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MAOA FIRST PLENARY SESSION
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1. A Randomized Trial of Reamed versus Non-Reamed Intramedullary Nail Insertion on Rates of Re-Operation in Patients with Fractures of the Tibia

*Marc F. Swiontkowski, M.D. (n)
Minneapolis, MN
Mohit Bhandari, M.D.
Hamilton, Ontario, Canada
(a-National Institutes of Health, Canadian Institutes of Health)

INTRODUCTION: The SPRINT primary outcome aimed to assess the impact of reamed versus unreamed intramedullary nailing on rates of re-operation in patients with open and closed fractures of the tibial shaft.

METHODS: Design: The Study to Prospectively evaluate Reamed Intramedullary Nails in Tibial fractures (SPRINT) was a multi-center, randomized trial including 29 clinical sites. Over a five-year period, SPRINT enrolled 1,339 skeletally mature patients with open or closed fractures of the tibial shaft amenable to surgical treatment with an intramedullary nail. Patients, outcome assessors, and data analysts were blinded to treatment allocation. Perioperative care was standardized, and re-operations before six months were not permitted unless there was critical bone loss (>1 cm, >50% bone). Patients were followed at discharge, two weeks post-discharge, and at 3, 6, 9, and 12 months post surgery. A blinded committee adjudicated all outcomes. Intervention: Patients received a statically locked intramedullary nail with either reamed or unreamed insertion. No reaming was permitted in the unreamed group. Main Outcome Measures: The primary outcome was re-operation to promote healing, treat infection, or preserve the limb (fasciotomy for compartment syndrome after nailing).

RESULTS: Among 1,339 enrolled patients, 1,226 patients were followed to one year. Across treatment groups, patients did not differ in age, gender, and closed and open fracture types (I-IIIB). The overall event rate was 17.8% (13.7% closed, 27% open fractures). In 826 patients with closed fractures (Table 1), Group A reduced the risk of an event by 33% (95% CI: 4-53%, P=0.03). Among 400 patients with open fractures (Table 2), Group A trended towards an increased risk of an event (rel. risk=1.26, p=0.16).

CONCLUSIONS: SPRINT investigators remain blinded to treatment allocation (this will be revealed in upcoming weeks). Based upon our blinded results, we identified an overall incidence of revisions smaller than reported in previous studies. Possible reasons for the overall lower event rates in SPRINT are as follows: (a) standardization of surgical and post-surgical care with results superior care among the SPRINT centers and surgeons and (b) proscription of surgery until after six months.

Table 1: Closed Fractures

	Total (N=826)	Group A (N=416)	Group B (N=410)	Stratified	
				RR	P Value
Events	113	45	68	0.67 (0.47, 0.96)	0.03
Autodynamization (included in total above)	41	12	29	0.42 (0.22, 0.80)	0.01

Table 2: Open Fractures

	Total (N=400)	Group A (N=206)	Group B (N=194)	Stratified	
				RR	P Value
Events	106	60	46	1.27 (0.91, 1.78)	0.16

2. Minimal Incision Surgery as a Risk Factor for Early Failure of Total Knee Arthroplasty

*Derek W. Miller, D.O. (n)
Joplin, MO
C. Lowry Barnes, M.D.
Little Rock, AR
(a,b,c,e-Wright Medical Technology)
R. Stephen J. Burnett, M.D.
Victoria, BC, Canada
(a-Smith & Nephew)
John C. Clohisy, M.D.
St. Louis, MO
(a-Wright Medical Technology; a,e-Zimmer, e-Smith & Nephew Endoscopy)
William J. Maloney, III, M.D.
Stanford, CA
(a-DePuy, Medtronic, c-Wright Medical Technology, Zimmer)
Robert L. Barrack, M.D. (n)
St. Louis, MO

Dr. Miller is the recipient of the Dallas B. Phemister, M.D. Physician in Training Award.

INTRODUCTION: A study was undertaken to determine the prevalence of revisions of total knee arthroplasty (TKA) following minimal incision surgery (MIS) and to compare revisions of MIS TKA procedures to revisions of TKA performed following a standard surgical approach.

MATERIALS AND METHODS: A consecutive series of revision TKA performed at three centers by five surgeons over the three-year time period 2004-2006 was reviewed. Revisions performed for infection and re-revisions were excluded. Complete review of clinical and radiographic data determined incision type, gender, age, time to revision, and primary diagnosis at time of revision.

RESULTS: Two hundred thirty-six first-time revisions were performed of which 43 (18.2%) had been MIS TKA and 193 (81.8%) had been a standard TKA. Patients with MIS were, on average, more likely to be female (73% versus 63%) and younger (61.7 years versus 66.2 years) although neither of these differences approached statistical significance ($p>0.2$). Most striking was the difference in time to revision which was significantly shorter for the MIS group (14.8 months versus 80 months, $p<.001$). The MIS group was much more likely to fail at <12 months (37% versus 5%, $p<.001$) and at <24 months (81% versus 22%, $p<.001$). The MIS group showed a trend to having a higher incidence of loosening as the primary cause for failure (58% versus 44%, $p<0.1$).

CONCLUSION: MIS TKA accounted for a substantial percentage of revision TKA in recent years at these centers. The high incidence of MIS failures occurring within 24 months is disturbing and warrants further investigation.

3. Labral Disease Associated with Femoroacetabular Impingement: Do We Need to Correct the Structural Deformity?

John C. Clohisy, M.D.
St. Louis, MO
(a,e-Zimmer)
Jeff Nepple, M.D. (n)
St. Louis, MO
Ryan M. Nunley, M.D. (n)
St. Louis, MO
Luke Zebala, M.D. (n)
St. Louis, MO
(David J. Gerlach, M.D., St. Louis, MO presented)

INTRODUCTION: Anterior femoroacetabular impingement (FAI) is recognized as a cause of acetabular labral disease and articular degeneration. The purpose of this study was to compare arthroscopic partial labral resection alone (Group I), and augmentation of this procedure with limited open osteochondroplasty (Group II) for the treatment of symptomatic FAI.

METHODS: Prior to April 2003 "cam" FAI disease was treated arthroscopically with partial labral resection and chondroplasty. Subsequently, the arthroscopic procedure was augmented with a limited open osteochondroplasty to correct the structural abnormality. We reviewed 221 hip arthroscopies. Radiographic parameters were utilized to identify FAI abnormalities. Two consecutive patient cohorts were identified: Group I - arthroscopic treatment of labrum and articular cartilage and Group II – hip arthroscopy augmented with osteochondroplasty of the femoral head-neck junction.

RESULTS: Group I (23 hips) and Group II (25 hips) patients had no difference in age, labral disease patterns, OA grade, or presence of chondromalacia. Mean follow-up was 2.3 years and 1.7 years, respectively (p=0.014). Severe acetabular chondromalacia was more common in Group II (p=0.036). At final follow-up, the Harris Hip Score was higher in Group II (91 points) compared to Group I (85 points). Good/excellent outcomes occurred in 74% of Group I and 92.0% of Group II hips. 21.7% of hips in Group I failed (required surgery), and no hips in Group II failed (p=0.04).

CONCLUSION: These data suggest that symptomatic hips with radiographic features of cam FAI have improved clinical outcomes and lower failure rates when the structural impingement abnormality is surgically corrected.

4. The Results of Charnley Total Hip Arthroplasty at a Minimum of 35 Years

Somyot Piyaworakhun, M.D. (n)
Iowa City, IA
*John J. Callaghan, M.D.
Iowa City, IA
(a,c,e-DePuy)
Steve S. Liu, M.D. (n)
Iowa City, IA
Devon D. Goetz, M.D.
West Des Moines, IA
(a-DePuy)
Richard C. Johnston, M.D.
Iowa City, IA
(c-Zimmer)

INTRODUCTION: To our knowledge, there are no 35-year follow-up studies of the Charnley total hip arthroplasty in the United States. The purpose of the study was to evaluate the results of a single surgeon series of primary Charnley total hip arthroplasties performed with cement at a minimum 35-year follow-up interval.

METHODS: Between July 1970 and April 1972, the senior author performed 330 Charnley total hip replacements with cement using a hand-packing cement technique. At minimum 35 years postoperatively, 13 patients (16 hips) were alive, with 1 patient (1 hip) lost to follow-up. Living patients were evaluated clinically with a standard terminology questionnaire, and WOMAC. Radiographic evaluation included loosening, lysis, and need for reoperation.

RESULTS: For the 16 hips in living patients, 7 acetabular components (44%) and 1 femoral component (6%) were revised for aseptic loosening. This compares to 25 (8%) acetabular components and 10 (3%) femoral components revised for all hips in the study cohort. Overall, 87% of the original prosthesis remains intact at the time of final follow-up, or at the time of the patient's death.

CONCLUSION: Our follow-up study at 35 years following Charnley total hip arthroplasty with cement demonstrates the remarkable durability of the results of the procedure. The long-term challenge continues to be revisions associated with problems of the bearing surface. This study should provide a benchmark for comparison as other studies reach this interval of follow-up.

5. Bone-Remodeling Around Cementless Acetabular Components: Intermediate-Term Follow-Up of a Randomized, Prospective Study

R. Michael Meneghini, M.D.
Farmington, CT
(e-Stryker)
*Kerry S. Ford, M.D. (n)
Rochester, MN
Arlen D. Hanssen, M.D.
Rochester, MN
(a-Zimmer)
David G. Lewallen, M.D.
Rochester, MN
(a,c,e-Zimmer)

INTRODUCTION: As opposed to femoral implants, bone remodeling around cementless acetabular components after total hip arthroplasty (THA) has not been well-characterized. Few clinical studies exist and are limited to very short-term follow-up. This study quantifies peri-acetabular bone density after THA at intermediate-term follow-up and compares stress-shielding around cementless, acetabular implants composed of two different materials.

METHODS: A randomized, prospective study of primary THA was performed from 1998 to 1999 comparing cementless, monobloc acetabular implants composed of titanium or porous tantalum. Sixteen hips (9 porous tantalum, 7 titanium) met inclusion criteria and underwent quantitative computed tomography at mean 7.5 years follow-up (range, 6.1 to 8.5). Bone mineral density (BMD) was calculated for regions adjacent to the acetabular component directly superior and posterosuperiorly. The BMD of the identical region in the contralateral hip was used as an internal control.

RESULTS: The averaged BMD decreased from the contralateral control at all distances adjacent to the titanium implant. In contrast, the averaged BMD increased at 4 of 5 distances adjacent to the porous tantalum implant. The average BMD was greater in the measured regions 6 mm to 12 mm adjacent to the porous tantalum compared to the titanium acetabular component ($p \leq 0.036$) and predominated posterosuperiorly ($p \leq 0.05$). The mean *relative* BMD increased in all regions adjacent to the porous tantalum component and ranged from 5% to 40% over the contralateral control hip.

CONCLUSIONS: This is the first study to characterize bone-remodeling around acetabular components at intermediate-term follow-up and the first to compare two implants differing in core material mechanical properties. This data demonstrates stress-shielding continues to exist beyond short-term around cementless acetabular components and likely occurs significantly less around highly porous metal with an elastic modulus similar to bone.

6. Rotator Cuff Repair in Patients Less Than 21 Years Old

Kenneth P. Unruh (n)
Rochester, MN
*Diane L. Dahm, M.D. (n)
Rochester, MN
John W. Sperling, M.D.
Rochester, MN
(e-Biomet)

BACKGROUND: Currently, there is little information regarding the results of rotator cuff repair in young patients. Therefore, the purpose of this study was to determine the results and rate of failure of rotator cuff repair in patients less than 21 years of age.

METHODS: Between 1981 and 2006, eight patients less than 21 years old underwent rotator cuff repair at our institution. The mean age of the patients at the time of surgery was 16.9 years old (range, 13-20). All patients were followed for a minimum of 1 year (mean, 7.5 years).

RESULTS: At the time of most recent follow-up, the mean simple shoulder test was 11.3 (range, 8-12). The mean ASES postoperative pain score was 43.3 (range, 30-50) and mean ASES function score was 47.2 (range, 38-50). Shoulder pain improved from a mean of 3 preoperatively to 1.1 postoperatively on a 5 point scale (p=0.0048). There was significant improvement in range of motion in active elevation from a mean of 142° preoperatively to 176° postoperatively (p=0.049). There was no significant change in external rotation (69 pre-operatively versus 71 postoperatively, p=0.682) or internal rotation (10^{th} thoracic vertebrae versus 11^{th} thoracic vertebrae postoperatively, p=1.0). According to Neer's criteria, there were 5 excellent, 3 satisfactory, and 0 unsatisfactory results. No shoulder required additional surgery.

CONCLUSIONS: Rotator cuff repair in young patients yields satisfactory results with significant improvement in pain and active elevation but not in internal or external rotation at mid-range follow-up.

LEVEL OF EVIDENCE: Therapeutic study, Level IV (Case series [no, or historical, control group]).

7. Lisfranc Injuries: Is Hardware Removal Necessary Following ORIF?

*Jeffrey A. Henning, M.D. (n)
Grand Rapids, MI
Clifford B. Jones, M.D.
Grand Rapids, MI
(a,e-Zimmer, a-Medtronic)
Debra L. Sietsema, Ph.D., R.N. (n)
Grand Rapids, MI
James R. Ringler, M.D. (n)
Grand Rapids, MI
Terrence J. Endres, M.D. (n)
Grand Rapids, MI
John G. Anderson, M.D.
Grand Rapids, MI
(e-Zimmer)
Donald R. Bohay, M.D.
Grand Rapids, MI
(e-Zimmer)

There is controversy regarding the need for hardware removal following ORIF of Lisfranc injuries. Over a seven-year interval from 1998 to 2005, 153 skeletally mature patients were retrospectively identified with Lisfranc injuries treated with ORIF. There were 93 males and 60 females with an average age of 34.9 years. The most common mechanisms of injury were MVA (58), fall (49), and crush injuries (23). The average follow-up was 18.1 months. Hardware removal was performed in 104 of 153 (68.0%) patients, at an average time of 6.6 months. Reasons for hardware removal consisted of surgeon protocol (84), prominence (17), and other (2). Nineteen total secondary surgeries, including salvage fusions and reconstructions, were noted. In the hardware removal group, 11 of 104 (10.6%) patients required secondary surgeries, compared to 8 of 49 (16.3%) of patients in the hardware retention group, which was not a statistically significant difference. Broken hardware was seen in 12/153 patients, 8 in the hardware removal group (7.7%), and 4 in the hardware retention group (8.2%). The average surgical charge for hardware removal at our institution was $3,100. Hardware retention following ORIF of Lisfranc joint injuries does not statistically affect rates of secondary surgery, does not increase the rates of broken hardware, and could prevent costly and possibly risky additional elective procedures.

8. Tetracycline Labeling as a Measure of Humeral Head Viability After Three- or Four-Part Proximal Humerus Fractures

Lynn A. Crosby, M.D.
Dayton, OH
(a-Exactech, Smith & Nephew, Synthes, e-Equinox [Exatech])
*Ryan P. Finnan, M.D. (n)
Dayton, OH
Christopher G. Anderson, M.D. (n)
Dayton, OH
Jon Gozdanovic, M.D. (n)
Dayton, OH
Mill W. Miller, Ph.D. (n)
Dayton, OH

BACKGROUND: Controversy exists regarding the optimal treatment for displaced three- and four-part proximal humerus fractures. The aim of this study was to investigate humeral head viability in displaced three- and four-part proximal humerus fractures at the time of hemiarthroplasty using tetracycline labeling and fluorescent microscopy.

METHODS: Nineteen consecutive adult patients (range 43-83 years) underwent hemiarthroplasty as definitive treatment for 20 displaced three- and four-part proximal humerus fractures after having received 500 mg of tetracycline hydrochloride orally every six hours for the immediate five preoperative days. Humeral head biopsies were taken from four pre-determined locations intraoperatively. The biopsies were prepared and analyzed with fluorescent microscopy.

RESULTS: All specimens in each biopsy location demonstrated fluorescence. There was no difference between the mean rank gray values for the four biopsy locations ($p=0.78$ with the Friedman test). There was no difference between the mean rank gray values for the four biopsy locations when analyzed according to three-part versus four-part fracture ($p>0.05$ with the Mann-Whitney test). There was an inverse relationship between age and fluorescence for the anterosuperior biopsy location ($p=0.033$ with Spearman correlation).

CONCLUSION: Vascular supply is preserved in displaced three- and four-part proximal humerus fractures, especially in younger patients in the anterosuperior aspect of the humeral head.

CLINICAL RELEVANCE: With intact vascularity to the humeral head, head-preserving techniques should be more strongly considered in the treatment of displaced three- and four-part proximal humerus fractures.

9. Functional Outcome for Three- and Four-Part Proximal Humerus Fractures Treated with a Locking Plate

*Ariana M. DeMers, D.O. (n)
Lansing, MI
Meredith H. Fabing, D.O. (n)
Royal Oak, MI
Michael P. Swords, D.O. (n)
Lansing, MI

PURPOSE: To evaluate the functional and radiographic outcome of locked plating for the treatment of displaced three- and four-part proximal humerus fractures.

METHODS: We evaluated 23 patients with displaced three- or four-part fractures of the proximal humerus. All patients were treated with open reduction internal fixation utilizing a locking proximal humerus plate. Average follow-up was at 15.3 months (6–46 months). Mean patient age was 58 years. There were 17 three-part and 5 four-part proximal humerus fractures. Validated functional outcome scores were used to evaluate the patients and included the Constant score, the American Shoulder and Elbow Surgeons score, the Simple Shoulder Test, the Euroqol EQ-50, and the UCLA shoulder score.

RESULTS: Radiologic review showed union in 21 patients, and AVN in one patient who underwent subsequent hemiarthroplasty. Plate removal was performed in five patients because of impingement. Mean forward elevation was 140º with a range of 102º to 170º. Mean abduction was 126º with a range of 85º to 170º. Functional testing results show mean American Shoulder Elbow scale (ASES) score of 83.6%, mean constant score of 82, mean Simple Shoulder Test score of 9/12, mean UCLA score of 31/35, mean Euroqol scale of 81/100, and a mean VAS pain score of 0.5/10.

CONCLUSION: We conclude that locked plate fixation of displaced three- and four-part proximal humerus fractures produces favorable short-term functional and radiographic outcomes.

MAOA BREAK-OUT SESSION #1
HIP
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10. Serum Cobalt and Chromium Levels in Patients with Bilateral versus Unilateral Hip Resurfacing

D. Gordon Allan, M.D. (n)
Springfield, IL
*Billy K. Parsley, M.D. (n)
Springfield, IL
Bradley W. Dyrstad, M.D. (n)
Springfield, IL
Joseph C. Milbrandt, Ph.D. (n)
Springfield, IL

INTRODUCTION: Metal-on-metal (MOM) bearing surfaces release ions locally and into the systemic circulation. This elevation raises concern about the long-term effects of elevated metal ions. The goal of the present study was to monitor serum cobalt (Co) and chromium (Cr) levels in patients after MOM resurfacing hip arthroplasty with the Cormet 2000 prosthesis. We present here pilot data on Co and Cr levels in patients with bilateral versus unilateral hip resurfacing devices.

METHODS: We prospectively collected patient characteristics, outcome, and serum samples from device implanted subjects at six months, one, two, and three years following surgery. Unilateral patients had one implant during the entire course of follow-up, and bilateral patients were included after the second implant surgery was performed. Serum Co/Cr levels were determined using high-resolution inductively coupled plasma mass spectrometry. Students t-test was used to compare ion levels in two groups based on the number of resurfacing implants (bilateral versus unilateral).

RESULTS: Forty-one unilateral and nine bilateral subjects were enrolled and followed for serum Co and Cr levels. In general, Co/Cr levels were increased at all time points when compared to control levels in both groups. Bilateral subjects had average serum level concentrations significantly higher than those observed for unilateral cases (Co: 5.99 versus 2.56 µg/L (p=0.0001); Cr: 6.66 versus 3.60 (p=0.0009).

CONCLUSION: Elevated serum Co/Cr levels were observed at all time points following implantation in both groups and serum levels were nearly two times higher in the bilateral group. Based on these preliminary findings, patients undergoing bilateral total hip resurfacing arthroplasty may need to be monitored more closely than those patients receiving unilateral devices. In addition, these bilateral cases may be at a greater risk of ion level toxicities than the unilateral population.

11. Metal Ion Levels in Hip Implant Patients Having Bearings with and without Differential Hardness

*C. Lowry Barnes, M.D.
Little Rock, AR
(a,b,c,e-Wright Medical Technology)
R. Scott Corpe, M.D.
Augusta, GA
(e-Wright Medical Technology)
Harlan C. Amstutz, M.D.
Los Angeles, CA
(a,e-Wright Medical Technology)
Andrew Parr, M.D. (n)
Indianapolis, IN
Anastasia Skipor, M.S. (n)
Chicago, IL
Joshua J. Jacobs, M.D.
Chicago, IL
(a,e-Archus, Medtronic, Spinal Motion, Wright Medical Technology, Zimmer)
Michael J. Anderson, M.D.
Milwaukee, WI
(c,e-Wright Medical Technology)
George Markovich, M.D.
Ft. Myers, FL
(a,e-Wright Medical Technology; e-Stryker Orthopaedics)

INTRODUCTION: Metal-on-metal (M/M) articulating surfaces are becoming increasingly popular for hip replacement surgery, but concerns regarding metal ions persist. The purpose of the current study is to evaluate chromium (SrCr) and cobalt (SrCo) ion levels in serum, in patients having either of two metal-on-metal bearings, one with differential hardness and one without**.**

METHODS: Ninety patients received metal-on-metal hip replacement with either an A-CLASS® BFH® stemmed total hip system (Group I) or CONSERVE® Plus resurfacing system (Group II). There were 30 patients in Group I and 60 in Group II. Articulating surfaces between groups shared the same diameter options, sphericity, and radial clearance. Both groups' femoral components articulated against identical acetabular components. The main difference between the two bearings was the differential hardness of the femoral heads. Group I heads were manufactured to be harder than the acetabular components. Group II components had no differential. Blood specimens were obtained and analyzed preoperatively and at 3, 6, and 12 months postoperative.

RESULTS: Mean Group I SrCr and SrCo at 12 months was 1.53 and 2.83 ppb, respectively. Group II was 3.17 and 2.95 ppb, respectively. Comparing the two groups revealed that for SrCr, Group II was statistically higher at all three postoperative time periods compared to Group I. No such difference was seen for SrCo. DISCUSSION: A clear, statistical difference exists in the SrCr levels between the groups at all postoperative time periods. Differential hardness is a promising approach to produce lower-wear metal-on-metal bearings.

12. Clinical Outcome Following Metal-on-Metal Hip Resurfacing Arthroplasty: A Single-Center Experience

D. Gordon Allan, M.D. (n)
Springfield, IL
*Lucas S. Rylander, M.D. (n)
Springfield, IL
Adam Wallace, B.S. (n)
Springfield, IL
Joseph C. Milbrandt, Ph.D. (n)
Springfield, IL

INTRODUCTION: Metal-on-metal (MOM) hip resurfacing is becoming a more accepted option to consider when treating younger and more active patients. Advantages include preservation of bone stock and a larger femoral head which increases range of motion without risk of dislocation. The purpose of this study is to describe and compare patient characteristics for revision versus non-revision cases treated at a single center with the Cormet 2000 resurfacing prosthesis.

METHODS: All patients received a cementless, press-fit cobalt chrome acetabular shell with plasma sprayed titanium and HA coating and cemented cobalt chrome femoral head. All subjects were evaluated preoperatively and annually thereafter using standardized questionnaires, physical examinations, and radiographic evaluations. Subjects were divided into two groups; those requiring revision surgery versus those that did not. A minimum of two years follow-up was required for inclusion.

RESULTS: Eighty-two hips were identified in subjects with an average weight of 212 lbs and a mean age of 51. Ten of 82 hips required revision surgery during follow-up (range 4 months to 4.8 years). The two-year revision rate was 2.44%. Overall, 66% of the patients were male; however, females accounted for 60% of the revision cases ($p<0.05$). Preoperative diagnosis of AVN was identified in 40% of the cases requiring revision (versus 14%). Body weight was significantly lower in patients requiring revisions, and the revision was more likely to occur on the left side (80%) and with smaller component sizes (<48 mm heads). No difference in age was observed between the two groups.

CONCLUSIONS: Our findings are consistent with previous reports that female patients, preoperative diagnosis of AVN, and smaller component size increase the risk for revision surgery following hip resurfacing. Future studies designed to better select ideal candidates for hip resurfacing should further reduce the revision rate in this population.

13. Patients' Perceptions of Hip Resurfacing Arthroplasty

*Todd P. Murphy, M.D. (n)
Rochester, MN
Duncan B. Ackerman, M.D. (n)
Rochester, MN
Robert T. Trousdale, M.D. (n)
Rochester, MN
Mark W. Pagnano, M.D.
Rochester, MN
(c-DePuy, Zimmer)
Rafael J. Sierra, M.D. (n)
Rochester, MN
Tad M. Mabry, M.D.
Rochester, MN
(a-DePuy, Stryker Orthopaedics, Zimmer)

INTRODUCTION: The purpose of this study was to understand patients' perceptions regarding hip resurfacing arthroplasty (HRA) and compare their understanding to conventional total hip arthroplasty (THA).

MATERIALS AND METHODS: A consecutive group of patients being evaluated for hip pain were asked to complete a survey regarding HRA. The survey was presented to the patient prior to evaluation by the treating adult reconstructive surgeon. Patients responded utilizing a Likert-type scale comparing conventional total hip arthroplasty to HRA. Responses were examined for association with patient age, gender, surgeon, and if the patient had discussed the expectations and outcomes of HRA with another surgeon.

RESULTS: A total of 139 consecutive patients were given the survey. Fifty-seven (41%) patients (29 males and 28 females) were aware of HRA and completed the survey. The mean age of the patients was 51 (range, 17-98) years. Of the patients that completed the survey, 42% had heard of the procedure through the Internet, 42% from family and friends, 19% from another orthopedic surgeon, and 16% from various other sources. Eighty-two percent felt HRA was a safer procedure, and 77% felt there was less chance of a complication with HRA when compared to total hip arthroplasty. Seventy-nine percent felt there was less soft tissue damage associated with HRA, and 80% of the patients felt that they would get back to their activities more quickly. Seventy-six percent of the patients felt that they would be more likely to get back to high impact activities, and 80% felt that their overall range of motion would be better with HRA. When asked what type of hip replacement patients preferred, 54% patients preferred HRA, 8% patients preferred conventional THA, and 38% were unsure.

CONCLUSION: Patient's perceptions of HRA are inconsistent with the published advantages and disadvantages of the procedure when compared to conventional THA. Most of the patients in our study received their information from sources other than an orthopedic surgeon.

14. Total Hip Arthroplasty in Patients with Alcoholic Avascular Necrosis of the Femoral Head

Michael J. Taunton, M.D. (n)
Rochester, MN
Robert T. Trousdale, M.D. (n)
Rochester, MN
*Brandon Yuan, B.S. (n)
Rochester, MN

BACKGROUND: Avascular necrosis of the femoral head in the setting of alcohol abuse is an important etiologic factor in the causation of symptomatic hip disease in young patients. We are not aware of any data documenting the outcomes of uncemented total hip arthroplasty for the diagnosis of avascular necrosis of the femoral head in the setting of alcohol abuse. The purpose of this study is to examine the outcomes of uncemented total hip arthroplasty for avascular necrosis of the femoral head in the setting of alcoholism.

METHODS: All primary total hip arthroplasties performed at the authors' institution from 1990 to February of 2002 using uncemented femoral stems and acetabular components were reviewed. There were 28 hips in 23 patients identified who had uncemented THA for the diagnosis of AVN of the femoral head secondary to alcoholism. There were 2 females and 26 males with an average age of 43. Fourteen of the arthroplasties were performed through the posterior approach, and 14 were performed through an anterior-lateral approach. Mean clinical follow up was 6.49 years.

RESULTS: There was significant improvement in hip pain and function scores. There were three hips that had a complication of instability. Implant survivorship free of revision at a mean follow-up of 6.5 years was only 82.1%. Three revisions were performed for aseptic loosening; two hips were revised for instability. One hip is awaiting revision for instability.

CONCLUSIONS: The failure rate at this mid-term follow-up is concerning with a lower survivorship for the endpoint of revision when compared to uncemented total hip arthroplasty for osteoarthritis. Instability is an important complication in these patients and should be taken into consideration at the index arthroplasty.

15. Resurfacing Arthroplasty for Patients with Osteonecrosis

*Bernard N. Stulberg, M.D.
Cleveland, OH
(a,e-Stryker Orthopaedics; e-Exactech)
Jayson D. Zadzilka, M.S.
Cleveland, OH
(a-Corin, Stryker Orthopaedics)

INTRODUCTION: The suitability of third generation metal-on-metal hip resurfacing for patients with a primary diagnosis of osteonecrosis (ON) has been debated. The preservation of femoral head bone stock for femoral prosthesis support is essential for long-term stability of the implant. We hypothesized that the Kaplan-Meier survival estimates for resurfacing patients with a primary diagnosis of ON would be significantly lower than the survival estimates for resurfacing patients with a primary diagnosis of osteoarthritis (OA).

METHODS: One thousand one hundred and forty-eight patients were implanted with a modern hip resurfacing system as part of a US multi-center investigational device exemption (IDE) study. Of these, 116 subjects had a preoperative diagnosis of ON. A multivariate analysis of variance was performed to identify risk factors for component revision for any reason.

RESULTS: A diagnosis of other than OA was found to be one significant risk factor. However, the survival estimates were not significantly different (95.9% and 95.8% at 24 months for OA and ON respectively, p=0.46). Comparing the Ficat stage III and IV to the OA population also did not show a significant difference in implant survival (95.9% OA and 96.1% ON III/IV at 24 months, p=0.57).

DISCUSSION AND CONCLUSION: Resurfacing arthroplasty for patients with ON appears to be a reasonable alternative given judgments of implant size, patient gender, and size of femoral deficiency. Further characterization will be needed to identify those specific patients with ON for whom resurfacing arthroplasty is not appropriate. For most patients however, it appears to be a safe and reasonable option.

16. Patient Activities Leading to Total Hip Arthroplasty Dislocation

James Howard, M.D. (n)
London, ON, Canada
Aaron J. Krych, M.D. (n)
Rochester, MN
*Nicholas O. Noiseux, M.D. (n)
Iowa City, IA
Daniel J. Berry, M.D. (n)
Rochester, MN

INTRODUCTION: The specific patient activities that commonly result in dislocation have not been scientifically delineated. The purpose of this study was to identify the common patient activities that result in THA dislocation in a large group of patients.

METHODS: Between January 1, 1998, and December 31, 2006, 8,579 primary THA and 3,548 revision THA were performed at our institution. Patients are routinely followed at regular intervals and at each time point specifically asked if a dislocation had occurred. The records of all patients with instability were retrospectively reviewed. The direction of dislocation, type of arthroplasty (primary versus revision), and specific patient activity resulting in dislocation (mechanism of dislocation) were recorded.

