summary, my current practice is to be selective in using tourniquets during total knee replacement.

DEBATE: Bilateral TKA in One Operation is Rarely Appropriate

Agree: Leo A. Whiteside, MD

Missouri Bone & Joint Center, Saint Louis, MO

The advantages of simultaneous bilateral total knee arthroplasty are few. It is more convenient for the patient and a little less expensive for the hospital. It has many disadvantages. Most studies show that the risks of cardiopulmonary complications are substantially greater for bilateral than for staged unilateral total knee arthroplasty, and this is especially true when one considers the selection bias inherent in all the retrospective studies, assigning the younger and healthier patients to the simultaneous bilateral cohort. Transfusion risk is higher for bilateral knees in every study. Many would agree that a Swan-Ganz catheter is necessary for bilateral TKA, and this procedure has its own set of complications. Many patients decide against having their second knee replaced, which also saves them time and money, so the apparent monetary advantage of bilateral total knee arthroplasty may not hold up. Because the complications can be so catastrophic, any advantage in terms of complication rate for the unilateral staged procedure should overcome any slight advantage in savings of time and money for the simultaneous bilateral total knee arthroplasty.

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DEBATE: *Bilateral TKA in One Operation is Rarely Appropriate*

Disagree: Thomas P. Sculco, MD

Hospital for Special Surgery, New York, NY

Bilateral one stage total knee replacement has a number of advantages. There is one operative procedure and anesthetic and overall recovery time is significantly reduced. It is a more cost effective procedure in that acute hospital stay is less and although rehabilitation time is greater in the short term overall it is less. Additionally if there is a bilateral flexion contracture present there is an inevitable loss of extension if a single knee is operated upon as this knee will assume the position of the unoperated knee. Patients greatly prefer having both knees corrected at one operative setting rather than having to have the inconvenience and pain associated with a second operative procedure at three to six months after the first one.

There are potential disadvantages to a one stage procedure. One concern has been that there is more perioperative morbidity associated with one stage bilateral total knee replacement. In a review of 501 patients undergoing bilateral one stage total knee replacement at the Hospital for Special Surgery there were no perioperative deaths, myocardial infarctions or cerebrovascular accidents. There were arrhythmias present in 5 % of patients. Fat emboli were present in 3% and 2 patients (0.4%) had pulmonary emboli. The average transfusion requirement was 2.6 units and allogeneic blood was required in 42 %. There were 2 deep infections, 3 hematomas and 5 patients with delayed wound healing. Average hospital stay was 7.2 days but this had decreased in the more recent patients. There was an increased incidence of major complications in patients with ASA classification 3 and with increasing age over 70 years.

New data indicates perioperative administration of hydrocortisone may mitigate lung injury as demonstrated by reduction in cytokine and desmosine levels in a randomized trial.

Patient selection is important and all patients are screened preoperatively by an internist and anesthesiologist. All patients underwent the procedure with epidural anesthesia with postoperative epidural PCA for 48 hours. All patients are discharged on warfarin and spend the operative night in the recovery room. The procedure has acceptable morbidity and great advantage in properly selected patients.

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10:45-10:51 am

Clinical Outcomes and Cost Analysis of Standard versus Barbed Sutures for Layered Closure in Primary Total Knee Arthroplasty

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Introduction

While no studies have reported on the use of barbed suture for closure in orthopaedics, the plastics literature has reported favorable results in terms of operative efficiency and outcome. We sought to determine if there were differences in clinical outcome and cost when comparing barbed suture to standard knotted suture in layered closure in primary total knee arthroplasty (TKA). We hypothesized that use of barbed suture in TKA closure would be associated with shorter closure times, less cost, and have no difference in complication rates compared to standard suture technique.

Methods

We performed a retrospective cohort study comparing two layered closure techniques in primary TKA. The barbed group consisted of 104 consecutive primary TKAs closed with barbed suture (#2 and 0 Quill™SRS PDO Suture). The standard group consisted of 87 consecutive primary TKAs closed with interrupted suture (#1 Ethibond™ and 2-0 Monocryl™). Cost analysis was based upon cost of suture and operating room time. Clinical outcomes were graded according to the Knee Society knee score. Clinical records were assessed for complications at six-week follow-up.

Results

Average closure time was significantly improved with the use of barbed suture (19.6 min vs. 22.0 min, $p=0.012$). The barbed suture cost \$36.70 more for each knee closure (\$43.16 vs. \$6.46).

When improved closure time was factored into the analysis, the total closure cost was not significantly different between the two groups (\$595.23 vs. \$627.51, $p=0.237$). There was no significant difference in total Knee society knee score improvement between the two groups ($p=0.479$). The complication rates were similar between the groups ($p=0.215$).

Conclusions

This study demonstrates that use of barbed suture is associated with significantly shorter closure time, similar overall cost, and no difference in clinical outcomes or postoperative complications in primary TKA. Positive experience with this closure methodology has lead to more widespread utilization at our institution.

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Six-Week Postoperative COX-2 Inhibitor Use Improves TKA Recovery: A Double-Blind, Placebo-Controlled Study

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A double-blind, placebo-controlled study of a selective COX-2 inhibitor was administered in 107 patients for six weeks after total knee arthroplasty to determine any benefits in knee rehabilitation. All patients received celecoxib 400mg preoperatively and during hospitalization. At hospital discharge, patients were randomized to receive celecoxib 200mg twice daily or placebo twice daily for six weeks. Narcotic use, knee flexion, Knee Society Score (KSS), Oxford Knee Score (OKS), and SF-12 scores were determined preoperatively and at postoperative intervals to one year. Visual Analog Scores (VAS) documented pain at rest, at night, and with activities. Narcotic pill use was statistically significantly lower for the celecoxib group (76.3 ± 55) compared with the control group (138 ± 117). The celecoxib group had significantly better VAS scores, knee flexion, KSS scores, OKS scores, and SF-12 physical composite scores than did the placebo group. Knee flexion remained significantly better in the celecoxib group through one year. No patient had an adverse medical event in response to the study medication. These results demonstrate that patients who took celecoxib for six weeks after TKA had a less painful and more rapid recovery.

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A Retrospective Evaluation of the Efficacy of Plasma Rich Platelet Gel for Improving Outcomes in Total Knee Arthroplasty

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Introduction

Numerous reports have suggested that the application of platelet rich plasma (PRP) to incision during TKA may substantially decrease postoperative bleeding. Furthermore, since excessive bleeding can increase postoperative pain and inflammation, use of a PRP has also been reported to decrease the need for analgesics and speed recovery following TKA. We sought to determine if an intraoperative application of PRP to incision: (1) reduced postoperative bleeding; (2) increased postoperative passive range of motion; (3) reduced postoperative analgesic use, and (4) decreased length of hospital stay.

Patients and Methods

140 patients who received an intraoperative application of PRP during TKA were matched closely to 139 patients undergoing TKA who did not receive PRP. Detailed data including the hemoglobin level, range of motion, postoperative narcotic use and length of hospital stay.

Results

The blood loss, as determined by the hemoglobin drop on postoperative day 2, between patients receiving PRP during surgery was similar to patients who did not receive PRP (3.75 vs. 3.59 g/dl). Differences in passive range of motion (87.9 vs. 88.1 degrees), narcotic requirement (27.4 vs. 31.7 morph. equiv), and length of stay (2.43 vs 2.62 days) were equally similar and not statistically significant.

Conclusion

These data suggest that unlike similar studies, there were no significant clinical differences among patients who received an intraoperative application of PRP compared to patients who did not receive PRP.

Level of Evidence

Level II, prognostic study.

2-Night Hospital Stay did not Increase TKA Complications or Readmissions

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Mayo Clinic, Rochester, MN

Introduction

There has been a push in recent years towards earlier discharge after total knee arthroplasty (TKA), but there is still some concern whether this practice could lead to higher complication and readmission rates. The objective of this study was to assess in a consecutive group of patients whether early discharge from the hospital resulted in higher complications rates and readmissions to the hospital. We hypothesized that the readmission rate with a rapid discharge protocol would increase 5%.

