

**MAOA POSTER PRESENTATIONS – 2006 ANNUAL MEETING
#1-25**

1. Outcomes of Surgical Approaches to Distal Humerus Fractures: Olecranon Osteotomy versus Triceps Reflection

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INTRODUCTION: Approach to the distal humerus for fracture fixation can be a surgical challenge. Osteotomy of the olecranon has gained popularity as a surgical approach for operative fracture treatment. This study is designed to investigate the differences between the triceps reflection anconeus pedicle (TRAP) and olecranon osteotomy surgical approaches.

MATERIALS AND METHODS: Forty-three patients who underwent surgical repair of distal humerus fractures between 2001 and 2003 were identified. Operative reports were analyzed to determine which surgical approach was used. Clinical records were reviewed to note the postoperative course, complications, and final outcome for each patient.

RESULTS: Forty-four patients met the selection criteria. The mean age of the patients was 55 years. Twelve patients sustained open fractures. All patients were treated with open reduction and internal fixation. Olecranon osteotomy was used for the surgical approach in 23; a triceps reflection was used in 21. In the osteotomy group, there were three nonunions of the distal humerus fracture, six wound healing complications, and two nonunions of the olecranon osteotomy. Both olecranon nonunions occurred in patients with wound healing complications. The triceps reflection cohort had two nonunions of the distal humerus and four wound healing complications. Triceps weakness, painful hardware, and incisional pain were uncommon complications in both groups. The mean length of follow-up was 19 months.

CONCLUSIONS: Olecranon osteotomy and TRAP are both acceptable surgical approaches for distal humerus fractures. Triceps weakness was not seen in either group. Most osteotomies heal uneventfully. However, nonunions can occur in patients with wound complications.

2. Pulmonary Embolism Following Operative Treatment of Proximal Humerus Fractures

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BACKGROUND: There have been multiple studies that have provided data on the prevalence of pulmonary embolism, the probability of death from a pulmonary embolism, and risk factors for the development of pulmonary embolism following lower extremity and pelvic trauma. However, there is no information on the risk of pulmonary embolism following the surgical management of proximal humerus fractures.

METHODS: A review of 85 consecutive patients who underwent operative treatment for acute proximal humerus fractures at our institution between January 1, 1999, and December 31, 2001, was performed to identify all patients who sustained a pulmonary embolism.

RESULTS: Postoperatively, five patients sustained a pulmonary embolism that was confirmed by computed tomography. Two patients had had a hemiarthroplasty and three were treated with open reduction internal fixation (two with blade plates, one with intramedullary rod). The overall incidence of pulmonary embolism in this series was 5.9%. None of the patients sustained a fatal pulmonary embolus.

CONCLUSIONS: The data from this study suggest that pulmonary embolism after operative treatment of proximal humerus fractures is not low. This study raises the question about the need for prophylactic anticoagulation following routine proximal humerus repair.

3. Surgery for Fractured Neck of Femur – Are Patients Adequately Consented?

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INTRODUCTION: Obtaining valid consent is a legal and ethical obligation when performing any procedure in clinical practice. This study was performed to identify the validity and effectiveness of the consent form and any potential improvement that could be made when taking consent.

MATERIALS AND METHODS: Case notes of 173 patients undergoing surgery for fractured neck of femur were retrospectively reviewed. Risks and complications of the surgery, as listed on the consent form, were noted. Sixty-five cases were excluded from the study as they had either old consent forms with no risks recorded or a consent form signed by a consultant due to patient inability to consent. Six of the consent forms could not be located in the notes. This left 102 consent forms to be analyzed.

RESULTS: The number of risks documented on each form ranged from 0-8 (mean 3.92). No risks were recorded in 2 of these 102 forms. Most commonly recorded risks were infection (95.1%), DVT/PE (81.4%), and failure of procedure (59.8%). It was shown that many of the consent forms analyzed did not have all the serious or frequently occurring risks recorded on them and that a large proportion of the forms had acronyms or phrases that may mean nothing to the patient.

Comparison of documented risks for different hip surgery was made using Fisher's exact test showing no significant difference between the risks recorded on the forms.

CONCLUSION: Although documentation of risks has shown to have been improved compared to old consent forms, patients are not necessarily given the most appropriate information to ensure consent is valid.

4. ♦ The Use of Bone Morphogenetic Protein 2 (BMP-2) in the Treatment of Post-Traumatic Nonunions and Malunions

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Nonunions and malunions of long bone fractures are a severe problem in orthopedics. There is a wide spectrum of treatment options, which usually include some type of grafting performed to the nonunion. The purpose of this study was to examine the use of BMP-2 in established nonunions and malunions as a treatment option.

METHODS: A retrospective review was undertaken from October 2002 when the author started using BMP-2 for fracture nonunion and malunion until November 2004. Thirty-six nonunions/malunions were included in our study. The treatment at the time of the nonunion or malunion consisted of open reduction and internal fixation with the addition of BMP-2 soaked in an absorbable collagen sponge.

RESULTS: The nonunions consisted of femurs (10), tibia (14), humerus (6), clavicle (4), and ulna (2). Twelve patients are still less than 12 months from their surgeries and are not yet at a point for radiographic assessment. Twenty of the remaining 24 (83%) fractures went on to radiographic union.

CONCLUSION: The data suggests that the use of BMP-2 in long bone fractures is a viable treatment option. Although our data collection is not yet complete, we did show an 83% union rate.

5. The Effect of Fusion Level on Facet Loading

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INTRODUCTION: Lumbosacral fusion is a common procedure for stabilization of the spine, but has been shown to result in chronic degenerative changes proximal to the fusion level. Quantification of the changes in the facet joint load proximal to fusion of various levels has not been established. To overcome inherent issues in use of fresh frozen cadaver spines in testing, a human lumbar spine mechanical analogue model was developed and used for this study.

METHOD: The human lumbar spine analogue model was tested and found to be similar in rigidities and range of motion to calf spines and frozen human spines. The model was instrumented with rosette strain gages mounted on the pars intra-articularis on facets L3 to L5; strain in these gages was an inference of relative facet load. Varying levels of posterior fusion were applied. After each application of instrumentation, the specimen was tested in right-to-left lateral bending while strains were recorded. The specimen was instrumented five independent times for each level of fusion to give a N of 5.

RESULTS: Right and left lateral bending demonstrated a decrease by up to 50% of the L5 strain (as compared to the noninstrumented model) with increasing levels of fusion. L4 strain increased by 75% with L5-S1 fusion and decreased by more than half with L4-S1 fusion. L3 strain increased by 25% with a L5-S1 fusion and 85% with a L4-S1 fusion. Rigidity of the segment increased with increasing fusion levels. Range of motion in the NZ decreased with increasing levels of fusion.

DISCUSSION AND CONCLUSION: Previous biomechanical studies using cadaveric human spines have been limited by the rapid degradation of the model. The current study used the previously validated human analogue spine and demonstrated more than doubling of strain in the adjacent segment proximal to the fusion for up to two levels of posterior fusion. An observed increase in posterior element strains correlates to increased facet joint loads and clinically documented degenerative changes.

6. Mortality Rates are Increased in Patients with Lumbar Stenosis Who Sustain Hip Fractures

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INTRODUCTION: There is growing concern that decompression should not be delayed in the elderly patient with lumbar stenosis and gait changes because of the risk of hip fracture. Mortality rates after hip fractures are higher in patients with delayed treatment because of pulmonary implications of extended bedrest in the elderly patient. Thus, timely decompression in elderly patients with marked gait changes may extend life span.

MATERIALS AND METHODS: Three groups of elderly adults (age >60) were retrospectively studied. Group I: 30 patients with hip fractures with a history of spinal stenosis and gait changes. Group II: 60 patients with hip fractures who did not have lumbar disease. Group III: 60 patients with spinal stenosis and gait changes who did not have hip fracture, but underwent lumbar decompression. All patients were followed for minimum two years. Survival analysis using log-rank test and Cox hazards analysis were performed to determine if survival was significantly different in the three groups. Co-morbidities were corrected for in this analysis.

RESULTS: Log-rank test: significantly higher survival function in Group II as compared to Group I ($X^2=3.6$, $p<0.03$) and in Group III as compared to Group I ($X^2=8.7$, $p<0.01$). Cox proportional hazards analysis demonstrated reduced survival in Group II when compared to Group I ($L=2.31$, $p<0.04$) and Group III ($L=5.47$, $p<0.02$).

CONCLUSION: Elderly patients with lumbar stenosis who fall and sustain hip fracture have significantly reduced survival. Thus, if a patient with lumbar stenosis has marked gait changes, and if there is a significant concern that the patient may fall and sustain a hip fracture, operative lumbar decompression should be strongly advocated and not delayed.

7. Rate of Total Disability After Lumbar Discogenic Fusion in the Workmen's Compensation (WC) Population

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PURPOSE/STUDY DESIGN: This retrospective review of WC patients who underwent single- or multi-level discogenic fusion with two year follow-up was performed to determine change in pain and functional outcome and the rate of total disability after lumbar discogenic fusion in the WC population.