RESULTS: Over the study period, there were 156 primary THA (pTHA) with 275 episodes of instability and 315 revision THA (rTHA) with 520 episodes of instability. The common activities resulting in dislocation included: getting up from a seated position (pTHA-15%, rTHA-28%), twisting to the side while standing (pTHA-14%, rTHA-6%), falls (pTHA-12%, rTHA-9%), reaching for an object on the floor while standing/bending at the waist (pTHA-11%, rTHA-8%), reaching for an object on the floor while seated (pTHA-10%, rTHA-10%), rolling over/changing positions in bed (pTHA-6%, rTHA-9%), and during foot care (pTHA-6%, rTHA-7%). The most common mechanism of posterior dislocation was getting up from a seated position (pTHA-26%, rTHA-34%) while the most common mechanism of anterior dislocation was twisting to the side while standing (pTHA-41%, rTHA-36%).

DISCUSSION/CONCLUSION: This information will help surgeons educate patients about the most common activities leading to hip dislocation so they can tailor postoperative activities to minimize the occurrence of this complication.

17. Early Femur Fracture After THA: Increased Prevalence Associated with Modern North American Practice

*Michael J. Taunton, M.D. (n)
Rochester, MN
Lawrence D. Dorr, M.D.
Inglewood, CA
(a,c,e-Zimmer)
William T. Long, M.D. (n)
Inglewood, CA
Manish R. Dastane, M.D. (n)
Inglewood, CA
Daniel J. Berry, M.D. (n)
Rochester, MN

BACKGROUND: Early acute displaced periprosthetic femur fracture after primary total hip arthroplasty (THA) has been uncommon. The authors identified a specific fracture pattern occurring with increased frequency after THA with contemporary implants, operative techniques, and rehabilitation protocols.

METHODS: The computerized databases of the authors' two institutions were used to identify all periprosthetic femur fractures occurring within 90 days of THA with an uncemented proximally coated femoral component between 1987 and 2007. During the study period, 3,346 such stems of multiple designs were implanted at the two institutions. Forty-one hips had an acute periprosthetic femur fracture within 90 days of the index arthroplasty. Twenty-eight of these consisted of a displaced, unstable fracture around the proximal implant, involving the femoral neck and the lesser trochanter (Vancouver A[L]). Detailed analysis of patients with this fracture pattern was performed.

RESULTS: There were 17 females, 11 males; age 25-84 (mean 65); BMI 21-39 (mean 31). Approach was posterior in 12, anterior in 9, and was considered minimally invasive in 5. Time from operation until fracture: 4 to 88 days (mean 27). Mechanism of injury: 8 had no defined trauma, 10 fell, 5 tripped or stumbled, 2 twisted, and 3 were standing. At fracture, 19 patients were still using arm support to ambulate. Fracture treatment consisted of revision THA in 24, ORIF without revision in 3, and nonoperative treatment in 1. Prevalence of this fracture pattern increased in a statistically significant manner ($p<0.05$) during the last three years of the study: 22 of the 30 fractures occurred since 2004.

CONCLUSIONS: This early acute postoperative fracture pattern is occurring with increased prevalence in association with contemporary North American THA practice (smaller incisions, accelerated rehabilitation protocols, greater utilization of uncemented proximally porous coated stems). Surgeons aware of the risk of this complication may take measures to reduce its occurrence.

18. Closed Treatment of Early Total Hip Arthroplasty Dislocation

*Scott C. McGovern, M.D. (n)
Rochester, MN
Joel Cummings, M.D. (n)
Rochester, MN
Robert T. Trousdale, M.D. (n)
Rochester, MN

BACKGROUND: Dislocation after total hip arthroplasty is a common complication. Nonoperative management with closed reduction and bracing may be successful for most dislocations. Little information is available on closed treatment of dislocation within the first week of primary total hip arthroplasty.

METHODS: Between 1969 and 2002, 27,441 primary total hip arthroplasties were performed at our institution. Eighty-nine patients dislocated within one week of index total hip arthroplasty. Clinic records, x-rays, and registry questionnaires were reviewed for all patients identified. Patients were followed until time of death or revision of the implant.

RESULTS: Seventy-three of the eighty-nine patients were treated initially with closed reduction. Sixty of these 73 patients (82%) were treated nonoperatively for instability. Forty-seven of 60 hips (78%) remained stable with nonoperative treatment. However, only 39 (53%) were both stable and revision free at final follow-up due to late problems of aseptic loosening or infection. Thirteen of the 73 patients (18%) treated initially with closed reduction failed nonoperative treatment and required revision surgery to address instability at an average of 61.6 days (range 2 to 388) after the index procedure. No difference in age, anesthesia, medical comorbidity, surgical approach, primary diagnosis, gender, acetabular liner elevation, head size, and acetabular component position was identified between patients successfully treated with closed reduction or those who failed nonoperative treatment.

CONCLUSION: Most patients with dislocation within one week of total hip arthroplasty were treated successfully with closed reduction. No differences were identified between these patients and those who failed closed treatment and required revision surgery for instability.

19. Total Hip Arthroplasty in Patients with Fibromyalgia has a High Complication Rate

*Michele R. D'Apuzzo, M.D. (n)
Rochester, MN
Miguel E. Cabanela, M.D.
Rochester, MN
(a,c,e-Stryker Orthopaedics)
Robert T. Trousdale, M.D.
Rochester, MN
(c,e-DePuy; e-Wright Medical Technology)
Rafael J. Sierra, M.D. (n)
Rochester, MN

INTRODUCTION: Fibromyalgia has been defined as a constellation of complaints including diffuse chronic pain and the presence of tender points. When presenting with hip arthritis as well, some surgeons may consider these patients poor candidates for joint replacement, due to their history of chronic pain and high incidence of associated psychiatric disorders which may lead to poor results after THA. The results of THA in patients with this diagnosis have not been reported previously.

METHODS: Between 1990 and 2001, 90 primary total hip arthroplasties were performed at our institution in 75 patients with a concomitant diagnosis of fibromyalgia. Ninety-three percent were female. Seventy-two percent had degenerative joint disease as primary diagnosis, and the average age at the time of surgery was 62 years. The patients were followed clinically for a mean of 6.3 years, and they were followed radiographically for a mean of 5.3 years.

RESULTS: Postoperatively, there were 40 complications after 29 procedures (32%). Of these, 28 were medical complications or did not require reoperation and 12 were surgical complications which required a reoperation. Seven hips required revision arthroplasty (7.7%). Seven hips had episodes of subluxation or dislocation (7.7%). Only one patient had persistent postoperative pain despite well-fixed implants.

DISCUSSION: Despite chronic pain complaints in this patient population, THR was successful in improving pain and function in the majority of patients. There was, however, a high prevalence of surgical complications that required reoperation or revision surgery. Instability was a common complication, and this should be discussed with these patients before THA.

MAOA BREAK-OUT SESSION #2
TRAUMA
April 17, 2008

20. Matched Cohort Pair Analysis of Operative versus Nonoperative Treatment of Displaced Scapular Fractures

*Jon P. Cornelius, M.D. (n)
Grand Rapids, MI
Clifford B. Jones, M.D.
Grand Rapids, MI
(a-Medtronic; a,e-Zimmer)
Debra L. Sietsema, Ph.D., R.N. (n)
Grand Rapids, MI
James R. Ringler, M.D. (n)
Grand Rapids, MI
Terrence J. Endres, M.D. (n)
Grand Rapids, MI
David J. Bielema, M.D. (n)
Grand Rapids, MI

OBJECTIVES: To determine patient outcome by matching operatively treated displaced scapular fractures using mini fragment fixation through a modified Judet approach to patients treated nonoperatively.

DESIGN: Retrospective review of scapula fractures over a four-year span.

PATIENTS/PARTICIPANTS: All diagnosed scapular fractures over four years (2002-2005) were determined. Of a total of 182 scapular fractures, 31 were treated with open reduction internal fixation and matched by age, occupation, and gender to 31 patients treated nonoperatively. Surgeon and patient criteria determined operative intervention. All patients were followed until healing or discharge from care (average 1 year, range 6-24 months).

MAIN OUTCOME MEASUREMENT: Radiographic assessment of healing, complications, pain, and return to work status.

RESULTS: The majority of patients were male (54M, 8 F) and resulted from blunt trauma. In the operative group, the mean displacement was 30.8 mm, shortening 39.0 mm, and angulation 27°. In the nonoperative group, the mean displacement was 19.6 mm, shortening 18.5 mm, and angulation 15.3°. These were statistically significant with $p<.001$. There was no statistically significant difference in AO fracture type, healing time, return to work, pain, or complications with $p>.05$.

CONCLUSIONS: Operative treatment of displaced scapula fractures can be expected to perform similarly to nonoperative scapula fractures in terms of healing, return to work, pain, and complications. Our data shows more severe fractures were treated with ORIF. Our fracture data may help guide indications for operative intervention of scapula fractures. Future research should include a prospective study to evaluate ORIF versus nonoperative treatment in the more severe fractures.

21. Orthogonal Pin Construct versus Uniplanar Pin Constructs for Pelvic External Fixation: A Structural Comparison

*Michael T. Archdeacon, M.D.
Cincinnati, OH
(a,e-Stryker Orthopaedics)
Sameh Arebi, M.D. (n)
Cincinnati, OH
T. Toan Le, M.D. (n)
Cincinnati, OH

PURPOSE (HYPOTHESIS): The purpose of this investigation is to compare the structural rigidity of an orthogonal external fixator pin construct with two different uniplanar external fixator pin constructs in a simulated bone model. We hypothesized that an orthogonal pin construct would be significantly more rigid than either an iliac crest or supra-acetabular uniplanar construct when loaded in plane (flexion/extension moment), and that the construct rigidities would not differ significantly when loaded out of plane (internal/external moment).

METHODS: Thirty hemi-pelvic sawbone models were constructed with one of three pin constructs: Orthogonal Pins, Iliac Crest Pins, or Supra-Acetabular Pins. Each construct was loaded with a servohydraulic materials testing machine in plane (flexion/extension moment) or out of plane (internal/external rotation moment). Structural variables included construct stiffness (rigidity), peak load, and energy to failure.

RESULTS: For in plane (flexion/extension moment) loading, a significant difference was noted between the stiffness for Orthogonal Pins compared to Iliac Crest and Supra-Acetabular Pins ($P<0.05$). However, for out of plane (internal/external rotation moment) loading, Supra-Acetabular Pins demonstrated significantly more stiffness (rigidity) than the Orthogonal and Iliac Crest Pins ($P<0.05$). No significant differences were noted in peak load, and energy to failure was significantly higher in both in plane and out of plane loading for the Orthogonal Pins construct ($P<0.05$)

CONCLUSION AND SIGNIFICANCE: This study demonstrates that an orthogonal pin construct for pelvic external fixation provides superior structural rigidity (stiffness) for in plane loading compared to either iliac crest or supra-acetabular constructs. The significance lies in the fact that rotationally unstable pelvic fractures are amenable to reduction/stabilization with any of the constructs; however, vertically unstable injuries (flexion/extension moment) may benefit from an orthogonal pin construct in terms of reduction and stabilization.

22. Evaluation of Computed Tomography Assessment of Hip Stability in Posterior Wall Acetabular Fractures

*David A. Ajibade, M.D. (n)
St. Louis, MO
Berton R. Moed, M.D. (n)
St. Louis, MO

INTRODUCTION: This study assessed the ability of static measurements of posterior acetabular wall fragment size to predict dynamic hip instability.

METHODS: Three methods were used to calculate posterior wall fracture fragment size using two-dimensional computed tomograms in 33 patients with isolated posterior wall acetabular fractures. These methods include those previously described by Calkins et al., which measures the smallest amount of intact acetabular arc and Keith et al., which measures fragment size at the level of the fovea, as well as the senior author's technique (a modification of that of Keith et al.) using the level of largest posterior wall deficit. Each method classifies hip instability into three groups: (1) stable, (2) indeterminate, and (3) unstable. All patients underwent dynamic fluoroscopic stress testing under general anesthesia (EUA) to determine actual hip instability, which served as the gold standard. The instability predicted from each method was compared to the EUA results and to each other using nonparametric statistics.

RESULTS: EUA showed 18 stable hips and 15 unstable. The three methods were found to be statistically different from each other (Kruskal-Wallis test) and the method of Calkins et al. was found to be statistically different from the EUA ($p=0.016$; McNemar test). However, both the method of Keith et al. and the senior author's were statistically similar to the EUA ($p= 0.25$ for both; McNemar test). As opposed to the other methods, all fractures predicted by the senior author's method to be either stable or unstable were found by EUA to have been appropriately described. Reanalysis of the data for better potential cut points revealed that neither of the other methods could be improved in this way.

DISCUSSION AND CONCLUSION: The senior author's method is the most predictive of hip stability. However, fractures involving 20% or more of the posterior wall were both stable and unstable by EUA, indicating that this dynamic exam should be used to determine hip instability.

23. Two Locking versus Three Non-Locking Screws: A Biomechanical Comparison in Normal and Osteoporotic Bone

Jennifer M. Smail, M.D. (n)
Cincinnati, OH
*T. Toan Le, M.D.
Cincinnati, OH
(a-Synthes-AONA Resident Grant/University Orthopaedic Research & Education Foundation)
Scott Williamson, B.S. (n)
Jackson, MS
Lyle Zardiackas, Ph.D. (n)
Jackson, MS

INTRODUCTION: This investigation was performed to determine whether two locking screws would provide a level of performance similar to three non-locking screws.

METHODS: Normal and osteoporotic bone were modeled by two different density foam cylinders. A locking screw construct with two locking screws on either side of a 1 cm fracture gap (5-hole plate) and a non-locking screw construct with three screws on each side (7-hole plate) were used. The four construct types (40 specimens) were tested for fatigue characteristics under torsional load and an eccentric bending moment load. Analysis of variance (ANOVA) tests with a p-value of 0.05 were performed.

RESULTS: Locking plates in normal bone had lower stiffness and torque during torsion testing (modulus 379 versus 473 N*mm/Deg, p=0.014; max torque 12055 versus 13521 N*mm, p=0.028), but there was no significant difference in angular displacement (46.8 versus 48.2 Deg, p=0.842). Locking plates in osteoporotic bone showed lower torque and angular displacement (3413 versus 4560 N*mm, p=0.008; 47.5 versus 57.8 Deg, p=0.022), but there was no difference in stiffness (130 versus 134 N*mm/Deg, p=0.910). Locking plates in normal bone survived 10% fewer cycles to failure during cyclic bending (95 versus 105 cycles, p=0.017), but there was no significant difference in maximum displacement or failure load (3.45 versus 2.29 mm, p=0.120; 589 versus 589 N, p=0.992). Locking plates in osteoporotic bone showed less displacement (1.44 versus 2.09 mm, p=0.017), but no significant difference in number of cycles to failure or failure load during cyclic bending (48 versus 52 cycles, p=0.201; 310 versus 322 N, p=0.676).

CONCLUSION: The results of this study suggest that the performance of locking plate constructs using only two screws is comparable to three non-locking screw constructs in osteoporotic bone. Normal bone, however, showed slightly better performance with the non-locking construct. This study addressed several factors which are important to the performance of locked plating, namely the different scenarios presented by torsional or axial loading, cyclic loading, and bone density. Clinically, this study suggests adequate fixation of short segments in juxta-articular fractures with fewer locking screws.

24. A Biomechanical Evaluation of Internal Fixation of Complex Tibial Plateau Fractures

*James D. Smith, M.D.
Mobile, AL
(a-Zimmer)
Sudhakar G. Madanagopal, M.D.
Mobile, AL
(a,b-Zimmer)
Albert W. Pearsall, IV, M.D.
Mobile, AL
(a,e-Zimmer)
Seenivasulu Kolakanuru, M.S.
Mobile, AL
(a-Synthes USA)

INTRODUCTION: Fixation of complex tibial plateau fractures has been evolving. With the introduction of locking periarticular plates, there is a concern of over utilization of these implants. Locking periarticular plates are promoted because of their superior biomechanical features. Currently, there are no biomechanical studies, which compare the traditional plates to stainless steel periarticular locking plates. All available studies are done with Synthes titanium LISS plate system. Our aim is to biomechanically compare the vertical subsidence of medial tibial condyle in an OTA fracture type 41-C2.1 (stable) and 41-C2.2 (unstable) in a saw bone fracture model fixed with locking plate or conventional plating technique

METHODS: OTA fracture type 41-C2.1 (stable) and 41- C2.2 (unstable) fracture model was created in 24 saw bones (12 in each group) simulating young adult bone. Three constructs were analyzed: (1) a unilateral non-locking lateral periarticular plate, (2) a unilateral locked lateral periarticular plate, and (3) a lateral non-locking periarticular plate + a medial antiglide. The construct was then mounted on a uniaxial loading machine and loaded to 700 Newton (70Kg) for 10,000 cycles in a single leg stance axis. Upon completion of the cyclic testing, each construct was loaded to failure (5 mm displacement was considered failure). Statistical analysis was performed with three-way ANOVA test. Post hoc analysis was performed using the Tukey test.

RESULTS: In both stable and unstable groups, the lateral nonlocking plate with a medial antiglide plate fixation technique had the least vertical subsidence of 0.02 mm and 0.6 mm respectively, as compared to lateral locking plate (1.5 mm and 2.67 mm) and lateral non-locking plate (1.5 mm and 5.0 mm). p value = 0.001.

CONCLUSION: In both OTA fracture type 41-C2.1 and 41-C2.2, the conventional lateral buttress plate with medial antiglide plate fixation provided higher resistance to vertical displacement of medial condyle than the single lateral locking or single lateral conventional buttress plate fixation.

25. The Expandable Intramedullary Nail: Stabilization of 112 Patients with Traumatic or Pathologic Long Bone Fractures

*James V. Worthen, M.D. (n)
Birmingham, AL
Herrick J. Siegel, M.D. (n)
Birmingham, AL

A novel technology which may reduce operative morbidity associated with other commonly used intramedullary nail systems is the Fixion™ (Disc Orthopaedic Technology, Tel Aviv, Israel) expandable proximal femoral nail (EPFN). The diameter of the implant can increase from a 10 mm to 16 mm, which allows for implant-endosteal contact continuously along the entire length of the femoral diaphysis. The small diameter at the time of insertion obviates the need for intramedullary reaming, which potentially reduces operative time and blood loss, and may reduce the risk of embolization. The conical shaped tip facilitates reduction and passing of the nail either in the case of a displaced fracture or a deformed canal. Distal locking is not performed; minimizing operative, as well as, fluoroscopic time. This study evaluates the safety and effectivity of this technology in the treatment of 112 patients with long bone fractures from either traumatic or pathologic etiologies. The follow-up average is 15.2 months (range: 11-47 months). Medical records and imaging studies were evaluated to determine the time to union, local and systemic complications, and implant survival. Twenty-eight patients had primary traumatic injuries, 11 were treated for delayed or nonunion, 42 impending pathologic fractures, and 31 complete pathologic fractures. At last follow-up, 110 of 112 devices remained in place. One was removed in a patient with a chronic nonunion secondary to radiation and soft tissue resection and the other had the device removed secondary to progression of an aggressive benign tumor. No intraoperative complications were noted. No postoperative infections or wound complications were reported. None of the impending long bone fractures progressed to fracture after stabilization. Union widely varied depending on the underlying etiology (4-10 months). The survival of the implant at one year postoperative was 100% and by two years, 98.2%. The expandable intramedullary nail appears to be safe and effective in the treatment of traumatic or pathologic long bone fractures.

26. Functional Outcomes of Operatively Treated Pelvic Ring Injuries

*Warren E. Gardner, M.D. (n)
Grand Rapids, MI
Clifford B. Jones, M.D.
Grand Rapids, MI
(a-Medtronic; a,e-Zimmer)
Debra L. Sietsema, Ph.D., R.N. (n)
Grand Rapids, MI
James R. Ringler, M.D. (n)
Grand Rapids, MI
Terrence J. Endres, M.D. (n)
Grand Rapids, MI
David J. Bielema, M.D. (n)
Grand Rapids, MI

PURPOSE: To evaluate the functional outcome measures and timing of improvement for operatively treated pelvic ring injuries.

MATERIALS AND METHODS: Over a five-year period of time, 1999-2004, 260 operatively treated, displaced, unstable, pelvic ring injuries in skeletally mature patients had prospectively measured functional outcome data at 6, 12, and 24 months. More males (151) than females (109) injured. Average age was 39.9 years (range 16-89).

RESULTS: Etiology was high energy trauma to low energy falls. Common comorbidities were osteoarthritis and depression. A large percentage of patients consumed alcohol (55%), smoked tobacco (42%), and/or consumed illicit drugs (24%). The SMFA outcome measures were highly reliable (r=.967). The function index (29.2, 26.7, and 21.9), bother index (33.1, 31.0, and 26.0), mobility (34.9, 32.3, and 24.9), and daily activity (35.6, 30.4, and 24.7) functional outcome measures all improved with each interval (6, 12, and 24 months), respectively ($p<0.05$). Gender, age, and BMI did not affect functional measures.

CONCLUSION: Functional outcome measures of operatively treated pelvic ring injuries continue to improve up to two years post injury. Operative and insurance intervention should be delayed until that time. Gender, age, and BMI did not affect outcome measures.

27. The Floating Hip: Complications and Outcomes

*Michael S. Hughes, M.D. (n)
Columbia, MO
Timothy A. Burd, M.D. (n)
Omaha, NE
Jeffrey O. Anglen, M.D. (n)
Indianapolis, IN

BACKGROUND: To perform a descriptive study of the course, treatment decisions, complications, and outcome of patients suffering simultaneous ipsilateral fractures of the femur and pelvis.

METHODS: Medical records and radiographs of 57 patients were reviewed retrospectively.

RESULTS: The average follow-up was 28 months. Fifteen patients (26%) had an acetabular fracture, 17 (30%) had a pelvic ring fracture, and 25 (44%) had both fractures concomitant with the ipsilateral femoral fracture. Eighty percent of acetabular fractures and 55% of pelvic ring fractures were treated surgically. Femur fractures underwent operation in 94% of cases. When multiple operative settings were used, the femur fracture was always fixed at the first operation. Complications were: deep venous thrombosis (DVT) (12%), heterotopic ossification (HO) (34%), femoral head avascular necrosis (AVN) (2%), osteoarthritis (OA) (16%), and traumatic sciatic nerve palsy (33%). At least partial nerve palsy resolution occurred in 53% of patients.

CONCLUSIONS: Ipsilateral injuries to the femur and the pelvis or acetabulum (“floating hip”) are severe injuries usually due to high-energy trauma. The acetabulum and pelvic ring are more commonly fractured together than either alone. The femur fracture will most commonly be addressed first, as in 65% of our cases in which both components were addressed at the same setting, and 100% of cases in which they were done in separate settings. Delays of surgery were common due to severity of systemic trauma. Surgeons should be aware of the high incidence of sciatic nerve palsy as well as treatment options and potential complications associated with this devastating combination of injuries.

Key Words: floating hip, sciatic nerve palsy, femur fracture, pelvic fracture, acetabulum fracture

28. An Outcomes Study with Two-Year Minimum Follow-Up of Nonoperatively Treated Denis Zone III Sacral Fractures

*Justin C. Siebler, M.D. (n)
Omaha, NE
Brian P. Hasley, M.D. (n)
Omaha, NE
Matthew A. Mormino, M.D.
Omaha, NE
(e-Zimmer)

PURPOSE: The purpose of this study is to report the natural history and outcomes of nonoperative treatment in patients with Denis Zone III sacral fractures at a minimum of two years follow-up.

METHODS: From 1997 to 2002, 18 patients with Denis Zone III sacral fractures were treated. Three patients required operative intervention due to secondary pelvic ring injuries, 15 were treated nonoperatively. Eleven patients were available for follow-up consisting of SF-36 and Roland-Morris back pain questionnaires, injury specific assessment of bowel, bladder, and sexual function, Gibbons classification, and radiographs demonstrating healing and fracture alignment; nine returned for physical exam.

RESULTS: One patient died at three months post-injury, three were lost to follow-up. Time to final follow-up averaged 43.5 months (range 25-67). Age ranged from 15 to 47; seven males and four females. Fracture patterns included five Roy-Camille type 1 fractures and six type 2 fractures. All fractures healed. Three type 2 fractures had an increase of kyphosis of 10-17°. SF-36 scores were uniformly lower, but within one standard deviation of their weighted age matched norms. Roland-Morris scores averaged 3.3±3.3. Gibbons classification scores initially averaged 2±1.2 and decreased to 1.5±0.8, each within their standard deviations. All seven patients with initial neurological deficits improved. Eight had residual bowel, bladder, and/or sexual dysfunction. One patient had sacral decompression at four weeks post-injury for delayed cauda equina syndrome.

CONCLUSION AND SIGNIFICANCE: Nonoperative treatment of Denis Zone III sacral fractures yields consistent healing with some increase in kyphosis. Increase in kyphosis did not correlate with final outcomes. SF-36 scores showed decreases compared to weighted age matched norms, but were biased by associated injuries. Despite improvement in initial neurologic deficits, residual complaints were common. This study documents nonoperative outcomes against which surgical management of these fractures will be compared.

29. The Impact of Antegrade Intramedullary Reaming on Bacterial Colonization in Open Femur Fractures

*James R. Romanowski, M.D.
Cincinnati, OH
(a-Orthopaedic Trauma Association)
Michael T. Archdeacon, M.D.
Cincinnati, OH
(a,e-Stryker Orthopaedics)
Paula Mobberley-Schuman, M.S. (n)
Cincinnati, OH
Alison Weiss, Ph.D. (n)
Cincinnati, OH

INTRODUCTION: Open femur fractures are a relatively common occurrence with pulse lavage and intramedullary reaming as typical components of fracture care. There exist no published, controlled "bench-top" studies evaluating the effects of reaming on local bacterial colonization and distal seeding.

METHODS: Under sterile conditions, iatrogenic diaphyseal fractures were created in 12 fresh frozen human cadaver femurs with subsequent inoculation of *S. aureus*. High pressure pulse lavage (3L NS) was then used to irrigate the fracture sites. The femurs were then divided into two groups of six paired specimens. Group I (control) femurs were sectioned in 1 cm increments and the intramedullary contents cultured. Group II (variable) femurs underwent additional antegrade intramedullary reaming with each 1 cm section cultured. Bacterial growth and colony forming units (CFU) were then compared between the two groups.

RESULTS: Pulse lavage produces a statistically significant level of bacteria beyond the inoculation site to areas considered initially sterile (Group I $p=0.018$, Group II $p=0.056$). With pulse lavage, there is a 24% decrease in colony forming units (CFU) per cm from the fracture site ($p<0.0001$) versus a 51% decrease/cm with reaming ($p<0.0001$). The addition of reaming fails to propagate bacteria beyond that of pulse lavage. ANOVA analysis reveals a significant difference at the 0-1.0 cm level between groups ($p=0.0325$). Peak bacterial seeding occurred at the 0-1.0 cm level for pulse lavage (mean 131.7 CFU) and for reaming at the 1.1-2.0 cm level (mean 36.5 CFU). No difference in distal metaphyseal seeding exists between the groups ($p=0.3409$). Reaming decreases bacteria at the 0-1.0 cm level of initial contamination ($p=0.0211$)

CONCLUSION: In the cadaver femur model, pulse lavage propagates bacteria within the intramedullary canal. Reaming decreases CFU at the 0-1.0 cm level of the fracture site and does not seed bacteria beyond the zone of pulse lavage. Contamination of the distal metaphysis is equivocal between lavage and reaming. Intramedullary reaming appears to be advantageous in bacterial control of open femur fractures.

MAOA BREAK-OUT SESSION #3
PEDIATRICS
April 17, 2008

30. The Treatment of Adolescent Tibia Vara with Hemiepiphysieodesis: Risk Factors for Failure

*Chad M. Hanson, M.D. (n)
Dallas, TX
Amy L. McIntosh, M.D. (n)
Rochester, MN
Karl E. Rathjen, M.D. (n)
Dallas, TX

INTRODUCTION: Lateral hemiepiphysieodesis is an attractive option for the treatment of the skeletally immature patient with Adolescent Blount's disease. However, results of this less invasive procedure are unpredictable. We sought to identify risk factors associated with failure of hemiepiphysieodesis.

METHODS: Inclusion criteria: Adolescent Blount's disease, age >10, open physes, lateral hemiepiphysieodesis about the knee, >2 years follow-up. Charts were reviewed. X-rays were evaluated for mechanical axis deviation (MAD), proximal medial tibial angle (PMTA), and distal lateral femoral angle (DLFA) preoperatively, at six months postoperative, and at final follow-up. MAD is the measured distance of the mechanical axis from the knee center. Mild varus = MAD 20-40 mm. Moderate varus = MAD 40-80 mm. Severe varus = MAD > 80 mm. Failure was defined as residual varus deformity requiring osteotomy or MAD > 40 mm (moderate to severe varus) at final follow-up.

RESULTS: There were 49 patients (46 male, 3 female) with 64 extremities that met inclusion criteria. The average age was 13.4 years, average BMI was 41, and the average follow-up was 3.3 years (2.1-5.0). Sixty-six percent of patients failed lateral hemiepiphysieodesis. Two-tailed t-tests were used to determine risk factors for failure. Weight > 100 kg ($p=0.03$), BMI > 40 ($p=0.01$), preoperative MAD > 60 mm ($p<0.001$), and PMTA < 76° ($p=0.035$) were associated with failure. Severe varus deformity was 3.5 X ($p=0.001$) more likely to fail than mild varus deformity, and 1.5 X ($p=0.02$) more likely to fail than moderate varus deformity (Cox proportion hazards models).

CONCLUSION: Lateral hemiepiphysieodesis may be an effective treatment for non-morbidly obese patients with mild deformity. Sixty-six percent of patients failed lateral hemiepiphysieodesis. Factors associated with failure include: BMI > 40, weight > 100 kg, MAD > 60 mm, and a PMTA < 76°.

31. Percutaneous Bridge Plating for Pediatric Femoral Diaphyseal Fractures

William D. Tressel, M.S. (n)
East Lansing, MI
*Clifford B. Jones, M.D.
Grand Rapids, MI
(a-Medtronic; a,e-Zimmer)
Debra L. Sietsema, Ph.D., R.N. (n)
Grand Rapids, MI
Terrence J. Endres, M.D. (n)
Grand Rapids, MI
James R. Ringler, M.D. (n)
Grand Rapids, MI
David J. Bielema, M.D. (n)
Grand Rapids, MI

PURPOSE: Pediatric femoral fracture treatment is varied. Each treatment has advantages and disadvantages. The goal of treatment is to avoid complications, reduce costs, and return function. Percutaneous bridge plating has many advantages and little disadvantages.

MATERIALS AND METHODS: Over a four-year time span, all pediatric femoral fractures were diagnosed. Only percutaneous bridge plating treatment was analyzed. Seventy-eight fractures were noted in 73 patients. Average age was 9 (range 3-16). Gender was 56 M and 22 F. Most common mechanisms were falls 15 (19%), MVA 12 (15%), and pedestrians 9 (12%). Four fractures (5%) were open. Forty-three fractures (61%) were associated with polytrauma.