Methods

The charts of 1016 TKA were reviewed for 90 day readmission and postoperative complications. 537 patients underwent TKA between January 1, 2008 and June 30, 2008 prior to implementation of early discharge protocol (Group 1). These were compared with 579 patients undergoing TKA between July 2009 and December 31, 2009 after the protocol was up and running for 6 months (Group 2). Patients' charts were reviewed for 90 day readmissions as well as complications. Patient age, gender, BMI and the ASA scores were used as independent variables. Approximately 600 patients in group 2 would give a power of 80% to detect a difference in readmission rates of 5%.

Results

The average LOS decreased from an average of 3.8 days in 2008 to 2.9 days in 2009. The readmission rate in group 1 at 30 and 90 days was 6.7% and 8.3%, respectively. In group 2, the readmission rate was actually lower, 5.5% and 7.9% respectively. There was no significant difference in readmission rates between Group 1 and 2 during the 90 days period (log rank p val=0.69). Further more, there was no association between readmission and TKA for the two time periods after adjusting for meaningful co-variables (OR 0.95(0.68,1.45)).

Discussion

A rapid discharge protocol after TKA did not increase the risk of 90 day readmission to the hospital. There was no significant difference in readmissions between groups when stratified by BMI or ASA scores and the protocol could be applied safely across all patient groups. A decrease in 1 day of length of stay is cost saving for the institution.

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SYMPOSIUM IV: LATEST KNOWLEDGE ON ALIGNMENT IN TKA

11:20-11:32 am

DEBATE: *The Best Way to Establish Alignment in TKA*

Mechanical Axis with CAS - William J. Hozack, MD¹

Gregory K. Deirmengian, MD

¹Rothman Institute Orthopaedics, Philadelphia, PA

Two issues we are dealing with in this debate

1. What is the best way to achieve mechanical axis alignment of a TKA?

- Prospective randomized studies prove that CAS is the best way
- Why do I use CAS?
- Information is power - even if mechanical axis numbers are found not to be the only critical issue, CAS gives the surgeon much more information about what is happening during the operation (soft tissue balance, component sizing, etc) and allows the surgeon to make more educated decisions about what to do, as compared to standard instrumentation systems.
- I like having the information available from CAS to help me make decisions about the operation, so I believe that CAS in some form is the future of TKA

2. Is the mechanical axis the proper way to align a TKA to achieve the best clinical result?

- Many studies suggest that clinical results of TKA are directly related to mechanical axis restoration
 - The problem is that not all studies have found this to be true
 - So, who and what to believe?
 - Does this controversy justify clinical application of unproven theories?

DEBATE: *The Best Way to Establish Alignment in TKA*

Cylindrical Axis with Patient Specific Guides – Stephen M. Howell, MD

Professor of Mechanical Engineering at University of California at Davis, Sacramento, CA

The clinical outcome with modern-day mechanically aligned TKA with conventional or computer assisted instruments has a ceiling effect with up to 1 out of 4 patients self-reporting dissatisfaction in the UK, Canada, and US ^{1,2,14}.

In most patients, mechanically aligning the limb and components to a neutral or 0° hip-knee-ankle angle changes the obliquity of the distal joint line and limb alignment from normal ^{5,10}. The change in the distal joint line requires a compensatory change in the posterior joint line (axial rotation) of the femoral component to minimize the inevitable imbalance of the collateral and retinacular ligaments ^{4,5}. The change in the obliquity of the distal and posterior joint lines from normal alters patellofemoral and tibiofemoral kinematics resulting in patellofemoral pain, instability, persistent effusions, and loss of motion and is believed to cause the ceiling effect with mechanically aligned TKA.

Kinematic alignment considers the 3-D alignment of the components with respect to the knee instead of the 2-D alignment of the components with respect to the center of the femoral head and ankle. The intent of kinematic alignment is the restoration of the normal 3-D orientation of the three axes that describe normal knee kinematics ^{7,8,11}. Shape-fitting a femoral component with symmetric, single-radius condyles on the articular surface of the femur after correcting for wear and kerf reestablishes the normal obliquity of the distal and posterior joint lines and the two parallel transverse axes in the femur about which both the tibia and patella flex and extend ^{7-9,11}. Most surgeons that perform kinematically aligned TKA notice a better clinical outcome, better motion, better patient satisfaction, and a quicker recovery than their patients treated with mechanically aligned TKA ^{7,11,12}.

Intraoperatively, kinematic alignment can be performed with patient-specific guides, navigation or manual instruments. Kinematic alignment of the femoral component is confirmed when the thickness of the two distal and two posterior bone resections equal the thickness of the condyle of the femoral component after correcting for cartilage wear (1-2 mm) and the kerf of the saw blade (1- 1.5 mm) ^{9,15}. With few exceptions, kinematic alignment restores motion and patella tracking without the release of the collateral, posterior cruciate, and retinacular ligaments as long as any medial, lateral, and posterior osteophytes are removed and the posterior capsule is released from the femur when there is a fixed flexion contracture ^{7,11,15}.

A CT analysis of 39 subjects with a kinematically and mechanically aligned TKA showed the average hip-knee-ankle angle and the femoral-tibial angle of the knee are the same, but the variability (0-21°) was wide within a subject. In the kinematically aligned TKA, the femoral component was $3 \pm 2^\circ$ more valgus and the tibial component was $2.4 \pm 2.4^\circ$ more varus. The 2.4° degree of varus of the kinematically aligned tibial component is similar to the $3 \pm 3^\circ$ varus of the tibial component in a clinical study that showed 96% survivorship at 10 years ¹³. Assuming that the alignment of the limb, knee, and components are important for the longevity of the prosthesis, then the rate of wear, loosening, and survival in the kinematically TKA should not be greater than the mechanically aligned TKA.

Although the principles of kinematic alignment are time honored since first described by Hollister in 1993 ⁶, the first clinical use of kinematic alignment in TKA in January 2006 is relatively new. We are awaiting a Level 1 randomized, double blind, clinical trial to determine the

differences and similarities in alignment, clinical outcome, and motion between kinematically and mechanically aligned TKA³.

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Alignment and BMI, Factors Associated with Total Knee Replacement Failures - Robert A. Malinzak, MD

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Kenneth E. Davis, MS

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Summary

A neutral overall alignment (2.5° - 7.9°) component position (tibia $>90^{\circ}$, femur $<8^{\circ}$) and a BMI <41 is critical for the survival of a total knee replacement.

Introduction

The purpose of this study was to determine the importance of tibiofemoral alignment and both femoral and tibial component positions upon failure of a total knee replacement. Whether the 'correction' of one component for another malaligned component, to produce a neutral overall alignment, is favorable. To define the range of neutral that is associated with the least amounts of failures, and the effect of BMI and alignment on implant survival.

Methods

We retrospectively reviewed the pre-operative BMI and the post operative overall coronal tibiofemoral and tibial and femoral component alignments in 6070 knees. Cox regression was performed on failures (excluding infection) with all patient-related factors including overall alignment, component positions and BMI.

Results

The tibial component position of $<90^{\circ}$ and a femoral component position of $>8^{\circ}$ were the primary component angles most likely to be the cause of failure ($p<0.0001$) and if both were abnormal there was a failure rate of 8.7%. Patients with both a neutral tibial (90° through 102°) and femoral component (< 7.9) had the best overall survival with a 0.2% failure rate. 'Correction' of component malalignment (varus or valgus) to attain neutral tibiofemoral alignment (2.5 through 7.4) resulted in failure rates of 1.5% (varus) and 1.4% (valgus), respectively. An increasing BMI resulted in an increasing failure rate in well-aligned knees (0.7% to 2.6%), varus knees (1.6% to 2.9%) and valgus knees (1.0% to 7.1%).