METHODS: Sixty-three WC patients who underwent combined interbody and posterior instrumented fusion for mechanical low back pain were studied. Two-year follow-up was available for all subjects. VAS and Oswestry were calculated pre- and postoperatively and patients were evaluated for work capacity after surgery. Total disability was defined as inability to return to any meaningful work. Patients were divided into three groups. Group 1 included 39 patients who underwent single-level fusion; Group 2 consisted of 19 patients who underwent two-level fusion; and Group 3 consisted of 5 patients who underwent three-level discogenic fusion. All multi-level fusions were performed at an outside facility. Paired t-tests were used to compare VAS and Oswestry scores before and after surgery and to compare improvement in VAS and Oswestry between Groups 1 and 2. Fisher's exact test was used to compare the proportion of patients on total disability in Groups 1 and 2. Group 3 could not be tested as the rate of total disability was 100%.

RESULTS: Group 1: Improvement in Oswestry and VAS ($p < 0.05$); 23% of patients filed for total disability. Group 2: No improvement in Oswestry, small improvement in VAS (1.1 points on a scale of 1-10; $p = 0.04$); 74% filed for total disability. Group 3: no improvement in VAS or Oswestry; 100% filed for total disability. Fisher's exact test: proportion filing for total disability higher in Group 2 than in Group 1.

CONCLUSIONS: Total disability is substantial in the WC patient undergoing lumbar discogenic fusion. These patients should be informed of the outcomes, particularly with multi-level discogenic fusion, before this is considered.

8. Outcomes of 9 mm Width Lumbar I/F Cage Posterior Lumbar Interbody Fusion with the Variable Screw Placement System

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To report the functional outcomes, fusion rate, and complications related to posterior lumbar interbody fusion (PLIF) with narrow 9 mm width Lumbar I/F cages.

SUMMARY OF BACKGROUND DATA: PLIF with the Lumbar I/F Cage and posterior Variable Screw Placement System (VSP) has increased the successful fusion rate to nearly 100% at the four lowest levels, L2-3 through L5-S1.

In the design of the cage, only the surface area of the opening for bone graft contact with the endplates would vary with the size of the cage. In the narrow cage, the bone healing potentially is compromised by the smaller surface area. For this reason, it is clinically important to study the clinical and fusion success of these narrow cages.

METHODS: Of 449 patients who underwent PLIF with the Lumbar I/F Cage and VSP from 1999 to 2002 in our practice, 115 patients were identified who had PLIF with 9 mm Lumbar I/F cages and VSP at a fusion level. Clinical success was determined with a modified Prolo score evaluating pain, function, medication usage, and economic status. Fusion success was determined by evaluation of plain radiographs and was defined by continuous bone bridging the fusion area with no lucencies.

RESULTS: Prolo scores were excellent in 42 (37%), good in 44 (38%), fair in 24 (21%), and poor in 5 (4%). Ninety-three patients (81%) had clinical success, and 22 (19%) were clinically unsuccessful. Fusion was successful in 113 (98%) and failed in 2 patients (2%). The failed fusions were both L1-2 PLIF associated with subsidence.

CONCLUSIONS: PLIF with 9 mm width Lumbar I/F Cage and VSP had 98% fusion success. This is comparable to the fusion success with PLIF with the 11 or 13 mm width Lumbar I/F cages and VSP.

9. Repair of Pars Interarticularis Defect with a Modified Songer Cable-Screw Construct

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INTRODUCTION: Spondylolysis and grade 1 spondylolisthesis are common defects found in the general population. While many remain asymptomatic or heal with non-operative management, a small subgroup of these patients will continue to have pain from this defect. Chronic pain that is localized to the pars defect and unresponsive to conservative management is an indication for operative intervention. While lumbosacral fusion has remained the gold standard, direct repair of the pars defect has been shown to be effective in this small population. Care must be taken to differentiate pain produced by pars interarticularis defects from discogenic or facet pain. Multiple surgical techniques have been described in an attempt to directly repair the pars defect. Most techniques rely upon compression across the pars defect after appropriate debridement and bone grafting. Multiple wire, screw, screw-wire, pedicle screw-wire, pedicle screw-hook, and pedicle screw-rod constructs have been described with uniformly good to excellent results. We report on a modification of the previously described Songer technique utilizing a pedicle screw-wire construct for direct repair of symptomatic pars defects.

STUDY DESIGN: A retrospective study of patient outcomes after utilizing a modification of the previously described Songer wire technique for symptomatic L5-S1 spondylolysis. This study was done to assess the outcomes after fixation of pars interarticularis defects utilizing a modification of the previously described Songer wire technique.

METHODS: Three patients were assessed for functional level, radiographic, and clinical evidence of healing.

RESULTS: All three patients proceeded to radiographic and clinical union. All patients reported resolution of their preoperative pain and excellent functional scores.

CONCLUSION: The use of this modification of the Songer wire technique for symptomatic L5-S1 spondylolysis provided excellent clinical, radiographic, and functional results in this small group.

10. Retrospective Review to Evaluate the Incidence of Premature Physeal Closure in Distal Tibial Salter-Harris Type I and II Physeal Injuries

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INTRODUCTION: There is a valid concern for premature physeal closure after a fracture involving the physis. Anatomic reduction of Salter-Harris fractures of the distal tibia decreases the potential for a growth disturbance. Interposition of soft tissues like periosteum can block closed anatomic reduction and increase the risk of growth disturbance. The presence of a residual physeal gap (3 mm or more) on post-reduction radiographs has been shown to increase the incidence of premature physeal closure.

MATERIALS AND METHODS: Thirty patients who had sustained distal tibial physeal injuries (Salter-Harris Type I or II) since 1998 were included. Demographic information, radiographs, and treatment protocols were reviewed to allow analysis of patients' outcomes.

RESULTS: Thirty patients with 30 fractures (14 left-sided and 16 right-sided) were included in the study. Eighty-three percent (25 of 30) fractures were Salter-Harris Type II. The overall rate of premature physeal closure was 20% (6 of 30). There was no statistical significance in relationships between age at injury, gender, pre-reduction or post-reduction physeal gap size, and incidence of premature physeal closure ($p=0.06$, 0.7 , 0.08 , and 0.4 respectively). The incidence of premature physeal closure was noted to be higher in patients who underwent closed manipulation ($p=0.03$), with the risk of developing a physeal bar approximately five times greater compared to the other patients. The presence of a residual physeal gap was associated with a 31% (4 of 13) premature physeal closure incidence, while only 12% (2 of 17) incidence if there was no residual physeal gap. This represents an increased risk of premature physeal closure of 2.5-fold based on the presence of a residual physeal gap. Of the patients undergoing open reduction, none have shown the presence of physeal bar formation.

CONCLUSION: The presence of a residual physeal gap in these injuries may predict a higher rate of premature physeal closure. In addition, the necessity of closed reduction may also increase the risk of premature physeal closure.

13. Hardware Failure in Nonunions of the Wrist, Forearm, and Elbow

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INTRODUCTION: Locking plates have recently been introduced for fracture care. However, the benefits of locking various types of plates have been poorly studied.

MATERIALS AND METHODS: Eight nonunions of the upper extremity with hardware failure were retrospectively analyzed.

RESULTS: Four nonunions were from the distal metadiaphyseal and metaphyseal region. One periarticular plate fractured, one reconstruction plate bent, one T-plate bent, and one dynamic compression plate fractured. None in this group had an intact plate with loosened screws.

In two nonunions of the both bones forearm diaphyseal fractures, one showed bending of reconstruction plates, and one case of screws loosening without plate failure of dynamic compression plates.

There were two supracondylar nonunions. One showed breakage of a locked one-third tubular plate and the other case demonstrated fracture of a locked reconstruction plate with screw breakage and pullout of a locked 3.5 mm LCP plate.

CONCLUSIONS: Studying modes of hardware failure can give insight into the biomechanical limitations of fixation choices. In this series, plates thinner than standard 3.5 mm dynamic compression plates fractured or bent without screw failure. Of the three nonunions associated with 3.5 mm compression plates, there was one case of screw loosening, one case of plate breakage, and in the locked plate, there was screw pullout without plate breakage or screw loosening.

CLINICAL RELEVANCE: Biomechanical studies evaluating whether there are any advantages of locking plates thinner than 3.5 mm dynamic compression plates is warranted.

14. Heterotopic Ossification of the Distal End of the Clavicle After a Subluxation or Fracture of the Acromioclavicular Joint

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INTRODUCTION: Our purpose is to describe extremely rare pathology associated with acromioclavicular subluxation in the young adult.

METHODS: We retrospectively reviewed six patients who presented complaining of shoulder pain localized to the acromioclavicular joint in conjunction with finding heterotopic ossification in the region of the distal clavicle. All patients were between 18 and 22 years of age. Surgical treatment was performed in four of six patients due to persistent symptoms. Outcomes were determined by utilizing both the UCLA and the ASES scoring systems. Time to return to sport was recorded. Final follow-up x-rays were obtained to assess for removal and/or recurrence of H.O.

RESULTS: Both operative and non-operative treatments were utilized. In the operative group, intervention consisted of open excision of the distal 7 mm of the clavicle, removal of the H.O., and imbrication of the superior AC ligaments. These patients returned to sport an average of 10.1 weeks. In the non-operative group, treatment consisted of physical therapy, activity modification, and NSAID's. Average return to sport following non-operative treatment was 11.4 weeks post-injury. All patients had good to excellent results.