RESULTS: Time to operation averaged 1 day (0-11 days, 89% 0-1 day). Most plates were 3.5 combi locked plates with a lesser but equal number of 3.5 DCP and 4.5 DCP. Length of stay averaged 5 days (range 0-45 days, 18% 0-1 day, 58% 2-4 days). The majority of patients (58%) began weight bearing at 2-6 weeks. Callus formation began at 2-6 weeks (84%). Fracture healing occurred by six weeks in 91%. Limp was resolved by three months in 54%. Pain was resolved by three months in 90%. Patients were back to active daily living without restrictions by three months in 96% of the fractures. Complications were noted with 4 superficial wounds, 4 problematic scars, 3 leg overgrowth < 12 mm, and 3 distal prominent plates. No nonunions or refractures were noted. Hardware (HW) was removed on average by six months (range 3 months to never). Outpatient percutaneous HW removal was performed in 100% of the cases.

CONCLUSION: Percutaneous bridge plating for pediatric femoral fractures is predictable and effective with minimal complications. Asymptomatic femoral overgrowth was minimal.

32. Comparison of Flexible Nails versus Plating for Pediatric Diaphyseal Fractures

William D. Tressel, M.S. (n)
East Lansing, MI
Clifford B. Jones, M.D.
Grand Rapids, MI
(a-Medtronic; a,e-Zimmer)
Debra L. Sietsema, Ph.D., R.N. (n)
Grand Rapids, MI
*Terrence J. Endres, M.D. (n)
Grand Rapids, MI
James R. Ringler, M.D. (n)
Grand Rapids, MI
David J. Bielema, M.D. (n)
Grand Rapids, MI

INTRODUCTION: Pediatric femoral diaphyseal fractures can be treated with a myriad of options. Flexible nailing (FN) and femoral plating (FP) are two mainstay treatments.

MATERIALS AND METHODS: Over a seven-year span, 1999-2005, 168 consecutive unstable displaced pediatric (<12 years old) femoral diaphyseal fractures were treated with either FN (56, 33%) or FP (112, 66%). With FN, 8 were performed open and 48 closed. With FP, 72 were performed percutaneously with relative stability while 40 were open with rigid fixation. Males (127) outnumbered females (41).

RESULTS: Most children were from a two parent setting (66%). Most children had commercial insurance (56%). The most common co-morbidity was ADHD (8%). Eleven fractures were open. The most common mechanism was MVA (23%) followed by sports (15%), fall (14%), and pedestrian (13%). Associated injuries were common (51%). Time to WB was 2-6 weeks (46%) with callus developing at 2-6 weeks (66%) and healing noted by 6-12 weeks (57%). Most patients (61%) did not receive any therapy. HW removal varied from three months to never. Limp (52%) and pain (85%) was resolved by three months. Only five patients had measurable asymptomatic LLD. Ninety-eight percent returned to ADL. Complications were noted: none (75%), scar (5%), LLD (3.8%), infection (2.9%), and HW prominence (3.8%). FN had earlier time to WB and HW removal ($p<0.05$). FP had less complications than FN ($p<0.05\%$). Percutaneous bridge plating had earlier callus, healing, and less complications, but later time to WB than FN ($p<0.05$). No significance existed for age, gender associated injury, limp, pain, or LLD.

CONCLUSION: If performed well, FN and FP provide efficient methods of stabilizing pediatric femoral diaphyseal fractures. FP results in fewer complications than FN. Percutaneous techniques result in quicker to radiographic healing and potentially WB/rehabilitation. HW removal resulted in no refractures or perioperative complications. Asymptomatic LLD was uncommon with either FN or FP. Associated injuries are common.

33. The Ponseti Method Provides a Safe and Effective Treatment of Myelodysplastic Clubfoot Deformity

*David J. Gerlach, M.D. (n)
St. Louis, MO
Matthew B. Dobbs, M.D. (n)
St. Louis, MO

INTRODUCTION: Myelodysplastic clubfeet are difficult deformities to correct. Historical attempts at nonoperative treatment led to prohibitive complications. Extensive surgical releases have thus become the primary treatment for these clubfeet. We compare the efficacy of the Ponseti method in treating myelodysplastic clubfeet to that in idiopathic patients.

METHODS: Sixteen myelodysplastic clubfoot patients (28 feet) and 20 idiopathic patients (35 feet) were gathered consecutively and followed prospectively while being treated by the Ponseti method. Clubfoot severity was graded by the Dimeglio system. Initial correction, casting and/or bracing complications, recurrences and subsequent treatments, and final foot position were evaluated.

RESULTS: 85.7% myelodysplastic clubfeet (24/28) compared with 91.4% (32/35) (p=0.16) idiopathic clubfeet were treated successfully with the Ponseti method. Average follow-up was 33 months and 36.75 months, respectively. Recurrence was more common in the myelodysplastic group (71.4% versus 25.7%; p=0.01). Further castings and/or heel cord tenotomy gave resolution in 75% of these patients. Final dorsiflexion averaged 18.1° for myelodysplastic patients, versus 23.5° in idiopathic patients (p=0.03). Complications within the myelodysplastic group were blistering (5 patients), cast slippage (3), non-compliance (3), and iatrogenic plastic deformation of the tibia (2). All complications were resolved by repeated casting and/or tenotomy except in two patients (4 feet), which required surgical release.

CONCLUSION: Myelodysplastic clubfoot may be effectively treated using the Ponseti method, though attention to detail is crucial to avoid complications. Long-term follow-up is needed to determine if avoidance of extensive soft-tissue release operations for myelodysplastic clubfoot will lead to improved outcomes.

34. Osteotomy Healing in Pediatric Osteogenesis Imperfecta Patients Receiving Low-Dose Pamidronate Therapy

*Michael A. Hawks, M.D. (n)
Omaha, NE
Paul W. Esposito, M.D. (n)
Omaha, NE

INTRODUCTION: Osteogenesis imperfecta (OI) is a genetic disorder characterized by bone fragility, low bone mass and growth, and bone deformities. The benefit of intravenous (IV) pamidronate therapy in pediatric OI patients in increasing bone mass and growth rate, as well as reducing bone pain and fracture rates, has been well described. Less well characterized, however, is the effect of IV pamidronate therapy on bone healing, specifically in the setting of osteotomies performed to correct long bone deformities treated with intramedullary rodding. A recent study reported delayed osteotomy healing at 12 months after a standard dosing schedule of IV pamidronate therapy was administered to pediatric OI patients. The purpose of this study is to report on osteotomy healing in pediatric OI patients receiving low-dose pamidronate therapy.

MATERIALS AND METHODS: Bone healing was evaluated on standard radiographs after 104 osteotomies in 58 intramedullary rodding procedures (42 femur, 16 tibia) in 25 patients (age at surgery, 1.1-6.5 years). Delayed union was diagnosed when an osteotomy line was at least partially visible at 12 months from the time of surgery. The following IV pamidronate protocol was used: age <2.0 years: 0.37 mg/kg/day for 2 days for 2 months; age 2.1-3.0 years: 0.56 mg/kg/day for 2 days for 3 months; age >3.1 years: 0.75 mg/kg/day for 2 days for 4 months. The total amount of pamidronate administered represents approximately one-half that administered using previously reported dosing schedules over all age groups.

RESULTS: Delayed fracture healing was observed in three cases, all involving the tibia. Two underwent secondary procedures including additional fixation and bone grafting, and clinical and radiographic healing was noted at six weeks. One patient suffered a fracture through the osteotomy site. This fracture healed at six weeks with activity restriction.

CONCLUSIONS: This study suggests using a low dose IV pamidronate protocol may lead to significant reductions in delayed healing and the subsequent necessity for secondary procedures. More research on this population will elucidate if the lower doses of IV pamidronate decrease the inherent benefits of the bisphosphonate.

35. Gore-Tex versus Traditional Cast Padding After Closed Reduction of Displaced Distal Radius Fractures in Children: A Retrospective Review

*Alison Rozansky, M.D. (n)
Copley, OH
Mark J. Adamczyk, M.D. (n)
Akron, OH
William C. Schrader, M.D. (n)
Akron, OH
Patrick M. Riley, M.D. (n)
Akron, OH
Dennis S. Weiner, M.D. (n)
Akron, OH
Halley Wasserman (n)
Rootstown, OH
Melanie Morscher, B.S. (n)
Akron, OH
Kerwyn C. Jones, M.D. (n)
Akron, OH

INTRODUCTION: Waterproof casts have been shown to be a safe and effective means of immobilization in children with minimally displaced fractures. The purpose of this study was to determine if waterproof Gore-Tex-lined casts are as effective as traditional cotton-lined casts in the immediate postoperative period after closed reduction of displaced distal radius fractures in children.

METHODS: We performed a retrospective review of distal radius fractures that underwent closed reduction and application of a long-arm cast between June 2004 and December 2006. A total of 124 cases were included (55 Gore-Tex, 69 traditional cotton-lined). The primary outcome measure was redisplacement in the cast. The cast index was also used to assess the quality of cast molding.

RESULTS: There were no significant differences between the two groups with regards to radial translation, angulation, or deviation at the time of injury, post-reduction, or cast removal. Redisplacement as measured by the change in angulation, deviation, and translation from the time of reduction to cast removal was also not significantly different between the two groups. The average cast index for the Gore-Tex and traditional cotton-lined groups was 0.89 and 0.86 respectively.

DISCUSSION/CONCLUSION: Waterproof Gore-Tex-lined casts can be used in the immediate post-reduction period for pediatric distal radius fractures without causing any significant increase in redisplacement. Waterproof casts also provide extensive benefits to the patient with regards to bathing, hygiene, and participation in aquatic activities.

36. The Three-Dimensional Configuration of the Typical Foot and Ankle in Diastrophic Dysplasia

*Dennis S. Weiner, M.D. (n)
Akron, OH
David Jonah, M.S. (n)
Baltimore, MD
(a-Little People's Research Fund, Inc.)
Steven Kopits, M.D. (deceased) (n)
Towson, MD

INTRODUCTION: Surgical correction of the foot and ankle in patients with Diastrophic Dysplasia is extremely difficult secondary to the markedly distorted pathoanatomy. Several authors have described superficially some of the clinical and radiographic findings typical of the Diastrophic Dysplasia foot and ankle; however, no description of the specific osseous deformities has been described in the literature. The purpose of this paper is to provide such a model, detailing the nature of deformity of each of the bones and joints in the foot and ankle and their relationship to each other from a pathoanatomical standpoint.

METHODS: A 3-dimensional sculpted model and detailed drawings were developed based on radiographs, CT reconstructions, and direct observation both in and out of surgery. Fifty-three patients representing 106 feet formed the basis of this analysis (age 3 days to 32 years). An additional 12 feet of the senior author's cases provided further confirmation of these deformities.

RESULTS: Superficially, the apparent deformity most closely resembles a Z-type foot or serpentine foot. The overall deformity bears no true resemblance to the idiopathic clubfoot. Typically, the hindfoot is in severe equinus with the subtalar joint being deformed into valgus and moving more posteriorly. In contrast to the idiopathic clubfoot, the navicular was markedly angulated laterally on the talus. The medial cuneiform was deviated medially on the navicular articulation. The forefoot was in marked varus positioning with varus of the entire metatarsals. The second to fifth metatarsals bend and curve near their bases as they tilt toward the first metatarsal.

DISCUSSION/CONCLUSION: The disturbed pathoanatomy of the Diastrophic Dysplasia foot and ankle reflects the difficulties in achieving any substantial surgical correction without customization. Surgical management of the foot and ankle in Diastrophic Dysplasia must be individualized and based upon a clear understanding of the unique segmental malalignment of the foot and ankle.

37. Can "Sniff Nasal Inspiratory Pressure" (SNIP) Determine Severity of Scoliosis in Pediatric Population?

*Mr. Manjunath Ramappa (n)
Middlesbrough, United Kingdom
Mr. Simon Gatehouse (n)
Newcastle, United Kingdom
Mr. David Fender (n)
Newcastle, United Kingdom
Mr. Mike Gibson (n)
Newcastle, United Kingdom

INTRODUCTION: Sniff nasal inspiratory pressure has become a valuable tool in assessing respiratory muscle weakness. Its role in the scoliosis population is still being defined.

AIM: To assess significance of Sniff nasal inspiratory pressure in pediatric patients with scoliosis.

METHODS: Eighty-nine pediatric patients were investigated with SNIP at the time of preoperative assessment for scoliosis surgery from January 2000 to December 2006. Patients were divided into neuromuscular (24) and idiopathic (55). Other causes and revision were excluded (10).

SNIP was evaluated with respect to curve pattern and curve degree. This included radiograph and case note review.

RESULTS: The mean SNIP value for the idiopathic and neuromuscular groups was 70cmH2O and 44cmH2O respectively. This was significantly different (0.006). The mean cobb angle for idiopathic pattern was 58°. For the neuromuscular group, it was 73°. There was no correlation between SNIP value and curve severity in either the idiopathic or neuromuscular group.

DISCUSSION: SNIP is a valuable test when used in conjunction with vital capacity and overnight oxygen saturation, height, comorbidities in the neuromuscular population. It is a sensitive indicator of respiratory muscle weakness. It does not appear to reflect increasing curve severity. It does not appear relevant in scoliosis without a neuromuscular disorder.

38. Long-Term Follow-Up of Congenital Hip Dislocation Treated with Open Reduction Through an Anterior Approach

*Matthew Mayfield, M.D. (n)
Brookline, MA
William C. Warner, M.D. (n)
Memphis, TN
James H. Beaty, M.D. (n)
Memphis, TN
Jeffrey R. Sawyer, M.D.
Germantown, TN
(a-Smith & Nephew, Wright Medical Technology, Synthes)

The anteromedial (Ludloff), posteromedial (Ferguson), and anterolateral approaches are widely used for reduction of CDH. Comparisons of the approaches have found no single approach superior for all congenitally dislocated hips. The purpose of this study was to review the long-term results of open reduction of CDH through an anterior approach.

Chart review identified 45 patients (51 hips) treated with open reduction through an anterior approach between 1983 and 2005; application of exclusion criteria left 27 patients (31 hips) for inclusion in the study. All surgeries were done by the same two pediatric orthopedic surgeons. The patients' charts were reviewed for preoperative treatments, operative note, length of hospitalization, postoperative treatments, and subsequent procedures including acetabuloplasties and femoral osteotomies. Initial radiographs taken prior to or at the time of surgery were reviewed for each patient, as were radiographs performed at the time of most recent follow-up. The patients were divided into two groups; those who underwent open reduction at 12 months of age or less (Group A), and those who underwent open reduction between 13 and 25 months of age (Group B).

The final acetabular index improved to 19.5 for all patients (18.2 for group A and 21.2 for group B). The average center-edge angle at most recent follow-up was 32.7 for all patients (31.2 for group A, 34.8 for group B). Two patients required subsequent procedures: Salter acetabuloplasty at age 2 and Ganz osteotomy at age 18 in one patient with initial surgery at 15 months of age, and Pemberton acetabuloplasty at age 4 in one patient with initial open reduction at 9 months of age. Growth disturbances (Bucholz and Ogden classification) were similar in the two groups. Our results suggest that an anterior approach for open reduction of congenital hip dislocations in patients younger than 24 months of age is safe and effective. The rates of growth disturbances and overall radiograph outcomes measured at long-term follow-up are comparable to those reported for other approaches.

39. Management of Distal Tibial Medial Malleolus Type 6 Physeal Fractures

*Ham Peterson, M.D. (n)
Rochester, MN
F. Stig Jacobsen, M.D. (n)
Marshfield, WI

Type 6 physeal fracture is a fracture in which part of the physis is missing. Usually, an accompanying part of the epiphysis or metaphysis, or both, is also missing. This is a result of an open fracture, caused by such things as a lawn mower, grain auger, motorboat propeller, motorized traffic accident, etc. Type 6 is the least common physeal fracture, but has the highest rate of complications, particularly the formation of a physeal bar. Without pre-emptive treatment, a physeal bar always forms, producing angular deformity and growth retardation. Excision of physeal bars following type 6 fractures has been uniformly unsuccessful. The distal tibial medial malleolus is the most common site for this fracture. This presentation provides strategies for the treatment of the distal tibial medial malleolus acute type 6 fracture and its otherwise inevitable physeal bar.

40. Clinical Scaphoid Fractures in Children

*Andrea Evenski, M.D. (n)
Akron, OH
Mark J. Adamczyk, M.D. (n)
Akron, OH
Alonna Norberg, M.D. (n)
Fargo, ND
John Norberg, M.D. (n)
Fargo, ND
Melanie Morscher, B.S. (n)
Akron, OH
Patrick M. Riley, M.D. (n)
Akron, OH

INTRODUCTION: Scaphoid fractures are often missed in children due to their rarity and difficulty with radiographic diagnosis. The purpose of this study was to determine the percentage of pediatric clinical scaphoid fractures with radiographic evidence of fracture at follow-up.

METHODS: We performed separate retrospective and longitudinal reviews of children referred to orthopedics with traumatic wrist pain from January 1995 to April 2002. A total of 149 cases were included. There were 118 cases with high clinical suspicion but no radiographic evidence of scaphoid fracture on initial exam. Patients were followed until discharge to determine whether they went on to true fracture.

RESULTS: Thirty-two percent (38/118) of pediatric clinically suspected scaphoid fractures were diagnosed as true fractures by subsequent radiographic evaluation. Comparing the physical exam findings of the two groups in the longitudinal arm, patients with volar tenderness over the navicular were more likely to go on to true fracture.

DISCUSSION/CONCLUSION: A high percentage (32%) of clinically suspected scaphoid fractures in children actually becomes radiographically evident fractures at follow-up. Volar navicular tenderness can be used as a sign to increase suspicion for eventual fracture. We recommend that all pediatric clinically suspected scaphoid fractures be immobilized with repeat radiographs and examination at two weeks.

MAOA BREAK-OUT SESSION #4
SPORTS
April 17, 2008

41. Post ACL Reconstruction Immobilization: Is It Necessary?

*Philip Q. Johnson, M.D. (n)
Fargo, ND
Noah Marks, M.D. (n)
London, ON, Canada

BACKGROUND: Immobilization following ACL reconstruction is a common practice. Reasons for using immobilization range protecting the knee/graft from further injury because it has always been done. Although this is reasonable justification for their use, they lack any scientific basis for their continued use. Additionally, the cost of using possibly unnecessary bracing techniques in the immediate postoperative period cannot be ignored. A recent search of orthopedic and physical medicine literature failed to turn up a study addressing this issue.

METHODS: A prospective, double-blinded clinical trial was performed at The Institute for Special Surgery, a private surgical center in Fargo, North Dakota. This trial included patients from 2005 and 2006. SAS V9.1 (SAS Institute, Crary, NC) was used to analyze the data. Sixty patients undergoing ACL reconstruction with a hamstring autograph tissue source were selected to one of three groups: (1) no immobilization, (2) two weeks use of knee immobilizer only, and (3) four weeks use of a hinged knee brace that could be unlocked whenever not weight bearing.

RESULTS: Patients in the no immobilization group had superior results in regards to range of motion. Results were statistically significant for both extension and flexion.

CONCLUSION: Post ACL immobilization is not necessary and in fact may be a disadvantage to postoperative recovery.

42. Effect of Fatigue on Knee Proprioception in the Elite Collegiate Athlete—Implications for ACL Injury

*Kip Wilkins, M.D. (n)
Detroit, MI
Clinton Brawner, M.S. (n)
Sterling Heights, MI
Steven Kateyian, Ph.D. (n)
Sterling Heights, MI
Henry T. Goitz, M.D. (n)
Sterling Heights, MI

PURPOSE: Since ACL injuries are more common in the later stages of athletic events, we hypothesize that fatigue induces a decrease in functional proprioception and plays a significant role in ACL injury. In order to standardize each subjects' fatigue according to their specific level of fitness, we developed a previously unreported "fatigue protocol".

METHODS: Fourteen competitive collegiate athletes (7 men/7 women) without prior knee injury were tested for "angular error" when asked to recreate random knee flexion angles in an erect, standing position. Knee flexion angles from 10-70° were taken in increments of 5°. Measurements were performed with a standardized electrogoniometer.

All athletes subsequently underwent a "fatigue exercise protocol" which included a treadmill run or increasing intensity to determine aerobic thresholds and V02 max. After 5 minutes of rest, each athlete ran at the rate determined by their fitness test until reaching fatigue. Then the "angular error" of the knee was calculated.

RESULTS: All subjects exhibited significantly higher "absolute angular errors" post-exercise (i.e., fatigue). However, no significant difference was found between gender. That is, the "change in proprioception" was similar between men and women.

CONCLUSIONS: Knee proprioception, as measured by "angular error" via an electrogoniometer, worsens with a standardized fatigue protocol. This finding may play a role in ACL injury when athletes experience fatigue during athletic play.

43. Cost Comparison of Allograft and Autograft Anterior Cruciate Ligament Reconstruction

*Minton Truitt Cooper, M.D. (n)
Columbus, OH
Angela Pedroza, B.S. (n)
Columbus, OH
Christopher C. Kaeding, M.D. (n)
Columbus, OH

The decision of whether to use allograft or autograft ligament for anterior cruciate ligament (ACL) reconstruction remains controversial. The purpose of this study is to compare the cost of ACL reconstruction using either hamstring autograft or tibialis anterior allograft.

METHODS: The hospital cost and charge data for patients undergoing ACL reconstruction by a single surgeon using either tibialis anterior tendon allograft (n=49) or hamstring tendon autograft (n=49) were retrospectively obtained and analyzed. Costs were broken down into several categories for comparison. Surgeon, operative technique, and surgical team were controlled.

RESULTS: The mean total hospital costs for ACL reconstruction was $4,072.02 for autograft and $5,195.19 for allograft for a difference of $1,123.16 ($P<0.0001$). The only other statistically significant differences found were in the costs of the supplies ($1,296.07 more for the allograft, $P<0.0001$) and the recovery room ($82.54 more for the autograft, $P<0.01$). No statistically significant differences were found in the costs for the operating room, anesthesia, or pharmacy.

CONCLUSIONS: The cost of ACL reconstruction performed by a single experienced surgeon is significantly less ($P<0.0001$) using hamstring autograft than using tibialis anterior allograft. This is primarily due to the cost of the supplies, including the graft itself, and is not found to be significantly offset by decreases in anesthesia, operating room, or recovery room costs.

DISCUSSION: The theoretical decrease in postoperative pain in the allograft patient may have accounted for the minor recovery savings, but the theoretical savings due to a shorter OR time did not result in significant savings. The increased OR time for autograft harvest was only 12 minutes. This may not hold true for less experienced surgical teams. This study did not evaluate the economic savings of allograft use with respect to shorter time to return to work and less postoperative physical therapy.

44. Long-Term Results of Arthroscopic Iliopsoas Tendon Release: Results of 30 Consecutive Cases

James S. Keene, M.D. (n)
Madison, WI
*Brian J. Ludwig, M.D. (n)
Madison, WI

INTRODUCTION: Short-term results (≤ 2 years) of arthroscopic iliopsoas tendon releases have documented that the procedure will prevent recurrent, painful snapping of the tendon. To date, however, the long-term results (>2 years) have not been reported. This study presents the results of 30 consecutive patients who had an arthroscopic release of their iliopsoas tendon and were evaluated two or more years after surgery.

METHODS: Ninety patients with painful snapping hips were evaluated with an MRI protocol that included injection of the hip with bupivicaine, Omnipaque, and gadolinium. The 30 patients reported here had no relief of their hip pain after the intra-articular injection, and thus had an ultrasound evaluation of their psoas tendon and an anesthetic injection into the psoas bursa. In all 30 patients, the bursal injection relieved their pain, and in 17, ultrasound demonstrated snapping of the tendon. All 30 patients had an arthroscopic release of the tendon at the lesser trochanter. All hips were assessed with the 100-point modified Harris hip scoring system prior to the release, and at 1.5, 3, 6, 12, and 24 months after surgery.

RESULTS: Average age of the 30 patients was 35 (range 15-62 years), and their preoperative scores averaged 44 points. After surgery, the patients had hip flexor weakness, used crutches for two to four weeks, and had six-week scores that averaged 69 points. Their scores continued to improve, and at 6 months averaged 87 points and at 12 months averaged 90 points (range 45-100 points). The patient that scored 45 points went on to have a total hip replacement due to hip pain from progression of his DJD. At a minimum follow-up of 24 months (range 24-42 months), the scores of the remaining 29 patients averaged 93 points (range 70-100 points). The patient that scored 70 points had a recurrence of intermittent snapping and mild hip pain, but felt that her hip was much improved (her preoperative score was 40 points) and did not desire further intervention.

CONCLUSIONS: An arthroscopic release of the iliopsoas tendon is a safe, outpatient procedure that will avoid the complications of open procedures, and provide long-term (≥ 2 years) relief from painful snapping of the tendon in most (97%) of the patients.

45. Predictors of Length of Recovery and Likelihood of Progression to Total Hip Arthroplasty After Hip Arthroscopy

Ho H. Lee, M.D. (n)
Cleveland, OH
*Alison K. Klika, M.S. (n)
Cleveland, OH
Boris Bershadsky, Ph.D. (n)
Cleveland, OH
Viktor E. Krebs, M.D.
Cleveland, OH
(a,b,e-Stryker Orthopaedics)
Wael K. Barsoum, M.D.
Cleveland, OH
(a,b,e-Stryker Orthopaedics; a-TissueLink Medical; b-Zimmer; c-Exactech, SS White, Wright Medical Technology)

INTRODUCTION: We define a normal recovery after hip arthroscopy, determine the predictive values of preoperative and intraoperative variables for recovery and for progression to total hip arthroplasty (THA) after hip arthroscopy.

METHODS: A retrospective review of 216 individuals treated with hip arthroscopy at a tertiary medical center was conducted by a single reviewer. Univariate analysis was used to identify independent variables that correlated with prolonged or short recovery following hip arthroscopy and also on variables correlated with progression to THA. Binary logistic regression analysis was used to develop and test multivariate models for predicting prolonged recovery and progression to THA.

RESULTS: Univariate analyses revealed multiple variables (spanning demographics, past medical history, radiographic findings, physical examination findings, and intraoperative findings) which were significantly ($p \leq 0.05$) correlated with prolonged recovery (13 significant predictors) and also with progression to THA (14 significant predictors). A multivariate predictive algorithm was generated using five significant predictors of prolonged recovery, which included Workman's compensation involvement, female gender, use of pain medications, presence of a limp, and presence of a lateral labral tear. This algorithm was tested successfully using an independent sample of 25 individuals. Three multivariate predictors of progression to THA after hip arthroscopy were identified, including radiographic presence of arthritis, female gender and the presence of grade 4 chondral lesions, and a predictive algorithm was generated.

DISCUSSION/CONCLUSIONS: With further validation, these predictive models may facilitate the proper counseling of patients regarding expectations for recovery after hip arthroscopy and also the likelihood of the need for joint reconstruction.

46. Results of Arthroscopic Iliopsoas Tendon Release in Competitive and Recreational Athletes

Scott A. Anderson, M.D. (n)
Madison, WI
*James S. Keene, M.D. (n)
Madison, WI

INTRODUCTION: Recent studies have shown that an arthroscopic iliopsoas tendon release can effectively treat recurrent, painful snapping of the tendon. However, a question that remains is whether athletes can return to competitive or recreational sports after this procedure. This study addresses this question by presenting the results of 5 competitive and 10 recreational athletes who had an arthroscopic release of their iliopsoas tendon.

METHODS: Fifteen athletes (2 college, 3 high school, 10 recreational) with painful snapping hips that had no pain relief after magnetic resonance arthrography, which included injection of bupivicaine into the hip joint, subsequently had an ultrasound evaluation of their iliopsoas tendon and an anesthetic injection into the psoas bursa. In all 15 patients, the injection relieved their hip pain, and in 10, real time imaging demonstrated snapping of the tendon. All 15 had an arthroscopic release of their iliopsoas tendon at the lesser trochanter. All hips were assessed with Byrd's 100-point modified Harris hip scoring system prior to the release and at 1.5, 3, 6, and 12 months after surgery.

RESULTS: Average age of the 5 competitive and 10 recreational athletes was 18 and 39 years, respectively, and their preoperative scores averaged 41 and 44 points. After surgery, the two groups had hip flexor weakness, used crutches for two to four weeks, and had six-week scores that averaged 87 and 63 points. The patients continued to improve, and at six months their scores averaged 94 and 98 points, and at 12 months 96 and 97 points, respectively. At an average follow-up of 17 months (range 12-33 months), none of the patients had recurrence of their snapping or pain. All 15 athletes returned to full participation in their sport, including Division 1-A soccer (she played 90 minutes/game) and crew, and high school softball (she played catcher) and basketball at an average of 8.8 months (range 4-12 months) after surgery.

CONCLUSIONS: An arthroscopic release of the iliopsoas tendon will relieve painful snapping of the tendon and allow high school, college, and recreational athletes to return to full participation in their sport.

47. All-Arthroscopic Rotator Cuff Repair Using Single Row Suture Anchor Fixation

*Gregory N. Lervick, M.D. (n)
Eden Prairie, MN
Michael Muffenbier (n)
Plymouth, MN
M. Russell Giveans, Ph.D. (n)
Minneapolis, MN
Rebecca M. Stone, M.S. (n)
Eden Prairie, MN

INTRODUCTION: All-arthroscopic rotator cuff repair continues to evolve. Fixation with double-row (DR) or trans-osseous equivalent (TOE) techniques may increase tissue healing. Follow-up study of single row (SR) fixation repairs is necessary to provide a benchmark for future comparison.

METHODS: Forty-three patients underwent all-arthroscopic rotator cuff repair by one surgeon using single row fixation. All repairs were performed with a consistent type of suture anchor, method of suture passage, and arthroscopic knot configuration. Patients underwent routine preoperative examination and MRI evaluation. At minimum two-year follow-up, a physical examination and physical performance test was performed by a blinded physical therapist. All patients completed pre- and postoperative outcome measures (Short Form-36 [SF-36], American Shoulder and Elbow Surgeons form [ASES], and the Simple Shoulder Test [SST]).

RESULTS: Outcome measures improved significantly in all categories: SF-36 from 68.02 to 83.34 ($p<0.01$), ASES from 45.89 to 92.86 ($p<0.01$), and SST from 5.24 to 10.67 ($p<0.01$). Postoperative range of motion was not significantly different between surgical and nonsurgical shoulders. The physical performance test, designed to simulate repetitive use of the arm, failed to demonstrate significant differences between surgical and nonsurgical shoulders. Overall, patient satisfaction was 95% (41 of 43 patients).

DISCUSSION/CONCLUSION: All arthroscopic rotator cuff repair using single row suture anchor fixation with first generation techniques of suture passage performed well. Range of movement and strength demonstrate little difference between surgical and nonsurgical sides. Future study of DR and TOE tendon fixation should be measured against the demonstrated success of SR fixation.

48. Hormonal Influences and Glenohumeral Laxity in Female Athletes

*Aimee S. Klapach, M.D. (n)
Minneapolis, MN
Michael Q. Freehill, M.D. (n)
Minneapolis, MN

INTRODUCTION: Generalized laxity occurs more commonly in women. There is conflicting data regarding the correlation between shoulder laxity and gender as well as shoulder laxity and generalized laxity. Several studies have shown little correlation between the levels of estrogen and progesterone and laxity in females. No study to our knowledge has examined the influence of androstenedione, free, total and bio-available testosterone, and sex hormone binding globulin and laxity. Our purpose is to evaluate the levels of these hormones and the degree of glenohumeral laxity as well as generalized laxity in collegiate female swimmers.