Conclusions

Attaining neutrality in all three alignments is important in increasing implant survival, however one should be aware that the patient's size also plays a major factor upon failure. Substantial 'correction' of one component to correct for another malaligned component in order to produce a neutrally aligned TKR is not beneficial. Neutrality is large enough for conventional instruments.

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SYMPOSIUM V: PATIENT SPECIFIC INSTRUMENTATION FOR TKA

1:00-1:06 pm

Improved Accuracy of Alignment with Patient-Specific Positioning Guides Compared with Manual Instrumentation in Total Knee Arthroplasty

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Vincent Y. Ng, MD

Jeffrey H. DeClaire, MD

Keith R. Berend, MD

Bethany C. Gulick, RT (R)

Joint Implant Surgeons, Inc., The Ohio State University, and Mount Carmel Health System,
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Background

Coronal malalignment occurs frequently in total knee arthroplasty (TKA) and reduces implant longevity and function. Designed to improve consistency and efficiency, patient-specific positioning guides (PSG) generated from preoperative imaging studies represent a paradigm shift from manual instrumentation (MI) and intraoperative computer navigation.

Questions/Purposes

We wished to compare the efficacy of PSG to MI in (1) restoring the mechanical axis of the extremity and (2) achieving neutral alignment of the femoral and tibial components.

Methods

We retrospectively examined 696 postoperative anteroposterior standing long-leg radiographs after TKA (545 PSG, 151 MI) by two surgeons. Coronal alignment was assessed by determining the zone in which the overall mechanical axis (OMA) passed through the knee, measuring the hip-knee-ankle (HKA) angle between the tibial and femoral mechanical axes, and finally, noting the alignment of the femoral and tibial components with respect to their mechanical axes.

Results

The OMA passed through the central third more frequently with PSG than MI for both surgeons (A: 86.6% vs. 77%, $p=0.02$; B: 86.4% vs. 74.5%, $p=0.11$). While the percent of HKA angle outliers $>3^\circ$ was similar between PSG and MI, the mean error from neutral for these patients was significantly less with PSG than MI (4.50° vs. 5.25° , $p=0.0031$). For the senior author, the tibial component demonstrated no significant difference between PSG and MI. With PSG, the average individual deviation from neutral for the femoral component was significantly less (0.91° vs. 1.34° , $p=0.0005$) and had fewer outliers $>2^\circ$ (4.9% vs. 19.6%, $p=0.017$).

Conclusions

Patient-specific positioning guides can assist in restoration of the mechanical axis with reduction in outliers.

Level of Evidence

Level III, retrospective case-control study

Accuracy of Implant Placement using Customized Patient Instrumentation

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Introduction

Alignment and positioning of implants is important in total knee arthroplasty (TKA). Customized patient instrumentation is a new innovation that combines preoperative planning with customized cutting jigs. The accuracy of implant placement has not been well studied. We compared the postoperative implant alignment of patients undergoing surgery with product A to traditional TKA instrumentation.

Materials and Methods

Twenty-five consecutive TKA using CPI were analyzed. Preoperative CT scans of the patients' lower extremities were segmented using product B. Limb alignment and mechanical axis were computed. Based on the preoperative planning protocol, virtual implantation of implant CAD models was done using Rhino. Postoperative coronal and sagittal views radiographs were obtained. Using 3D-image-matching software, relative positions of the femoral and tibial implant were obtained from radiographs. Lowest contact point between femur and tibial inserts was calculated, imported into Rhino and compared to virtual surgical placement. Twenty-five TKAs implanted using traditional instrumentation were analyzed for postoperative alignment. For product A, difference in alignment from the preoperative plan was calculated. For the traditional TKA group, targeted alignment was 90° in both planes for the femur and 90° coronal for the tibia

Results

In the product A group, mean absolute difference between planned and actual femoral placement was 0.67° (SD 0.5) in the coronal plane and 1.2° (SD 0.9) in the sagittal plane. For the tibia, it was 0.9° (SD 0.6) in the coronal and 1.3° (SD 0.9) in the sagittal plane. For the traditional instrumentation group, difference from ideal placement for the femur was 1.5° (SD 1.6°) in the coronal and 2.3° (SD 1.3°) in the sagittal plane. For the tibia, it was 1.8° (SD 1.6°) in coronal plane.

Discussion

In this study product A achieved accurate implant positioning and was superior to traditional total knee instrumentation.

Cost-Utility Analysis of Patient Specific Cutting Blocks for TKA

Robert L. Barrack, MD¹

Adrienne Ford, MPH

Keith A. Foreman, RN

Bradley Ellison, MD

Jinjun Zhu, MD, PhD

Ryan Nunley, MD

¹Washington University School of Medicine, Saint Louis, MO

Introduction

Increased focus has been directed towards optimizing the efficiency and cost-utility associated with total knee arthroplasty (TKA). The purpose of this study was to compare perioperative time, material resource utilization, sterile processing, and success in achieving the basic coronal alignment target for conventional instrumentation versus customized cutting guides for TKA.

Methods

The full cycle of sterile processing for TKA instrumentation was analyzed and divided into the following phases: instrument collection, transportation, decontamination (manual and mechanical washing), instrument tray assembly, and sterilization. Each phase was timed for five conventional and five customized TKA cases by an independent observer, not involved with the surgical procedure, using standard industrial efficiency methodology. Operative times and success in achieving coronal alignment of a femorotibial angle of 2-8° was also compared between the two approaches.

Results

On average, 4 fewer trays of instruments were needed to perform a customized TKA compared with conventional TKA. Timed measurements were averaged for the following phases of processing for conventional and customized TKA, respectively: instrument collection (11.0 vs. 7.4min; $p = 0.031$), transportation (8.8 vs. 6.4 min; $p = 0.06$), manual washing (40.0 vs. 29.8 min; $p = 0.007$), mechanical washing (41.0 vs. 41.0), tray assembly (86.4 vs. 17.6 min; $p = 0.0002$), sterilization (60.0 vs. 60.0 min). Total processing times for conventional and customized TKA were 4.2 and 2.8 hours ($p = 0.0004$), which only resulted in an actual hospital cost savings of \$24.59 per case.

In a series of 100 knees (50 with standard instrumentation, 50 with custom cutting blocks) the tourniquet time averaged 5 minutes less for the cutting block cases ($p=0.1$) and the total operative time averaged 11 minutes less ($p<0.05$) which resulted in a total estimated hospital savings per case of approximately \$250, exclusive of the cost of the MRI and cutting block. With the numbers available, the cutting block cases did not demonstrate a significant improvement in the incidence of achieving the coronal alignment target.

Discussion and Conclusion

Customized TKA cutting guides reduced perioperative processing time significantly compared with conventional TKA instrumentation and achieved modest savings in hospital cost through small savings in instrument processing and operative time. Improvement in achieving basic coronal plane alignment could not be demonstrated. Given the additional cost per case of an MRI and cutting block, the cost-benefit of the custom cutting block approach is difficult to justify in the absence of a proven advantage in clinical result and patient satisfaction which was not addressed in this study and is being investigated in an ongoing RCT.

Keywords: Economic / Cost Analysis; Research / Clinical

**The FDA has not cleared the following: Manufacturer Biomet; product or device: Vanguard, Signature for the use described in this presentation.

1:30-2:25 pm

**HOW I DO TKA IN 2011:
VIDEO, PANEL DISCUSSION, AUDIENCE QUESTIONS**

Moderator: Daniel J. Berry, MD¹

Panel: Robert E. Booth, Jr., MD²

Robert B. Bourne, MD³

Douglas A. Dennis, MD⁴

Thomas K. Fehring, MD⁵

W. Norman Scott, MD⁶

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This will be an interactive and practical session focusing on how a panel of expert surgeons—all of whom are Knee Society members—perform a total knee arthroplasty. Case examples and video will be used to illustrate how these individuals perform specific technical steps of the operation. The session will be fast paced and will seek both consensus and individual opinions.