DISCUSSION/CONCLUSION: We report a condition not previously reported. Heterotopic ossification of the distal clavicle can occur following injury to the acromioclavicular joint and can contribute to pain and dysfunction of the joint. We feel this pathologic condition is due to the pleuripotential cells in the distal clavicle. Both surgical and non-surgical approaches may be used. The treating physician should be aware of the possibility of this condition following even low-grade injury to the joint in the young adult.

**15. Percutaneous Plating of Distal Tibial Fractures:
Preliminary Results**

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INTRODUCTION: Treatment of distal tibial fractures using minimally invasive plate osteosynthesis (MIPO) techniques may minimize damage to soft tissues and the vascular integrity of bony fragments. The use of locking plates is a rigid fixation and proper anatomical reduction is essential in order to avoid nonunion.

OBJECTIVE: To assess the outcome of patients treated with locking plates for distal tibial fractures.

METHODS AND RESULTS: We present a multicenter retrospective review of 18 patients (13 males and 5 females) treated with MIPO for distal tibial fractures. Their mean age was 42 years (range 14-69). According to AO fracture classification, there were 15 patients from 43A fractures; 1 from 43B, and 2 from 42A. Commonest cause of injury was high-energy trauma. Seventeen patients had closed injury and 16 patients had closed reduction. All patients were fully weight-bearing within an average period of 9 weeks (range 0-20). Average time to union was 5 months (range 4-9) and a follow-up period of 12 months. There were two nonunions; one of them a chronic heavy smoker. The other patient underwent autologous bone grafting, but did not unite. Postoperative radiographs of both patients showed a significant gap at the fracture site. There was one superficial infection and no failures of fixation.

CONCLUSION: MIPO is an effective method of treatment for distal tibial fractures. The use of indirect reduction techniques and small incisions is technically demanding, but decreases surgical trauma to soft tissues. It is a rigid fixation and, therefore, proper anatomical reduction is vital.

16. Intra-Articular Injection of Hylan G-F 20 for the Treatment of Shoulder Osteoarthritis

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PURPOSE: The purpose of this study was to evaluate the safety and efficacy of hylan G-F 20 for the treatment of shoulder osteoarthritis.

METHODS: This was a prospective, observational study in which patients with advanced osteoarthritis of the shoulder, who failed to get satisfactory pain relief from standard, conservative methods (physical therapy, steroid injection, anti-inflammatory medication, analgesics), received three weekly, fluoroscopically guided injections of hylan G-F 20 (2 cc), in addition to customary care. Visual numeric pain score at rest, with activity, and at night and adverse events were recorded at all visits.

RESULTS: Twenty-four shoulder joints with osteoarthritis (9 males, 15 females; mean age 65 ± 12 years) were treated with hylan G-F 20. Mean pain scores at visit one (baseline; first injection) were: 53 ± 25 at rest, 54 ± 33 with activity, and 65 ± 31 at night. At the final follow-up visit (mean 19 weeks, range 1-43 weeks after first injection), mean pain scores were: 24 ± 27 at rest ($p < 0.005$ versus baseline), 32 ± 29 with activity ($p < 0.05$ versus baseline), and 31 ± 31 at night ($p < 0.005$ versus baseline). Most patients (92%) reported that they were satisfied or very satisfied with the results of the injections. There were no reported side effects or episodes of pain after injections.

CONCLUSIONS: This study demonstrates the use of intra-articular hylan G-F 20 injections as a safe and efficacious option for treatment of painful osteoarthritis of the shoulder.

17. Locking Plate Fixation for Proximal Humerus Fractures in the Elderly

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INTRODUCTION: The treatment of proximal humerus fractures in the elderly population remains challenging. The significant rise in the number of proximal humerus fractures in this population is predicted to continue to increase in the coming decades. Controversy exists regarding nonoperative versus operative treatment of these patients. We sought to evaluate the results of locked plate fixation of proximal humerus fractures in elderly patients.

METHODS: Retrospective review of a consecutive cohort of elderly patients treated with locked plate fixation for unstable proximal humerus fractures.

RESULTS: Ten consecutive elderly patients (mean age 82; range 77-90) with unstable proximal humerus fractures were treated with locking plate fixation. There were four Neer 2-part, three 3-part, and three 4-part fractures. At minimum 12-month follow-up, the results of this new device were encouraging. All patients healed clinically and radiographically. Average active elevation was 121° (range 100-155°) and external rotation was 33° (range 20-45°). All patients had minimal to no pain and normal function in activities of daily living. There were no infections, re-operations, instances of avascular necrosis, or perioperative medical complications.

CONCLUSIONS: These results demonstrate that operative repair with locked plate fixation is a viable option for treatment of complex proximal humerus fractures in the elderly population.

18. Return to Sexual Activity Following Total Knee Arthroplasty

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Little information exists regarding return to sexual activity following TKA. The purpose of this study was to determine the impact of TKA on return to sexual activity in a large group of patients. Surveys were sent to 1,630 patients who underwent primary TKA with a single implant between 1995-2000. Patients were asked about their ability to return to sexual activity following TKA, timing of return, and most comfortable position. They were also asked whether they felt the information received regarding return to sexual activity was adequate. Surveys included information necessary to calculate modified knee society pain and function scores. Minimum follow-up was two years. 1,098 patients responded (67%). There were 593 females and 505 males. Average age at surgery was 67 years (20-91). 460 patients (42%) returned to sexual activity within four months. Those returning within four months had higher Knee Society function scores than those returning later or not at all ($p < 0.0001$). 93 (8.5%) patients stated they had not returned to sexual activity. This group reported increased pain (lower Knee Society pain score) than those who had returned ($p = 0.004$). 201 patients (23%) stated that TKA interfered somewhat or greatly with sexual activity. Patients younger than 70 were more likely to cite impairment ($p = 0.01$). Men reported faster return to sexual activity than women ($p < 0.0001$). Women most commonly reported that being on the bottom was their most comfortable position, while men responded most commonly that being on top was most comfortable ($p < 0.0001$). Younger patients (< 70) were more likely to respond that being on the bottom was more comfortable ($p = 0.01$). 749 (86%) felt the information received regarding return to sexual activity following TKA was adequate.

19. Internet Promotion of MIS and CAOS in TKA by Members of AAHKS

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Minimally Invasive (MIS) and Computer Assisted Orthopaedic (CAOS) surgical options in Total Knee Arthroplasty (TKA) have recently prompted increased discussion in the orthopedic community. There are few controlled studies evaluating the efficacy and safety of these options. One of the goals of the AAHKS is to facilitate the exchange of knowledge concerning education, research, and treatment of disorders of the knee. Hence, it is the responsibility of members of this society to disseminate accurate information concerning TKA. This study examined the internet sites of AAHKS members to evaluate the level of promotion these procedures were receiving.

The internet was searched for web sites related to active members of the AAHKS. Commonly used search engines Google, Yahoo, and Excite were chosen as representative of common patient searches. Physician's name and permutations thereof were used as keywords to conduct the search. For each surgeon, all web sites found were browsed and evaluated for MIS and CAOS TKA information. Both direct (surgeon/private practice) and indirect (institution/hospital) information from the sites was evaluated.

Active AAHKS physicians were found to have 727 total web sites. 8.4% and 12.7 % of these sites made indirect and direct reference to MIS TKA, respectively. Quicker recovery was suggested by 8.4% and 8.0% of these sites, respectively. In contrast, MIS specific TKA risks were presented by only 4.7% and 3.2% of sites, respectively. CAOS TKA was discussed in 4.3% and 5.6% of these sites, respectively.

Although MIS and CAOS TKA were frequently discussed and advertised by some surgeons, only a small percentage of AAHKS members directly promote or make claims to these techniques on the internet. MIS and CAOS TKA information was often associated with AAHKS surgeons through institutional web sites or hospital affiliations. While our findings confirm that MIS and CAOS TKA is not commonly promoted via the internet by members of the AAHKS, it is important to note that from a patient perspective, MIS and CAOS information which is indirectly associated with a surgeon may be mistaken as an endorsement of the procedure without a clear statement of position on the part of the surgeon.

20. Preoperative Factors Affecting Knee Range of Motion After Total Knee Arthroplasty

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PURPOSE: Knee range of motion is an important measure following total knee arthroplasty (TKA). No previous studies comparing knee motion and previous contralateral TKA or medical co-morbidities were found. The purpose of this study was to create a predictive model of flexion outcomes after TKA, analyze two new potential variables, and to identify population trends in change of knee flexion after surgery.

METHODS: We prospectively followed 169 patients having 208 primary TKAs between 1994 and 2003 with follow-up ranging from one to eight years. Thirty-nine of these patients underwent delayed bilateral TKA. Regression tree analysis was used to construct a predictive tree and to identify population trends in change of motion after joint replacement.

RESULTS: Preoperative flexion was the best predictor of postoperative flexion for those patients having their initial TKA. For patients having delayed bilateral TKA, the first knee's postoperative flexion was the most significant predictor of postoperative flexion for the second knee (P value <0.0001) and accounted for 42% of the variability ($r^2 = 0.42$). The average difference in motion between delayed TKAs was $1.2 \pm 9.6^\circ$ (\pm one standard deviation). Except for extreme obesity (BMI > 43 kg/m²), individual and total medical co-morbidities were not found to be predictive of motion. TKA had a normalizing effect on our cohorts' postoperative flexion distribution. The greatest flexion changes occurred in patients with a preoperative flexion of < 85° or > 117.5°, who gained or lost a mean of $33 \pm 16^\circ$ and $9 \pm 10^\circ$ of flexion respectively.