METHOD: IRB approval was obtained. Forty-one collegiate swimmers were evaluated using the following examinations: general health and sports survey; physical examination of the shoulder including laxity, examination of generalized laxity via the Nicholas, Beighton, and Carter & Wilkinson tests, and serum analysis of free, total and bio-available testosterone; androstenedione; and sex hormone binding globulin. Statistical analysis was performed utilizing the spearman correlation analysis, T-test, Wilcoxon rank-sum, and regression analysis models in order to explore the relationships between hormone level and generalized laxity as well as hormone levels and shoulder laxity.

RESULTS: For all hormones except sex hormone binding globulin, the mean hormone levels demonstrated a greater trend for those with generalized laxity than for those with no generalized laxity. Shoulder laxity significantly correlated with generalized laxity ($p<0.001$). There is a significant relationship between generalized laxity scores and total testosterone levels with use of oral contraceptives ($P=0.003$).

DISCUSSION AND CONCLUSION: In this pilot study to assess the questions of gender, hormonal influence, and both generalized and glenohumeral laxity, the levels of hormones showed a positive trend with generalized laxity in female collegiate swimmers. Presence of shoulder laxity was correlated with generalized laxity. Oral contraceptive use affected both generalized laxity scoring and total testosterone levels.

49. In Vivo Degradation Characteristics of Bioabsorbable Cross-Pins in Anterior Cruciate Ligament Reconstruction

Eric Pifel, M.D. (n)
Columbus, OH
Angela Pedroza, B.S. (n)
Columbus, OH
Joseph Yu, M.D. (n)
Columbus, OH
*Christopher C. Kaeding, M.D. (n)
Columbus, OH

PURPOSE: The objective of this study was to evaluate the degradation behavior of bioabsorbable femoral cross-pins following anterior cruciate ligament (ACL) reconstruction.

METHODS: Four patients underwent ACL reconstruction using hamstring autograft with femoral fixation provided by a polylactic acid/polyglycolic acid copolymer (Lactosorb L15) cross-pin. Serial computed tomography (CT) scans were performed of the surgically reconstructed knees at approximately six weeks, four months, one year, and two years, postoperatively. A single experienced musculoskeletal radiologist evaluated the CT scans for the density of the pins and surrounding bone as well as the morphology of the pins at the various time intervals.

RESULTS: On average, the cross-pins demonstrated a relative reduction in density of 7.7%, 49.1%, and 75.0% at four months, one year, and two years, respectively. Bone density values adjacent to the pin decreased by an average of 8.6% between six weeks and four months. At one year, an additional 14.2% reduction in bone density was seen, but at two years, the relative reduction in bone density had decreased to 7.4%. Evaluation of pin morphology revealed that minimal change had occurred after six weeks. At four months, all of the pins were showing some morphologic changes on the surface, but none had fractured. After one year, two of the pins had fractured and by two years, all of the pins had fractured. None of the pins had completely reabsorbed at two years postoperatively.

CONCLUSIONS: Based upon the findings of this study, LactoSorb L15 cross-pins for femoral fixation in ACL reconstruction remain largely unchanged four months postoperatively, suggesting that this device maintains the necessary structural integrity to allow early integration of soft tissue grafts within bone tunnels. In addition, by two years the cross-pins had degraded by 75% without osteolysis or other evidence of an aggressive host inflammatory response.

50. Injuries in Division I Collegiate Swimming

Brian R. Wolf, M.D. (n)
Iowa City, IA
*Alexander E. Ebinger, B.S. (n)
Iowa City, IA
Carla Britton, M.S. (n)
Iowa City, IA

BACKGROUND: Relatively little is known about injury patterns in collegiate swimming. The purpose of this study was to describe the injury patterns for a Division I swimming program over a five-year period.

METHODS: Injury data on collegiate level swimmers at one institution was available electronically. Data on location of scholarship status, preferred swimming event, duration of injury, body part injured, and student athlete year in school was reviewed.

RESULTS: Over a period of five years, 111 injuries were found in female swimmers and 113 injuries in male swimmers. Injuries were most commonly seen in middle distance swimmers. Shoulder injuries were most common for both males and females, followed by head and axial skeleton. Knee and leg problems were seen more commonly in female swimmers. Freshmen female swimmers were more commonly injured than upperclassmen. This was not seen in male swimmers.

CONCLUSION: Shoulder injuries are common in collegiate swimming. More injuries are seen with incoming freshman female swimmers. This may be related to increases in yardage at the collegiate level.

51. A Randomized, Prospective Study of Three MIS Surgical Approaches in THA: Comprehensive Gait Analysis

*R. Michael Meneghini, M.D.
Farmington, CT
(a-Biomet, OREF; a,e-Stryker Orthopaedics;)
Shelly Smits, R.N., B.S.N. (n)
Indianapolis, IN
Rafael Bahamonde, Ph.D. (n)
Indianapolis, IN

INTRODUCTION: Purported advantages of total hip arthroplasty (THA) performed with minimally invasive surgical (MIS) approaches are less muscle damage and faster recovery. Currently, there is little data that objectively and scientifically evaluates these claims. Comparative gait analysis was performed on patients who underwent THA utilizing one of three different MIS approaches.

METHODS: Twenty-four consecutive patients, who met study selection criteria, were randomized to THA through one of three MIS surgical approaches (fluoroscopically assisted two-incision, mini-posterior and mini-anterolateral). Eight patients were enrolled in each study arm. The mean patient age was 54 years (range, 38 to 74) with an average BMI of 26 (range, 21 to 30). Each patient underwent preoperative and postoperative gait analysis. Gait parameters were recorded and calculated during walking on level ground and included peak ground reaction force (GRF), velocity, limb loading rate, and abductor torque.

RESULTS: All three surgical approach groups demonstrated overall improvements in measured gait parameters at the six-week postoperative analysis. However, the anterolateral approach patients showed a decrease in the peak GRF at mid-stance, while the two-incision and posterior approaches demonstrated an increase in GRF at the same cycle of gait. There was no difference in the postoperative gait parameters between the two-incision and posterior surgical approaches.

CONCLUSIONS: The results of this gait analysis fail to demonstrate any significant advantage of the two-incision approach over the posterior approach in gait parameters and early functional recovery. Furthermore, the anterolateral approach demonstrates a gait pattern consistent with abductor muscle injury in the early recovery period, despite the use of a minimally invasive approach.

52. Reliability of Radiographic Diagnoses in the Young Adult Hip: A Multicenter Study

John C. Clohisy, M.D.
St. Louis, MO
(a,e-Zimmer)
John C. Carlisle, M.D. (n)
St. Louis, MO
Paul Beaule, M.D.
Ottawa, ON, Canada
(a-Stryker Orthopaedics; a-Zimmer; a,b,e-Wright Medical Technology; b-Corin; e-BrainLAB)
*Robert T. Trousdale, M.D.
Rochester, MN
(c-DePuy, Wright Medical Technology)
Young Jo Kim, M.D.
Boston, MA
(a-OREF, Siemens Medical)
Karen Steger-May (n)
St. Louis, MO
Patrick Morgan, M.D. (n)
St. Louis, MO
Michael Millis, M.D. (n)
Boston, MA

BACKGROUND: Radiographic evaluation provides essential information regarding the diagnosis and treatment of young adult hip disorders, yet the interpretation and reliability of radiographic parameters is under-investigated. The purpose of this study is to evaluate the reliability of hip specialists to identify important radiographic features and to make a diagnosis based on plain radiographs alone.

METHODS: We performed a blinded, retrospective radiographic review of 25 control hips, 25 with developmental dysplasia (DDH), and 27 with femoroacetabular impingement (FAI). All cases had AP pelvis, frog-lateral, cross-table lateral, and false profile views. Readers assessed acetabular version, inclination and depth, position of the femoral head center, head sphericity, head-neck offset, and joint congruity. Observers made a diagnosis categorizing each hip as: normal, DDH, FAI, or combined DDH/FAI (features of both). Readers included six hip specialists and one fellow.

RESULTS: Acetabular inclination had good intraobserver (kappa 0.72) and interobserver (kappa 0.61) reliability. Determination of femoral head center position had good intraobserver reliability (0.77), but poor interobserver reliability (0.48). Assessment of Tonnis osteoarthritis grade had good interobserver reliability (0.59), but poor intraobserver reliability. All other measurements, including diagnosis, had poor interobserver and intraobserver reliability (kappa < 0.55). None of the recorded data points had interobserver or intraobserver kappa values indicative of excellent reliability (>0.75).

CONCLUSIONS: Many of the radiographic parameters utilized to diagnose DDH and/or FAI in the adult population are not reproducible or reliable. A more accurate set of definitions must be developed in order to allow for more accurate diagnosis of early hip disease.

SUMMARY STATEMENT: Many of the radiographic parameters utilized to diagnose DDH and/or FAI in the adult population are not reproducible or reliable.

53. Risk of Retear: Allograft versus Autograft ACL Reconstruction

Angela Pedroza, B.S. (n)
Columbus, OH
Jack T. Andrish, M.D. (n)
Cleveland, OH
Robert Marx, M.D. (n)
New York, NY
Eric C. McCarty, M.D.
Boulder, CO
(a-Stryker; c-DJ Ortho)
Richard D. Parker, M.D. (n)
Cleveland, OH
Kurt P. Spindler, M.D.
Nashville, TN
(a-DonJoy, Smith & Nephew)
Rick W. Wright, M.D.
St. Louis, MO
(a-Arthrex, Smith & Nephew)
*Christopher C. Kaeding, M.D. (n)
Columbus, OH

PURPOSE: Risk of retear after ACL reconstruction is a common question asked by patients who are contemplating ACL surgery. Thus, the purpose of this study is to evaluate variables that may predict a patient's chance of retearing their reconstructed ACL.

METHODS: Data from a single surgeon was taken from the MOON (Multicenter Orthopaedics Outcome Network) and evaluated to build a model that shows good predictive ability of ACL retear. One surgeon was chosen due to the ability to control inter-surgeon variability. This model was then validated using the other MOON surgeons. A logistic regression was used with the outcome variable retear versus no retear. Patient specific variables considered were age, gender, height, weight, and activity level. Surgery specific variables considered were graft type, primary/revision, and concomitant medial or lateral meniscal damage.

RESULTS: A total of 291 subjects from the single MOON surgeon were included in the model building and 692 subjects from the rest of the MOON surgeons were used to validate the model. Age and graft type were significant predictors of retear for both the single surgeon and the rest of the MOON surgeons. Activity level was a significant predictor for the single MOON surgeon, but was not for the rest of the MOON surgeons. Since the odds ratios for both the single and the rest of the MOON surgeons were similar for graft type and age, pooled odds ratios were reported. The odds of retear for subjects who had an allograft reconstruction were 4.7 times higher than the odds of retear for a subject that had an autograft reconstruction. The odds of retear for a decrease of ten years of age is 1.93 compared to someone ten years older.

CONCLUSIONS: A younger patient has a 1.93 times higher risk of retear than a person ten years older. A patient who had their ACL reconstruction using allograft tissue was 4.7 times more likely to have torn their reconstructed ACL compared to a patient who had their ACL reconstruction using autograft tissue. This information can be useful in counseling younger patients and those that opt for allograft tissue regarding their apparent increased risk of ACL retear.

54. The Effect of Corticosteroids on the Biomechanical Strength of Rat Rotator Cuff Tendon

*David K. Mikolyzk, M.D.
Maywood, IL
(a-Walgreens Foundation)
Anthony S. Wei, M.D. (n)
Maywood, IL
Pietro Tonino, M.D.
Maywood, IL
(d-Regeneration Technologies, Inc.)
Guido Marra, M.D.
Maywood, IL
(a-Walgreens Foundation)
Ryan D. Himes, B.S. (n)
Maywood, IL
Denis A. Williams, M.D.
Maywood, IL
(a-Walgreens Foundation)
Frederick H. Wezeman, Ph.D. (n)
Maywood, IL
John J. Callaci, Ph.D. (n)
Maywood, IL

Dr. Mikolyzk is the recipient of the Edward D. Henderson, M.D. Physician in Training Award.

BACKGROUND: Corticosteroids are commonly used in the nonoperative management of rotator cuff disease. The effect of steroids on tendon properties is poorly understood, and current data is contradictory and diverse. The biomechanical effect of steroids on rotator cuff tendon has not been studied. Our aims were to characterize the biomechanics of the acute injury response of rat rotator cuff tendon, and to examine the effects of corticosteroids on both injured and intact cuff tendon.

METHODS: One hundred and twenty-nine male Sprague-Dawley rats were randomly assigned to four groups: control, tendon injury, steroid treatment, and tendon injury plus steroid treatment. Unilateral tendon injuries were created with full-thickness defects across 50% of the total width of the infraspinatus tendon 2 mm medial to its insertion on the humeral head. Steroid treatment consisted of a single dose of methylprednisolone (0.6 mg/kg), equivalent to a human dose, placed onto the tendon under direct vision. Contralateral shoulders in the injury group served as nonoperative controls. At one, three, and five weeks postoperatively, the shoulders were harvested, and the infraspinatus tendon was subjected to biomechanical testing.

RESULTS: At one week the load, stress, and stiffness were significantly decreased in the steroid group compared to control ($p<0.0005$ for all variables). At one week the stress in the injury plus steroid group was significantly decreased compared to injury alone ($p<0.0005$). At one week stress was decreased more by steroid exposure than cutting the tendon in half ($p<0.0005$). At both the three-week and five-week time points, there was no significant difference between the control group and the steroid group in regards to load, stress, or stiffness. There was also no difference in load, stress, or stiffness between the injury group and the steroid plus injury group at three and five weeks.

CONCLUSIONS: A single dose of corticosteroid significantly weakens both intact and injured rat rotator cuff tendon at one week. This effect is transient as the steroid exposed groups returned to control levels by three weeks and remained at control levels at five weeks.

55. Estimation of the Biomechanical Composite of Tissue-Engineered Menisci Developed from Human Meniscal Cells Seeded onto Poly-L-Lactic Acid/Poly-epsilon-Caprolactone (PLLA/PCL) Scaffolds

*Andrew J. Schoenfeld, M.D. (n)
Akron, OH
William J. Landis, Ph.D. (n)
Rootstown, OH
Robin Jacquet, M.S. (n)
Rootstown, OH
Elizabeth Lowder, B.S. (n)
Rootstown, OH
Noritaka Isogai, M.D. (n)
Kinki, Japan
Mark C. Leeson, M.D. (n)
Akron, OH

Dr. Schoenfeld is the recipient of the E. W. Johnson, Jr., M.D. Physician in Training Award.

INTRODUCTION: Despite recent advances in meniscal tissue engineering, complete development of engineered constructs created from human meniscal fibrochondrocytes has yet to be achieved. This study reports experimental findings demonstrating tissue-engineering procedures that support the growth of meniscal fibrochondrocytes, expression of fibrochondral genotype, and formation of viable meniscal tissue.

METHODS: Meniscal fibrochondrocytes were isolated from fresh surgical specimens and seeded onto synthetic PLLA/PCL polymer scaffolds. Constructs were implanted into the dorsal subcutaneous space of athymic nude mice. Control scaffolds, devoid of meniscal cells, were implanted simultaneously in additional mice. Constructs were harvested in sequential fashion at multiple time-points over 20 weeks. Constructs were sectioned and analyzed with a variety of histochemical/biochemical stains to assess general specimen morphology, collagen production and organization, and cellular viability and proliferation. Collagen speciation was further elucidated by RT-PCR.

RESULTS: Evaluation of meniscal sections revealed continued growth and proliferation of fibrochondrocytes over the course of 20 weeks. Meniscal fibrochondrocyte proliferation increased over time of implantation, with cellular consolidation demonstrated as the synthetic polymer was naturally and progressively hydrolyzed. PLLA/PCL scaffolding, implanted in nude mice without cells, remained inert throughout the experiment. Type I collagen and proteoglycan were identified in constructs and type I collagen production and organization also increased over time. Section comparisons showed similarities between constructs and normal human meniscal tissue in terms of cellular morphology, collagen production, and zonal organization, especially in longer implanted meniscal constructs.

CONCLUSIONS: The present results demonstrate that meniscal tissue can be developed from fibrochondrocytes seeded onto biodegradable polymer scaffolds. The engineered human meniscal cells retain the ability to proliferate in vivo, maintaining genotype and phenotype and reproducing a native meniscal environment rich in type I collagen.

56. Two-Stage Reimplantation for Infected Shoulder Arthroplasty

*Justin P. Strickland, M.D. (n)
Cincinnati, OH
John W. Sperling, M.D.
Rochester, MN
(e-Biomet)
Robert H. Cofield, M.D.
Rochester, MN
(c-Smith & Nephew)

INTRODUCTION: While frequently discussed as a standard treatment option for the management of the infected shoulder arthroplasty, there is very little information on the actual outcome of two-stage reimplantation for the infected shoulder arthroplasty. Therefore, the purpose of this study was to determine the results and rate of failure of two-stage reimplantation for the management of the infected shoulder arthroplasty.

MATERIALS AND METHODS: Between 1995 and 2004, 17 patients (19 shoulders) were treated with a two-stage reimplantation at our institution for the treatment of a deep periprosthetic infection after shoulder arthroplasty. All 19 shoulders were followed for a minimum of two years or until the time of revision surgery (mean, 35 months).

RESULTS: There were 2 excellent results, 4 satisfactory results, and 13 unsatisfactory results. Twelve of the 19 shoulders (63%) were considered free of infection at the most recent follow-up. The mean pain score improved from 4.2 (out of 5) to 1.8. Mean elevation improved from 42° to 89°, external rotation from 30° to 43°, and internal rotation from the sacrum to L5. There were 14 complications.

CONCLUSION: The data from this study suggest that two-stage reimplantation for an infected shoulder arthroplasty is associated with a high rate of unsatisfactory results, marginal success at eradicating infection, and a high complication rate.

MAOA BREAK-OUT SESSION #5
TOTAL KNEE ARTHROPLASTY
April 18, 2008

57. Liner Exchange and Bone Grafting for Osteolysis and Wear Following Total Knee Arthroplasty

*Matthew E. Lovell, M.D. (n)
Iowa City, IA
John J. Callaghan, M.D.
Iowa City, IA
(a,c,e-DePuy)
Steve S. Liu, M.D. (n)
Iowa City, IA
Stephen G. Taylor, M.D.
West Des Moines, IA
(a-DePuy)
Devon D. Goetz, M.D.
West Des Moines, IA
(a-DePuy)
John C. Clohisy, M.D.
St. Louis, MO
(a-Wright Medical Technology; a,e-Zimmer; e-Smith & Nephew)

INTRODUCTION: Treatment of osteolysis with wear of the polyethylene in well-fixed modular acetabular components by liner exchange and bone grafting is not infrequently performed in revision total hip arthroplasty. The purpose of this study is to evaluate the technique of tibial polyethylene liner exchange and bone grafting in a selected group of total knee replacement revisions.

METHODS: Twenty-four total knee replacements (<3% of the knee revisions performed by four surgeons) were performed with liner exchange and bone grafting in cases with intact components and large areas of osteolysis (as large as 44 cm^2 on a single projection) at the time of revision. The minimum follow-up was two years. The average age at the time of revision was 61 years. The average area of osteolysis was 4x4 cm^2. Ninety-five percent of knees had a minimum two-year radiograph, average three years. Knees were evaluated for need for re-revision, bone graft incorporation, and loosening.

RESULTS: At minimum two-year follow-up, two knees had required a re-revision for loosening. On radiographs, 16 cases demonstrated complete filling of the radiographic defects and 8 demonstrated partial incorporation.

CONCLUSIONS: In this select group of revision TKR patients, many of whom would have required extensive structural allografts, bone grafting and liner exchange has provided durable mid-term results.

58. Minimum Five Year Results of the ADVANCE® Medial-Pivot – A Multi-Center Study

*Michael J. Anderson, M.D.
Milwaukee, WI
(c,e-Wright Medical Technology)
Robert Kruse, M.D. (n)
Milwaukee, WI
Chris Leslie, D.O.
Milwaukee, WI
(e-Wright Medical Technology 2000-2003)
Louis Levy, M.D.
Milwaukee, WI
(e-Wright Medical Technology)
James Pritchett, M.D. (n)
Milwaukee, WI
Jonette Hodge, R.N., B.S.N.
Milwaukee, WI
(d,e-Wright Medical Technology)

With the goals of optimizing kinematics of the knee, maximizing function, and relieving pain, TKA was performed using a medially-pivoting knee prosthesis. The purpose of this multi-center study was to determine the durability and performance of this prosthesis at minimum five years follow-up.

Between February 1999 and June 2001, 276 patients underwent 298 primary TKAs, at five centers. The posterior cruciate ligament was sacrificed in 65% of the procedures. After five to seven years of surgery, 189 patients (204 knees) were available for evaluation, 29 died, and 4 were revised. Knee Society Score (KSS) and radiographs were assessed in patients who returned while patients unwilling to return were asked their status via telephone.

Two knees underwent revision for infection, one for a tibial tray that loosened due to trauma, and one for unknown causes. Mean age of the evaluated patients was 69 years (39 – 87 years). Mean latest follow-up was 5.4 years, with a maximum of 7.6 years. There were 76 (44%) males. Five-year survivorship using Kaplan-Meier analysis was 97.2%. Preoperative mean KSS and flexion was 33 points and 107°, respectively, improving at latest follow-up to 90 points and 121°. All radiographs exhibited well-fixed implants with no sign of gross migration or pending failure.

Previously reported clinical results in a separate study showed the prosthesis to be performing well at five to seven years with 98.1% survivorship. The present study corroborated that measure of durability with survivorship of 97.2%, with good function at mid-term follow-up across multiple surgeon practices.

59. The Value of Intraoperative Gram Stain in Revision Total Knee Arthroplasty

*Patrick M. Morgan, M.D. (n)
Minneapolis, MN
Robert L. Barrack, M.D. (n)
St. Louis, MO

BACKGROUND: Management of the failed total knee arthroplasty remains challenging. Paramount to choosing the correct treatment is an effective evaluation for periprosthetic infection. When preoperative modalities used to detect sepsis are equivocal, the surgeon may be forced to rely upon intraoperative testing. While the efficacy of intraoperative frozen section has been established by several authors, the value of the intraoperative Gram stain in the revision total knee is unclear.

METHODS: We reviewed 945 revision total knee arthroplasties from three university-affiliated institutions; 97.5% of cases had an intraoperative Gram stain for review. Of these cases, 269 knees were classified as infected based on (1) presence of the same organism on two cultures, (2) growth on solid media of an organism with other objective evidence of infection, (3) histologic evidence of acute inflammation, or (4) gross purulence. Preoperative laboratory studies were reviewed including ESR, CRP, and WBC in all cases and, when available, joint aspiration.

RESULTS: Intraoperative Gram stain was found to have a sensitivity of 26% and a specificity of 99%. The positive and negative predictive values were 98% and 79% respectively. The test accuracy was 80%. Patients with a true-positive Gram stain had a statistically significant higher preoperative ESR, preoperative WBC, and nucleated cells on aspiration when compared to patients with a false-negative Gram stain ($p<0.05$). Of the 67 patients with a true-positive Gram stain, only one had a normal preoperative workup; a preoperative aspiration had not been preformed. In no case did the intraoperative Gram stain alter treatment if the patient had undergone a complete preoperative laboratory evaluation including joint aspiration.

CONCLUSIONS: The intraoperative Gram stain was found to have poor sensitivity, negative predictive value and test accuracy, and failed to alter treatment in any patient with a complete preoperative evaluation. While commonly performed, these data do not support the routine use of intraoperative Gram stain in revision total knee arthroplasty and suggest the practice should be abandoned.

60. Does Substantially Higher Patient Activity Account for UKA Failures? A Cautionary Note for Future High-Performance TKA Designs

Mir H. Ali, M.D. (n)
Rochester, MN
Diane L. Dahm, M.D. (n)
Rochester, MN
*Mark W. Pagnano, M.D.
Rochester, MN
(a-DePuy, Stryker Orthopaedics, Zimmer)

INTRODUCTION: Unicompartmental knee arthroplasty (UKA) has some recognized advantages over TKA including better ROM, in-vivo knee kinematics, and patient-rated function, but at the price of a higher revision rate. Recent work has correlated postoperative activity with the risk for failure. We sought to quantify activity after UKA compared to TKA to determine if greater activity might account for some of the difference in revision rates. We hypothesized that compared to TKA: (1) UKA patients would routinely engage in more demanding activities, (2) UKA patients would more often participate in sports deemed not recommended, and (3) UKA patients would attain a higher level of function.

MATERIALS: Two hundred three patients with a UKA done between 2000 and 2005 were surveyed at two years minimum. Knee Society, UCLA activity, Tegner, patient-rated activity scores, and participation in 40 different athletic activities were documented.

RESULTS: (1) UKA patients engaged in more demanding activities than TKA patients (UCLA score 7.8 versus 6.1; $p<0.05$), (2) UKA patients more often participated in high impact sports not recommended by the Knee Society (31% versus 16%; $p<0.05$), and (3) UKA patients achieved higher levels of function (Knee Function score 79.2 versus 71; $p<0.05$).

CONCLUSION: Part of the difference in UKA and TKA revision rates is likely attributable to substantially greater activity after UKA. While interest exists to develop TKA designs that more closely mimic UKA function (better ROM, in-vivo kinematics, normal feel), surgeons should be aware that an unintended consequence may be greater patient activity resulting in higher revision rates.

61. Primary Total Knee Arthroplasty Following Infected Tibial Plateau Fracture

*A. Noelle Larson, M.D. (n)
Rochester, MN
Arlen D. Hanssen, M.D.
Rochester, MN
(a-DePuy, Zimmer; a,c-Stryker Orthopaedics)
Joseph R. Cass, M.D. (n)
Rochester, MN

INTRODUCTION: Total knee arthroplasty performed following tibial plateau fracture has a known high rate of complication. This is the first report addressing the outcomes of total knee arthroplasty (TKA) performed after infected tibial plateau fracture.

METHODS: Between 1971 and 2005, 19 primary TKAs were performed following infected tibial plateau fractures. Patients were matched for age, gender, and arthroplasty date to 19 controls status post TKA for tibial plateau fracture with no previous history of infection. Clinical outcomes and Knee Society (KS) scores were assessed retrospectively.

RESULTS: Fifteen patients had operative treatment of the fracture; four, nonoperative. Three fractures were open. All had deep infection. Time from fracture to arthroplasty was a median of 2.7 years. Mean age at arthroplasty was 58.3 years. Five patients had a two-stage arthroplasty. Eleven received antibiotic-impregnated cement with the arthroplasty. Mean clinical follow-up was 4.5 years. KS scores were not available on two patients due to death and loss to follow-up. Following surgery, KS scores significantly improved from 44.8 to 61.1 for pain ($p=0.0012$) and from 38.8 to 63.5 for function (<0.0001). The control group, however, showed greater improvement in KSS score, with the pain score and function scores increasing by 25.5 and 37.6 points, respectively. Eleven patients (58%) required re-operations for: 3 - wound complications, 2 - manipulation, 2 - revision for aseptic loosening, 2 - definitive treatment with resection arthroplasty, and 2 - above the knee amputation. Recurrent infection occurred in five patients (26%) at a mean of 1.1 years. According to Kaplan Meier analysis, five-year survival is 81.4% (SD 9.7%). Three controls required manipulation (16%), but none developed infection or required revision (mean follow-up 8.3 years).

DISCUSSION AND CONCLUSION: Despite the use of antibiotic cement, and, in some, two-stage arthroplasty, there are high rates of recurrent infection (26%) and re-operation (58%) in this patient population.

62. Predicting Patient Discharge Disposition Following Total Joint Arthroplasty

*Trevor Murray, M.D. (n)
Cleveland, OH
Karen Green (n)
Cleveland, OH
Joe Styron, B.S. (n)
Cleveland, OH
Alison K. Klika, M.S. (n)
Cleveland, OH
Bishoy Gad, M.S. (n)
Cleveland, OH
Matthew Pifer, M.S. (n)
Cleveland, OH
Boris Bershadsky, Ph.D. (n)
Cleveland, OH
Wael K. Barsoum, M.D.
Cleveland, OH
(a,b,e-Stryker Orthopaedics; a-TissueLink Medical; b-Zimmer; c-Exactech, SS White, Wright Medical Technology)

INTRODUCTION: Efforts to increase efficiency and decrease length of stay require accurate pre-planning of patient discharge following total joint arthroplasty (TJA). The purpose of this study was to develop and evaluate an easily administered form to preoperatively predict patient discharge following TJA.

METHODS: A form was generated by a multidisciplinary group of clinicians which identified a set of preoperative factors relevant to patient discharge including age, gender, BMI, comorbidities, preoperative ambulatory status, projected postoperative weight bearing, home environment and location, and caregiver assistance. Data was collected from a review of 516 medical charts for patients that had undergone primary TKA (n=103), revision TKA (n=104), bilateral TKA (n=102), primary THA (n=106), and revision THA (n=101). A stepwise multinomial logistic regression model was used to identify predictors of discharge to a skilled nursing facility (SNF), rehabilitation facility, or home.

RESULTS: Patients were more likely to be discharged to either a SNF or rehabilitation facility if they underwent bilateral TKA ($p<0.001$); were female ($p<0.001$), have their heart disease monitored ($p=0.003$); or are older ($p<0.001$). Patients are more likely to be discharged home if preoperatively they are capable of independent ambulation in the community ($p=0.014$). Patients discharged to either a SNF or rehabilitation facility were not significantly different except patients undergoing bilateral TKA were more likely to be discharged to a rehabilitation facility ($p<0.001$).

DISCUSSION/CONCLUSION: With further validation, this model may be a useful tool for preoperatively predicting a patient's discharge disposition, which is valuable to the hospital, clinicians, patients, and families in efficiently preparing for postoperative care.

63. Use of Long-Term Tunneled Epidural Catheters for Managing the Stiff Total Knee Arthroplasty

*Craig J. Della Valle, M.D.
Chicago, IL
(a,b,e-Zimmer; b-Ortho Biotech, Inc., Smith & Nephew, Stryker Orthopaedics)
Sharat K. Kusuma, M.D. (n)
Chicago, IL
Aaron G. Rosenberg, M.D. (n)
Chicago, IL
Asokumar Buvanendran, M.D. (n)
Chicago, IL

INTRODUCTION: Inadequate range of motion (ROM) after total knee arthroplasty (TKA) can be multifactorial, but oftentimes is related to inadequate pain control. This study evaluates the safety and short-term efficacy of long-term continuous epidural infusions for managing the stiff TKA.

METHODS: Ninety-one patients had a fluoroscopically-guided epidural catheter placed ipsilateral to the surgical side at the L2-L3 level and tunneled to the opposite flank area. The epidural was dosed for the procedure and then continued for approximately seven weeks. Patients were discharged with home health care services and placed on prophylactic antibiotics. Indications for the tunneled epidural included open revision for stiffness, arthroscopic release for stiffness, manipulation under anesthesia or primary TKA in patients with a history of stiffness or chronic regional pain syndrome.