The John Insall Award

2:26-2:32 pm

Comparable Clinical Outcomes in a Randomized Clinical Trial of a Fixed Vs. Mobile Bearing Posterior Stabilized TKA

Ormonde M. Mahoney, MD^{1,2}

Tracy L. Kinsey, MSPH^{1,3}

Jianhua Shen, MS⁴

¹Athens Orthopedic Clinic, PA, Athens, GA

²Department of Kinesiology, University of Georgia

³Department of Epidemiology, University of North Carolina at Chapel Hill

⁴Stryker Orthopaedics

Summary

A multicenter randomized trial comparing 252 mobile and 255 fixed bearing posterior stabilized total knee arthroplasty revealed no evidence of clinically significant benefit of the mobile bearing design.

Background

The kinematic conflict resulting from the use of highly conforming articular surfaces and the desire to accommodate complex knee motion patterns has long been recognized by total knee arthroplasty implant designers[1, 2]. Mobile bearing (MB) designs were conceived in the late 1970's and the product A total knee has subsequently enjoyed remarkable success in the U.S.[3-5]; however, concerns remain about the risks of bearing dislocation and fine particle debris generation in MB devices[6-8]. Beginning in 2001, a prospective single blinded randomized multicenter trial comparing a MB tricompartmental cemented posterior stabilized total knee with a similar fixed bearing (FB) design was undertaken at fourteen U.S. centers as an FDA monitored investigational device exemption. The purpose of this paper is to compare the clinical, functional, and survivorship outcomes of mobile and fixed bearing devices used in that investigation.

Methods

With Institutional Review Board approval 507 primary TKA of 416 patients from 14 U.S. centers were randomized to FB or MB devices from November 2001 to August 2007. WOMAC, Short Form-12, Knee Society Scores, and range of motion were compared at 6, 12, and 24 months post-op. Radiographs were reviewed by an independent radiologist. Kaplan-Meier survivorship was compared using the log rank test. Retrieved MB device components underwent independent laboratory analysis. The study had >80% power to detect sub-clinical differences of outcome assessment scores. [9]

Results

There were no differences (all $p > .05$) of mean clinical assessment scores or of mean score changes from baseline at any post-operative interval; 95% confidence intervals (CI) furthermore excluded clinically significant differences for most outcomes (i.e., clinical outcomes were statistically equivalent). At 2.2 to 7.8 years followup, 19/252 MB and 13/255 FB knees had undergone revision of any component. Survival at 6 post-operative years was 90.1% (95% CI 84.1, 93.9) for MB and 94.2% (95% CI 90.1, 96.6) for FB ($p=0.351$, log rank test). Two MB and no FB tibial components were revised for loosening. There was one case of MB insert dislocation. Three of 12-retrieved MB inserts demonstrated mild abrasive wear on the articular surface, and only one on the undersurface.

Conclusion

With adequate statistical power, the study revealed no clinically significant functional benefit of the MB design. Though survivorship was not statistically different, more revisions were observed in the MB group.

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The Mark Coventry Award

2:36-2:42 pm

CRP in joints: A Molecular Marker for Periprosthetic Joint Infection?

Javad Parvizi, MD, FRCS ¹

William J. Hozack, MD

Christina Jacovides, BS

Bahar Adeli, BA

Kwang Am Jung, MD

¹Rothman Institute at Thomas Jefferson University, Philadelphia, PA

Introduction

The goal of our study was to determine whether the accuracy of the serum C-reactive protein (CRP) assay for detection of periprosthetic joint infection (PJI) could be improved by measuring CRP in synovial fluid rather than in blood serum. Such an assay could improve the accuracy of diagnosis of PJI without significant added cost to hospitals.

Methods

Synovial fluid specimens were collected from 53 patients undergoing revision total knee arthroplasty. CRP levels were measured using an individual CRP ELISA (16 samples; 8 infected, 8 uninfected) and a multiplex immunoassay platform (53 samples; 17 infected, 36 uninfected). Results from preoperative serum CRP assays conducted by the hospital laboratory were collected for comparison. Sensitivity, specificity, and receiver operating characteristic (ROC) curve analyses were performed for each assay, with diagnosis of infection based on institutional criteria.

Results

CRP concentrations differed significantly between infected and uninfected joints in all three assays. The area under the curve was 0.965 for the individual ELISA, 0.931 for the multiplex assay, and 0.872 for the serum CRP assay. Sensitivity and specificity were 87.5% and 87.5% for the individual ELISA, 93.3% and 88.9% for the multiplex assay, and 80% and 89.7% for the serum CRP assay.

Discussion

Measuring CRP in synovial fluid rather than in serum appears to improve the test's diagnostic strength, especially its sensitivity. Although this finding should be confirmed in a larger cohort, if the serum CRP assay can be adapted for use in synovial fluid, we believe such an assay holds great promise as a new, potentially low-cost, diagnostic marker for PJI.

The Chitranjan Ranawat Award

2:46-2:52 pm

Is Neutral Mechanical Alignment Normal for all Patients? The Concept of Constitutional Varus.

Johan Bellemans, MD, PhD

William Colyn, MD

Hilde Vandenneucker, MD

Jan M. K. Victor, MD, PhD

University Hospitals Leuven, Pellenberg, Belgium

Background

Traditionally, knee surgeons believe that during TKA neutral mechanical alignment should be restored.

A number of patients may however exist for whom neutral mechanical alignment is abnormal. Patients with so called “constitutional varus” knees have since their end of growth always had varus alignment. Restoring neutral alignment in these cases may in fact be abnormal and undesirable, and would almost per definition require some degree of medial soft tissue release. It was the purpose of this study to investigate which percentage of the normal population has constitutional varus knees, how this can be recognized, and which factors contribute.

Methods

A cohort of 250 asymptomatic adult volunteers between 20 and 27 years old was recruited for this study. All of these underwent full leg standing digital radiography on which 19 different alignment parameters were analyzed as described by Paley. At the same time a cohort of 800 youngsters was analyzed clinically to determine the influence of activity level on growth and the development of lower leg alignment. The incidence of constitutional varus alignment was determined and contributing factors were analyzed using ANOVA and multivariate prediction models.

Results

The average mechanical alignment in normal adult males was 1.9° varus, in females 0.8° varus. 32 % of adult males and 17% of females had constitutional varus knees with a natural mechanical alignment $\geq 3^\circ$ varus.

Constitutional varus was associated with increased sports activity during growth, increased femoral varus bowing, an increased varus femoral neck-shaft angle, and an increased femoral anatomic-mechanical angle ($p < 0.05$)

Conclusions

An important fraction of the normal population (32 % of males, 17% of females) has a natural alignment at the end of growth of $\geq 3^\circ$ varus. This might be a consequence of Hueter-Volkmann's law. Restoration of mechanical alignment to neutral in these cases may therefore not be desirable and in fact unnatural for them.

3:10-3:16 pm

Diagnosis of Periprosthetic Joint Infection: Promising Molecular Technologies

Javad Parvizi, MD, FRCS

Rothman Institute at Thomas Jefferson University, Philadelphia, PA

Introduction

The goal of our study was to determine whether the accuracy of the standard serum C-reactive protein (CRP) assay for detection of periprosthetic joint infection (PJI) could be improved by measuring CRP in synovial fluid. Such an assay might improve the accuracy of diagnosis of PJI without significant added cost to hospitals.