CONCLUSIONS: Knee flexion after TKA is dependent upon multiple variables, the most important of which is preoperative flexion. For patients having delayed bilateral TKA, the first knee's motion is the most significant predictor of flexion for the second knee. This relationship between delayed TKAs has not been previously reported to our knowledge. Medical co-morbidities, aside from extreme obesity, did not affect TKA motion. TKA normalizes a population's flexion distribution and reflects regression towards the mean with those having preoperative flexion at either extreme experiencing the greatest change.

21. Anterior Knee Pain and Total Knee Arthroplasty: Are They Related?

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INTRODUCTION: Anterior knee pain is often cited as a factor relating to patient dissatisfaction after total knee arthroplasty. In studies examining total knee arthroplasty, the incidence of anterior knee pain ranged from 2-11%. Factors implicated as causative in producing the pain include: implant design, surgical technique, component alignment, joint line restoration, and restoring patellar thickness.

METHODS: Anterior knee pain was prospectively evaluated in 102 subjects: 51 TKA (PS design) subjects with patellar resurfacing by a single surgeon and 51 controls. All subjects were matched for age, sex, body mass index, and knee function score. Control subjects were excluded if they had prior knee surgery, trauma, or abnormal radiographs. A patellar score was calculated for all subjects using a specific questionnaire that examines anterior knee pain, quadriceps strength, and function.

RESULTS: Hospital for Special Surgery mean score was 92.1 in the TKA group and 93.0 in the control group. Patellar mean score was 25.9 in the TKA group and 28.8 in the controls. In the TKA group, 11 of 51 subjects (22%) reported anterior knee pain, most commonly described as mild (73%). In the control group, 7 of 51 subjects (14%) reported anterior knee pain, described as mild by 86%. The difference in anterior knee pain between the two groups (8%) is not statistically significant ($p=.44$).

DISCUSSION/CONCLUSION: This data suggests that anterior knee pain is present in a certain percentage of the healthy population and that anterior knee pain following total knee arthroplasty may not be directly related to surgical factors.

22. A Comparison Study: Bilateral Total Knee Arthroplasty with and without Surgical Navigation

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INTRODUCTION: A retrospective study was performed to validate the use of surgical navigation for bilateral total knee arthroplasty (TKA). The goal of the study was to evaluate the difference in accuracy and safety for patients undergoing bilateral TKA with and without surgical navigation.

METHODS: Twenty-eight patients received bilateral TKA with surgical navigation. A comparable group of 28 patients matched according to age, sex, and diagnosis was selected. These patients received bilateral TKA using the standard instrumentation. Knee Society scores were used for clinical evaluation, while component placement and alignment was determined using the Knee Society Radiological Evaluation. Perioperative and early postoperative clinical activity was assessed including blood usage, tourniquet time, intraoperative anesthetic stability, length of hospital stay, and postoperative complications.

RESULTS: At the one-year follow-up, the average knee score was slightly higher for navigation (94.9) than standard (91.5). Intra- and postoperative medical complications were comparable in both groups, although anesthetic stability was slightly better with surgical navigation. Complications during the immediate postoperative period included two deaths, one from myocardial infarction (age 82, standard) and the other from pneumonia with ARDS (age 68, navigation), and one stroke (standard). The radiological findings were as follows: AP femur 93.9% (navigation)/100% (standard), AP tibia 100%/95%, femorotibial angle 94.1%/85%, lateral femur 94.1%/78.9%, and the lateral tibia 91.2%/42.1% within accepted limits respectively.

DISCUSSION: Results suggest that surgical navigation is a suitable approach for patients undergoing bilateral TKA. Accuracy improved using navigation for component placement and alignment in bilateral TKA.

23. Computer Assisted Surgery: Why You Should Use it for TKA

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INTRODUCTION: Total knee arthroplasty (TKA) surgery has achieved a high degree of success since the introduction of concepts of alignment and ligament balance in the early 1970s. Continuing pressure to improve function and longevity from the operative intervention has led to the design of increasingly sophisticated devices placed with the use of mechanical jigs. While significant improvement has been made, errors of alignment and stability remain. Methods to diminish the margin of error have not been substantially improved with mechanical jigs, suggesting that intraoperative feedback is difficult to teach and learn, and resulting decision-making is not as predictable as one would hope.

METHODS: The senior author has used the Stryker Surgical Navigation System as directed to achieve appropriate alignment and stability for 142 primary total knee arthroplasties since mid 2003.

RESULTS: Results have shown restoration of the mechanical axis of the leg within acceptable limits for 97.7% of the knees operated on using navigation. Two of the navigated knees have been revised to date. One knee has undergone debridement for hematogenous infection; the other knee was revised for patellar malposition.

DISCUSSION: Surgical navigation has been demonstrated to provide more predictable alignment of the leg in multiple investigators hands when compared to the conventional techniques. Bathis et al reported restoration of the mechanical axis within acceptable limits for 96% of the patients included in their study when navigation was used¹. The number of revisions necessary in the future should decrease with a technique such as surgical navigation. Use of it now, to learn and perform TKA is appropriate and advisable.

References:

¹Bathis H, Perlick L, Tingart M, Luring C, Zurakowski D, Grifka J: Alignment in Total Knee Arthroplasty. J Bone Joint Surg Br 86(B):682-687, 2004.

24. Blood Conservation in Primary Total Knee Arthroplasty

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INTRODUCTION: Blood loss associated with total knee arthroplasty often results in the need for postoperative transfusion. Several methods of blood conservation are commonly used to decrease the risk of homologous transfusion. These include autologous pre-donation, epoetin alpha supplementation, intraoperative and postoperative blood salvage, and soft tissue treatment. The purpose of this study is to measure the efficacy of the TissueLink System in primary total knee arthroplasty.

METHODS: A single surgeon series of 288 patients undergoing computer assisted primary total knee arthroplasties (TKA) from 2001 to 2005 were retrospectively reviewed. The control group consisted of 116 patients including 41 males and 75 females with a mean age of 66.8 and a mean body mass index (BMI) of 34.8. The test group consisted of 172 patients with the TissueLink System used as an intra-operative method of blood conservation. The test group included 66 males and 106 females with a mean age of 67.0 and a mean BMI of 32.3. Pre- and postoperative hemoglobin levels were analyzed for all patients.

RESULTS: The average drop in hemoglobin level for control patients was 1.12 (S.D.+/- 1.05) g/dL with a mean postoperative hemoglobin level of 11.01 (S.D.+/-1.67) g/dL. The overall rate of transfusion within the control group was 2.59% (3 of 116). The three transfused patients had low hemoglobin levels prior to surgery. In the test group, 0% of patients treated with TissueLink required transfusion. However, the average drop in hemoglobin level in the TissueLink group was 2.53 (S.D.+/-1.14) g/dL with a mean postoperative hemoglobin level of 10.86 (S.D.+/-1.29) g/dL. T-test ($p=.05$) revealed no significant difference between the average drop in hemoglobin level of control and test groups as well as no significant difference between the postoperative hemoglobin levels.

CONCLUSIONS: While pre- and intraoperative methods of blood conservation should be employed, the lack of a statistically significant difference between the postoperative hemoglobin levels of control and test patients does not support the routine use of the TissueLink System in primary TKA.

25. Augmented Tantalum Patella in Total Knee Arthroplasty

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INTRODUCTION: The purpose of this study was to assess the early clinical outcome of novel porous tantalum augmented patellar implant. The extent of tissue ingrowth in an augmented tantalum metal patella, retrieved eight months after implantation was also evaluated.

METHODS: Between 2001 and 2004, the senior author performed six total knee arthroplasties in patients with severe patellar bone loss treated with a trabecular metal augmented patellar implant. After suturing the tantalum base to the residual extensor mechanism, the all-polyethylene articulating surface was cemented into position using standard techniques. The patients were assessed using Knee Society scores (KSS), knee pain, flexion, and complications as outcome measures. The retrieved implant was analyzed using polarized light microscopy, scanning electron microscopy and energy-dispersive spectroscopy. Image analysis was performed to quantify tissue ingrowth.

RESULTS: At last follow-up, KSSA (72 versus 49) and KSSF (59 versus 31) were significantly improved when compared to preoperative levels ($p < .05$). There was no significant difference in flexion at last follow-up (98° versus 112°). There were no clinical complications related to patella. In the analysis of the retrieved implant, open (spherical) and closed (triangular) pores in the metal structure were identified. Tissue penetration was only observed in spherical pores. Ninety-two percent of the volume of the available spherical pores had tissue ingrowth. Total tissue ingrowth (including closed pores) was 80%. The open pores had an abundant tissue ingrowth and vascular development when compared to the closed pores.

If noted, the author indicates something of value received. The codes are identified as: a – research or institutional support; b – miscellaneous funding; c – royalties; d – stock options; and e – consultant or employee.

◆ The FDA has not cleared the drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an “off label” use).