RESULTS: The mean duration of epidural infusion was 49 days. Mean follow-up following removal of the catheter was 393 days. The mean preoperative VAS pain score of 5.6 was lower during epidural infusion (3.2; $P<.001$) and at most recent follow-up (4.5; $P<.001$). The mean preoperative ROM of 80.2 degrees improved to 103.3 degrees at final follow-up ($P<.001$). Minor catheter related complications occurred in six patients and three patients had motor weakness that required infusion adjustment (10% minor complications). There were two major complications related to a fall (one wound dehiscence and one patellar tendon avulsion).

DISCUSSION: This study demonstrates the safety and short-term efficacy of placing a tunneled long-term epidural catheter for managing the stiff TKA, however, muscular strength must be monitored closely.

64. Complications Associated with Realignment Osteotomy of the Knee Performed Simultaneously with Additional Reconstructive Procedures

Brian R. Wolf, M.D. (n)
Iowa City, IA
*Michael C. Willey, B.S. (n)
Iowa City, IA
Baris Kocaglu, M.D. (n)
Iowa City, IA
Carla Britton, M.S. (n)
Iowa City, IA
Annunziato Amendola, M.D.
Iowa City, IA
(c-Arthrex)

OBJECTIVES: The purpose of this study was to determine if the knee realignment opening wedge osteotomy combined with concurrent additional knee reconstruction procedures is related to a higher incidence of complications relative to isolated osteotomy.

METHODS: A retrospective review was performed to identify high tibial osteotomy (HTO) and distal femoral osteotomy (DFO) patients from January 2001 to January 2006. Chart review was performed to document additional procedures done in combination with the osteotomy, and to identify subsequent minor and major complications. Isolated osteotomy patients were grouped together (Group 1), as were combined osteotomy and reconstructive cases (Group 2). Complication rates were compiled for the entire cohort and for each group.

RESULTS: A total of 84 knee opening wedge realignment osteotomies were performed, including 62 HTOs and 22 DFOs. The study group consisted of 54 men and 30 women. The average age was 35.1 years. Group 2 patients were younger than Group 1 patients, 40.1 versus 27.9 years. Isolated osteotomy was performed in 40 patients (Group 1), and an osteotomy with additional significant reconstructive procedure was performed in 44 patients (Group 2). At a minimum of ten months, major complications were found in 15% of Group 1 patients and in 15.9% of Group 2 patients, relative risk 1.061. Minor complications were found in 25% of Group 1 patients and 18.1% of Group 2, relative risk 0.853. Neither difference was statistically significant. When analyzed by location of osteotomy, major complications were found in 14.5% of HTO patients and 18.2% of DFO patients. Minor complications were found in 24.2% of HTO patients and 13.6% of DFO patients.

CONCLUSIONS: The rates of complication in the current series of opening wedge HTO and DFO were similar to previously reported osteotomy series using various techniques. Our results suggest that combined knee realignment osteotomy and additional significant reconstruction procedures does not result in excessive minor or major complications and is safe.

65. Long-Term Evaluation of Correlation Between Intraoperative Navigation and Radiographic Measurements of TKA Limb Implants

Mark A. Yaffe, B.S. (n)
Chicago, IL
Susan E. Gall, B.S. (n)
Chicago, IL
*S. David Stulberg, M.D.
Chicago, IL
(e-Aesculap)

INTRODUCTION: In a previous study, a lack of correlation was shown to exist between TKA alignment measurements performed using an intraoperative navigation system and standard one-month postoperative radiographs. Soft tissue conditions and postoperative pain may play key roles in helping to explain the poor correlation. The purpose of the current study is to utilize long-term radiographs to assess whether the correlation between intraoperative navigation measurements and standard radiographs is consistently weak or changes in magnitude over time.

METHODS: Fifty-eight computer-assisted TKAs were performed. Mechanical axis, femoral, and tibial implant alignment measurements were recorded intraoperatively using the navigation system and with anterior-posterior and lateral view radiographs taken at one-month (short-term) and two-years (long-term) postoperative. The correlation and degree of variation between the measurements performed using the intraoperative navigation system, one-month, and two-year postoperative radiographs were evaluated.

RESULTS: Short and long-term radiographs exhibited a strong degree of correlation that was statistically significant. Long-term radiographic measurements were closer to ideal alignment and exhibited less variability than short-term radiographs. Both short- and long-term radiographic measurements exhibited poor correlation with intraoperative navigation measurements.

DISCUSSION: This study suggests that the factors affecting the correlation between intraoperative navigation and postoperative radiographic measurements change over time. Radiographs taken more than one year after surgery appear to be more accurate and reliable than those performed one month postoperative. Improvements in soft tissue conditions, such as flexion contractures, or improvements in knee pain, could help account for these findings. This study can help establish a timeframe when the most accurate and reliable measurements of postoperative TKA limb alignment can be performed.

66. Experience with a Navigated Saw in Computer-Assisted TKR

Hani Haider, Ph.D.
Omaha, NE
(a-Biomet)
Andres O. Barrera, Ph.D.
Omaha, NE
(a-Biomet)
*Craig R. Mahoney, M.D.
West Des Moines, IA
(e-Smith & Nephew)
Amar S. Ranawat, M.D.
New York, NY
(a,e-DePuy, Stryker Orthopaedics)
Chitranjan S. Ranawat, M.D.
New York, NY
(a,c-DePuy, Stryker Orthopaedics)
Kevin L. Garvin, M.D.
Omaha, NE
(a-Biomet, Smith & Nephew)

A previously introduced navigated-freehand bone cutting technique for TKR has been tested only by our surgeons. This study reports on evaluation in the hands of external surgeons with widely-varying TKR expertise.

Seven orthopedic surgeons prepared a synthetic distal femur. The NoMiss was used to navigate the bone-specimen and a saw to osteotomize the femur. Each surgeon performed five timed experiments and each experiment required the completion of all five cuts of one bone-specimen. Implant “fit” and “alignment” were physically measured with a navigated implant trial and produced numeric fit and alignment indices. All cut-bones were also digitized to compute smoothness and alignment indices representing how rotated and offset the implant was relative to ideal.

The average cutting-time was 10.2 ± 4.3 minutes. The average-roughness Ra was 0.19 mm, and the difference between the highest-50-peaks and lowest-50-valleys was <1.2 mm. Twenty-one out of 35 bones were tight on the implant-trial without cementation. The worst looseness was in flexion and extension with average range <1.6°, and <1 mm in translation. Average implant alignment error was 1.2°. Linear-translation errors averaged 1.4 mm. Analysis of all cut-surfaces showed the chamfers as the extreme-outliers.

This study showed high reproducibility of cuts and a narrow envelope of alignment error. Alignment with NoMiss in previous studies was superior and the cutting was faster compared to using conventional TKR cutting-blocks, and this was echoed here. Feedback from the surgeons surpassed our expectations. We anticipate significant further improvements with the inclusion of novel smart software/hardware techniques.

MAOA BREAK-OUT SESSION #6
BASIC SCIENCE
April 18, 2008

67. Hey1 Protein is an Important Mediator of Bone Morphogenetic Protein 9 Induced Osteogenic Differentiation of Mesenchymal Stem Cells

*Katie A. Sharff, B.S. (n)
Chicago, IL
Xiaoji Luo, M.D. (n)
Chicago, IL
Wen-Xin Song, M.D. (n)
Chicago, IL
Jinyong Luo, M.D. (n)
Chicago, IL
Seungryong Cho, B.S. (n)
Chicago, IL
Xiao Han, B.S. (n)
Chicago, IL
Gary He, M.D. (n)
Chicago, IL
Anthony G. Montag, M.D. (n)
Chicago, IL
Xiaochuan Pan, Ph.D. (n)
Chicago, IL
Hue H. Luu, M.D.
Chicago, IL
(a-OREF)
Rex C. Haydon, M.D.
Chicago, IL
(a-Brinson Foundation, MTF, NIH, OREF)
Tong-Chuan He, M.D. (n)
Chicago, IL

BACKGROUND: Bone regeneration is critical to the effective management of many musculoskeletal disorders including fracture healing and osteoporosis. Mesenchymal stem cells (MSCs) are progenitor cells that can differentiate into osteogenic, chondrogenic, adipogenic, and myogenic lineages. We previously demonstrated that bone morphogenetic protein 9 (BMP-9) is one of the most potent and yet least characterized BMPs that are able to induce osteogenic differentiation of MSCs both *in vitro* and *in vivo.* Expression profiling analysis of MSCs has revealed that the Hey1 gene is significantly upregulated in response to BMP-9. This study investigated the functional role of the Hey1 gene in BMP-9 induced osteogenic differentiation.

METHODS: The effect of Hey1 on BMP-9 induced osteogenic differentiation was characterized *in vitro* using quantitative real-time PCR analysis and a histochemical and colorimetric alkaline phosphatase assay. The role of Hey1 was evaluated *in vivo* by subcutaneous injections of the BMP-9 infected MSC lines in nude mice. Ectopic ossification in the mice was evaluated using quantitative microCT analysis and histological H&E staining.

RESULTS: Silencing Hey1 expression diminished BMP-9 induced osteogenic differentiation of MSCs both *in vitro* and *in vivo*, and led to chondrogenic differentiation.

Conversely, constitutive Hey1 expression in MSCs resulted in enhanced BMP-9 mediated bone matrix mineralization. We further demonstrated that Hey1 and Runx2, an essential osteogenic mediator, acted synergistically in BMP-9 induced osteogenic differentiation. Furthermore, the defective osteogenic differentiation caused by Hey1 knockdown was rescued by exogenous Runx2 expression.

CONCLUSION: Our findings strongly suggest that Hey1, through its interplay with Runx2, has a critical role in regulating BMP-9 induced osteogenic differentiation of MSCs. Findings from this study have expanded our understanding of the osteogenic activity of BMP-9 and its interaction with the target gene, Hey1. This knowledge may contribute to the development of novel therapies for bone regeneration.

68. ♦rhBMP-2 Use in Osteomyelitic Bone Defects

B. Matthew Hicks, M.D.
Fort Wayne, IN
(a,e-Medtronic)
*David A. Coats, M.D. (n)
Fort Wayne, IN

RhBMP-2 on an absorbable collagen sponge (ACS) has been shown to be efficacious in open tibial fractures and interbody spine fusions. The purpose of this study was to evaluate the safety and potential applications of rhBMP-2/ACS (INFUSE) in osteomyelitic bone defects.

After obtaining IRB approval, a retrospective review was undertaken of all patients treated by a single surgeon with rhBMP-2/ACS. Ten patients were identified who had rhBMP-2/ACS in combination with calcium phosphate granules placed in an osteomyelitic bone defect. There were 7 males and 3 females. The average age was 55. Locations of the bone defect included 4 tibias, 3 ulnas, 2 femurs, and 1 calcaneus. Four patients required flap coverage as part of the reconstruction. All patients underwent staged debridements and received six weeks of intravenous antibiotics prior to the index surgery. The average duration of follow-up is 11.7 months.

There were no perioperative complications associated with the use of rhBMP-2/ACS. All ten of the ten bone defects have healed. There have been no recurrences of infection. One patient-related complication involved a refracture of a femur three months after removal of an ilizarov fixator. All cultures were negative at the time of the surgical repair of the fracture.

The treatment of osteomyelitic bone defects has historically been augmented by autologous bone graft. We report successful healing of ten consecutive osteomyelitic bone defects using rhBMP-2/ACS in combination with calcium phosphate filler as an autograft replacement. This preliminary review was encouraging. Further investigation with larger prospective studies should be considered.

69. Effect of Adenoviral Vector BMP-13 Gene Therapy in a Rat Rotator Cuff Model

*Samuel C. Coy, M.D. (n)
Chicago, IL
Gregory H. Dairyko, M.D. (n)
Chicago, IL
Tong-Chuan He, M.D. (n)
Chicago, IL
Michael A. Terry, M.D. (n)
Chicago, IL

PURPOSE: Adenoviral vector gene therapy has shown promise for the delivery of growth factors to tendons. Biologic augmentation of rotator cuff tears is being investigated. Studies have shown that bone morphogenic proteins (BMP) 12, 13, and 14 augment tendon healing. To our knowledge, BMP gene therapy has not been studied in a model of rotator cuff tears. The objective of this study was to determine whether adenoviral vector BMP-13 could be introduced effectively in the rat supraspinatus tendon without causing a significant inflammatory response.

METHODS: Recombinant adenoviruses expressing BMP-13 (AdBMP-13) were constructed and four different viral titers ($5x10^7$, $1x10^8$, $5x10^8$, and $1x10^9$) were prepared for this study. Bilateral supraspinatus tendons of eight Sprague Dawley rats were exposed and injected with the different viral titers. Each titer was tested in four tendons. Four rats were sacrificed at one week after surgery, and the remaining rats were sacrificed at two weeks. The retrieved tendons were sectioned for histologic evaluation of inflammatory response.

RESULTS: At both time points (one and two weeks), there was minimal difference in the amount of inflammation between the different viral titers. The tendons were sectioned at the musculotendinous junction and at their insertion into the humerus. Little inflammation was detected in the tendon substance itself. Incidentally there was an increased amount of fibrocartilage at the tendinous insertions of the specimens injected with higher titers of adBMP-13.

CONCLUSIONS: Our findings show that adBMP-13 may be injected into the rat rotator cuff without causing a notable inflammatory response. Future research will investigate the ability of adBMP-13 to augment healing of a supraspinatus defect in the rat rotator cuff model.

70. Effects of Erythromycin on Osteoblast Viability, Proliferation, and Differentiation

*David C. Markel, M.D.
Southfield, MI
(a-OREF, Stryker Orthopaedics)
Xing Peng, M.S. (n)
Detroit, MI
Ralph B. Blasier, M.D. (n)
Detroit, MI
Weiping Ren, M.D. (n)
Detroit, MI

Bone integrity is maintained through the delicate balance between osteoblastic bone formation and osteoclastic bone resorption. We have confirmed that erythromycin (EM), a macrolide antibiotic, is an effective osteoclast inhibitor. The aim of this study was to further determine the effects of EM on osteoblast viability, proliferation, and differentiation in MC3T3-E1 preosteoblast cell line. MC3T3 cells were exposed to different concentrations of EM (0-5 μg) for predetermined time. Cell proliferation was assessed by direct cell counting. Cell viability was evaluated by both LDH activity assay and live/dead staining assay. Cell differentiation was determined by alkaline phosphatase (ALP) bioassay and gene expression analyses using real-time quantitative RT-PCR. EM showed no significant cytotoxic effects on MC3T3 cells. There was no significant increase of LDH activity and the percentage of dead cells in MC3T3 cells treated with EM up to 10 μg/ml for three days. EM treatment resulted in a significant increase in cell proliferation compared to untreated cells (p<0.01). EM treatment (1-5 μg) resulted in a significant increase of ALP activity. The up-regulation in ALP activity indicates the initiation of cell differentiation, which was further confirmed by quantitative gene profile analysis. Using RT-PCR technique, we found that genes of bone morphogenetic protein-2 (BMP-2), bone sialoprotein-II, and type 1 collagen, were significantly increased by EM treatment in a dose- and time-dependent manner. In conclusion, our data suggested that EM enhances cell proliferation and initiates osteoblastic differentiation in MC3T3 cells. These findings confirmed that EM is a highly selective osteoclast inhibitor without significant cytotoxic effect on osteoblasts. Further investigation is required to determine how the anabolic effect of EM on osteoblasts can be translated to bone quality and bone turnover in vivo.

71. Immunohistochemical Analysis of Collagen Type VI and GRP-78 Expression in Human Minimal and Advanced Osteoarthritis (OA) and Non-OA Cartilage

*Ian Gradisar, M.D. (n)
Akron, OH
Danielle Speicher, B.S. (n)
Rootstown, OH
Anthony Baraga, B.S. (n)
Rootstown, OH
Denise McBurney, B.S. (n)
Rootstown, OH
Walter Horton, Jr., Ph.D. (n)
Rootstown, OH

Osteoarthritis (OA) is a degenerative cartilage disease with varying degrees of severity within a joint. The study purpose was to define the location of a marker of healthy articular cartilage (Collagen Type VI) and that of a known stress marker of chondrocytes (GRP-78) and to compare their sites of expression in minimal and advanced disease. Analysis of these markers in OA and non-OA cartilage may help explain if they are protective or destructive of articular cartilage.

Intra-patient minimal and advanced OA knee samples were obtained from knee compartments. Immunohistochemical staining was used to assess the location of both Collagen Type VI and GRP-78 and to compare minimal and advanced OA to that of non-OA cartilage. A histological grading of OA cartilage in terms of surface fibrillation, cell cloning, and matrix depletion was used to score samples as a formal assessment of OA severity. This new grading system was compared to gross observation of overt lesions and to immunohistochemical staining.

Early results indicate that the expression of Collagen Type VI is upregulated in the pericellular region of minimal OA versus non-OA and an increase in territorial staining (40.0% versus 6.3%) and interterritorial staining (65.0% versus 37.5%) in advanced disease. Preliminary results of immunohistochemical staining of GRP-78 show increased expression in OA, with no correlation of severity of cartilage degeneration. In addition, the histological grading of samples has consistently correlated advanced disease with gross inspection as well as the immunohistochemical staining. The abnormal distribution of Collagen Type VI occurs irrespective of knee compartment and alignment of both varus and valgus knees in OA. In advanced OA tissue, GRP-78 appears upregulated and histological grading displays increased fibrillation, cloning, and matrix depletion. Collagen Type VI is found to be less associated with chondrocytes and more diffuse in the matrix with advanced disease. It is still unknown whether these changes represent a causative or effectual relationship to disease progression.

72. The Effects of Inflammation of GFAP Expression in Satellite Cells of the Dorsal Root Ganglion

*Krzysztof B. Siemionow, M.D. (n)
Cleveland, OH
Alexandra Klimczak, Ph.D. (n)
Cleveland, OH
Maria Siemionow, M.D. (n)
Cleveland, OH
Robert F. McLain, M.D.
Cleveland, OH
(a-Abbott Spine, DePuy Spine; a,e-Stryker Spine)

Satellite cells (SC) are thought to be neuroglial cells that closely interact with nerve cells of the dorsal root ganglion (DRG). GFAP is the principle intermediate filament in mature astrocytes and its loss impaired Schwann cell proliferation and delayed nerve regeneration after injury. GFAP modulates neuronal glutamate transporter function and its activation leads to an increase in intracellular Ca2+, resulting in microglial activation and cytokine secretion, which may lead to pain sensitization. The objective of this study was to identify the effects of inflammation on the expression of GFAP in SC of the DRG at various time points.

METHODS: Eighty-two rats underwent a hemilaminectomy. Two distinct procedures at the L5 DRG were investigated: (1) Group I, the inflammation group, in which fragments of chromic-gut suture were laid adjacent to the DRG, and (2) Group II, tight ligature, the ischemia group, in which the root was tightly ligated proximal to the DRG with chromic-gut. DRGs were harvested at 6 hours, 24 hours, 48 hours, 72 hours, and 7 days postoperatively. The contralateral DRG served as an internal control. Group III was the sham group. The harvested DRG were analyzed for SC immunoreactivity using GFAP polyclonal antibody.

RESULTS: One hundred sixty-four DRGs were harvested and available for analysis. Naïve controls did not express GFAP. Group I: GFAP expression was observed in 30% of SC and SC sheaths at 6 hours, 85% at 24 hours, 100% at 48 hours, 72 hours, and 7 days. In contralateral internal controls, 5% of SC and SC sheaths expressed GFAP at 6 hours, 20% at 24 hours, 30% at 48 hours, and 100% at 72 hours and 7 days. The difference in GFAP expression at 6 hours, 24 hours, and 48 hours was significant ($p<0.05$). Group II: SC did not express GFAP at any time point. GFAP expression was undetectable in nerve cells during all tested time points.

CONCLUSIONS: Under physiologic conditions, the expression of GFAP by SC is undetectable by immunohistochemistry. As the inflammatory process develops, GFAP expression increases, with 30% of SC at 6 hours and 85% of SC at 24 hours being GFAP immunoreactive. This data suggests that SC are potential mediators of the inflammatory process and could take part in the pathogenesis of pain.

73. ♦The Effects of Basic Fibroblast Growth Factor on Acute Rotator Cuff Injury in a Rat Shoulder Model

*Denis A. Williams, M.D. (n)
Chicago, IL
Pietro Tonino, M.D.
Chicago, IL
(a-Walgreens Foundation, d-Regeneration Technologies)
David K. Mikolyzk, M.D. (n)
Maywood, IL
John J. Callaci, Ph.D.
Chicago, IL
(a-Walgreens Foundation)

BACKGROUND: The utilization of growth factors with rotator cuff repairs may help decrease the incidence of postoperative re-rupture of the repaired tendon.

HYPOTHESIS: Administration of bFGF in an alginate gel will increase early healing mechanical parameters in injured rat rotator cuff tendon.

STUDY DESIGN: Controlled laboratory study.

METHODS: The infraspinatus tendons of 39 shoulders of 350 grams – 400 gram Male Sprague Dawley rats were exposed to recombinant basic fibroblast growth factor (rbFGF) or vehicle control. For the injury model, two groups had surgically created 1 mm (half tendon width) full thickness defect 2 mm from the insertion site on the humerus. A dose of 200 ng of rbFGF or vehicle control (Alginate) was administered to randomly chosen rats. Tendons were harvested at 1 week, 2 weeks, and 4 weeks. In all groups, the infraspinatus tendon was dissected, isolated, and left attached to the humerus. In the injury model, the intact portion of the injured tendon was divided across tendon fibers at the level of the injury leaving only the healing granulation tissue in continuity with the remaining proximal and distal portions of the tendon and loaded to failure.

RESULTS: No statistical differences were noted in any of the measured parameters at one and two weeks. At four weeks, the granulation tissue size of the injury group was 0.4 mm^2 versus 2.7 mm^2 in the rbFGF injury group $P<0.001$. Stiffness at four weeks for the injury tendons was 2.15 N/mm versus 3.54 N/mm in the rbFGF treated group $p=0.006$. However, stress measured 8.19N in the injury group which was markedly higher than the rbFGF treated group 2.07 $P<0.001$.

CONCLUSIONS: At four weeks, healing tissue of acutely injured rotator cuff exposed to rbFGF has an increase in ultimate load to failure (41% compared to control), stiffness, and area of callus size when exposed to rbFGF. However, stress is markedly less at this time indicating that the ultimate load to failure increase is largely a function of increased area of the healing tendon.

CLINICAL RELEVANCE: Our findings suggest a role of rbFGF or similar growth factors in accelerating the healing of injured rotator cuff tendon.

74. The Effect of Neuropeptides on Bovine Articular Cartilage Proliferation

Jeremy White, M.D. (n)
Madison, WI
Amanda Herzog, B.S. (n)
Madison, WI
Erik Bergersen (n)
Madison, WI
Jonathan Snitzer (n)
Madison, WI
Josiah Decker, B.S. (n)
Madison, WI
Ray Vanderby, Ph.D. (n)
Madison, WI
Herman F. Stampfli, M.S. (n)
Madison, WI
*Matthew C. Niesen, B.S. (n)
Madison, WI
Lee D. Kaplan, M.D. (n)
Madison, WI

Damage to articular cartilage leads to an incomplete healing response. This has elicited interest in improving the understanding of chondrocyte biology and finding ways to stimulate a more effective repair response. Neuropeptides play a role in the proliferative and reparative processes of many tissue types, but little is known about their effects on articular cartilage. This study aims to investigate the effect of four neuropeptides on articular chondrocytes.

Bovine chondrocytes were cultivated in monolayer culture in media alone or media containing one of four neuropeptides: NPY, CGRP, SP, and VIP. Enzymatically digested chondrocytes from the articular surface of the femoral trochlea, femoral condyles, and patella of freshly slaughtered veal (n=8) were plated at 1x10^5 cells/mL in DMEM complete media with 5% FCS and Pen/Strep. Media was exchanged with fresh DMEM complete media with the appropriate treatment: control (media only), positive control (media + 100 ng/mL IGF-1), and media with neuropeptide. Proliferation assays were conducted at days 2, 4, 6, and 8.

Substance P showed a statistically significant stimulatory effect on chondrocyte proliferation that was greatest at a concentration of 5 μg/ml. NPY and VIP showed a dose dependent suppressive effect on chondrocyte proliferation that was greatest at their highest concentrations and was significant at all time points, with the exception of VIP at day 2. CGRP showed no significant effect on proliferation. Overall, SP showed a reliable stimulation of chondrocyte proliferation while NPY and VIP showed dose-dependent depressive effects.

These findings support the idea that the peripheral nervous system, through neuropeptides, exerts direct influence on articular chondrocytes. This may provide some insight into the pathophysiology of inflammatory and degenerative arthritis and provide targets for modifying the repair response of articular cartilage.

75. Evaluation of Connective Tissue Growth Factor Expression in Aggressive Fibromatosis

*Thomas J. Scharschmidt, M.D. (n)
Akron, OH
Scott D. Weiner, M.D. (n)
Akron, OH
Walter Horton, Jr., Ph.D. (n)
Rootstown, OH

Aggressive fibromatosis (also known as extra-abdominal desmoid tumor), as its name implies, is a benign, locally aggressive neoplasm of fibrous origin. Although somewhat controversial and not clearly proven, the tumor is thought to arise from the connective tissue surrounding the musculature or fascia. The process has been shown to be clonal, confirming that it is neoplastic and not reactive in nature.

When diagnosed, the recommended treatment of the lesion is wide surgical resection if possible. Although benign, after surgical resection, the lesion has a tendency to recur locally with a reported recurrence rate of approximately 40%. This makes the diagnosis relatively simple but the treatment complex.

Connective tissue growth factor (CTGF) is a downstream mediator of fibroblasts that is induced by transforming growth factor beta (TGF-beta). CTGF stimulates both fibroblast proliferation and matrix production. TGF-beta and CTGF are both integral to normal wound healing and have been found to be over expressed in pathologic fibrotic conditions such as scleroderma and pulmonary fibrosis. In addition, one report in the literature has reported that TGF-beta is expressed in 65% of aggressive fibromatosis lesions. The expression of CTGF in aggressive fibromatosis has not been evaluated.

Our methodology utilizes archival human tissue obtained intraoperatively during normal surgical excision of aggressive fibromatosis. The tissue undergoes immunohistochemical analysis of CTGF expression using a prior validated methodology.

The purpose of this study is to evaluate the expression of CTGF in human aggressive fibromatosis utilizing immunohistochemistry techniques. Identifying potential adjuvant therapy targets in this difficult to treat condition would be extremely valuable in reducing the unacceptably high recurrence rates, which would in turn reduce the morbidity associated with radiation therapy and more extensive surgical interventions.

76. Experimental Evaluation of the Pullout Strength of Self-Tapping Cortical Bone Screws in Cadaveric Osteoporotic Bone

*Vivek Sahai, M.D. (n)
Akron, OH
Andrew J. Schoenfeld, M.D. (n)
Akron, OH
Gregory A. Vrabec, M.D. (n)
Akron, OH

INTRODUCTION: Pathophysiologic alterations in osteoporosis increase susceptibility to fracture and lead to complications in osteofixation. Prior research, conducted in synthetic models, indicated that adequate fixation strength could be attained by penetration of self-tapping screw (STS) tips beyond the trans cortex in osteoporotic bone, thus maximizing the bone-screw interface. This study sought to evaluate performance of STS inserted to different depths in cadaveric osteoporotic bone.

METHODS: Twenty-four 3.5 mm Synthes STS were inserted into 12 metaphyseal regions of cadaveric, osteoporotic bone (BMD=0.630 g/cm^2). Screws were divided into four groups based on depth of insertion relative to the trans cortex: I, -1 mm; II, 0 mm; III, +1 mm; and IV, +2 mm. Uniaxial load to failure was performed at a rate of 0.1 mm/s using an Instron 8511 testing system. All results were normalized relative to screw performance at 0 mm. Pullout strength, loading energies, and stiffness were determined from load displacement curves and one-tailed t-tests were performed to determine the effect of depth of insertion on these variables.

RESULTS: Pullout strength, loading energy, and stiffness were significantly reduced ($p<0.05$) in all screws inserted short of the trans cortex. Pullout strength was also significantly diminished ($p<0.05$) in screws inserted flush with the trans cortex. No significant differences could be identified between screws inserted 1 and 2 mm beyond the trans cortex. There were no significant differences identified in displacement characteristics.

DISCUSSION: Results presented here demonstrate that penetration of the trans cortex by at least 1 mm significantly increases the pullout strength of STS in osteoporotic bone. These results reinforce findings previously reported in synthetic models, but this remains the first study of its kind to be performed in cadaveric osteoporotic bone. Due to large variations in bone mineral density within each cadaveric specimen, no statistical difference could be determined for screws inserted 1 and 2 mm beyond the trans cortex. Though the cadaveric specimens were demonstrably osteoporotic, certain regions of the bone have higher bone mineral density, and screw position may have influenced the ultimate results.

MAOA BREAK-OUT SESSION #7
SHOULDER
April 18, 2008

77. Articular Cartilage Lesions of the Glenohumeral Joint in Patients with Instability

*Meredith L. Anderson, M.D. (n)
Rochester, MN
Jan P. Szatkowski, M.D. (n)
Rochester, MN
Mark S. Collins, M.D. (n)
Rochester, MN
Diane L. Dahm, M.D. (n)
Rochester, MN
Doris E. Wenger, M.D. (n)
Rochester, MN

INTRODUCTION**:** The purpose of the study was to assess the incidence and diagnostic performance of magnetic resonance (MR) imaging in detecting articular cartilage injuries in patients with instability of the glenohumeral (GH) joint.

METHODS: Cohort study of 100 consecutive patients with diagnostic MR imaging and shoulder arthroscopy for instability from 1997-2006. Thirteen MR exams were excluded due to metal hardware or significant motion artifact. MR images were reviewed by consensus for the presence and grade of articular cartilage lesions by two musculoskeletal radiologists blinded to the arthroscopic findings. MR findings were correlated with arthroscopic findings. Sensitivity, specificity, and accuracy of MR (with and without IV contrast) for prediction of cartilage lesions in the GH joint were determined.

RESULTS: Mean patient age was 27.0 ± 10.2, with 79% males and 68.9% with previous shoulder dislocation. By clinical exam, anterior instability was present in 82.1% and, posterior instability was present in 17.9% of patients. Cartilage injuries were found in 63.2% of patients. From the 87 shoulder MR exams, 55 were performed with and 32 without intra-articular gadolinium. Overall sensitivity, specificity, and accuracy for detection of articular cartilage lesions were 87.2% (95% CI 75.9, 93.7), 80.6% (63.7, 90.8), and 84.9% (75.8, 90.9) respectively. No statistically significant difference was found between MR exams with and without intra-articular gadolinium (p=0.89).

DISCUSSION/CONCLUSION: Cartilage lesions are found in over half of patients with GH instability. MR can be used as a non-invasive method for assessment of articular cartilage damage of the GH joint prior to diagnostic arthroscopy.