Methods

Synovial fluid specimens were collected from 72 patients undergoing revision total knee arthroplasty. Synovial CRP levels were measured using an individual CRP ELISA (15 samples; 10 infected, 5 uninfected) and a multiplex immunoassay platform (72 samples; 29 infected, 43 uninfected). Results from preoperative serum CRP assays conducted by the hospital laboratory were collected for comparison (68 samples; 29 infected, 39 uninfected). Sensitivity, specificity, and receiver operating characteristic (ROC) curve analyses were performed for each assay, with diagnosis of infection based on institutional criteria.

Results

Synovial CRP concentrations differed significantly between infected and uninfected joints in all three assays. The area under the curve was 0.840 for the individual ELISA, 0.919 for the multiplex assay, and 0.885 for the serum CRP assay. Sensitivity and specificity were 70.0% and 100.0% for the individual ELISA, 86.2% and 97.7% for the multiplex assay, and 82.8% and 84.6% for the serum CRP assay.

Discussion

Measuring CRP in synovial fluid rather than in serum appears to improve the test's diagnostic strength, especially its sensitivity. Although this finding should be confirmed in a larger cohort, if the serum CRP assay can be adapted for use in synovial fluid, we believe such an assay holds great promise as a new, potentially low-cost, diagnostic marker for PJI.

Risk Factors for Periprosthetic Joint Infection and Postoperative Mortality following Total Knee Arthroplasty in Medicare Patients

Kevin J. Bozic, MD, MBA

Edmund Lau, MS

Kevin Ong, PhD

Steven M. Kurtz, PhD

Harry E. Rubash, MD

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Introduction

The specific risk factors for periprosthetic joint infection (PJI) and postoperative mortality in elderly TKA patients are poorly understood. The purpose of this study was to identify the baseline medical co-morbidities that are associated with increased risk of PJI and postoperative mortality in Medicare TKA patients.

Methods

The Medicare 5% sample was used to calculate the relative risk of PJI and postoperative mortality as a function of baseline medical co-morbidities in 83,011 patients who underwent primary TKA between 1997 and 2007. 30 co-morbid conditions were examined using Cox regression, controlling for age, sex, race, Census region, public assistance, and all other baseline co-morbidities. The adjusted hazard ratios for each co-morbid condition were evaluated, and Wald's χ^2 statistic was used to rank the degree of association of each condition with PJI or postoperative death.

Results

The most significant independent risk factors for PJI (in order of significance, $p < 0.005$ for all comparisons) were congestive heart failure (CHF) (HR: 1.28, 95% CI: 1.13-1.46), chronic pulmonary disease (HR: 1.22, CI: 1.10-1.36), pre-operative anemia (HR: 1.26, CI: 1.09-1.45), diabetes (HR: 1.29, CI: 1.06-1.34), and depression (HR: 1.28, CI: 1.08-1.51). The most significant independent risk factors for postoperative mortality were CHF (HR: 2.15, 95% CI: 1.71-2.69), metastatic cancer (HR: 4.40, CI: 2.67-7.26), renal disease (HR: 2.23, CI: 1.68-2.96), peripheral vascular disease (HR: 1.49, CI: 1.20-1.87), and cerebrovascular disease (HR: 1.49, CI: 1.19-1.87).

Conclusions

CHF, chronic pulmonary disease, pre-operative anemia, diabetes, and depression are associated with an increased risk of PJI following TKA in Medicare patients. CHF, metastatic cancer, renal disease, peripheral vascular disease, and cerebrovascular disease are associated with an increased risk of postoperative mortality following TKA in Medicare patients. This information is important when counseling patients regarding the risks of PJI and postoperative mortality following TKA.

Irrigation and Debridement for Periprosthetic Infections: Does the Organism Matter?

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Adolph V. Lombardi, Jr., MD³

Ben Zmistowski, BS⁴

Nicholas Brown, BS⁵

Jeffrey Luna, MD⁶

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The Periprosthetic Infection Consortium⁸

²OrthoCarolina Hip and Knee Center, Charlotte, NC

Introduction

Irrigation and debridement (I&D) is an attractive treatment alternative for periprosthetic joint infection (PJI). I&D failure rates average 64% (range 10.5% to 84%) and may be associated with causative organism type and virulence. The study objective was to compare revision rates for PJI due to Streptococcal organisms to other organisms treated with I&D.

Methods

A multicenter retrospective cohort study of 177 consecutive PJIs treated with I&D was performed. Failure was defined as reoperation for PJI.

Results

Failure rate for Streptococcal infections was 67% (18 of 27) compared to 66% (67 of 102) for other organisms. Failure rate for sensitive staphylococcus was also 67% (38 of 57) compared to a 71% (17 of 24) failure rate for resistant staphylococcus

Conclusion

These results indicate that eradication rates of I&D for a streptococcal PJI are comparable to other causative organisms. I&D should play a limited role in the PJI treatment algorithm regardless of organism type.

DEBATE: Static Cement Spacers are the Gold Standard for 2-Stage Exchange

Agree: Michael A. Mont, MD

Sinai Hospital of Baltimore, Baltimore, MD

Infection is a devastating complication of total knee arthroplasty. After component explantation and prior to component replantation, patients are placed on intravenous antibiotics for a minimum of 6 weeks. In addition, patients are implanted with an antibiotic impregnated cement spacer to treat the localized infection. Historically, the antibiotic cement spacers have been static-type spacers, which may limit the patient's range of motion and ability to ambulate. Concerns exist regarding the structural integrity and stability of dynamic-type spacers, as catastrophic failures could lead to even more operative time. The purpose of this presentation will be to outline the advantages and disadvantages of static spacers, as well as to present the experiences at the senior author's institution with both static and dynamic spacers.

The advantages of using static spacers include re-infection rates that are comparable to those seen with dynamic spacers, the ability to use the spacer with larger bone defects, their technical ease of use, potential for decreased operative time, and lower cost than dynamic spacers. Four studies have directly compared the re-infection rates following the use of either static or dynamic spacers [1-4]. These studies all report no statistical difference in re-infection rates between the two types of spacers.

One of the potential disadvantages of static spacers is decreased range of motion and functional scores. Although there may be deficits during the period while the spacer is in place, these deficits do not appear to be retained following prosthesis re-implantation. In a study that compared functional outcomes between patients who had either static or dynamic spacers, at final follow-up after re-implantation there was no difference in either Hospital for Special Surgery knee scores or maximum flexion values between the two cohorts [2].

Complications and catastrophic failures are a major concern with the use of dynamic spacers [5-7]. The senior author recently reviewed outcomes in revision total knee arthroplasty stratified by static or dynamic spacer type. Static spacers were used in 81 knees, and dynamic spacers in 34 knees. Clinical records and radiographs were reviewed to determine complications including spacer dislocation, fracture, and soft-tissue compromise that led to re-operations. There were no complications reported in the static-type spacer treated cohort, while there were 4 complications (12%) requiring re-operation in the dynamic spacer group. There were 2 complete femoral component spacer fractures, 1 complete femoral dislocation, and 1 tibial subluxation leading to wound breakdown and placement of a medial gastrocnemius flap. The difference in complication rate between the two cohort's was statistically significant ($p=0.0067$).

Although dynamic spacers offer the patient the potential for increased range of motion and improved ambulatory ability during the interim prior to re-implantation, there appears to be no long-term advantage whereby the patient retains these benefits. Patients who have static spacers have comparable re-infection rates, and long-term functional outcomes. With the potential for catastrophic failure requiring re-operation procedures, it is the opinion of the senior author that static spacers should be considered the gold standard, as the risks of dynamic spacer use currently outweigh any potential benefit.

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DEBATE: Static Cement Spacers are the Gold Standard for 2-Stage Exchange

Disagree: Bassam A. Masri, MD, FRCSC

University of British Columbia, Vancouver, BC, Canada

Total knee replacement is one of the most successful operations in orthopaedics. Infection is a rare yet devastating complication of the procedure with a reported prevalence of 0.5 – 3%. The treatment of infected knee replacement remains challenging, with a success rate of at best 90%, counting recurrent and new infections as failures. Literature that quotes a success rate of over 95% did not include infection with a new organism as a failure. For the patient, however, an infection is an infection regardless of the infecting organism, and therefore it is best to look at success rate as the rate of complete eradication of infection regardless of the infecting organism.