**MAOA POSTER PRESENTATIONS – 2006 ANNUAL MEETING
#26-48**

**26. Short-Term Clinical Outcome of Patients Treated with
a Metal-on-Metal Resurfacing Hip Replacement**

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INTRODUCTION: Bone preservation and minimal wear metal-on-metal technology of resurfacing arthroplasty represents a promising solution for the younger patient who requires a hip replacement. The purpose of this study was to evaluate the early outcomes of patients treated with the Cormet 2000[®] resurfacing hip prosthesis.

METHODS: All surgical procedures were performed by a single surgeon (DGA). Thirty-one hips in 28 patients, with a mean age of 51 years, were prospectively evaluated pre-operatively and at a minimum of two year follow-up using standardized questionnaires, physical examinations, and radiographic evaluations.

RESULTS: For 28 of 31 hips, patients rated their satisfaction with the procedure as excellent, 2 as good, and 1 as fair. Mean Harris Hip scores increased from 50 preoperatively to 96 at last follow-up ($p < .001$). Level of pain, ability to perform activities of daily living, and flexion (98 at last follow-up) significantly improved compared to preoperative scores ($p < .05$). Comparison of hip ratios for the operative hip to the contralateral hip in Charnley Class-A patients demonstrated accurate reconstruction of the normal anatomy ($p = .96$). One patient with a femoral neck fracture and one with femoral loosening required revision to a total hip replacement.

CONCLUSION: The short-term clinical outcome of the Cormet 2000 hip resurfacing prosthesis has been good indicated by excellent Harris Hip Scores, ROM, and high patient satisfaction, with most patients able to return to a high level of activity. In this patient group, with a life expectancy of 30-50 years, long-term follow-up will be critical.

27. AcuMatch® Highly Modular Femoral Stem in Revision Total Hip Arthroplasty: A Prospective Evaluation

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INTRODUCTION: The goal of this study was to prospectively evaluate clinical results of Exactech's AcuMatch® M-series prosthesis, a novel three-piece modular femoral stem in revision THR.

METHODS: Fifty-one femoral stems implanted in 49 patients undergoing revision total hip replacement were prospectively analyzed at a mean follow-up time of 3.1 (2-5) years. Surgical procedures were performed by a single orthopedic surgeon. Patients were evaluated preoperatively and at annual follow-up visits using standardized questionnaires, physical examinations, and radiographic evaluations. Harris Hip scores, range of motion, functional outcome measures, and SF-12 scores were determined at each follow-up period. Paired t-tests were used to compare preoperative and postoperative mean scores. Statistical significance was determined as $p \leq .05$

RESULTS: Mean Harris Hip scores were 36 preoperatively and 79 at last follow-up ($p < .0001$). Flexion increased from 78 preoperatively to 92 at last follow-up ($p < .01$). Mean SF-12 score was significantly improved at last follow-up ($p < .05$). One patient with reactivation of a deep infection was controlled with antibiotics. Two dislocations occurred in the 51 cases. One patient with deficient abductors was revised for recurrent dislocation.

CONCLUSION: The ability to fit the metaphysis and diaphysis independently without regard for ultimate version or length resulted in preservation and use of existing bone stock. Without a modular design, either component orientation or bony apposition would have to be compromised. Clinical outcome has been satisfactory over the short-term in this difficult patient population.

28. Analysis of Retrieved Modular Prostheses

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INTRODUCTION: The *in vivo* degradation of metal alloy implants compromises the structural integrity of the implant, and the release of the degradation products may result in the onset of an adverse biological reaction in the host leading to osteolysis and aseptic loosening of the implant. The work presented here reports the failure analyses of seven modular implants (six hip prostheses and one knee implant). The duration of implantation ranged from six months to three years.

METHODS: Examination and analysis included energy dispersive x-ray microanalysis for identification of chemical composition, macroscopic examination, SEM study of fracture surfaces, and study of alloy microstructure by optical microscopy.

RESULTS: Two of six modular hip implants were fractured *in vivo*. Macroscopic examination showed close topographical similarities between the two. The dark elliptical striations on the fractured face indicated the occurrence of "low cycle fatigue". SEM images confirmed the presence of corrosive attack causing formation of dents and the dimples on the fracture site. SEM images also exhibited numerous microcracks, the characteristic feature of the stress corrosion cracking and/or corrosion fatigue assisted by environment. In five hip implants, Energy Dispersive Spectroscopy (EDS) confirmed the presence of traces of metallic ions in the tissue around the implant, and nothing unusual was found in one modular hip implant. The modular knee prosthesis had loose and corroded Morris tapers, and no traces of metallic ions were detected.

CONCLUSION: Taper performance is influenced by metallurgy, the load carried, and the effect of the local microenvironment. Methods to reduce the impact of these factors may reduce the incidence of taper related failure.

29. The Safety and Efficacy of Minimally Invasive Total Replacement Knee

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INTRODUCTION: Increasing demand of arthroplasty procedures and the large expenditure of resources devoted to them call for optimization of this practice. Minimally invasive (MI) total knee replacement (TKR) is one way to optimize this. We examined and compared its safety and efficacy in a prospective cohort.

MATERIALS AND METHODS: We prospectively have followed 67 consecutive MI TKR and 28 traditional TKR cases, for a minimum of six months. All patients received a cemented, cruciate retaining, Stryker Duracon TKR. Patients have preoperative and postoperative knee society scores (KSS), range of motion (ROM) assessment, and SF-12 scores.

RESULTS: Incision is 4.5 inches long and anatomic alignment is 5° of valgus in average in the MI group. This group had three DVT, one PE, and one temporary foot drop cases. Postoperative KSS and ROM improved significantly ($p < 0.05$) and equivalently in both groups. The ROM was the same at four weeks in the MI group compared to the traditional group at six weeks.

DISCUSSION: The most common cause for revision of TKR is error in surgical technique². This concern frequently arises in MIS techniques. Another concern is injury to the skin. In our series, there were no cases of component malposition or skin breakdown. MIS TKR was equally safe and efficacious as traditional TKR with regards to the complications of DVT, PE, and neurological injuries^{1,3}. Both techniques were similarly efficient based on the KSS and ROM. However, the MI group had earlier recovery of ROM and independent gait.

¹Callahan CM, et al: Patient outcomes following tricompartmental total knee replacement. A meta-analysis. *Jama* 271:1349-57, 1994.

²Fehring TK, et al: Early failures in total knee arthroplasty. *Clin Orthop Relat Res*:315-8, 2001.

³Schinsky MF, et al: Nerve injury after primary total knee arthroplasty. *J Arthroplasty* 16:1048-54, 2001.

30. Preoperative Templating of Surgeon Controlled Factors in THA: Accuracy in Predicting Bearing Stress

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Prosthetic wear and osteolysis are the principle sources of late aseptic THA failure. Wear is related to stress and influenced by both patient factors and reconstruction factors. Surgeons influence reconstruction factors via prosthetic choice and surgical technique. Preoperative template analysis and comparison with actual reconstruction serves as a method for determining optimal reconstruction and the accuracy of achieving it.

Bearing stress in 15 THA was compared with preoperative templates with respect to acetabular inclination angle, body moment arm, and prosthetic offset. Stress (MPa) was determined to be a function of the free body vector solution for joint force (N) and contact area of the prosthetic head and was determined by custom software interpretation of radiographs/templates. Templated stress and reconstruction stress were compared and analysis of variance performed for individual surgeon controlled factors.

Templated stress was 85% accurate in predicting reconstruction stress (average 1.66 MPa). No difference was found between templated and reconstruction body moment arm or prosthetic offset, with no detectable effect on stress ($p=0.065$ and 0.45). An 18% error was noted predicting reconstruction acetabular inclination ($41.4 \pm 9.4^\circ$) with a significant impact on stress ($p=0.017$).

Bearing stress is predicted 85% accurately via careful preoperative templating. Of the surgeon-controlled factors, acetabular inclination angle was the most poorly predicted and had the greatest effect on stress. This study leaves room for the possibility that more accurate computer assisted surgical techniques could improve reconstruction biomechanics and influence bearing stress.

31. A Posterior Stabilized Constrained Knee Modular System for Difficult Primary and Revision TKA

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Difficult primary and revision total knee arthroplasty (TKA) with constrained knee systems is becoming more common. Modular systems are critical to success. We retrospectively reviewed 421 difficult primary and revision TKA cases performed by a single surgeon using a modular posterior-stabilized, constrained component (PSC).

Between July 1992 and December 2003, 421 consecutive TKA using a PSC system were performed in 395 patients. Forty-seven cases were primary, 11 were conversion, 271 were revision, 90 were reimplantation, and 2 were part of an intramedullary total femoral replacement. Ninety-five patients (102 PSC) died during follow-up.

Follow-up averaged 4.5 years. The preoperative Knee Society (KS) clinical scores averaged 48.0 and improved to 79.0 postoperatively. Range of motion improved from 91° to 101°. Incidence of manipulation was 9.5%. Aseptic revision of one or more components occurred in 24 cases (5.2%) with 6 (1.4%) for arthrofibrosis, 5 (1.2%) aseptic loosening, 4 (1.0%) extensor mechanism dysfunction, 3 (0.7%) instability, 2 (0.5%) soft tissue impingement, 3 (0.7%) periprosthetic fracture and 1 (0.2%) malignant tumor. Septic failure occurred in 8 (8.9%) reimplantation cases and in 14 (4.2%) others.