78. The Superior Labrum Dilemma: Does It Need Repair? Interobserver Agreement in Classification and Treatment Decisions

*Brian R. Wolf, M.D. (n)
Iowa City, IA
Warren R. Dunn, M.D. (n)
Nashville, TN

BACKGROUND: The decision on how to treat superior labrum pathology can be complex. The distinction between Type I and Type II Superior Labrum Anterior Posterior (SLAP) lesions is often blurry. The purpose of this study was twofold: to identify which historical and intra-operative factors fellowship trained shoulder surgeons use to make decisions on treatment for SLAP pathology, and to assess interobserver variation in classifying SLAP lesions.

METHODS: Sixteen shoulder surgeons were asked to rank the following historical and intraoperative factors for relative importance when deciding treatment for SLAP pathology: age, gender, sport/job activity of patient, physical examination findings, history of injury, hand dominance, MRI findings, workman's compensation status, and other additional shoulder pathology found at the time of surgery. The surgeons were then asked to watch arthroscopy videos of varying degrees of superior labrum pathologies and subsequently classify the injury and propose a treatment. The videos were analyzed without a clinical vignette, and then subsequently with a clinical vignette providing the factors identified as important in the ranking survey. Classification and treatment agreement was then analyzed.

RESULTS: A patient's job or sports activity was ranked as the most important factor in determining treatment for superior labrum pathology, followed closely by age, physical examination findings, and other shoulder pathology found at surgery. There was moderate agreement on classification and treatment decisions amongst surgeons. Historical factors do seem to alter treatment decisions.

CONCLUSIONS: SLAP lesions remain difficult to classify. Classification often dictates treatment. Combining intraoperative findings and historical factors is important in treatment decisions.

79. Anterior and Posterior Capsulolabral Advance for Shoulder Instability

Kyle Anderson, M.D.
Southfield, MI
(e-Arthrex)
Ross Cooper (n)
Royal Oak, MI
*Matthew M. Ragsdell, D.O. (n)
Royal Oak, MI
Steve Scher, P.T. (n)
Royal Oak, MI

OBJECTIVE: Although the role of arthroscopy in management of shoulder instability is continually increasing, there are several relative contraindications in which many would prefer open stabilization. In cases of significant bone loss (Hill-Sachs lesions and large bony Bankart lesions), patients with prior stabilization treatment, those individuals involved in collision sports, patients with true multidirectional instability, and those that have experienced multiple pre-treatment dislocations are often treated with open procedures. We have begun treating this patient group with an arthroscopic technique that advances the entire glenohumeral ligament, to include both the anterior and posterior bands. The objective of this study is to assess the outcome of high-risk instability patients using this technique.

METHODS: Beginning in 2004, 43 patients (31 males, 12 females) were treated with a surgical technique that involves the use of suture anchors anteriorly and posteriorly, along with advancement of the entire glenohumeral ligament-labral complex. Minimum follow-up for these patients was one year postoperatively, and each had one of the aforementioned risk factors. Patient outcome was assessed using the American Shoulder and Elbow Surgeons self-evaluation to assess pain and shoulder function, and range of motion was monitored in postoperative visits.

RESULTS: Statistical computations were made based on distribution of scores using non-parametric statistical testing. Average American Shoulder and Elbow Score was 87.28 (47-100). Two shoulders (ASES Scores of 47 and 58) had recurrence of a dislocation postoperatively; however, neither of them had undergone revision stabilization following this. Of the 43 patients, 27 of them returned to competitive sports activities in an average of 5.94 months (1.25–12 months). Of these 43 athletes, 20 would be classified as contact/collision athletes and/or repetitive overhead athletes, and they showed an average of 6.1 months (1.25–12 months) return to full activity. Average age of these patients was 26.05 (13–64 years).

CONCLUSIONS: In this group of patients that have high relative risk of recurrence, this procedure appears to be a reasonable alternative to open procedures. Further follow-up within the group is needed to evaluate long-term stability, and the patient's ability to return to overhead and collision sport activity.

80. Early Results for Rotator Cuff Repair with Mason-Allen Configuration versus Double Row Suture Bridge Techniques

Joshua M. Neubauer, M.D. (n)
Milwaukee, WI
*David J. Gibbons, M.D. (n)
Milwaukee, WI
William T. Pennington, M.D. (n)
Milwaukee, WI
Brian Bartz, P.A. (n)
Milwaukee, WI

INTRODUCTION: Several techniques for rotator cuff repair have been described. More recently, a trend has been to re-establish the footprint of the cuff with extension of the repair laterally such as with double row fixation. While this offers theoretical advantage over previous techniques such as single row fixation, the current study aimed to compare results of the two methods of fixation.

METHODS: Non-randomized assessment of 66 patients who had undergone arthroscopic rotator cuff repair with a Mason-Allen configuration (MAC) were compared to 26 patients who had the suture bridge configuration which effectively provided double row fixation and re-creation of the rotator cuff footprint. VAS, UCLA, and ASES scores were collected for both groups preoperatively; then again at 3, 6, and 12 month intervals. In addition, strength assessment for subscapularis, supraspinatus, and infraspinatus was compared.

RESULTS: No significant difference was shown between the two fixation methods preoperatively or at the three-month follow-up visit. At the six-month follow-up visit, the suture bridge configuration group showed poorer results for each of the VAS, UCLA, and ASES scores. At 12 months, the UCLA and ASES scores were no different, and the VAS score was slightly better for the MAC group. Strength in the MAC repair group at 12 months exceeded that for the suture bridge group for subscapularis, supraspinatus, and infraspinatus.

DISCUSSION: Suture bridge configuration for rotator cuff repair is thought to provide a better repair by bringing more of the torn cuff back in contact with the insertion site on the humerus. The current study suggests that a single row fixation method with a Mason-Allen configuration provides better outcomes as per strength assessment as well as VAS scores.

81. The Significance of Calcar Restoration in Preventing Varus Collapse of Proximal Humerus Fractures with Medial Comminution: A Biomechanical and Clinical Evaluation

*Kevin J. Thompson, M.D.
Birmingham, AL
(a-Synthes)
Brent A. Ponce, M.D.
Birmingham, AL
(a-Synthes)
David A. Volgas, M.D.
Birmingham, AL
(a-Synthes)
James P. Stannard, M.D.
Birmingham, AL
(a-Synthes)
Jorge E. Alonso, M.D.
Birmingham, AL
(a-Synthes)
Alan Eberhardt, Ph.D.
Birmingham, AL
(a-Synthes)
Chad Corrigan, B.S.
Birmingham, AL
(a-Synthes)

INTRODUCTION: Locked plating has gained popularity in the treatment of proximal humerus fractures. However, failure with varus collapse has been reported in up to 10-30% of cases. Our hypothesis is: varus collapse is a result of (1) calcar (medial) comminution, and (2) lack of fixation across the calcar. The purpose of this study was to: (1) evaluate our experience and, (2) biomechanically test the role of calcar stability in varus collapse.

METHODS: Clinically, 36 consecutive patients with 37 fractures over a 5-year period were identified. The humeral head shaft angles (HHSA) and the humeral head to greater tuberosity height (HHGTH) were measured, with changes greater than 8° or 4 mm constituting a failure. Biomechanically, three-part fractures were uniformly created and reduced with a proximal humeral locking plate in 12 matched pairs of cadaveric humeri. To simulate calcar comminution, 6 of the 12 pairs had a 1 cm wedge removed from the medial cortex. In each matched pair, one shoulder had calcar fixation with screws placed across the fracture site along the inferior aspect of the surgical neck, while the other did not. The shoulders were then loaded to failure.

RESULTS: Clinically, there were 15 patients with varus collapse (40.5%). Five fractures (13.5%) had loss of fixation necessitating revision surgery, while ten patients (27%) had varus collapse with changes in the average HHSA and HHGTH of 13° and 4.4 mm respectively. Of the 15 fractures which failed, only one had calcar restoration ($p<0.001$). Biomechanically, the comminuted fracture specimens failed at significantly lower loads and energy levels ($p<0.02$, $p<0.03$ respectively) than the non-comminuted models. Significance was also noted in the fractures with calcar fixation.

CONCLUSIONS/SIGNIFICANCE: Calcar comminution critically destabilizes proximal humerus fractures and can lead to varus collapse, even with locked plating, and needs to be recognized clinically as a predictor of loss of fixation and poor outcome. Appropriate calcar fixation can provide additional stability and resist the tendency for varus collapse.

82. Locked Plating of Proximal Humeral Fractures: Complications and Functional Outcomes

*Daniel K. Williams, M.D. (n)
Grand Rapids, MI
Clifford B. Jones, M.D.
Grand Rapids, MI
(a-Medtronic; a,e-Zimmer)
Debra L. Sietsema, Ph.D., R.N. (n)
Grand Rapids, MI
James R. Ringler, M.D. (n)
Grand Rapids, MI
Terrence J. Endres, M.D. (n)
Grand Rapids, MI

PURPOSE: To evaluate the complications and functional outcomes of locked plating technique in the treatment of proximal humeral fractures.

MATERIAL AND METHODS: Over a five-year period of time, 2001-2006, 76 fractures in 76 patients were treated with locked proximal humeral plating techniques. Average and median age was 61 years old and 60 years old, respectively (range 23-90). Gender was predominately female (47 females, 29 males). All patients had prospectively gathered outcome data using DASH, SF36, and SMFA measurements at 6, 12, and 24 months.

RESULTS: The mechanism was varied: low energy fall (41, 53%), MVA (18, 23%), high-energy fall (12, 16%), and other (5, 8%). Technical related complications were noted: intra-articular screw placement (7) with operative removal (6) and proximal plate placement resulting in impingement and hardware removal (7). Overall complications were screw loosening (4), AVN with collapse (8), axillary neuropraxia (1), infection (2), and fracture below plate (2). SMFA and SF36 are strongly reliable in the patient sample (r=.89). At two years, DASH scores were 24.6 and 41.0 for isolated and polytrauma patients, respectively. For age differences, DASH scores were 22.5 and 33.6 for ages < 65 and >/= 65 years old, respectively. SF36 consistently correlated to SMFA scores. When evaluating SMFA scores, younger, compared to older, patients continue to improve until the two-year mark for function and arm/hand ($p<0.05$), but not for bother ($p=.18$). Polytrauma patients consistently perform worse than isolated injury patients at each time interval.

CONCLUSION: Locked plating of proximal humeral fractures is a technically demanding procedure with high surgical and injury complications. Younger patients' outcomes consistently improve up to two years. Since older patients plateau at one year, then decline in function, a maintenance program should continue past one year.

83. Complications and Results of a Consecutive Series of 215 Shoulders with a Second Generation Shoulder Arthroplasty Design

*Robert S. Rice, M.D. (n)
Rochester, MN
John W. Sperling, M.D.
Rochester, MN
(e-Biomet)
Robert H. Cofield, M.D.
Rochester, MN
(c-Smith & Nephew)
Cathy Schleck, B.S. (n)
Rochester, MN
Joseph Mileti, M.D. (n)
Rochester, MN

INTRODUCTION: The purpose of this study was to evaluate the outcome of the first 215 consecutive shoulders that underwent total shoulder arthroplasty with a modular design by one surgeon to determine the results, complications, risk factors for an unsatisfactory result, and rates of revision surgery.

MATERIALS AND METHODS: Between 1995 and 1999, 215 consecutive total shoulder arthroplasties with a modular prosthesis were performed by one surgeon. Minimum two-year follow-up was available for 210 shoulders (mean, 5.2 years). The mean age of the 86 female and 108 male patients was 66 years at the time of surgery (range, 30-87 years).

RESULTS: Mean active abduction increased from 95° preoperatively to 145° postoperatively and external rotation improved from 29° preoperatively to 61° postoperatively. At the most recent follow-up, there were 17 patients (9%) who had moderate or severe pain. According to a modified Neer result rating system, 51% had an excellent result, 35% a satisfactory result, and 14% had an unsatisfactory result. There were five shoulders that underwent revision surgery.

DISCUSSION: The data from this study suggests that patients undergoing total shoulder arthroplasty with a modular prosthesis may achieve satisfactory long-term pain relief. However, in comparison to prior studies of first generation designs, the complication rate as well as the specific types of complications have changed significantly with a second generation design.

84. Functional Assessment of Reverse Total Shoulder Arthroplasty with 12 Months Follow-Up

William T. Pennington, M.D. (n)
Milwaukee, WI
Joshua M. Neubauer, M.D. (n)
Milwaukee, WI
*Brian Bartz, P.A. (n)
Milwaukee, WI

INTRODUCTION: One primary function of the rotator cuff is to maintain an appropriate relationship between humeral and glenoid articulation, which is lost in massive tears. This superior migration of the humeral head is addressed with the reversed technique when measures short of arthroplasty will not address the pathology and patient's needs.
The reverse shoulder prosthesis is a prosthesis that has been in clinical use in Europe since 1985 and was approved for use in the United States in 2004. Indications for the reverse total shoulder arthroplasty include: painful arthritis associated with irreparable rotator cuff tears (cuff tear arthropathy); failed hemiarthroplasty with irreparable rotator cuff tears; pseudoparalysis due to massive, irreparable rotator cuff tears; and some fractures of the shoulder not repairable or reconstructable with other techniques.

METHODS: Reverse total shoulder arthroplasty was performed with the Delta III prosthesis on 24 patients with 12 months follow-up. They were followed at intervals of 3, 6, and 12 months. Preoperatively and at each postoperative visit, ROM and dynamometric evaluation was performed. In addition, ASES, UCLA, and VAS scores were obtained.

RESULTS: Preoperative ASES score improved from 17 preoperative to 69 at 3 months and 76 at 6 months postoperative. Visual Analog Score (VAS) improved from 7.9 to 1.4 and 0.9 at 3 and 6 months postoperative, respectively. UCLA scores improved from 7.8 to 21 and 26 at 3 and 6 months postoperative. Active ROM at this time is reported at six months relative to preoperative values, with improvement from 68° to 118° in abduction, 68° to 125° in forward flexion, 40° to 55° in external rotation, and 32° to 62° in internal rotation.

DISCUSSION: Results of reverse total shoulder arthroplasty in the U.S. are still in the rather early stages. The current study reported objective measures at 3, 6, and 12 month intervals including ASES, VAS, and UCLA scores and active ROM—all of which showed favorable results supporting the use of total shoulder arthroplasty.

85. Results of Total Shoulder Arthroplasty with an Uncemented Monoblock Bone In-Growth Porous Tantalum Glenoid Component

*Meredith H. Fabing, D.O. (n)
East Lansing, MI
J. Michael Wiater, M.D.
Beverly Hills, MI
(e-Zimmer)

OBJECTIVE: To evaluate the functional and radiographic outcome of total shoulder arthroplasty with a bone in-growth porous tantalum glenoid component.

METHODOLOGY: Twenty-five total shoulder arthroplasties were performed with porous tantalum glenoid components. All patients were available for follow-up at an average of 22 months (range, 14-33 months). The mean age was 62 years (range, 29-84) and the preoperative diagnoses were osteoarthritis (19), juvenile rheumatoid arthritis (2), rheumatoid arthritis (2), avascular necrosis (1), and post-traumatic arthritis (1). Patients were evaluated with a visual analog pain scale, ASES score, Constant score, and radiographic analysis.

RESULTS: Pain decreased in all patients from a mean of 8 to 1 on the VAS ($p<0.005$). The mean ASES score improved 61 points ($p<0.005$). The mean relative Constant score improved 44 points ($p<0.005$). Active forward elevation improved from 75° to 132° ($p<0.005$). At latest follow-up, all glenoid components had complete in-growth of the keel portion. Four shoulders had incomplete lucencies. Most lucencies were in zones 1 and 5 and were likely due to improper seating of the component rather than polyethylene wear induced osteolysis or mechanical loosening secondary to poor in-growth. Four components (16%) in three patients had evidence of tantalum shedding and could be at risk for fracture of the porous tantalum keel.

CONCLUSION: The short-term results of porous tantalum total shoulder arthroplasty have shown significant functional improvement and pain relief in all patients. No clinical or radiological failures of humeral or glenoid components were seen. Porous tantalum prostheses show promise with excellent in-growth potential, but have an unacceptably high rate of tantalum shedding due to problems with the early design of the prosthesis and instrumentation.

86. Comparison of Reversed (Semiconstrained) and Unconstrained Total Shoulder Arthroplasty: A Preliminary Report

Gregory N. Lervick, M.D. (n)
Eden Prairie, MN
*M. Russell Giveans, Ph.D. (n)
Minneapolis, MN
Rebecca M. Stone, M.S. (n)
Eden Prairie, MN
Jason R. Ash, P.A. (n)
Eden Prairie, MN

INTRODUCTION: Reversed total shoulder arthroplasty (RTSA) has demonstrated a relatively high complication rate in most clinical series. We compared the initial series of RTSAs performed by a single surgeon to a similar group who underwent unconstrained total shoulder arthroplasty (TSA).

METHODS: Thirty-one patients underwent RTSA, and 32 underwent TSA over a two-year time period. Both cohorts were consecutive and included both revision and primary surgeries. Subjects completed both pre- and postoperative outcome measures (Short Form-12, American Shoulder and Elbow Surgeons Form, Western Ontario Rotator Cuff Index, and Western Ontario Osteoarthritis of the Shoulder Index). A complete chart review was performed at a minimum of six months post surgery, to examine readmission, reoperation, and overall complication rates. Standard radiographs were obtained at regular postoperative intervals and analyzed.

RESULTS: Mean SF-12, ASES, WORC, and WOOS scores improved significantly in both treatment groups at early (six month) follow-up ($p<0.001$). Both pre- and postoperative outcome scores were significantly higher in the TSA group than in the RTSA group. The rates of minor and major complications were similar in both groups. Two patients in each group undergoing revision procedures had positive intraoperative cultures despite negative pathologic findings at the time of surgery.

CONCLUSION: Both TSA and RTSA resulted in significant improvements in self-reported function, with a high rate of patient satisfaction. The early major and minor complication rates were similar in both groups, despite the fact that the RTSA study population represented the initial experience with this surgical technique.

MAOA BREAK-OUT SESSION #8
FOOT AND ANKLE
April 18, 2008

87. Functional Outcome of Operatively Treated Lisfranc Injuries

Clifford B. Jones, M.D.
Grand Rapids, MI
(a-Medtronic; a,e-Zimmer)
*Debra L. Sietsema, Ph.D., R.N. (n)
Grand Rapids, MI
Jeffrey A. Henning, M.D. (n)
Grand Rapids, MI
John G. Anderson, M.D.
Grand Rapids, MI
(e-Zimmer)
Donald R. Bohay, M.D.
Grand Rapids, MI
(e-Zimmer)

PURPOSE: To evaluate the functional outcome of operatively treated Lisfranc injuries.

MATERIALS AND METHODS: Over a seven-year interval from 1998 to 2005, 199 skeletally mature patients were identified retrospectively with operatively treated Lisfranc injuries. Eighty-five consecutive patients had prospectively measured SMFA functional outcomes and satisfaction surveys. The gender was 37 males and 48 females. Mean age was 39 years old (range 17-93).

RESULTS: The mechanism was fall (31), MVA (24), crush (15), equestrian (5), or twisting (10). Patients were operatively treated with open reduction internal fixation (ORIF, 53) or primary arthrodesis (PA, 32). The SMFA reliability for this patient sample was 0.892. The function and bother outcomes were 19.4 and 15.8, respectively. The function (21.5 versus 16, $p=.11$) and bother (17.5 versus 13.0, $p=.25$) outcomes were not significantly different for ORIF versus PA, respectively. In the ORIF group, HW removal (40 of 53) performed better than HW retention (13 of 53) with outcome bother, but not function measures of (14.7 versus 26.1, $p<0.05$) and (20.0 versus 26.2, $p=0.20$), respectively. Patients without secondary surgery performed better than patients with secondary surgery with outcome function and bother measurements of 18.5 versus 41.0 ($p<0.00$) and 13.7 versus 42.3 ($p<0.00$), respectively. The phone survey (ranked 1-5) measured improved satisfaction of PA results of 1.47 and appearance of 1.71 compared to ORIF at 1.95 and 2.27, respectively ($p<0.05$). Pain, unemployed, cuboid injury, screw breakage, polytrauma, and initial external fixation were correlated with poor functional outcomes ($p<0.05$).

CONCLUSION: If performed well, either ORIF or PA technique function well. Patients are more satisfied with the results and appearance of PA over ORIF. HW removal compared to HW retention positively affect bother not function measures. Secondary surgeries negatively affect both bother and function measures. Patients with pain, associated foot or polytrauma injuries function worse.

88. Perioperative Costs Associated with Ankle Fractures in Obese Patients

*Bryan J. Pack, M.D. (n)
Grand Rapids, MI
Clifford B. Jones, M.D.
Grand Rapids, MI
(a-Medtronic; a,e-Zimmer)
Debra L. Sietsema, Ph.D., R.N. (n)
Grand Rapids, MI
James R. Ringler, M.D. (n)
Grand Rapids, MI
Terrence J. Endres, M.D. (n)
Grand Rapids, MI
David J. Bielema, M.D. (n)
Grand Rapids, MI
Gregory J. Golladay, M.D.
Grand Rapids, MI
(e-Zimmer)

INTRODUCTION: To evaluate the results of operative ankle fracture treatment in obese patients. Most ankle fractures can be operatively treated as an outpatient. Obesity is worsening and becoming more frequent. If not performed efficiently, isolated ankle fractures in obese patients can be costly and time consuming.

MATERIALS AND METHODS: Over an 18-month period, 183 total unstable displaced, consecutive isolated, operative ankle fractures were evaluated. Average age was 45 (range 16-95). The gender was 106 females and 77 males. The majority of injuries were low energy (121, 66%). Standard AO principles were used for operative stabilization. All patients were discharged when able to independently ambulate.

RESULTS: The body mass index (BMI) was calculated: underweight (1, 0.5%), normal (36, 19%), overweight (61, 33%), obese I (52, 28%), obese II (24, 13%), morbidly obese (9, 5%). The average length of stay (LOS) was 1.7 days (range 0-21). LOS was outpatient (n=47, 26%), 1 day (n=62, 34%), 2 days (n=31, 17%), 3 days (n=18, 10%), or > 4 days (n=21, 12%). Obesity lead to a longer LOS ($p<0.005$, $r=0.25$): class 1 & 2 (average 1.1 day), class 3 (average 1.4 day), class 4 (average 2.2 day), class 5 (average 1.9 day), and class 6 (average 3.9 days). Average in patient PT visits was 1.4 (range 0-6). Obese patients had more PT visits ($p<0.05$): class 1 & 2 (average 1, range 0-4), class 3 (average 1.2, range 0-6), class 4 (average 1.5, range 0-6), class 5 (average 1.6, range 0-6), and class 6 (average 3, range 2-6). Obesity correlated with pre injury ambulation ($p<0.05$), but not complications or discharge status. Pre injury disposition was correlated with discharge location (<0.05). Discharge status was home (157, 84%), assisted living (3 obese, 2%), nursing home (2 obese, 1%), acute rehab (2 obese, 1%), sub acute rehab (3 obese, 5 overweight, 2 normal, 5%), and home with PT (3 morbid obesity, 1.5%).

CONCLUSIONS: Overweight or obese patients are common (80%). Ankle fracture treatment in obese patients do not have increased complications, but are more costly requiring extended hospital stays, extended care facilities, and physical therapy encounters before discharge.

89. Segmental Injuries of the Foot and Ankle Predict Amputation and Disability

Jacob M. Lantry, M.D. (n)
St. James, NY
Venkatachalapathy Perumal, M.D. (n)
Louisville, KY
*Craig S. Roberts, M.D. (n)
Louisville, KY

INTRODUCTION: Segmental foot and ankle injuries are less common than isolated foot and ankle injuries. The purpose of our study was to determine the risk of distal segmental amputation and unemployment in patients with these injury patterns.

METHODS: We performed a retrospective chart review of 23 patients with multiple, ipsilateral injuries of the foot and ankle. Injuries were defined anatomically as forefoot, midfoot, hindfoot, or ankle, and patients were divided based on the number of levels injured.

RESULTS: At a mean follow-up of 12.9 months, patients were assessed for amputation and ability to return to work. Amputations occurred in five patients (21.7%) and were most common in those with three-level injuries. Odds ratios showed that patients with an amputation were 9.75 times as likely to have a three-level injury than a two-level. They were 6.5 times as likely to have a four-level injury than a two-level, and 1.5 times more likely to have a three- than a four-level injury. Four of the five patients with an amputation were injured in a motorcycle accident. Twenty patients were employed prior to injury. Twelve had not returned to work (60%), seven returned with restrictions, and only one patient returned to pre-injury activities. The number of levels injured did not influence ability to return to work.

CONCLUSIONS: Patients with segmental foot and ankle injuries are at risk for amputation of the distal portion of the involved extremity and inability to return to their pre-injury employment level (disability).

Twenty-three patients with injuries to multiple ipsilateral anatomic segments of the foot and ankle were reviewed at a mean of 12.9 months. Five had amputations and 12 had not returned to work.

90. Long-Term Evaluation of Interdigital Neuroma Treated by Surgical Excision

*John W. Womack, M.D. (n)
Memphis, TN
David R. Richardson, M.D. (n)
Memphis, TN
G. Andrew Murphy, M.D. (n)
Memphis, TN
E. Greer Richardson, M.D. (n)
Memphis, TN

One of the challenges of evaluating the clinical outcomes of this procedure is the lack of standardized and validated scoring systems that evaluate outcomes of neuroma excision. The purpose of this study was to examine a large cohort of patients who had previously undergone interdigital neurectomy and evaluate their clinical outcomes by using a previously developed scoring system as well as a visual analog scale. In addition we wanted to identify risk factors that may lead to poorer outcomes in some patient populations.

Retrospective review identified 232 consecutive patients who had neuroma excision between 1994 and 2004, after failure of conservative treatment. All procedures were done by two orthopedic foot and ankle specialists through a dorsal approach with release of the transverse metatarsal ligament. Each patient was contacted via mail and given a Neuroma Clinical Evaluation Score survey as well as a visual analog score. Each patient received a unique identification number, allowing the evaluation process to be single blinded.

Of the 232 patients contacted, 120 (52%) returned their completed surveys. The average Giannini neuroma score was 53. Based on this scoring system, 61 feet (51%) had good or excellent results, 12 (10%) had fair results, and 48 (40%) had poor results. The average VAS score was 2.54 (range 0 to 10). Outcomes were not significantly affected by ages, gender, concomitant procedures, or diabetes. The only variable that produced a significant ($p=0.027$) difference in outcome was the location of the neuroma: patients with neuromas in the second webspace had worse outcomes than those with third webspace neuromas on both the VAS and neuroma score.

Although this retrospective review identified location in the second webspace as a possible prognostic indicator of poor outcome, the more important finding may be that outcomes of neuroma excision do not appear to be affected by the gender or age of the patient or by concomitant forefoot procedures and that outcomes in patients with diabetes mellitus are equivalent to those in nondiabetic patients.

91. Comparison of the Single versus Double Incision Technique for Achilles Tendon Reconstruction with Flexor Hallucis Tendon Transfer – Is the Second Incision Really Necessary?

*Leonard K. Kibuule, M.D. (n)
Omaha, NE
Richard Hughes, M.D. (n)
Omaha, NE
Timothy C. Fitzgibbons, M.D. (n)
Omaha, NE
David J. Inda, M.D. (n)
Omaha, NE
Scott T. McMullen, M.D. (n)
Omaha, NE

BACKGROUND: Flexor hallucis longus (FHL) tendon transfer as a technique for Achilles tendon reconstruction for tendinopathy has been well described in the literature. Traditional techniques involve use of a two-incision procedure, with an incision into the posterior hindfoot and another into the medial plantar foot. Harvesting the FHL through the plantar incision with the foot in a prone position can be difficult and does increase the risk of neural vascular injury in the plantar aspect of the foot. Den Hartog and others have described harvesting the tendon through a single posterior incision with good results. The purpose of this study was to review our experience comparing the single- and double-incision technique of Achilles tendon reconstruction.

MATERIALS AND METHODS: Between 1999 and 2006, 45 patients diagnosed with insertional Achilles tendinopathy underwent treatment by the senior authors (TCF, SM, DI) with reconstruction of their Achilles with the transfer of their FHL tendon. This was performed using a traditional two-incision technique as described by Wapner. Recently, one of the senior authors (TCF) began to utilize primarily a single-incision for Achilles reconstruction. A retrospective review of patients was performed to compare the surgical morbidity and clinical results of those who had a single-incision versus a double-incision surgical approach. The average age of patients was 51-years-old (with 14 male and 31 female individuals) who underwent reconstruction. The average follow-up period was 17 months. Of the 45 patients treated, 9 underwent a single-incision technique and 36 a two-incision technique.

RESULTS: Seven of nine patients treated with a single-incision had good clinical results without complication at final follow-up. Twenty-seven of the two-incision group also had an uncomplicated course. Complications included wound healing issues, residual tendon discomfort, and peri-incisional numbness. At final follow-up, the overall complication rate was about the same.

CONCLUSION: Achilles tendon reconstruction using a single-incision technique continues to reproduce similar clinical results with equivocal complications and is likely a viable option for often difficult cases.

92. Radiographic Analysis of the Adult Flatfoot Deformity

*Paul R. Sensiba, M.D. (n)
Dayton, OH
Michael Mariscalco, M.D. (n)
Dayton, OH
Nathan Williams, M.D. (n)
Dayton, OH
Richard T. Laughlin, M.D.
Dayton, OH
(a-Smith & Nephew, Synthes)

INTRODUCTION: Adult acquired flatfoot is a complex deformity with numerous radiographic measurements described to define the deformity. The purpose of this study was to evaluate the inter- and intraobserver reliability of radiographic measurements of adult acquired flatfoot deformity on both digital and conventional x-rays, compare the results of digital versus conventional x-rays, compare the observes based on experience, and describe the correlations between measurements.

METHODS: Digital weight-bearing x-rays of 20 patients who presented with complaints of ankle or arch pain were examined. Three digital x-rays consisting of AP, lateral, and hindfoot alignment views were obtained at the time of presentation as part of the routine office visit. Six measurements were made on the x-rays by one senior orthopedic resident just off his foot and ankle rotation, a junior orthopedic resident, and a third-year medical student. Each observer took measurements independently and was blinded to patient identification and was blinded to the others' measurements. Measurements of all patients were taken three times on separate occasions with the order of films randomized.

RESULTS: Interobserver reliability of the Talus/Second Metatarsal angle was 0.830, of the Calcaneal Pitch angle was 0.948, of the Talus/First Metatarsal angle was 0.781, the Medial Cuneiform/Fifth Metatarsal Distance was 0.991, the Tibial/Calcaneal displacement was 0.870, and the Calcaneal Angulation was 0.834. Interobserver reliability with digital x-rays was similar to that of conventional radiographs. Intraobserver reliability increased with observer experience, but was still very good even for the novice observer.

DISCUSSION: Adult acquired flatfoot deformity is a complex condition that is difficult to quantify radiographically. Of the six measurements taken, the Medial Cuneiform/Fifth Metatarsal Distance and the Calcaneal Pitch Angle were found to have the highest interobserver reliability. As the experience of the observer increased, the intraobserver reliability increased. However, we found that even a novice observer was able to produce a high intraobserver reliability for these measurements.