Historical treatment included a two-stage exchange whereby the knee is left flail but immobilized between stages. This has led to scarring and difficulty in reimplantation. This technique was extended by adding an antibiotic-loaded spacer to separate the femur from the tibia. This still required immobilization, which led to difficulty reimplanting the knee and ultimate potential stiffness. Moreover, static spacers tend to move causing bone erosion, more bone loss and additional difficulty in reimplantation. An alternative to this approach is the use of antibiotic-loaded prostheses between stages. These are referred to as articulated spacers.

One such treatment involves sterilizing the existing femoral component, and cementing a thin polyethylene liner using highly antibiotic-loaded cement. Other techniques have included free hand articulated spacers or molded articulated spacers made of antibiotic cement with either a cement of metal on polyethylene articulations.

Results to date with articulating spacers have been encouraging, with less bone loss in the articulated spacer group. In addition, reimplantation is significantly simplified thus making the surgery easier and easier surgery leads to fewer complications.

**The FDA has not cleared the following: Manufacturer DePuy; product or device: Knee Prostalac for the use described in this presentation.

SYMPOSIUM VIII: SURGICAL TECHNIQUES FOR REOPERATIONS AND REVISIONS

3:45-3:51 pm

Synthetic Mesh Reconstruction for Patellar Tendon Disruption in Total Knee Arthroplasty

James A. Browne, MD¹

Arlen D. Hanssen, MD²

²University of Virginia, Charlottesville, VA

²Mayo Clinic, Rochester, MN

Background

Patellar tendon disruption associated with total knee arthroplasty is an uncommon but potentially disastrous complication. Simple suture fixation is insufficient while autograft and allograft tendon reconstruction techniques have variable results. We have developed a simple, straightforward technique using synthetic mesh which appears reliable, is cost effective, and avoid problems associated with other treatment alternatives.

Methods

We retrospectively reviewed 13 consecutive patients at an average age of 60 years (range 37 to 77 years) who underwent extensor mechanism reconstruction for chronic and subacute patellar tendon disruption following knee arthroplasty. Five patients had already failed an allograft extensor mechanism reconstruction, 5 patients had a history of deep periprosthetic infection, and 8 patients had a prior revision knee arthroplasty. The surgical technique included use of a knitted monofilament high-density polypropylene graft to reconstruct the patellar tendon and to facilitate fixation of adjacent host tissue into the graft. Follow-up was available for all patients at a mean of 40 months (range, 11 to 118 months).

Results

Three patients had evidence of failure of the graft reconstruction, all occurring within 6 months. One patient with previous sepsis had recurrent infection and was treated with arthrodesis. The remaining 9 patients demonstrated an extensor lag less than 10 degrees and have had no loss of extension at final followup. Knee flexion was maintained in all patients postoperatively. The mean preoperative Knee Society scores for pain and function were 36 points (range, 3 to 54 points) and 20 points (range, 0 to 60 points), respectively. At the time of most recent follow-up, the Knee Society pain and function scores had improved significantly, to a mean pain score of 76 points (range, 34 to 96 points) and a mean function score of 50 points (range, 0 to 100 points) ($p < 0.01$). Marlex mesh was significantly less expensive than allograft (\$122 for mesh versus \$1227 for Achilles tendon or \$4437 for a whole extensor mechanism).

Conclusions

Synthetic mesh reconstruction of a disrupted patellar tendon is a simple surgical procedure that was successful in most patients. This reconstruction is also inexpensive compared to allograft tendon reconstruction and eliminates the possibility of disease transmission associated with allograft implantation. A durable result was observed in the majority of patients, many of whom had multiple previous procedures and failed allograft reconstructions. No complications specific to the synthetic mesh were observed.

Restoration of Patellar Height in Revision Total Knee Arthroplasty

Saurabh Khakharia, MD

Giles R. Scuderi, MD

Insall Scott Kelly Institute for Orthopedics and Sports Medicine, New York, NY

Introduction

Restoration of patellar height and joint line is important in revision TKA for normal knee function and kinematics. The purpose of this study was to determine the change in the patellar height in patients who underwent septic and aseptic revision TKA.

Materials and Methods

102 revision TKA performed between 2006-2009 was retrospectively reviewed and the pre-operative and post-operative patella heights were compared. 26 patients had inadequate radiographs for comparison. Of the remaining 76 knees, patients who received distal augmentation were included in the study. 12 knees had 2 stage revisions for infected TKA and 64 knees had revision for aseptic failure. 10 out of 12 knees in septic group and 48 out of 64 knees in aseptic group received distal augmentation. Radiographic analysis of the patella height using the Insall-Salvati (IS) ratio was done preoperatively and postoperatively in both groups.

Results

Pre-operatively in septic group (10 knees): 6 knees had normal patellar height (mean- 1.07; range from 0.97 to 1.16), 3 patella alta (mean: 1.29; range from 1.21 to 1.36), and 1 patella baja (IS ratio- 0.75). The mean preoperative and postoperative IS ratio in septic group is 1.10 and 0.97 respectively. Postoperatively, in 8 out of 10 knees (80%) the joint line was restored with distal augmentation. Pre-operatively in aseptic group (48 knees): 28 knees had normal patellar height (mean: 1.01; range from 0.91 to 1.17), 8 patella alta (mean: 1.25; range from 1.20 to 1.33) and 12 patella baja (mean: 0.77; range from 0.67 to 0.80). Overall, the mean preoperative IS ratio was 0.99 and the mean postoperative IS ratio was 1.04. Postoperatively, 10 of 12 patella baja (83%) improved with distal femoral augmentation. Preservation of distal femoral bone impacted joint line position, as determined by the distance from the epicondyles and the meniscus scar.

Conclusion

Normal patella height can be maintained and patella baja improved by either augmentation of the distal femur or preservation of bone stock with restoration of the distal joint line during revision TKA.

Contemporary Fixation Strategies for Periprosthetic Femur Fractures

George J. Haidukewych, MD
Orlando Health, Orlando, FL

The most common clinical situation involves a distal femur fracture above a well fixed, previously well functioning TKA. Internal fixation is typically the procedure of choice, since the vast majority of fractures will heal. Revision or distal femoral replacement is typically reserved for loose prostheses or those with inadequate distal bone stock where ORIF is likely to fail. Below are some technical tips and pearls for internal fixation:

Nails

Retrograde nails can be useful if the intercondylar notch allows access for a starting point. A generous incision can allow access and direct visualization during nail insertion. A long nail is recommended due to the improved alignment and fixation that diaphyseal engagement offers. Short nails should not be used. Newer nails have multi-planar locking screws that may be advantageous for shorter distal fragments. A distal fragment of sufficient length must be present for successful nailing.

Locking Plates

The author prefers plates for the vast majority of these fractures due to the cluster of very, very distal locking screws most plates provide. An anterolateral incision (over the flare of the lateral femoral component) provides improved visualization. A bump under the knee and draping of the contralateral extremity can facilitate visualization of the reduction. The most common error is hyperextension of the distal fragment. The plate is inserted submuscularly and gross reduction is obtained with manual realignment of the limb. The distal guide pin must be parallel to the joint line. Typically all distal and at least four proximal screws are used. Careful fluoroscopic vigilance is required to minimize malreduction. Avoid valgus, hyperextension, and fracture distraction. Confirm that the plate is not too anterior on the femoral shaft.

Post operative management

Touch down weight bearing for at least 6 weeks. Two arm support for a total of 12 weeks. ROM can usually be started immediately. For non-compliant or demented patients, consider bed to chair mobilization only for 6 weeks. Most fractures unite by 12 weeks.