The authors present a single surgeon experience using a PSC modular knee system to address difficult primary and revision TKA. It is clear from this review that a PSC modular knee can adequately address bone loss and ligamentous instability to restore function. In this study, failure due to aseptic loosening and instability was low with each occurring in 1%. The reinfection rate with two-stage reimplantation was low at 8.9%.

A posterior stabilized constrained modular knee can adequately address bone loss and ligamentous instability to restore function in difficult cases.

32. Novel Uses for Computer Assisted Navigation in Total Knee Arthroplasty

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INTRODUCTION: Computer assisted navigation (CAN) for total knee arthroplasty (TKA) has not been evaluated in retained intramedullary hardware or femoral deformity, whereby conventional techniques would be insufficient for confident alignment. We present a case series of four patients with six knee arthroplasties utilizing CAN. We introduce a new application of CAN in TKA.

MATERIALS AND METHODS: We prospectively have followed four patients with six knees having either a femoral malunion or retained intramedullary femoral hardware requiring TKA. The Stryker-Liebinger CAN system was utilized due to the inability to use the intramedullary femoral alignment guides. Patients have been followed with preoperative and postoperative Knee Society Score (KSS) and SF-12 scores at one, three, and six months. Follow-up ranged from one month to six months. This will be updated at the time of presentation.

RESULTS: No complications were reported. All patients expressed satisfaction with their postoperative results. All postoperative films revealed the joint lines to be perpendicular to the mechanical axis and parallel to the floor. Postoperative KSS and ROM improved significantly ($p < 0.05$).

DISCUSSION: CAN was employed to ensure adequate alignment of the components using the mechanical axis of the lower limb. The accurate determination of the mechanical axis is inconsequential to severe deformity¹. Although CAN does help to establish this, it is no substitute for proper surgical technique, judgement, or experience.

¹Bathis H, et al: Alignment in total knee arthroplasty. A comparison of computer-assisted surgery with the conventional technique. *J Bone Joint Surg Br* 86:682-7, 2004.

33. Unilateral Tibial Polyethylene Liner Failure in Bilateral Total Knee Arthroplasty – Bilateral Retrieval Analysis at Eight Years

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INTRODUCTION: Problem: Polyethylene wear has been identified as a significant contributing factor to failure in total knee arthroplasty. Laboratory wear analysis and the effect of sterilization methods of polyethylene have provided insight into this factor. Purpose: to report on the isolated effect of method of sterilization (gamma irradiation barrier versus gamma-air) in bilateral TKA in a retrieval analysis with biomechanical testing of the retrieved polyethylene.

METHODS: Case report with dramatic imaging and graphic polyethylene retrieval analysis. A 65-year old male underwent bilateral simultaneous TKA surgery for OA of both knees using a cruciate retaining knee. At eight years, swelling, effusions, and giving way developed in the left knee, requiring a liner exchange procedure which was performed bilaterally. The retrieved polyethylene components from both knees were analyzed for method of sterilization, shelf-life. Micro and Macroscopic retrieval analysis was performed for articular and nonarticular wear. Biomechanical laboratory testing was performed to determine polyethylene toughness, and infrared spectroscopy to determine oxidation.

RESULTS: Method of sterilization (Gamma-air sterilized [L knee] and gamma-barrier [R knee]) was analyzed as an isolated variable in this retrieval. Shelf-life (L=79 mo; R=10 mo) differed between the two liners. The gamma-air liner (L) demonstrated dramatic wear, delamination, oxidation, and reduced toughness despite a thicker insert. In contrast, the gamma-barrier liner (R) demonstrated minimal wear. Poster figures/graphs: Figures: Poly Liner retrieval macro and microscopic analysis. Biomechanical Graphic displays: oxidation versus distance from nonarticular surface; toughness versus distance from nonarticular surface; oxidation versus toughness.

CONCLUSION: This dramatic retrieval analysis isolates the effect of sterilization on wear and biomechanical properties of polyethylene used in TKA. The clinical implications of this study emphasize the importance of polyethylene shelf life, sterilization techniques, and associated failure that may occur in the mid-term of recent TKA polyethylene designs. The dramatic clinical effects of wear/sterilization method are presented in this poster.

34. Follow-Up of a Cemented Collared Matte Finish Femoral Component at 19 to 20 Years Using Contemporary Cementing Technique

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INTRODUCTION: The purpose of this study was to evaluate the results of cemented total hip arthroplasty at 19 to 20-year follow-up using a collared matte finish femoral component that was inserted with contemporary cementing technique.

METHODS: Three hundred four primary consecutive non-selected cemented total hip replacements were performed in 273 patients between January 1984 and December 1985 by a single surgeon. The average age at surgery was 68.2 years. All hips were performed using the same metal-backed cemented acetabular component and the same cemented matte finish, collared, cobra-shaped femoral component. On the femoral side, a distal cement plug and cement gun delivery system was used. The hips were evaluated for revision for loosening, radiographic loosening, and osteolysis.

RESULTS: At 19 to 20-year follow-up, 140 patients with 160 hips were living and 130 patients with 141 hips were deceased. Three patients were lost to follow-up. Minimum 19 to 20-year radiographs were obtained on 78% of the living patients. For all patients, only nine femoral components (3%) were revised for loosening and only six (2%) other components were radiographically loose. Of the living patients, eight components (5%) were revised for loosening. Four other components (2.5%) were radiographically loose.

DISCUSSION: Collared matte finished femoral components became the standard in cemented replacement in the late 1970's and early 1980's in America. These results using contemporary cementing techniques and this design produced durable results in this study with only 3% of femoral components revised at 20 years.

35. Five to Ten Year Follow-Up of Cementless Total Hip Arthroplasty in Patients Age 50 and Under, Using a Contemporary Extensively Coated Femoral Implant

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INTRODUCTION: The purpose of the present study is to report the prospective five to ten year follow-up of total hip arthroplasty performed in patients age 50 and under using a contemporary extensively coated cementless femoral component.

METHODS: Between June 1994 and December 1999, the senior author performed 115 consecutive cementless total hip arthroplasties in patients under age 50. The extensively coated Prodigy femoral component was utilized in all patients. The average age at the time of surgery was 39 years (range 18-49 years). The patients were prospectively evaluated for clinical results as well as the need for femoral revision, subsidence, osteolysis, and bone ingrowth. Patients were followed from five to ten years with the mean clinical follow-up of 7.8 years. All living patients had a minimum five-year radiograph.

RESULTS: At five to ten year follow-up, 110 of the 115 components in 95 patients were living. No patient was lost to follow-up. No femoral component required revision for any reason during the follow-up. Clinical results revealed 60% of patients still performing moderate labor. Only two patients complained of any thigh pain. Radiographic results demonstrated bony ingrowth in all but one femoral component.

DISCUSSION: The results with this second generation extensively coated femoral component are slightly better than the first generation extensively coated stems in terms of fixation with over 99% bone ingrown compared to 90% reported in studies using the first generation cementless extensively coated stems. We conclude, in an active, young patient population with newer stem designs as well as improved surgical techniques, femoral fixation is not a concern.

36. Loss of Functional Independence After Hip Fracture Surgery

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BACKGROUND: Multiple studies have investigated predictors of mortality in geriatric hip fracture patients. Less is known of factors contributing to postoperative loss of independent functioning. The objective of this study is to investigate the effects of medical co-morbidities, age, gender, timing of surgery, length of hospitalization, and ASA score on loss of independent living in hip fracture patients.

METHODS: A retrospective study of 1,434 patients undergoing hip fracture surgery was done. Age, gender, delay to surgery, and length of hospitalization were tabulated. Preoperative medical co-morbidities were determined using ASA score and ICD-9 codes. Medicare admission source codes and discharge disposition codes were used to determine pre-admission and post-discharge level of independence. Statistical analysis was done on SPSS 12.0 using an independent t-test, ANOVA, chi square, and Mann-Whitney U test. A predictive model was developed using logistical regression analysis.

RESULTS: Patients with decreasing independence after surgery were older ($p < .001$), had surgical delays greater than two days ($p < .001$), and higher ASA scores ($p < .001$). There was no difference in length of hospitalization or secondary procedures. Logistic regression modeling showed age ($p < .001$), delay to surgery ($p = .011$), and ASA score ($p = .027$) to be predictive of loss of independence. Length of hospitalization and secondary procedures were not predictive.

CONCLUSIONS: In patients undergoing hip fracture surgery, loss of independence may be predicted by increasing age, greater delay to surgery, and increasing ASA score. Length of hospitalization and presence of other procedures were not predictive.

37. Predictors of Perioperative Mortality in Hip Fracture Patients

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BACKGROUND: Several studies have investigated predictors of morbidity and mortality in hip fracture patients. Timing of operative treatment, total length of hospitalization, number and type of medical co-morbidities, and ASA score have all been shown to predict mortality rates after hip fracture surgery. Less is known of factors contributing to postoperative loss of independent living. The objective of this study is to investigate the effects of medical co-morbidities, timing of surgery, length of hospitalization, and ASA score on perioperative mortality and loss of independent living in patients undergoing operative treatment for hip fracture.

METHODS: A retrospective study of all hip fracture patients over age 65 admitted to a single hospital over a seven year period identified 1,434 patients who underwent operative management. Patient age, gender, delay to surgery, and total length of hospitalization were tabulated. Preoperative medical co-morbidities were determined using ASA score as well as ICD-9 codes for secondary diagnoses and procedures. Medicare admission source codes and discharge codes were used to determine pre-admission and discharge level of independence. Statistical analysis was done on SPSS 12.0 using an independent t-test, ANOVA, chi square, Mann-Whitney U test, and binary logistical regression analysis.