93. Experience of an Orthopedic Foot and Ankle Center with the Use of Osteocartilaginous Transplant Both Autograft and Allograft in Patients with Osteochondral Disease of the Talus

*Randon C. Johnson, M.D. (n)
Omaha, NE
David J. Inda, M.D. (n)
Omaha, NE
Scott T. McMullen, M.D. (n)
Omaha, NE
Timothy C. Fitzgibbons, M.D. (n)
Omaha, NE

INTRODUCTION: Osteochondritis dissecans (OCD) and other osteochondral abnormalities of the talus are a frequent problem encountered by the orthopedic foot and ankle subspecialist. The initial procedure has been and still remains the arthroscopic debridement with either drilling of the base of the defect or microfracture. Failures of the initial procedure, however, may be salvaged with osteochondral transplant. The procedures described for this include the mosaicplasty or OATS procedure. The purpose of this paper is to review our experience with this difficult problem, and to identify which factors, if any, contribute to the outcomes of osteochondral transplant after failed drilling or microfracture of talus OCD lesions.

MATERIALS AND METHODS: Between 1999 and 2007, 97 patients were treated surgically for osteochondral lesions of the talus. Ninety-six of the 97 patients underwent an index procedure of ankle arthroscopy with debridement and drilling or microfracture of the talus lesion. Of the 97 patients seen in this time period, 8 failed after the initial procedure and required osteochondral transplant. One additional patient underwent osteochondral transplant as the index procedure. The average age of the patient at the time of osteochondral transplant was 32-years-old. Of the nine patients, five cases were associated with workmen's compensation claims.

RESULTS: The average AOFAS score at the time of last follow-up was 91 (range 87-100).

CONCLUSION: Arthroscopic debridement and drilling or microfracture still remains the gold standard for OCD lesions of the talus. However, in the subset of patients who fail the index procedure, osteocartilaginous transplant remains a viable salvage procedure with good results.

94. The Safety of Forefoot Metatarsal Pins in Lower Extremity Fixation: A Cadaveric Study

Matthew O. Barrett, M.D. (n)
Alexandria, VA
*Allison M. Wade, M.D. (n)
Columbia, MO
Gregory J. Della Rocca, M.D.
Columbia, MO
(a-Synthes)
Brett D. Crist, M.D. (n)
Columbia, MO
Jason H. Calhoun, M.D.
Columbia, MO
(a-Cambre, Pfizer; b-eMedicine, Update)
Jeffrey O. Anglen, M.D. (n)
Indianapolis, IN

INTRODUCTION: External fixation is widely used for trauma and reconstruction of the extremities. External fixator devices spanning the ankle or portions of the foot may utilize pins placed across metatarsal bases. We have undertaken an anatomical study to evaluate the safety of pins placed across the bases of metatarsals one and two and spanning the first interspace.

METHODS: Ten cadaveric feet were obtained for this study. Under fluoroscopy, a single 4 mm Schantz pin was advanced percutaneously from medial to lateral across the bases of metatarsals one and two. Specimens were then dissected. Injury to the deep plantar branch of the dorsalis pedis artery, when present, was recorded, and distance from pin to deep plantar branch was also recorded when injury was not present.

RESULTS: In 5 of 10 feet, the deep plantar branch of the dorsalis pedis artery was lacerated by the transmetatarsal pin. In 4 of 10 feet, the pin contacted the artery, but did not damage it. In one foot, the pin was noted to be 4 mm from the artery. Any pin with a starting point within 18 mm of the tarsometatarsal joint placed the artery at risk.

CONCLUSIONS: Transmetatarsal pins as a component of external fixator devices place the deep plantar branch of the dorsalis pedis artery at significant risk. This risk does not diminish with further distance from the tarsometatarsal joint due to the oblique course of the deep plantar branch. Other methods of obtaining forefoot or midfoot external fixation are recommended in order to avoid vascular injury.

95. Recent Experience of an Orthopedic Foot and Ankle Subspecialty Group Treatment of Diabetic Wounds at a Formal Wound Care Center Using High Tech Dressings

*Brian D. Kleiber, M.D. (n)
Omaha, NE
Timothy C. Fitzgibbons, M.D. (n)
Omaha, NE
Scott T. McMullen, M.D. (n)
Omaha, NE
David J. Inda, M.D. (n)
Omaha, NE
Kathleen M. Grier, M.D. (n)
Omaha, NE

BACKGROUND: Treatment of diabetic ulcers in a formal multiple subspecialty wound care center has been well described. We have previously described our experience in our wound care center. The recent changes in Medicare and insurance reimbursement have now forced a change in the types of dressings that are used because of the lack of the ability to have comprehensive home care. This has forced patients who previously were treated with twice a day dressing changes and frequent debridements to be treated with high tech dressings that are allowed to stay on longer and do not need quite the acute nursing care. The purpose of our study is to review our recent experience with these high tech dressings.

METHODS: From 2005 through 2007, a total of 344 patients with diabetic wounds were treated to completion of wound healing by the authors at our Wound Care Center (WCC). We limited our data collection to plantar wounds only. We excluded patients that required the use of vacuum assisted closure devices and those requiring formal operative treatment whether by two-stage debridement or amputation. This left a total of 61 patients with 108 plantar wounds. All patients seen in the WCC have an assessment of wound size and receive limited wound debridement at follow-up visits. Many are cultured at presentation and placed on a course of oral antibiotics. Additional off-loading measures are undertaken when necessary. Patients are given instructions on dressing changes. Follow-up appointments are at 2-3 week intervals. Wounds are considered healed when there is complete dermal coverage. We recorded dressing type, initial wound size, and time to completion of healing. For this study, we considered the gold standard to be twice daily saline and triple antibiotic dressings. There were 54 wounds in this group. Average size of those wounds was 13.6 mm in length by 8.7 mm in width by 2.5 mm in depth with 1.4 mm of undermining. Antibiotic usage was seen in 91%. The gold standard dressing was compared to high tech dressings including Oasis (9 wounds; average size of 10.5 mm x 7.2 mm x 1.4 mm x 0.6 mm), Prisma (15 wounds; 10.5 mm x 9.9 mm x 2 mm x 1.5 mm), Aquacel Silver (7 wounds; 5.1 mm x 6.6 mm x 3 mm x 1.3 mm), Biafine (18 wounds; 14.3 mm x 10.4 mm x 2.7 mm), Regranex (3 wounds; 10.7 mm x 8.7 mm x 6.7 mm x 4.7 mm), and Xenaderm (2 wounds; 7.5 mm x 5 mm x 3.5 mm x 2.5 mm). Overall, 54 wounds were treated with high tech dressings with an average size of 9.8 mm x 8 mm x 3.2 mm x 1.8 mm. Antibiotics were used in 74%.

RESULTS: Fifty-four wounds were treated with saline and triple antibiotic dressings and 54 were treated with high tech dressings. Time to completion of healing was 61.7 days for the saline and triple antibiotic treated group. Mean time to healing was 69.2 days in the high tech dressing group. Oasis was used on 9 wounds with a healing time of 62.9 days. Prisma was used in 15 wounds with a healing time of 73.8 days. Aquacel Silver was used in 7 wounds and healing was in 86.9 days. Eighteen wounds were treated with Biafine and healing occurred in 45.7 days. Three wounds received Regranex and time to healing was 126.3 days. Xenaderm was used on 2 wounds and time to healing was 76.5 days.

CONCLUSIONS: In our experience, high tech dressings are a valuable tool in the treatment of plantar diabetic wounds. These dressings require less frequent changes and are easy to manage. Differences in wound healing rates are negligible when compared to our gold standard. Limitations of our study include a relatively small sample size, and we did not include the variable of relative cost when comparing our dressing types.

96. ♦Extra-Articular Distal Tibia Fractures: A Mechanical Evaluation of Four Different Treatment Methods

*Michael P. Hoenig, M.D.
Charlotte, NC
(a-Synthes)
Fan Gao, Ph.D. (n)
Chicago, IL
Jeremy Kinder, M.D. (n)
Chicago, IL
Li-Qun Zhang, Ph.D. (n)
Chicago, IL
Erich Gaucher, B.S. (n)
Chicago, IL
Cory A. Collinge, M.D.
Fort Worth, TX
(c-Biomet, e-Smith & Nephew)
Bradley R. Merk, M.D.
Chicago, IL
(a-Synthes, Stryker Orthopaedics)

There is a lack of consensus as to the most effective operative treatment for distal tibia metaphyseal fractures. The purpose of this cadaveric biomechanical study was to compare the mechanical properties of standard plating (SP), locked plating (LP), intramedullary nailing (IM), and angular stable intramedullary nailing (ASM) for the treatment of axially unstable distal tibia metaphyseal fractures (AO/ OTA type 43A3).

A distal tibia metaphyseal fracture was created in 32 fresh frozen cadaveric lower limbs by performing an osteotomy 30 mm above the plafond. Specimens were divided into four groups. Specimens underwent fracture fixation with a standard distal tibia plate (Synthes LC-DCP medial distal tibia plate; Paoli, Pennsylvania), a medial locked plate (Synthes LCP Medial Distal Tibia Plate), an intramedullary nail (Synthes titanium cannulated EX tibial nail), or an angular stable intramedullary nail (Synthes titanium cannulated EX tibial nail with Angular Stable Locking System). Specimens were loaded vertically along the tibial axis to 700 N to determine stiffness from load-displacement curves. Specimens were then cyclically loaded to 700 N for 10,000 cycles and then loaded to failure.

The IM group was significantly stiffer than the LP group ($p=0.012$) which was stiffer than the SP group ($p=0.025$). The IM group also demonstrated significantly greater failure strength than the LP group ($p=0.047$) which was significantly greater than the SP group ($p=0.01$). The ASM group was similar to the LP group for stiffness and strength ($p=0.5$ and 0.78, respectively). The IM group had the greatest failure energy and all groups were significantly greater than the SP group.

This study demonstrated that, under axial loading, both intramedullary nailing and locked plating provide stable fixation, but intramedullary nailing resulted in the highest stiffness, failure strength, and failure energy for AO/OTA type 43A3 fractures with as little as 3 cm of distal bone stock.

97. Survivorship of UKA Revisions in a Community Joint Registry

*Terence J. Gioe, M.D. (n)
Minneapolis, MN
Thomas E. Dudley, M.D. (n)
Minneapolis, MN
Penny Sinner, M.S. (n)
St. Paul, MN
Susan Mehle, B.S. (n)
St. Paul, MN
Kathleen Killeen, B.S. (n)
St. Paul, MN

INTRODUCTION: Perceptions of the difficulty and outcome of UKA revision (UKAR) vary. The purpose of this study was to analyze the survival of UKAR compared to total knee arthroplasty revision (TKAR) in a community total joint registry. We hypothesized that UKAR would have better survival, a lower infection rate, and lower costs than TKAR.

METHODS: One hundred eighty knee arthroplasty revisions (68 UKAR/112 TKAR), defined as a minimum of tibial or femoral component revision, were identified from a community joint registry population of 7,587 knee implants performed between 1991 and 2005. Variables analyzed for this population included indication for revision, components used, and implant/hospital costs. Univariate analyses were done, cumulative revision rates were calculated, and the log-rank test was used to compare different groups.

RESULTS: 5.9% (4/68) of the UKAR were revised for a second time and 6.3% (7/112) of the TKAR were re-revised. Thirty-nine percent (44/112) of TKAR surgeries required more than one femoral or tibial metal augment compared to 0% of the UKAR patients ($p<.001$). Similarly, 39% (44/112) of the TKAR surgeries had two stemmed components placed compared to 1% (1/68) of the UKAR surgeries ($p<.001$). The mean liner thickness for the tibial insert was also significantly greater for the TKAR group (15.5 mm, range 8-30 mm) than for the UKAR group (12.8 mm, range 8-25 mm) ($p<.001$). Fifty-seven percent (39/68) of UKA revisions required no form of augmentation and were revised as a “primary” TKA. UKAR did not demonstrate a lower infection rate than TKAR. There were significantly more TKAR than UKAR patients (42% versus 12%, $p<.001$) with an implant cost ≥ $5,200 and more TKAR patients (48% versus 25%, $p=.002$) with hospital costs ≥ $33,000. There was no significant difference in survival between the two groups. The UKAR group had a CRR of 9.7% (95% CI = 0.3% - 19.1%) and the TKAR group had a CRR of 26.9% (95% CI = 5.9% - 47.9%).

DISCUSSION: Although UKAR has demonstrably lower cost and less bone loss than TKAR, we were unable to demonstrate either improved survival or a lower infection rate for UKAR versus TKAR.

98. Femoroacetabular Impingement: What is the Fate of the Contralateral Hip?

John C. Clohisy, M.D.
St. Louis, MO
(a,e-Zimmer)
Michael Dobson (n)
St. Louis, MO
Lucian C. Warth, B.S. (n)
Iowa City, IA
Steve S. Liu, M.D. (n)
Iowa City, IA
Karen Steger-May (n)
St. Louis, MO
*John J. Callaghan, M.D.
Iowa City, IA
(a,c,e-DePuy)

INTRODUCTION: Femoroacetabular impingement (FAI) is a precursor to osteoarthritis (OA) of the hip. To investigate the fate of impingement abnormalities we analyzed the contralateral hip in patients undergoing THA for advanced FAI. Our purpose was to determine the bilaterality of FAI abnormalities, and to describe the prognosis of these deformities.

METHODS: We reviewed 508 patients ≤ 50 years of age treated with THA. Radiographic review identified 70 hips that had OA secondary to FAI (71% cam, 5% pincer, 24% combined). Bilaterality was determined radiographically, and the fate of the contralateral hip was analyzed by determining radiographic presence and progression of OA, and the need for subsequent THA.

RESULTS: Seventy-one percent of the patients were male, and the average age was 43.2 years. The contralateral hip was analyzed on radiographs over an average 9-year period (range, 4-30 years). One hundred percent of the contralateral hips had radiographic features of FAI. Forty-nine (70%) of the contralateral hips demonstrated degenerative disease. Fourteen had advanced OA at presentation, 41 had progressive joint space narrowing, 25 had progression of Tönnis OA grade, and 26 underwent subsequent THA. Statistical analysis showed that alpha angle, LCEA, joint space width, and head-neck ratio have strong predictive value for subsequent THA ($p<0.001$). Age had predictive value for progression in Tönnis OA grade ($p<0.05$).

DISCUSSION: This study demonstrates that FAI abnormalities are commonly bilateral and are associated with OA progression in the majority of hips. Patients diagnosed with FAI should have both hips monitored, and joint preservation surgery or THA considered when appropriate.

SUMMARY SENTENCE: This study demonstrates that FAI abnormalities are commonly bilateral, and are associated with OA progression in the majority of hips.

99. Uncemented THA for High Dislocation DDH: Results with Femoral Shortening Subtrochanteric Osteotomy

*Aaron J. Krych, M.D. (n)
Rochester, MN
James Howard, M.D. (n)
London, Ontario, Canada
Robert T. Trousdale, M.D.
Rochester, MN
(a,c,e-DePuy; e-Wright Medical Technology)
Miguel E. Cabanela, M.D.
Rochester, MN
(a,c,e-Stryker Orthopaedics)
Daniel J. Berry, M.D. (n)
Rochester, MN

INTRODUCTION: When performing THA for high DDH, obtaining long-term stable implant fixation and optimizing patient function remains a surgical challenge. The purpose was to evaluate clinical and radiographic results of uncemented THA with simultaneous subtrochanteric shortening osteotomy in these patients.

METHODS: Between 1992 and 2005, 28 primary uncemented total hip arthroplasties in combination with subtrochanteric shortening osteotomy were performed in Crowe grade 4 hip dysplasia on 24 patients (20 female, 4 male) with a mean age of 48 years. Patients were evaluated at a mean of 3.9 years postoperatively (minimum 2 years).

RESULTS: The mean Harris hip score increased from 43 points preoperatively to 88 points at final followup, with 92% of patients having excellent or good outcomes. Ninety-two percent of osteotomies healed uneventfully. Complications included nondisplaced intraoperative femoral fracture in five cases, osteotomy nonunion with associated femoral loosening in two, femoral loosening in one, hip instability in four, liner disengagement in one, and acetabular loosening in one. No neurologic stretch injuries were identified. All remaining components were well-fixed at last radiographic follow-up.

DISCUSSION/CONCLUSION: Uncemented THA with placement of the cup at the level of the anatomic hip center combined with subtrochanteric femoral shortening osteotomy in high developmental hip dislocation led to a high rate of uncemented implant fixation, osteotomy healing, and very good function. The complication rate, though higher than routine primary THA, is acceptable.

100. Review of 199 Lisfranc Injuries Treated with ORIF or Primary Arthrodesis

Jeffrey A. Henning, M.D. (n)
Grand Rapids, MI
Clifford B. Jones, M.D.
Grand Rapids, MI
(a-Medtronic; a,e-Zimmer)
Debra L. Sietsema, Ph.D., R.N. (n)
Grand Rapids, MI
*James R. Ringler, M.D. (n)
Grand Rapids, MI
Terrence J. Endres, M.D. (n)
Grand Rapids, MI
John G. Anderson, M.D.
Grand Rapids, MI
(e-Zimmer)
Donald R. Bohay, M.D.
Grand Rapids, MI
(e-Zimmer)

ORIF and primary arthrodesis are both treatment options in patients with Lisfranc injuries. Over a seven-year interval from 1998 to 2005, 199 skeletally mature patients were identified retrospectively with operatively treated Lisfranc injuries, including 119 males and 80 females. ORIF was performed in 153 patients (76.9%) and primary arthrodesis in 46 (23.1%). The most common mechanisms were MVA (71), fall (68), and crush injuries (27). Polytrauma was associated in 44 patients (22.1%). Secondary surgeries, including salvage fusions and reconstructions, were performed in 22/199 patients (11.1%), 19/153 (12.4%) following ORIF, and 3/46 (6.5%) following primary arthrodesis. Polytrauma was statistically associated with increased rates of secondary surgery when compared to isolated injuries, 25.0% versus 7.1% ($p<.05$), respectively. Patients with associated cuboid injuries had increased rates of secondary surgery compared to patients without, 21.1% versus 8.7% ($p<.05$), respectively. Of the 15 patients who required immediate temporary external fixation prior to definitive fixation, 5/15 (33%) required eventual secondary surgery, compared to 17/184 (9.2%) patients who did not receive initial external fixation. Pain present at the final follow-up was statistically correlated with having a secondary surgery and those patients receiving ORIF as the initial treatment. Patients treated with primary arthrodesis had lower rates of secondary surgeries. Increased rates of secondary surgery were seen in patients with polytrauma, patients with associated cuboid injuries, and those requiring initial external fixation. Pain was statistically correlated with the need for a salvage secondary procedure and after receiving ORIF as the primary procedure.

101. Total Shoulder Arthroplasty in Patients with Parkinson's Disease

*Thomas J. Kryzak, M.D. (n)
San Antonio, TX
John W. Sperling, M.D.
Rochester, MN
(e-Biomet)
Cathy Schleck, B.S. (n)
Rochester, MN
Robert H. Cofield, M.D.
Rochester, MN
(c-Smith & Nephew)

BACKGROUND: Currently, there is little information available on the results of total shoulder arthroplasty in patients with Parkinson's disease. Therefore, the purpose of the current study was to determine the results, risk factors for an unsatisfactory outcome, and rates of failure of total shoulder arthroplasty in patients with Parkinson's disease.

METHODS: Between 1978 and 2005, 49 total shoulder arthroplasties were performed in patients with Parkinson's disease for osteoarthritis of the shoulder. Forty-three shoulders (36 patients) were followed for a minimum of two years (mean, eight years) or until the time of revision surgery.

RESULTS: Total shoulder arthroplasty in patients with Parkinson's disease was associated with significant improvement in pain from 4.6 to 1.8 ($p=0.001$), external rotation from 21° to 44° ($p = 0.001$), and active abduction from 110° to 119° ($p = 0.0489$). There was no significant improvement in internal rotation ($p=0.09$). There was no significant difference in outcome between males and females nor was there an association with stage of Parkinson's disease and outcome ($p>0.05$). Based on the Neer result rating system, there were 10 excellent, 13 satisfactory, and 20 unsatisfactory results. Eight shoulders underwent revision arthroplasty. Three of the eight revisions were performed less than one year from the time of surgery due to instability.

CONCLUSION: Total shoulder arthroplasty is associated with significant long-term improvement in pain, external rotation, and abduction in patients with all stages of Parkinson's disease. However, early postoperative instability appears to be increased in this patient population.

LEVEL OF EVIDENCE: Therapeutic study, Level IV (case series).

102. Percutaneous Start Site Determines Proximal Femoral Fracture Reduction and Outcome

*Scott M. Holthusen, M.D. (n)
Grand Rapids, MI
Clifford B. Jones, M.D.
Grand Rapids, MI
(a-Medtronic; a,e-Zimmer)
Debra L. Sietsema, Ph.D., R.N. (n)
Grand Rapids, MI
James R. Ringler, M.D. (n)
Grand Rapids, MI
Terrence J. Endres, M.D. (n)
Grand Rapids, MI
David J. Bielema, M.D. (n)
Grand Rapids, MI

Trochanteric start site nails have a double curvature. Insertion site for proximal femoral fractures has not been fully elucidated. Obesity complicates starting site accuracy.

Over a four-year period of time, all pertrochanteric femoral fractures were diagnosed at a level one trauma center. A retrospective analysis of trochanteric start site nails used for pertrochanteric fractures was determined. A total of 163 patients with 163 fractures were evaluated. Fracture pattern, osteoporosis, starting point, radiographic alignment, tip apex distance (TAD), body mass index (BMI), complications, and failures were determined.

Average age was 72 years old (18-96 years old). Gender was 94F and 64M. BMI averaged 27 (range 15-45). A Gamma type nail was inserted in all cases. Majority of cases were falls (75%) or MVA (9%). Average hospital stay was 7 days (range 2-29). Start site was performed via a percutaneous technique resulting in piriformis (26%), medial half trochanter (43%), and lateral half trochanter (28%) start sites. The insertion site determined the initial and final anatomic result ($p<0.01$, $r=0.36$). Anatomic reductions were obtained in 65% of piriformis, 57% of medial, and 12% of lateral start sites. Obesity worsened the start site position ($p<0.05$) with a BMI > 30 leading to a more lateral start site and varus reduction. Shortening averaged 5 mm (range 0-45 mm). Screw cut out occurred in 4 patients (2%). TAD averaged 18 mm total (range 5-38). More anatomic reductions resulted in less failures and smaller TADs ($p<0.01$). Medial start site also resulted in smaller TAD as compared to lateral start sites ($P<0.01$). Screw cut out was related to reduction and TAD ($p<0.05$, $r=0.26$).

CONCLUSION: Percutaneous techniques assist in improved trochanteric nail start sites. Piriformis and medial trochanteric start sites result in anatomic proximal femoral reductions, smaller TAD, and less failures. Obesity interferes with accurate start sites resulting in higher failures and TADs.

103. Repair of Articular Cartilage Defects with Allograft Cartilage-Biphasic Tricalcium Phosphate

Frederick M. Azar, M.D. (n)
Memphis, TN
Paul A. Whatley, M.D. (n)
Memphis, TN
Huang Jinsong, M.D.
Memphis, TN
(a-Medtronic)
Karen Hasty, Ph.D.
Memphis, TN
(a-Medtronic, Smith & Nephew)
Hong-Sik Cho, Ph.D. (n)
Memphis, TN
Sunho Oh, Ph.D. (n)
Memphis, TN
Joo Ong, Ph.D. (n)
Memphis, TN
*Robert K. Heck, Jr., M.D.
Memphis, TN

The purpose of this study was to determine the efficacy of an allograft cartilage-biphasic tricalcium phosphate implant in restoring articular cartilage.

Biphasic tricalcium phosphate discs of two different porosities, 40% and 10%, were constructed. Porcine articular cartilage was harvested from two-week old subjects and cultured in DMEM with fetal bovine serum, glutamate, and L-ascorbic acid to induce them to produce matrix. These were then centrifuged to create allograft chondrocyte-matrix discs ready for implantation. Six osteochondral defects were created in each of two 6-month old pigs: four sites were implanted with a 40% porosity biphasic tricalcium phosphate disc and four with a 10% porosity disc, both flush with the surrounding subchondral bone; four defects had no disc implantation to act as controls. The defect sites were treated with 5% trypsin/EDTA solution and soluble type I collagen before implantation. One subject was sacrificed at one month, the other at two months. The knees were then grossly inspected, examined under x-ray and microCT, and studied histologically.

All discs and allografts remained secure in their original positions. All sites that received the cartilage/ECM allografts had a much more normal-appearing articular surface than their respective counterparts. The defect site implanted with high porosity biphasic tricalcium phosphate-cartilage allograft was replaced by bone, and produced a surface that was perfectly congruent with the adjacent normal cartilage. Furthermore, the surface was replaced by a hyaline cartilage-like tissue.

Reconstructing osteochondral defects with allograft chondrocyte/ECM grafts supported by biphasic tricalcium phosphate discs appeared to allow subchondral bone surface development and, subsequently, a supported hyaline cartilage surface flush with the surrounding cartilage in a porcine model.

104. Metabolic Activity in Osteoarthritic Knees Correlates with Body Mass Index

*Matthew C. Niesen, B.S. (n)
Madison, WI
Elizabeth B. Gausden (n)
Madison, WI
Avery L. Buchholz, B.S. (n)
Madison, WI
Matthew G. Wisniewski (n)
Madison, WI
Christine Dufour, B.S. (n)
Madison, WI
David R. Verbunker (n)
Madison, WI
Herman F. Stampfli, M.S. (n)
Madison, WI
Matthew W. Squire, M.D. (n)
Madison, WI
Lee D. Kaplan, M.D. (n)
Madison, WI

Osteoarthritis (OA) is the most common form of arthritis in the United States and has been linked to obesity. It is hypothesized that obesity, defined as a body mass index (BMI) over 30 kg/m^2, increases the incidence of OA through increased joint pressure and disruption of normal metabolism. The study's purpose was to identify the relationship between chondrocyte metabolism and BMI in osteoarthritic tissue.

Cartilage was removed from the medial and lateral femoral condyles after total knee arthroplasty and digested in collagenase. The chondrocytes were then resuspended in alginate beads at 2x10^6 cells/mL. The beads were equilibrated in media containing fetal bovine serum for 7 days (37°C). Beads were then separated into wells (8 beads/well) with 1 mL media. The media was changed and saved every 48 hours. After nine days in wells, beads were digested with 55 mM sodium citrate and separated into their cell matrix and alginate portions. Glycosaminoglycan (GAG) content from the cell pellet, the alginate, and the collected media was measured using the dimethylmethylene blue (DMMB) assay. The results were normalized to DNA content.

The results taken from the ninth day of the experiment demonstrate a proportional relationship between BMI and metabolic activity ($p=0.0003$, $n=12$). On the same day, there was a significant difference in normalized GAG content between the obese (BMI > 30 kg/m^2) and non-obese patients (BMI < 30 kg/m^2) ($p=0.0087$, $n=12$).

The findings support the connection between osteoarthritis and obesity previously reported. The increase in metabolic activity occurring in obese patients may be explained by the increased axial loading of the joint that occurs with increased weight, imitating a constant impact injury and overwhelming the maintenance functions. In summary, metabolic activity in knee chondrocytes increases with BMI in this population of osteoarthritic patients.

MAOA BREAK-OUT SESSION #9
SPINE
April 19, 2008

105. A Prospective Study of Anterior Lumbar Interbody Fusion Employing a Single Interbody Cage

*George R. Schoedinger, III, M.D. (n)
St. Louis, MO
Charles F. Hildebolt, Ph.D. (n)
St. Louis, MO

The results of a prospective study of 733 consecutive patients treated between 1998 and 2007 with anterior lumbar discectomy and interbody fusion with a single BAK proximity cage are presented. Main outcome measures are fusion rate, functional capacity (FC), and patient satisfaction. Main diagnoses are herniated lumbar intervertebral discs, degenerative lumbar disc disease, and symptomatic spondylolisthesis. Most patients had a history of injury and were involved in some form of litigation. All patients had failed nonoperative treatment. Smokers were excluded, and the majority of patients weighed within 10% of the normal BMI. Operating time, blood loss, length of stay, and complications were also studied. Average length of stay was 3.2 days. Complications included retroperitoneal hematoma, retrograde ejaculation, postoperative ileus, and superficial wound infection. There were no deep wound infections or other serious complications. Average length of time to fusion as defined by thin slice CT scan was 3.2 months with almost 99% fusion rate at one year. Pseudoarthrosis was documented in 1% of patients and verified by surgical exploration. The average postoperative functional capacity of those returning to work was one grade below the functional capacity prior to injury. Average time to MMI was 6.4 months. Follow-up at two and five years is suggestive of 83% patient satisfaction as measured by the Short Pain Survey. Based on this study, anterior lumbar fusion with a single BAK proximity cage is a safe procedure with excellent fusion rates and patient satisfaction.

106. Outcomes of Early-Onset Spine Implant Associated Infections

*Mir H. Ali, M.D. (n)
Rochester, MN
Elie F. Berbari, M.D. (n)
Rochester, MN
Todd J. Kowalski, M.D. (n)
Rochester, MN
Paul M. Huddleston, M.D. (n)
Rochester, MN

BACKGROUND: Spinal instrumentation is an established method of achieving spinal fusion. Early-onset spine implant-associated infection and its subsequent effects on arthrodesis and outcomes are unclear.

METHODS: We identified all patients with instrumented spinal fusions performed between 1994 and 2002. Thirty patients developed early-onset spinal implant associated infection. The medical records, imaging, laboratory results, microbiology, and pathology were reviewed.

RESULTS: Twenty-eight of the 29 patients were treated with surgical debridement, implant retention, and antibiotic therapy. Patients averaged 2.2 ± 1.3 surgical debridements, 33 ± 12 days of intravenous antibiotics, and 353 ± 29 days of oral suppressive therapy. Seventy-two percent (21/29) of patients demonstrated successful treatment from this regimen; 28% (8/29) of patients required additional surgical debridement and/or modification of antibiotic therapy. Excluding seven oncology patients, all patients had successful treatment of infection defined as wound healing with return of inflammatory laboratory markers to normal levels, at an average of 7.3 ± 3.0 months following initial surgery. Radiographic fusion occurred at an average of 13.2 ± 5.0 months. Despite successful arthrodesis, 44% of patients were significantly disabled by paraspinal pain and 41% continued to require opiates.

CONCLUSIONS: Early-onset spinal implant associated infections are highly morbid and best treated with early debridement, implant retention, and antibiotic therapy. Wound healing and inflammatory laboratory values should be followed closely to monitor treatment success. Time to arthrodesis is significantly prolonged.

107. Effect of Prodisc-L Prosthesis Height on Lumbar Spine Kinematics and Foraminal Size

*John L. Gaffey, M.D.
Maywood, IL
(a-Synthes Spine)
Alexander J. Ghanayem, M.D.
Maywood, IL
(a-DePuy, Medtronic, Synthes)
Robert Havey, B.S. (n)
Maywood, IL
Michael Voronov, B.S. (n)
Maywood, IL
Mark Sartori, B.S. (n)
Maywood, IL
Gerard Carandang, M.S. (n)
Maywood, IL
Celeste Abjornson, Ph.D.
West Chester, PA
(e-Synthes Spine)
Patwardhan Avinash, Ph.D.
Maywood, IL
(a-Synthes Spine)

INTRODUCTION: We investigated the effect of ProDisc-L prosthesis height on the kinematics and neural foraminal size at the implanted segment.