Distal Femoral Replacement: Salvage for Comminuted Periprosthetic Fractures

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For severe periprosthetic fractures of the distal femur, resection of the distal femur and reconstruction with a distal femoral replacement (DFR) prosthesis can be an effective salvage procedure. Such implants have a rotating hinge articulation, a design which permits motion in flexion-extension, rotation and longitudinally by allowing some distraction of an inner bearing component with its outer articulation. As compared to a fixed hinge articulation, the rotating hinge design minimizes stress transfer to the fixation interface.

Appropriate patient selection for distal femoral replacement is important. In a systematic review of 415 cases of acute distal femur fractures above TKA, fixation with a retrograde intramedullary nail resulted in significantly lower nonunion rates and secondary surgical procedures as compared to nonoperative treatment, conventional plating and locked plating.¹ Certainly if there is adequate bone stock for fixation of the periprosthetic fracture then distal femoral replacement should not be considered. However in patients with a comminuted fracture and poor bone quality, particularly the elderly patient with low functional demand, DFR is an appropriate procedure.

The experience at several institutions with rotating hinge arthroplasty (with either standard distal femoral component or DFR) for knee arthroplasty salvage (including periprosthetic fracture) shows a relatively high complication rate (infection 7-14%; loosening 9%; patellar complications 13%; component breakage 10%).^{2,3,4} In a study focused on DFR for periprosthetic fracture, 20 patients (22 knees) with average age of 69.5 years and follow up of nearly 5 years had mean Knee Society knee and functional scores of 82.8 and 40 with 10 postoperative complications in 5 patients requiring further surgery.⁵ Both cemented and uncemented fixation of the intramedullary stem of the DRF has proven successful but in patients with poor bone quality cement fixation is favored.

Distal femoral replacement can be an effective salvage for patients with comminuted periprosthetic fractures but should be performed only when alternative methods of treatment are not feasible. Patients should be informed of the relatively high complication rate.

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SYMPOSIUM IX: ECONOMICS AND IMPLANT SELECTION

4:20-4:26 pm

Costs and Cost Management Strategies for Knee Replacement Devices

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Introduction

Hospitals facing rising costs for knee replacement devices are pursuing a variety of strategies to gain greater cooperation with their medical staffs and better purchasing relationships with device manufacturers. The purpose of this study was to quantify the patient, hospital, and market characteristics associated with variation in device costs and total surgical costs, and to assess the effectiveness of hospital strategies for cost management.

Methods

Clinical, demographic, and economic data were collected on 10,280 patients undergoing total knee replacement at 61 hospitals in 8 states in 2008. Device costs and total surgical cost per case were determined for each procedure. Multivariate statistical analyses were used to determine the independent effects of implant vendor concentration/market share in a hospital, annual hospital procedure volume, hospital size, teaching status, hospital market structure, and population size in the local market on implant costs and total procedure costs.

Results

Average device costs per patient ranged from \$3,380 to \$10,744. Hospitals purchasing larger number of devices experienced lower costs per device, but concentration of purchases among a small number of device vendors was associated with higher costs per device for TKR procedures (both $p < .01$). Hospitals using more costly implants experienced higher additional non-implant related costs than hospitals using less costly implants ($p < .01$).

Conclusions

Among the hospitals studied, there was wide variation in knee replacement device costs across hospitals, even after adjusting for patient diagnoses, co-morbidities, and complications. Lower cost was significantly associated with volume purchasing, but not with restrictions on the number of implant vendors available at a particular hospital.

High Flexion Knees - Are We Getting What We Are Paying For?

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Introduction

Flexion following total knee arthroplasty (TKA) remains one of the most important factors in patient satisfaction. Because of relatively poor improvement in flexion with early designs, newer high-flexion designs have been marketed. The purpose of our study was to compare flexion of three high-flexion designs with two standard designs. A secondary endpoint was to compare clinical and radiographic gravity-assisted and active-assisted postoperative flexion.

Methods

Clinical measurement with goniometer and radiographic measurement were obtained by three independent orthopedists. Gravity-assisted flexion (patients maximally bent their own knees) and active-assisted flexion (patients' knees maximally bent with assistance until inhibited by anterior knee discomfort or posterior soft tissue impingement) were recorded and compared with measurements from lateral radiographs obtained with knees in the same positions.

Results

Included in the study were 144 knees (108 patients). Mean gravity-assisted flexion preoperatively was 110° for both groups and postoperatively was 111° clinically and 109° radiographically for the standard design and 114° and 116°, respectively, for the high-flexion design (both $p < 0.05$). Postoperative active-assisted flexion was 115° clinically and 118° radiographically for the standard design and 119° and 124°, respectively for the high-flexion design (both $p < 0.05$). Knee Society knee and function score were similar both preoperatively and postoperatively between standard and high-flexion groups. Measurements obtained by three examiners were highly correlated, especially for radiographic measurements.

Conclusion

Although the high-flexion designs achieved statistically significant greater flexion, the orthopaedic surgeon will need to decide whether the increase in cost of the implant justifies a relatively small increase in flexion. Flexion reported can depend considerably on the method of measurement used.

Results of High Flexion Total Knee Arthroplasty. Is Increased Flexion Obtained?

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Background/Rationale

High-flexion total knee arthroplasty (TKA) prostheses are designed to improve flexion and clinical outcomes. High magnitudes of knee flexion can increase implant loads and fixation stresses, creating concerns of premature failure.

Questions/Purposes

The purpose of this report is to evaluate the clinical and radiographic results of a high flexion TKA design.

Methods

A prospective clinical and radiographic review of 144 patients implanted with 154 high flexion TKA from 2004 to 2008 was performed. The mean follow-up duration was 45 months (range, 24-79). Statistical analysis was performed on functional and radiographic data.

Results

Average knee flexion improved from 122.5° to 129.2°. Patients with preoperative knee flexion $\leq 120^\circ$ had a statistical increase in postoperative flexion (110.9°-124.1°), while patients with preoperative knee flexion $>120^\circ$ did not (127°-131.2°). The mean Knee Society Score (KSS) improved from 40.9 to 94.8 postoperatively. Subjects with preoperative flexion $\leq 120^\circ$ had a greater improvement in KSS (64.5 vs. 49.8). There was a 42.9% occurrence of posterior femoral radiolucent lines. No prosthetic loosening was observed.

Conclusion

Excellent results of a high flexion TKA were observed at short term follow-up duration. Subjects with preoperative flexion $\leq 120^\circ$ experienced greater increases in knee flexion and KS Scores. A relatively high incidence of posterior femoral radiolucent lines was observed, possibly associated with high knee flexion or the increased posterior femoral bone resection required for use of the investigated TKA design. This data suggests subjects with less preoperative motion are more likely to benefit from insertion of a high flexion TKA.

All Polyethylene Tibial Component in Young, Active Patients A Concise Follow-up with Minimum 10 Years

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Introduction

This is the first long-term report of all-polyethylene tibial implant in 35 active patients under 50 years old. We previously reported mid-term results of all polyethylene tibial components in younger, active patients. This is a follow-up report of the same group of patients with special reference to survivorship and activity level.

Material and Methods

Between November 1992 to June 2000, 53 patients younger than 60 years old (74 knees) that underwent cemented all-poly tibial component were included. All patients were followed prospectively using clinical and radiographic criteria as defined by the Knee Society. At minimum 10 years follow-up, 5 patients were deceased, 4 were lost to follow-up and two refused to participate in the study, leaving 42 patients (59 knees) for final analysis.