RESULTS: Of the 1,434 patients, 1,108 patients were female and 326 were male. 1,330 were admitted from home while 104 were transferred from a skilled medical care facility. 165 patients were discharged to home; 1,217 were transferred to a skilled medical facility and 52 expired (32 female, 20 male) prior to discharge. 11,304 secondary diagnoses and 578 secondary procedures were identified. The median number of secondary diagnoses was 7. The most common mechanisms of injury were home accident (640 patients) and unspecified fall (608 patients). Intertrochanteric fractures were most common (692 patients) followed by femoral neck fractures (601 patients). ASA score was found to be predictive of loss of independence ($p < .001$) as well as peri-operative mortality ($p < .001$). Increasing patient age was predictive of loss of independence ($p < .001$) as well as mortality ($p < .001$). Surgical delay of greater than two days was found to correlate with peri-operative loss of independence ($p < .001$) as well as mortality ($p < .001$). Total length of hospitalization was found to correlate with mortality ($p < .001$), but not with loss of independence. Male gender was found to correlate with increased mortality ($p = .006$), but not with loss of independence. Number of secondary diagnoses/procedures did not predict loss of independence or mortality.

CONCLUSIONS: In patients undergoing surgery for hip fracture, increasing ASA score predicts both loss of independence as well as death, while total number of medical co-morbidities does not predict either. Although not necessarily causative, surgical delay of greater than two days correlates with both loss of function and peri-operative mortality following hip fracture surgery. As well, total length of hospitalization is correlated to mortality, but not necessarily causative. Male gender is predictive of mortality. Increasing age correlates with both morbidity and mortality.

38. Serum and Breast Milk Levels of Methylmethacrylate Following Surgeon Exposure During Arthroplasty

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INTRODUCTION: Although pregnant personnel are encouraged to leave the operating room during mixing and application of polymethylmethacrylate (PMMA), there is no information regarding the safety of exposure to methylmethacrylate (MMA) fumes for breast-feeding females. The objective of this study was to evaluate the relative risk to breast-feeding females of MMA inhalational exposure during arthroplasty.

METHODS: Two breast-feeding surgeons had blood samples drawn immediately after exposure to MMA during eight arthroplasty procedures, with 17 breast milk samples collected immediately after completion of the procedures, and at 6, 6+ n (variable), and 24 hours. Two healthy breast-feeding females without exposure to MMA served as controls. All samples were analyzed for MMA using a previously published head space gas chromatography (GC) protocol.

RESULTS: The GC protocol detected MMA at levels as low as 0.5 ppm. No serum or breast milk sample demonstrated evidence of MMA at that level, nor did any surgeon sample assay higher than the control specimens. Serum and milk samples spiked with MMA yielded the analyte peak as expected, evidencing no interference from either matrix.

DISCUSSION: This is the first study to demonstrate that MMA is not detectable in serum or breast milk following inhalational exposure during arthroplasty. Breast-feeding females can safely use their breast milk after such exposure. Furthermore, prohibition of exposure to PMMA during pregnancy should also be reconsidered, given virtually undetectable serum levels.

39. Three to Five Year Radiographic Follow-Up of Moderately Cross-Linked Marathon Polyethylene in Total Hip Replacement

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INTRODUCTION: The senior author has been using moderately cross-linked 5 Mrad heat melted polyethylene exclusively for over five years. This study evaluated the three to five year radiographic follow-up to determine the rate of head penetration with this material and the relationship of head penetration to activity.

METHODS: Between October 1999 and June 2002, 176 consecutive primary total hips were performed in 162 patients using moderately cross-linked (5 Mrad) Marathon polyethylene. Three to five year radiographic follow-up performed at our institution was available on 100 hips. The average age of the patients at the time of surgery was 58 years. Head penetration into the polyethylene liners was measured using edge detection techniques. In addition, 25 patients wore SAM type pedometers for one to two weeks after their final follow-up radiograph.

RESULTS: The average radiographic head penetration was 0.08 mm/year (range 0-0.16). This included the initial "wear in" period in the first year. This compared to our previously reported control group of patients with gamma irradiation in air in which the rate of head penetration including the "wear in" period averaged 0.14 mm/year. Wear rates in the Marathon hips significantly correlated with activity level as measured by the SAM pedometer ($p=0.05$). There were no fractures of the polyethylene.

DISCUSSION: Moderately cross-linked Marathon polyethylene demonstrated a 45% reduction in polyethylene wear compared to the author's gamma irradiated in air components. Wear rates correlated with activity level. This reduction in wear is less than that reported in hip simulators where this material was studied.

40. Revision Total Hip Arthroplasty: The Patient's Perspective

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INTRODUCTION: A study was undertaken to assess the revision patients' level of satisfaction, understanding of the reason for failure, and expectations for longevity of their revision THA.

MATERIALS AND METHODS: A consecutive series of hip arthroplasty cases from three referral centers during the previous five years formed the study group.

A member of the surgical team reviewed the operative report, clinical record, and radiographs to determine the diagnosis at revision, procedure performed, and the etiology for the failure. Patients were then contacted independently by an experienced medical interviewer and rated their degree of satisfaction with the original arthroplasty, the revision arthroplasty, and their expectations for longevity of the revision procedure.

RESULTS: During the time period of the study, 607 revision procedures were performed of which 369 surveys were successfully completed (60.8%). Patient satisfaction with the primary procedure was directly related to the time to revision with those revised less than ten years expressing a high degree of dissatisfaction. The majority of patients (69%) expect their revision to last longer than their primary regardless of the revision diagnosis or how long the primary procedure lasted prior to revision. The surgeon's assessment of the reason for failure agreed with the patient's assessment less than half of the time.

CONCLUSION: Though the majority of revision THA patients are satisfied with the results of their revision procedure, most do not agree with their surgeon as to why the original arthroplasty failed and most have unrealistic expectations regarding how long their revision procedure will last.

41. Experience with a Hydroxyapatite-Coated Titanium Plasma-Sprayed Implant at 15-18 Years

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The debate about benefits of hydroxyapatite (HA) in primary total hip arthroplasty (THA) continues with advocates reporting early improvements in pain and function and enhanced fixation. Others have reported no significant difference in long-term outcomes with application of HA to an already proven fixation surface. We previously reported more rapid clinical improvement with an HA coated tapered titanium implant. This study reports the long-term follow-up data on 192 consecutive THAs in which a standard femoral stem or a HA coated stem was implanted.

Between 1987 and 1990, 192 consecutive primary THA were performed using a single stem geometry. All were tapered, proximally porous-plasma-sprayed (PPS) titanium. In 61 THAs, the proximal PPS surface was hydroxyapatite. In 129, the PPS surface was titanium. Survivorship was evaluated using Kaplan-Meier and log-rank tests. Harris hip pain and total scores were calculated.

At average 11.6 years follow-up, one stem (non-HA) was revised for aseptic loosening. No significant differences were noted in any variable including pain scores, HHS, stem revision, or the incidence of acetabular liner or cup revision for polyethylene wear or loosening. Survivorship of non-HA stems with aseptic loosening as the end-point was 99.2%. Survivorship of HA stems was 100%.

Long-term outcomes of proximally PPS femoral stems are excellent regardless of HA application. No long-term benefit or detriment is noted by its application to this design. With the current trend towards rapid recovery and shortened hospital stay, the use of HA may warrant reinvestigation.

Long-term outcomes of proximally porous-plasma-sprayed tapered titanium femoral stems are excellent regardless of hydroxyapatite application.

42. Patients Preferred a Mini-Posterior THA Over a Contralateral Two-Incision THA: Results in Patients Treated with the Same Anesthetic and Rehab Protocol

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INTRODUCTION: Much discussion has focused on the potential early functional benefits of the two-incision THA approach. Most of the reports to date, however, involve selected patients who were treated with advanced anesthetic and rehabilitation protocols that make comparison to historical data difficult. We have had a broad experience with the two-incision THA and now have a subgroup of patients who have had a two-incision THA on one side and a mini-posterior THA done on the contralateral side with the same anesthetic and rehabilitation protocol.

MATERIALS AND METHODS: In 2003 and 2004, 26 patients have had staged bilateral THA with a two-incision hip on one side and a mini posterior hip on the other side. A comprehensive anesthesia protocol and rapid rehabilitation protocol was employed after each operation. Patients completed a milestone diary of their early function, were asked to state a preference for one hip or the other, and state a reason why.

RESULTS: Sixteen of 26 patients preferred the mini posterior hip: 50% because of better early recovery, 25% because of better cosmetic result, and 25% because of combination of better recovery and better cosmetic result. Eight patients preferred the two-incision THA and all of them attributed that to better early recovery. Two patients had no preference.

CONCLUSION: Patients who have had both a mini-posterior THA and a two-incision THA more often preferred the mini-posterior side. In this study, the added technical difficulty of the two-incision THA was not rewarded with better function or greater patient satisfaction.

43. Muscle Damage During Minimally Invasive Total Hip Arthroplasty: Single-Incision Smith-Peterson versus Posterior Surgical Approach

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BACKGROUND: Minimizing muscle damage is one of the reported benefits of minimally invasive surgical (MIS) approaches to THA. Muscle-sparing approaches purportedly utilize intermuscular intervals, theoretically minimizing the amount of muscle damage during the procedure. However, this has not been substantiated in clinical or cadaveric studies. An emerging muscle-sparing MIS technique is the modified anterior Smith-Peterson (S-P) approach. The purpose of this study is to comparatively quantify the extent and anatomic location of muscle damage that occurs in the MIS S-P and posterior approaches in THA.

MATERIALS AND METHODS: THA was performed in six fresh-frozen human cadavers (12 hips). In each specimen, one hip was randomly assigned to the anterior S-P approach and the contralateral hip assigned to the posterior approach. Upon completion of the procedure, muscle damage was assessed using an accepted technique described previously.

RESULTS: Damage occurred to a lesser extent in the muscle of the gluteus medius and minimus, as well as the gluteus minimus tendon, with the anterior S-P approach than the posterior approach. Muscle damage occurred to the tensor fascia lata and direct head of the rectus femoris during the anterior S-P approach. The piriformis or conjoined tendon was transected in 50% of the anterior approaches. The posterior approach involved intentional detachment of the piriformis and conjoined tendon in every specimen, as well as measurable damage to the abductor muscles and gluteus minimus tendon.

CONCLUSION: The MIS anterior S-P approach appears to minimize abductor muscle and tendon damage compared to the posterior approach; this may be mitigated by muscle damage to the TFL and rectus femoris in the S-P approach. Transection of the piriformis and conjoined tendon may occur when mobilizing the femur during the anterior S-P approach. Further clinical outcome studies and gait analysis are necessary to ascertain the functional implications of these findings.

44. Dislocation of the Hip After Reimplantation for Infection: An Analysis of Risk Factors

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BACKGROUND: Dislocation has been reported as a frequent complication following revision hip arthroplasty. Dislocation as a complication following reimplantation for the infected hip has also been described although the frequency and associated risk factors are less clear. The purpose of this study is to assess the frequency and the risk factors for dislocation after reimplantation for infection.

METHODS: Two hundred five patients treated with revision hip arthroplasty were studied. Thirty-four of the patients were revised with a two-staged reimplantation for infection. All patients were followed for a minimum of two years or until dislocation. The following risk factors for dislocation were analyzed: number of operations, leg length, offset, head size, age at reimplantation, and length of time from resection to reimplantation. The rate of dislocation was compared to those undergoing revision for aseptic failure.

RESULTS: Eight patients dislocated, including 5 (14.7%) of 34 in the infected group and 3 (1.7%) of 171 in the non-infected group ($p < 0.01$). In the infected cohort, reimplantation occurred after a mean of 244 days in those with a dislocation compared to 131 days in the controls ($p = 0.06$). Patients with a dislocation had a mean age of 57.6 years at reimplantation, compared to 70.7 years in those without a dislocation ($p = 0.07$).

CONCLUSIONS: The rate of dislocation is much higher in revisions for infection than revisions for aseptic failure. Patient age and length of time from resection to reimplantation may be important variables affecting stability.

**45. Acute Colonic Pseudo-Obstruction (Ogilvie Syndrome)
After Lower Extremity Arthroplasty**

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INTRODUCTION: Acute colonic pseudo-obstruction (ACPO or Ogilvie's syndrome) is an uncommon postoperative complication of total hip arthroplasty (THA) and total knee arthroplasty (TKA) characterized by massive colonic dilatation and the potential for significant morbidity and mortality.

MATERIALS/METHODS: This is a retrospective case-control review of 1,170 THAs and TKAs performed by one surgeon between 1995-2001 which identified 18 patients with Ogilvie's. Radiographs and records were analyzed for risk factors and treatment effectiveness.

RESULTS: Eleven of 708 (1.6%) THAs and 7 of 462 (1.5%) TKAs developed Ogilvie's postoperatively. Seventeen of these 18 (94%) patients had preoperative conditions or medications previously identified as risk factors for Ogilvie's. The use of patient-controlled-analgesia was associated with a trend of shorter times to the development of symptoms. Colonic decompression was performed in seven patients and was associated with significantly shorter hospitalizations.

CONCLUSIONS: Acute colonic pseudo-obstruction after arthroplasty of the knee is as prevalent as it is after arthroplasty of the hip. Reports of Ogilvie's after TKA are uncommon. The seven patients in this study is a considerable addition to what has been reported to date. Most patients that develop ACPO have risk factors that can be identified preoperatively. Knowledge of these risk factors enables the treating physician to anticipate which patients may be at higher risk for developing ACPO, and, therefore, warrant hyper vigilance for the development of this condition and judicious use of PCA in at-risk patients. This is the first report to quantify the benefit of decompressive colonoscopy in the arthroplasty population which can reduce the risk of perforation as well as decrease the length of hospitalization.

46. Simple Guidelines for Reducing Blood Transfusion in Total Joint Replacement Patients

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INTRODUCTION: Research has linked allogeneic transfusions with immunosuppression, increased postoperative infection rates and wound healing problems. Transfusion rates are influenced by preoperative Hgb level, perioperative blood loss, and postoperative Hgb level “triggers”. Studies show that outcomes of patients with Hgb as low as 7 g/dL were not significantly different than the traditional trigger of 10. We documented Hgb levels, transfusions, complications, and missed physical therapy in joint replacement patients at our level 1 trauma center, in order to create a guideline for transfusion in future patients.

MATERIALS AND METHODS: We retrospectively reviewed 78 consecutive patients who received joint replacement. Preoperative, lowest postoperative, discharge H/H, type of surgery, EBL, PAD/Allogeneic units transfused, medical comorbidities/complications, missed PT, and length of stay were recorded. Forty-four percent received PRBC. Ten patients donated preautologous (PAD) 15 units, only 6 patients received transfusion, 5/6 (83%) were transfused 7 units allogeneic. Thirty-two percent had significant cardiac or pulmonary disease. Sixty-eight percent with PMH received transfusions. Fifty-four percent missed PT once. Fourteen percent missed PT twice due to blood infusion.

DISCUSSION/CONCLUSION: Our study showed that transfusions are not given consistently. Often blood is transfused based on Hgb alone with two units given when one unit would suffice. To bring consistency to the process, we propose the following guideline for blood transfusions in joint replacement patients:

Group A: Cardiac, Vascular, or Pulmonary Patients

Hgb < 9.5	Transfuse	1	unit PRBC's
Hgb < 9.0	Transfuse	2	units PRBC's

Group B: Healthier, patients > 55 yo

Hgb < 8.5	Transfuse	1	unit PRBC's
Hgb < 8.0	Transfuse	2	units PRBC's

Group C: Healthier, patients 35 to 55 yo

Hgb < 8.0	Transfuse	1	unit PRBC's
Hgb < 7.5	Transfuse	2	units PRBC's

Group D: Healthy patients < 35 yo

Hgb < 7.5	Transfuse	1	unit PRBC's
Hgb < 7.0	Transfuse	2	units PRBC's

47. Evaluation of Component Positioning in Primary Total Hip Arthroplasty When Using an Imageless Navigation Device Compared to Traditional Methods

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Complications such as dislocation, impingement, and limited range of motion may result from the malposition of total hip implants. The traditional use of mechanical guides, anatomic landmarks, and surgeon experience still allows for significant errors in component orientation. Computer-assisted navigation systems have been developed in an attempt to improve overall implant alignment and eliminate the complications associated with component malposition. To assess the efficacy of an imageless navigation system, a review of prospectively collected data obtained by a single joint specialist surgeon was undertaken. One hundred fifty patients were divided into three groups and compared. Group 1: 50 cases with THAs performed using traditional alignment techniques, Group 2: first 50 Stryker Imageless navigation cases, Group 3: second 50 Navigation cases. Groups were compared based on demographics, cup anteversion/inclination, leg length, OR time, EBL, and incision length. Computer-assisted navigation technology resulted in a controlled and reproducible technique of performing total hip replacements.

**48. Histological Effects of Hyaluronic Acid on the
Supraspinatus Tendon in a Rat Model of Rotator Cuff
Tendinitis**

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OBJECTIVES: Tendinitis of the rotator cuff often involves the supraspinatus tendon and may lead to chronic, morphological changes within the tendon. Hyaluronic acid (HA) has been hypothesized to promote soft tissue healing, decrease pain, and reduce adhesions. This study was undertaken to assess the soft tissue healing response of the rat supraspinatus tendon following HA injection in a rat model of rotator cuff tendinitis.

METHODS: Sub-acromial injections of bacterial collagenase were administered to 24 adult male Sprague-Dawley rats simulating rotator cuff tendinitis. The shoulders were subsequently injected with HA or normal saline (control) once weekly for three consecutive weeks. After one week, the animals were sacrificed in groups of eight at one month intervals. The supraspinatus tendons were harvested and examined histologically. An established grading scheme was applied.

RESULTS: No significant differences were noted between groups at any of the time periods or compared to the controls relative to overall cellularity, collagen orientation, vascularity, number of inflammatory cells, or cell shape.

CONCLUSIONS: While HA has been shown to promote soft tissue healing and decrease inflammation, sub-acromial injections of HA did not appear to alter the healing characteristics of the rat supraspinatus tendon based on histological parameters.

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