Results

Good to excellent results were achieved in 96% of patients. Kaplan-Meier survivorship at 10 years for revision due to mechanical reasons and for all failures was 100% and 97% respectively (one case of infection and one revision for fracture). There were no cases of malalignment, aseptic loosening, excessive wear or osteolysis. Seven patients (9 knees) had incomplete, non-progressive demarcation at the zone 1 tibial interface. The mean WOMAC score was 31 ± 14 , KSS scores improved from an average of 48 to 97. Sixty-two percent of patients were participating in sport activities such as running, gym exercises and playing tennis or golf with a mean UCLA score of 7.2. Anterior knee pain was present in 9% of cases. The incidence of noise and asymptomatic crepitation was 14%. There was no case of painful crepitation requiring scar excision.

Discussion and Conclusion

Long-term follow-up of all-poly TKR demonstrates excellent clinical and radiographic results in younger, active patients, as 62% continue to participate in sport activities.

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All Polyethylene Tibial Components for all Patients

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Introduction

Modular tibial components (MBT) have demonstrated locking mechanism dysfunction, breakage, backside wear, and osteolysis which have compromised survivorship. All polyethylene tibial components (APT) eliminate problems associated with MBT, but APT utilization has generally been limited to older, less active patients. The purpose of this study was to assess the survivorship of APT's compared with modular tibial implants in a non age, or activity selected TKA population.

Materials and Methods

From 1999 to 2007, 775 primary TKA utilizing one implant design, and performed by one surgeon at one academic medical center were identified from a longitudinal database. The APT 2 cohort was comprised of 558 patients. MBT (217) was used for the following patients: BMI >37.5, tibial bone loss or defects, contra lateral MBT knee from a prior TKA operation. Prior to 1999, APT 1 (76) were implanted in elderly or minimally active patients (Lahey Clinic Demand Category 3 or 4).

Results

The APT groups were significantly older (APT1 76.2, APT2 70.11 and MBT 64.7, $p < .01$) and had a lower BMI than the MBT group (APT1 27.4, APT2 30.8, MBT 33.8, $p < .01$). Survivorship, as defined by revision surgery for any reason, was APT1 97.4%, APT2 98.9% and MBT 97.2%. There were 4 (1.6%) tibial failures in the MBT group all in patients with BMI >40. There were no revisions for loosening or osteolysis in the APT groups.

Conclusion

All polyethylene tibial components perform as well or better than MBT implants in a non-selected TKA population. All tibial revisions in this study occurred in the heaviest patients (BMI >40) with MBT. The heaviest patients remain problematic for modern TKA. No patient with a BMI >40 received an APT. It remains to be seen if APT may be more enduring in the super obese than MBT. The results of this study include younger patients and the 98.9% survivorship is similar to previous studies of APT demonstrating survivorships of >97% at >10 years in older patients. The results of the APT1 group, with no revisions noted at an average follow-up of 152 months, attest to the enduring performance of APT in a selected patient population. It remains to be seen if the APT2 group will match this performance in a population not selected by age or activity. This study demonstrates that APT when utilized without regard for activity and age is equivalent or superior to the use of MBT. In this study, patients with BMI greater than 40, poor proximal tibial bone, or proximal tibial bone defects did not receive APT. It remains to be seen if APT may be used successfully in these patient groups. APT utilization also can be associated with a significant reduction in primary TKA hospital cost in this age of health care reform and cost control.

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

- Update clinical skills and basic knowledge through research findings and biomechanical studies.
- Discuss the various surgical and non-surgical treatments and management of conditions related to the knee joint.
- Determine indications and complications in total knee arthroplasty.
- Critique presentations of surgical techniques and demonstrations of treatment options.
- Evaluate the efficacy of new treatment options through evidence-based data.

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Some pharmaceuticals and/or medical devices at the Specialty Day Meeting have not been cleared by the U.S. Food and Drug Administration (FDA) or have been cleared by the FDA for specific purposes only. The FDA has stated that it is the responsibility of the physician to determine the FDA status of each pharmaceuticals and/or medical devices he or she wishes to use in clinical practice.

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Each participant in The Knee Society Specialty Day Meeting has been asked to disclose if he or she has received something of value from a commercial company, which relates directly or indirectly to the subject of their presentation. The Knee Society has identified the options to disclose as follows:

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Joseph W George, Jr MD (Vermilion, OH): (n) Submitted on: 08/09/2010. *

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Stephen M Howell, MD (Sacramento, CA): 1 (Biomet);2 (Biomet, Stryker);3B (Biomet; Stryker);7 (Saunders/Mosby-Elsevier);8 (Knee, American Journal of Sports Medicine); Submitted on: 09/14/2010. *

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Edmund Lau, MS (Menlo Park, CA): 3B (Stryker; Kyphon Inc.; Amgen Co; Alcon Corp.); Submitted on: 06/14/2010. *

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Adolph V Lombardi Jr, MD (New Albany, OH): 1 (Biomet; Innomed);2 (Biomet);3B (Biomet);5 (Biomet);8 (Journal of Arthroplasty; Journal of Bone and Joint Surgery - American; Journal of the American Academy of Orthopaedic Surgeons; Journal of Orthopaedics and Traumatology; Surgical Technology International; Clinical Orthopaedics and Related Research);9 (American Board of Orthopaedic Surgery, Inc.; Hip Society); Submitted on: 09/21/2010. *

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William J Maloney MD (Redwood City, CA): 1 (Wright Medical Technology, Inc.; Zimmer); 3C (ISTO Technologies; Moximed); 4 (Abbott; Gillead; ISTO Technologies; Johnson & Johnson; Merck; Moximed; Pfizer); 5 (AO; Biomet; DePuy Spine; DePuy, A Johnson & Johnson Company; DePuy, A Johnson & Johnson Company; Nuvasive; Smith & Nephew; Stryker; Zimmer); 8 (Journal of Orthopaedic Research; Journal of Orthopaedic Science); 9 (AJRR; Hip Society); Submitted on: 04/27/2010. *

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James P McAuley, MD (London, ON): 1 (DePuy, A Johnson & Johnson Company);2 (DePuy, A Johnson & Johnson Company);3B (DePuy, A Johnson & Johnson Company);6 (Canadian Institutes of Health Research (CIHR); Inova Health Care Services; Smith & Nephew; Zimmer); Submitted on: 04/12/2010. *

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Travis James Menge, MD (Nashville, TN): (n) Submitted on: 12/28/2010. *

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Susan Marie Odum (Charlotte, NC): 9 (Association of Clinical Research Professionals; American Association of Hip and Knee Surgeons); Submitted on: 05/25/2010 and last confirmed as accurate on 09/17/2010. *

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Alexis Pozen (n) Submitted on: 06/07/2010 and last confirmed as accurate on 09/09/2010. *

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Aaron Glen Rosenberg, FACS, MD (Chicago, IL): 1 (Zimmer);2 (Zimmer);3B (Zimmer);4 (Zimmer);7 (Wolters Kluwer Health - Lippincott);8 (American Journal of Orthopedics; Knee; Wolters Kluwer Health - Lippincott ; Orthopedics Today; SLACK Incorporated); Submitted on: 04/06/2010 and last confirmed as accurate on 09/08/2010. *

Harry E Rubash, MD (Boston, MA): 1 (Zimmer);5 (Biomet; Zimmer); Submitted on: 05/27/2010 and last confirmed as accurate on 10/21/2010. *

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W Norman Scott, MD (New York, NY): 1 (Zimmer); Submitted on: 04/07/2010 and last confirmed as accurate on 04/07/2010. *

Giles R Scuderi, MD (New York, NY): 1 (Zimmer Salient Surgical);2 (Zimmer Salient Surgical);3B (Zimmer Salient Surgical);7 (Springer Elsevier Thieme World Scientific);8 (Surgery of the Knee);9 (Knee Society ICJR); Submitted on: 08/05/2010. *

Thomas P Sculco, MD (New York, NY): 8 (American Journal of Orthopedics); Submitted on: 04/11/2010 and last confirmed as accurate on 10/28/2010. *

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Lyndsay Somerville, PhD (London, ON): (n) Submitted on: 12/26/2010. *

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