METHODS: Seven human lumbar spines (age: 54.4 ± 11.4; L1-sacrum) were tested intact, and after discectomy at L4-5 and sequential insertion of ProDisc-L implants of increasing heights (10, 12, and 14 mm). The specimens were tested in flexion (8Nm) and extension (-6Nm) with a 400N follower preload; and in lateral bending (± 6Nm) and axial rotation (± 5Nm) without preload. 3-D motions were measured at L4-5. Prosthesis motion was also monitored using video-fluoroscopy during flexion and extension. Foraminal sizes at L4-5 were estimated for the intact spine and after each implantation using finely graded cylindrical probes. Effects of implant height on the kinematics and foraminal size were assessed using paired comparisons with Bonferroni correction (10 mm versus 12 mm, 10 mm versus 14 mm, and 12 mm versus 14 mm).

RESULTS: Increasing implant height significantly decreased flexion-extension (F-E) ROM ($p<0.05$ for all 3 comparisons): from 9.2 ± 1.9° at 10 mm, to 7.7 ± 2.0° at 12 mm, and 5.8 ± 2.4° at 14 mm. Lateral bending (LB) decreased with stepwise increase in implant height relative to the 10 mm implant ($p<0.05$): 5.7 ± 2.8° at 10 mm, 4.6 ± 2.6° at 12 mm, and 3.6 ± 1.7° at 14 mm. Axial rotation (AR) also decreased with increased implant height, but the difference was significant only between 10 and 12 mm heights ($p<0.05$): 3.9 ± 1.9° at 10 mm, 3.2 ± 2.0° at 12 mm, and 3.0 ± 2.2° at 14 mm. Increasing implant height produced a significant increase in foraminal size ($p<0.05$ for all 3 comparisons): from 9.4 ± 1.3 mm at 10 mm, to 9.7 ± 1.3 at 12 mm, and 9.9 ± 1.4 at 14 mm.

CONCLUSIONS: Increasing implant height significantly decreased ROM by up to 37 ± 21% in F-E, 33 ± 18% in LB, and 29 ± 28% in AR. The increase in foraminal size, while significant, was only 4.6 ± 3.2%. These results suggest that a smaller implant height should be selected to optimize the ROM of the implanted segment, and neuroforaminal decompression should be accomplished via direct decompression rather than distraction with a larger implant.

108. Functional Outcomes of Thoracic and Lumbar Spine Fractures

*Bradford A. Wall, M.D.
Wichita, KS
(a-Stryker Spine, Synthes Spine)
Alan Moskowitz, M.D.
Wichita, KS
(a-Stryker Spine, Synthes; e-Stryker Spine)
M. Camden Whitaker, M.D.
Wichita, KS
(a-Stryker, Synthes; e-Stryker)
Teresa L. Jones, MPH, MT (ASCP) (n)
Wichita, KS
Catherine Maben, LRTRCT (n)
Wichita, KS

BACKGROUND: Few studies have evaluated the functional outcomes of traumatic thoracic and lumbar vertebral body fractures. We hypothesized that a kyphotic angle of greater than 30° resulting from significant vertebral body fracture (T1-L5) will lead to reduced function.

METHODS: A retrospective review of approximately 700 patients from two level one trauma centers were identified by ICD-9 codes for fractures of the thoracic or lumbar spine. Of those, approximately 340 were found to have either compression or burst fractures of the thoracic or lumbar vertebral bodies. Injury films were reviewed and initial kyphotic fracture angles were recorded. Forty-seven were recruited for follow-up evaluation; physical exam; AP and lateral radiographs; and Nottingham Health Profile, SF-36, Oswestry, Roland and Morris questionnaires.

RESULTS: The patients were stratified into two groups: those with initial kyphosis greater than (group 1) and less than (group 2) 30° kyphosis. There were 7 patients in group 1 and 40 in group 2. The two groups were similar based on sex and age. No statistically significant difference was found between the two groups in regards to energy, pain, emotional reaction, social isolation, sleep, or increase in amount of kyphosis. Statistically significant decrease in mobility was detected with group 1 reporting less mobility.

CONCLUSION: Based on this evaluation of traumatic thoracic and lumbar vertebral body fractures, the initial fracture kyphotic angle is not predictive of functional outcome.

109. The Anterior Approach to Sacroiliac Joint Arthrodesis

*Charles Gerald T. Ledonio, M.D. (n)
Minneapolis, MN
Marc F. Swiontkowski, M.D. (n)
Minneapolis, MN

The anterior approach to the sacroiliac joint allows arthrodesis with bone grafting to be performed with ease due to direct visualization of the joint. However, there is a theoretical risk of damaging the lumbosacral plexus and L5 nerve root because of its close proximity.

PURPOSE: To describe the anterior approach to sacroiliac joint arthrodesis and its outcome for sacroiliac joint disorders.

METHOD: Twenty-one patients who had sacroiliac joint arthrodesis (anterior approach with plates and screws) between August 1998 and May 2006. The 7 men and 14 women in the study group had an average age of 48 years with a minimum follow-up of eight months. Patient derived outcome measures included The Oswestry, SMFA, and patient satisfaction survey. A physical examination was performed by an independent orthopedic clinical research fellow. After consent obtained, they were asked to follow-up at the clinic to be evaluated by an independent orthopedic research fellow. Medical records were reviewed retrospectively.

RESULTS: For all 19 patients, nonoperative treatment had failed, and for all, the diagnosis was confirmed by pain relief with intra-articular sacroiliac joint injections under radiographic guidance. Sixteen patients (84%) had solid fusion while two patients had persistent nonunion and one had a repeat SI joint arthrodesis in another state. Seventeen of 19 patients had multiple back surgeries prior to the SI joint arthrodesis and about 30% of patients were referred because of nonunion of the SI joint. Average SMFA was 33.82 and patient satisfaction average was 7/10. On the average, patients reported a 70% improvement after SI joint arthrodesis.

CONCLUSIONS: In carefully selected patients with documented SI joint dysfunction or instability, sacroiliac joint arthrodesis through the anterior approach appears to be safe and effective with a high rate of union.

110. The Effects of Thread Pitch on Pull-Out Strength and Failure Characteristics of Lateral Mass Screws

*Selvon F. St. Clair, M.D.
Cleveland, OH
(a-Stryker Orthopaedics, b-Instrumentations)
William H. Montgomery, Jr., M.D.
Cleveland, OH
(a-Stryker Orthopaedics, b-Instrumentations)
Serkan Inceoglu, Ph.D.
Cleveland, OH
(a-Stryker Orthopaedics, b-Instrumentations)
Robert F. McLain, M.D.
Cleveland, OH
(a-Stryker Orthopaedics, b-Instrumentations)

INTRODUCTION: The Oasys (Stryker) and Axon (Synthes) are lateral mass screw systems designed for the posterior stabilization of the upper spine. The Oasys screw has a new fine-threaded shaft design with the thread pitch of 1.1 mm, while the Synthes screw has a cancellous threaded design with pitch of 1.75 mm. Both screw systems were designed for standard unicortical fixation in lateral masses using standard techniques. We hypothesize that using a bi-cortical fixation in the lateral masses, the pullout and failure characteristics of the fine-threaded lateral mass screws will be superior to the cancellous threaded lateral mass screws.

MATERIALS AND METHODS: Five cervical vertebrae were utilized and DEXA scanned prior to instrumentation. The subaxial cervical levels (C3, C4, C5, and C6) were bi-cortically instrumented at a standard lateral mass screw start point with either of the equally-sized screws (Oasys or Synthes). Each individual cervical vertebra was then mounted in a testing machine using specially designed jigs with the orientation of the axis of each screw parallel to the pull-out ram. The screws were axially pulled out at a rate of 1 mm/minute. Load-displacement data were recorded, and peak loads and stiffnesses were calculated. Data was analyzed using a paired t-test.

RESULTS: The Oasys lateral mass screws with fine-threaded pitch and the Synthes lateral mass screws with cancellous threaded pitch demonstrated comparable peak loads at pullout (mean±SD: 663±485 N versus 634±341 N, respectively). Similarly, the Oasys and the Synthes screws had comparable pullout stiffness (1563±661 N/mm versus 1268±733 N/mm, respectively). No significant difference between the screws in pullout stiffness and peak loads was demonstrable ($p>0.05$).

DISCUSSION: The difference in thread pitch of the two lateral mass screws investigated did not affect the pullout strength and failure characteristics when bi-cortical fixation technique was employed.

111. The Use of Polymethyl Methacrylate (PMMA) Augmentation of Osteopenic Bone for Fracture Repair

*Gregory P. Graziano, M.D. (n)
Ann Arbor, MI
Todd Bafus, M.D. (n)
Ann Arbor, MI
Gregory Poulter, M.D. (n)
Ann Arbor, MI

Fracture of the osteopenic spine can be a reconstructive dilemma. Fragile bone, coupled with a rigid metallic construct, can often lead to catastrophic failure with loss of fixation, adjacent level fractures, nonunion, and continuing fracture collapse. Kyphoplasty offers a unique method of improving fracture fixation by obtaining anterior load sharing with fragment stability and preventing adjacent level fracture with additional vertebral augmentation.

Stabilization through kyphoplasty with augmentation of adjacent levels and PMMA screw augmentation has been used in the reconstruction of the osteopenic spine with fracture in nine patients. There were seven male and two female patients.

The cause of osteopenia was myeloma (5), lymphoma (1), non-small cell lung cancer (1), and post-menopausal osteoporosis (2).

Each patient had multiple kyphoplasties with augmentation of the fracture, cement supplementation of the screws, and kyphoplasty of the adjacent segment. The indications for surgery were pain and disability in all nine patients. Additionally, two patients demonstrated mild cord compressive symptoms and three lumbar radicular symptoms.

The follow-up averaged 6 months (range 3-12 months). All patients demonstrated good relief of their perspective symptoms with stable healing constructs at their last visit. There has been no evidence of construct loosening in any patient. Complications included one patient with retained drain, one with pulmonary embolism, and two deaths unrelated to the surgery.

The use of multiple kyphoplasties with PMMA construct augmentation is a useful adjunct in the reconstruction of the osteopenic spine with fracture.

MAOA BREAK-OUT SESSION #10
HAND/UPPER EXTREMITY
April 19, 2008

112. Actual Delivery Location of Carpal Tunnel Injections: A Cadaveric Study

Joseph E. Robison, M.D. (n)
Fayetteville, NC
*John M. Ryan, M.D. (n)
Cleveland, OH
Peter J. Evans, M.D., Ph.D., FRCSC (n)
Cleveland, OH
Jeffrey N. Lawton, M.D. (n)
Cleveland, OH

PURPOSE: The study goals were to examine how and where injected material distributes using a standard carpal tunnel injection technique, to clarify the role of passive needle motion in directing injection, and to assess risk to the median nerve.

METHODS: Thirty-four cadaveric specimens were injected with 1 ml of methylprednisolone acetate containing tissue dye. A 5/8 inch 25 gauge needle was inserted into the skin at the intersection point of the wrist flexion crease and the midline of the ring finger ray, then directed distally at a 45° angle. The fingers were then passively flexed and extended, and any motion of the needle was documented. The injection was performed and the arm was then dissected through the carpal tunnel from the mid-palm to the distal aspect of the forearm.

RESULTS: Fourteen of the 34 specimens (41%) had injection solution freely distributed within the carpal tunnel. Seventeen specimens (50%) demonstrated solution deposited into either the tenosynovial sheaths of flexor tendons or in the general synovium of the carpal tunnel. Two injections resulted in solution deposition into a wall of the carpal tunnel. One injection was in the subcutaneous tissue. Needle motion with passive digit excursion was documented in 18 specimens. Only four of those specimens demonstrated free distribution of solution (22%). Out of the 16 specimens that did not show passive needle motion, solution was freely distributed in 11 (69%). The median nerve was not penetrated in any specimen.

CONCLUSIONS: (1) A significant percentage of carpal tunnel injections result in a focal deposition of solution, not free distribution. (2) Although needle motion with passive digit excursion may confirm that the needle tip is within the carpal tunnel, it indicates the injection is not likely to be freely dispersed throughout the carpal canal. (3) The injection method utilized in this study is unlikely to put the median nerve at risk.

113. Comparison of a FiberLoop and Supramid in Zone II Flexor Tendon Repair Using a Cyclic Protocol

*Ryan W. Patterson, M.D., M.P.H. (n)
Cleveland, OH
Aaron Anderson, M.D. (n)
Cleveland, OH
Chase Donnelly, B.S. (n)
Cleveland, OH
Richard Drake, Ph.D. (n)
Cleveland, OH
Kathleen Derwin, Ph.D. (n)
Cleveland, OH
Jeffrey N. Lawton, M.D.
Cleveland, OH
(a,e-Small Bone Innovations)

INTRODUCTION: The purpose of this study was to investigate differences in gap formation and failure load between FiberLoop (Arthrex, Inc., Naples, FL) and Supramid (S. Jackson Inc., Alexandria, VA) sutures in zone II flexor tendon repairs.

METHODS: Twenty paired flexor tendons from human, cadaveric hands were used. FDP tendons were obtained from the ring, middle, and index fingers, transected in zone II, and repaired with either 4-0 FiberLoop or 4-0 looped Supramid using a standard 8-strand cruciate repair technique followed by a running epitendinous 6-0 prolene suture. The repaired tendons were cycled 8,000 times between 2N and 25N at 1 Hz and then pulled at 12 mm/minute until failure. Suture markers were placed on both sides of the repair site to analyze gap formation optically. Outcome measures included gap formation at 8,000 cycles and failure load. Statistical differences were analyzed using a paired t-test ($p<0.05$).

RESULTS: No significant differences were found between groups for gap formation at 8,000 cycles ($p=0.91$). Gap formation averaged 1.7 ± 0.6 mm for Supramid and 1.8 ± 0.7 mm for FiberLoop repairs. FiberLoop repairs failed at higher loads ($p<0.05$). Failure load averaged 63.1 ± 11.9 N for Supramid and 70.8 ± 8.5N for FiberLoop repairs.

CONCLUSION: This cyclical protocol approximates the forces seen during the first six weeks of active, assisted flexor tendon rehabilitation. Both FiberLoop and Supramid repairs were able to withstand cyclical loading with less than 2 mm gap formation. Our data suggest FiberLoop repairs may withstand higher failure loads, which may make FiberLoop more advantageous in a clinical setting.

115. Long-Term Outcomes of the Treatment of Scaphoid Nonunion with and without Flexion Deformity

*Jaret M. Butler, M.D. (n)
St. Louis, MO
Mathew T. Phillips, M.D. (n)
St. Louis, MO
Thomas F. DeBartolo, M.D. (n)
St. Louis, MO
Deb R. Kreimeyer, OT-L, CHT (n)
Mason City, IA
Cecil Thomas, Ph.D. (n)
St. Louis, MO

Outcomes following treatment of scaphoid nonunion have been undesirable in cases of persistent nonunion, malunion, and when treatment is initiated after onset of arthritis. This study evaluates the long-term outcomes of scaphoid nonunion treatments including volar interposition grafting for flexion deformity and in-situ autologus grafting when alignment is maintained.

A retrospective review revealed 19 patients treated for scaphoid nonunion prior to the development of arthritic changes. Twelve patients with scaphoid malalignment and/or carpal collapse were treated with volar interpositional bone grafting (group 1). Seven patients with preserved scaphoid and carpal alignment were treated with in-situ autologus bone grafting (group 2). Outcome variables included radiographic union, arthritis, and carpal collapse, Cooney Scores, and Patient Rated Wrist Evaluations (PRWEs).

Follow-up averaged 13 years (range 5.3 to 21 years). No patients had a persistent nonunion. Of the remaining 18 patients, radiographic arthritis was minimal (0 or stage I) for 10/12 group 1 patients, and minimal for 5/6 patients in group 2. Cooney Score averages were 78 (group 1) and 80 (group 2). Average PRWEs were 18.8 (group 1) and 6.8 (group 2). Scapholunate angles were between 30-60° except for two patients in group 1 and one patient in group 2. Differences between groups were not significant for all outcome variables.

Correction of scaphoid flexion deformity produced long-term outcomes that compare favorably to in-situ bone grafting within our series and to published reports. This series further confirms the importance of anatomically aligned scaphoid union in obtaining long-term favorable outcomes.

116. Ulnar Impaction: Results, Complications, and Effect at the Distal Radioulnar Joint

*Andrew D. Markiewitz, M.D. (n)
Cincinnati, OH
Aaron C. Markiewitz (n)
Cincinnati, OH
Nathan D. Markiewitz (n)
Cincinnati, OH

Ulnar shortening has become a common procedure for ulnar impaction, ulnar sided laxity, chronic triangular fibrocartilage tears, and triquetral-lunate instability. Several techniques have been proposed to decompress the carpus, but limited information exists on long-term outcomes, effect on distal radioulnar joint (DRUJ) congruity, and complications. Rather than comparing multiple procedures for multiple issues, this study reviewed ulnar shaft shortening for ulnar impaction to improve the power of the results. Cases were reviewed to determine the variables that affect success and failure of the procedure. Failure was defined by continued pain, limited motion, change in profession, or revision surgery. A minimum follow-up of two years was required for inclusion. A retrospective review of all remaining charts was performed under Institutional Review Board approval. Success was dependent on union, non-workers compensation cases, preoperative ulnar prominence, a congruous DRUJ, and preservation of motion. Patients were less satisfied with delayed union, stiffness, ulnar nerve irritation, and labor-intensive professions. Overall, ulnar shaft shortening was successful in unloading the lunate, preserving motion, and allowing a return to one's profession.

117. A Biomechanical Comparison of Three Distal Humerus Fixation Methods

*Veerabhadra Reddy, M.D.
Charlotte, NC
(a-Stryker Trauma)
Yupeng Ren, M.S. (n)
Chicago, IL
Robert Matlock, M.D.
Chicago, IL
(a-Accumed, Stryker, Synthes)
Li-Qun Zhang, Ph.D. (n)
Chicago, IL
Bradley R. Merk, M.D.
Chicago, IL
(a-Stryker Orthopaedics, Synthes)

INTRODUCTION: Much of the failure in the treatment of distal humerus fractures has been attributed to the method of osteosynthesis. Our purpose was to compare the biomechanical strength of locking parallel plates, standard parallel plates, and locking orthogonal plates in a cadaver model.

METHODS: Eighteen cadaveric humeri were acquired and divided into three groups of six specimens. Bone mineral density analysis was conducted to ensure no significant difference between the groups. A 5 mm wide osteotomy was made just proximal to the olecranon fossa in each specimen and the plates were applied according to standard surgical technique. Stiffness of each construct was measured in the coronal, sagittal, and axial planes before and after cyclic loading. Ultimately each specimen was loaded to failure in extension.

RESULTS: In all modes of stiffness, testing the locking parallel plate construct had a significantly higher stiffness than the standard parallel plate (ANOVA, $p < 0.05$). The locking parallel plates had a significantly higher stiffness than the locking orthogonal plates only in the coronal plane. The locking orthogonal plates were significantly stiffer than the standard parallel plates only when measuring stiffness in the coronal plane after cyclic loading. In testing load to failure, the locking parallel plates were again significantly stronger than the standard parallel plates, but not the locking orthogonal plates.

CONCLUSION: The use of locking plate technology significantly increased the strength of the parallel plate construct. This is due to the biomechanical advantage that a fixed angle construct provides in osteoporotic, periarticular fractures. The increased stiffness in the coronal plane of the locking parallel plates when compared to the locking orthogonal plates is attributed to the increased contact area of the bone-screw interface that the parallel plates have compared to the orthogonal plates. In clinical application, we feel that the locking, parallel distal humerus plates will create the strongest biomechanical construct.

118. Two Hylan GF-20 Injections Reduce Osteoarthritic Shoulder Pain and Improve Function for Six Months

Victoria A. Brander, M.D.
Chicago, IL
(a-Genzyme)
*Ameer Gomberawalla, B.A. (n)
Chicago, IL
Michelle Chambers, P.A. (n)
Chicago, IL
Mark K. Bowen, M.D. (n)
Chicago, IL
Gordon W. Nuber, M.D. (n)
Chicago, IL
Regina A. Bart, P.A. (n)
Chicago, IL
Laci Naber, B.A. (n)
Chicago, IL

The study is an FDA- and IRB-approved, prospective, open-label, pilot investigation of the safety and efficacy of two hylan GF-20 injections for painful glenohumeral osteoarthritis. Thirty-six subjects who met eligibility criteria received two injections of 2 cc hylan GF-20, under fluoroscopic guidance and confirmed by arthrogram, two weeks apart. Subjects were enrolled if they had significant pain despite at least three months of nonsurgical care. No new treatments were allowed during the course of the study. Analgesics were discontinued 24 hours before visits. Data collected were range of motion, strength, radiographs, rotator cuff integrity by MRI, visual analogue pain score (VAS) at rest, night, and with activity, shoulder-related quality of life (Western Ontario Rotator Cuff Index, WORC), and medication use. Subjects were re-evaluated after each injection and at 6, 14, and 26 weeks. Changes from baseline for VAS, function, ROM, and rescue medication use were recorded in Excel and analyzed using SPSS. Intent-to-treat analysis was performed. The type and severity of adverse events were recorded. Most subjects had advanced (modified Kellgren and Lawrence grade III or IV)[i] osteoarthritis. Mean VAS at baseline was 63 (SD 14.4). Clinically (more than 20 points) and statistically significant reductions in VAS pain were seen at 6 ($p < .001$), 14 ($< .001$), and 26 ($p < .001$) weeks. Mean improvement in WORC at 6 months was 16 ($p < .001$), with most gains in “lifestyle” and “emotion” questions. Age, gender, BMI, and rotator cuff pathology did not correlate with response. Three subjects described heightened pain for a few days after injections. Three subjects reported greater pain at six months and were unsatisfied. Four had experienced no effect of treatment. There were no inflammatory reactions.

In summary, two hylan GF-20 injections improved pain and function and should be considered as part of a multimodal shoulder osteoarthritis treatment program.

119. Pectoralis Reference for Humeral Height During Hemiarthroplasty: Correlation with Gender and Height

*Michael L. Caravelli, M.D. (n)
Chicago, IL
Michael Hoenig, M.D. (n)
Charlotte, NC
Erich Gaucher, M.D. (n)
Chicago, IL
Bradley R. Merk, M.D.
Chicago, IL
(a-Stryker Orthopaedics, Synthes)
Imran Omar, M.D. (n)
Chicago, IL
Jason L. Koh, M.D.
Chicago, IL
(e-Aesculap, Arthrex)

Accurate restoration of humeral head height during shoulder hemiarthroplasty can be challenging for proximal humerus fractures. Several studies have suggested the use of the pectoralis tendon as a reproducible landmark for establishing humeral head height. The purpose of this study was to determine the average distance between the upper border of the pectoralis tendon insertion and the humeral head (PMH) and greater tuberosity (PMGT). We sought to determine if a correlation existed for patient height and gender. Fifty-six cadaveric shoulders (28 female and 28 male) were dissected to measure the distance from the upper border of the insertion of the pectoralis tendon into the humerus to the top of the humeral head (PMH) and to the top of the greater tuberosity (PMGT) using a caliper. Similar measurements were performed on MRI scans of 120 shoulders (57 male and 63 female). Patient height was recorded as well. The PMH in the MRI group was 6.0 ± 0.6 cm (length ± SD) for all patients, 6.3 ± 0.5 cm for males, and 5.7 ± 0.6 cm for females. In the cadaveric group, the PMH was 6.3 ± 0.7 cm for all samples, 6.7 ± 0.5 cm for males, and 5.8 ± 0.6 cm for females. The PMGT in the MRI group was 5.0 ± 0.6 cm for all patients, 5.3 ± 0.5 cm for males, and 4.8 ± 0.6 cm for females. The PMGT in the cadaveric group was 5.5 ± 0.5 cm for all specimens, 5.9 ± 0.5 cm for males, and 5.1 ± 0.7 cm for females. There was a statistically significant difference between males and females for average PMH and PMGT in both the cadaveric ($p << 0.05$) and MRI groups ($p << 0.05$). There was a statistically significant linear correlation between patient height and PMH ($r = 0.37$) and PMGT ($r = 0.27$) for the MRI group. The PMH and PMGT are useful landmarks for establishing humeral head height during hemiarthroplasty. The PMH and PMGT vary based on gender and height and should be considered when performing hemiarthroplasty of the shoulder. A general rule of thumb, based on MRI data, is for PMH to be 5.6 cm in a 5 foot tall individual and to increase in increments of 0.3 cm for every 6 inches in height. The PMGT should also be 0.8 cm lower than the top of the humeral head.

MAOA BREAK-OUT SESSION #11
HIP
April 19, 2008

120. Intra-Articular Hip Disease Patterns Correlate with Structural Pathoanatomy

John C. Clohisy, M.D.
St. Louis, MO
(a,e-Zimmer)
*Jeff Nepple, M.D. (n)
St. Louis, MO
Ryan M. Nunley, M.D. (n)
St. Louis, MO

INTRODUCTION: Early hip disease is commonly mechanically based and associated with developmental dysplasia (DDH) and/or femoroacetabular impingement (FAI). Improved understanding of intra-articular disease patterns and severity will enhance surgical planning and treatment. The purpose of this study was to analyze intra-articular disease patterns associated with early hip disease.

METHODS: A retrospective review of radiographs and operative findings was performed for 400 consecutive hip arthroscopies. Two hips were excluded for inadequate records. Hips treated with isolated reconstructive procedures (osteotomy or surgical dislocation) were excluded. Three hundred ninety-eight hips (374 patients) were included and 258 (65%) patients were female. Established radiographic parameters of DDH and FAI were utilized.

RESULTS: Three hundred fifty-six (89.4%) hips had acetabular labral tears with 92% of these in the anterior and/or superolateral regions. Two hundred seventy-three (69%) had acetabular chondromalacia with 69% of these located anterior and/or superolateral. Male gender was associated with decreased head-neck offset (≥4 mm), larger labral tears (>20 mm), and severe acetabular chondromalacia (all, $p<0.001$). Seventy-one hips with mild DDH (LCEA <20) were more likely to have Grade IV chondromalacia when compared to structurally normal hips ($P<0.001$). Two hundred two hips with decreased femoral head-neck offset (≤4 mm) were associated with male gender, larger labral tears, both acetabular and femoral chondromalacia, severe acetabular chondromalacia, and posterior acetabular chondromalacia (all, $P<0.001$).

CONCLUSION: The anterior and superolateral acetabular labrum and rim are the most common sites of early articular disease. Underlying structural abnormalities (DDH and FAI) are associated with severe articular chondromalacia, while male gender and FAI are associated with more extensive labral and articular cartilage disease.

SUMMARY SENTENCE: Underlying structural abnormalities are associated with severe articular chondromalacia, and FAI correlates with extensive labral and articular cartilage disease.

121. Total Hip Replacement in Patients 25 Years of Age and Younger

*Chris Wells (n)
Iowa City, IA
John J. Callaghan, M.D.
Iowa City, IA
(a,c,e-DePuy)
Steve S. Liu, M.D. (n)
Iowa City, IA
David W. Hennessy, B.S. (n)
Iowa City, IA

INTRODUCTION: With older techniques, the results of total hip arthroplasty in the very young patient were not encouraging. Although recently, including at this meeting last year, some multiple surgeon reports using newer techniques have been more encouraging. The purpose of the present study is to report a single surgeon experience of total hip replacement in patients 25 years of age and younger.

METHODS: Thirty-nine hips in 34 patients, 25 years of age and under, who underwent total hip arthroplasty, were followed for a minimum of two years. The mean age at surgery was 21.2 years (range 14 to 25). Average BMI was 30.6. The most common diagnoses were osteonecrosis of the hip in 8, childhood structural conditions in 11 (CDH, SCFE, Legg-Perthes), and juvenile RA in 7. Patients were evaluated with clinical Harris Hip Ratings, need for revision, and radiographic loosening.

RESULTS: At minimum two-year follow-up, average 6.5 years (range 2 to 16 years), three hips were lost to follow-up. Only three hips required revision, for polyethylene wear and osteolysis which were treated by liner exchange and bone grafting as necessary. Complications include postoperative dislocation in two hips, transient sciatic nerve palsy in one hip, and an intimal tear of the femoral artery in one hip. Eighty-five percent of patients had a good or excellent Harris Hip Rating. No components were radiographically loose (only three hips had cemented femoral components).

CONCLUSION: Fixation of the THR construct in this younger population appears to be durable with all cementless components demonstrating bony ingrowth. Bearing surface wear is our major concern. Patients should be counseled for the need for regular follow-up.

122. Modular Uncemented Femoral Reconstruction in THA for Developmental Dysplasia of the Hip

*Michael P. Nett, M.D. (n)
Rochester, MN
Arlen D. Hanssen, M.D.
Rochester, MN
(a-DePuy, Zimmer; a,c-Stryker Orthopaedics)
Jason Hull, M.D.
Rochester, MN
(a,b-DePuy)
Daniel J. Berry, M.D. (n)
Rochester, MN

INTRODUCTION: Total hip arthroplasty for developmental dysplasia of the hip remains a surgical challenge. Modular uncemented reconstruction facilitates management of the dysplastic femur by allowing the surgeon to accommodate for the abnormal anteversion, coxa valga, and the metaphyseal-diaphyseal mismatch often present. The purpose of this study was to evaluate the clinical and radiographic results of primary THA for DDH using modular uncemented femoral reconstruction.

METHODS: Between 1997 and 2005, 35 primary total hip arthroplasties using a modular uncemented femoral component were performed in developmental dysplasia of the hip in 30 patients (23 female, 7 male) with a mean age of 46 years. At the time of last follow-up, at a mean of 3 years postoperatively (range 2-9), patients were evaluated by physical exam, radiographs, and determination of Harris hip scores.

RESULTS: The mean Harris hip score improved from 49 points preoperatively to 93 points at final follow-up, with 94% of patients having good to excellent outcomes (HHS > 80). All femoral components were well fixed at last radiographic follow-up. No reoperations were performed. Complications included one transient femoral nerve neuropraxia which resolved by three-month follow-up and one postoperative hematoma which did not require operative intervention.

DISCUSSION/CONCLUSION: Primary total hip arthroplasty with an uncemented modular femoral reconstruction provided excellent clinical results, consistent stable implant fixation, and a low rate of complications in patients with hip dysplasia with associated femoral anatomic abnormalities.

123. The Use of Distally-Fixed, Modular Stems in Total Hip Arthroplasty

*Preetesh Patel, M.D. (n)
Weston, FL
Alison K. Klika, M.S. (n)
Cleveland, OH
Viktor E. Krebs, M.D.
Cleveland, OH
(a,b,e-Stryker Orthopaedics, TissueLink Medical; b,e-Shukla Medical)
Wael K. Barsoum, M.D.
Cleveland, OH
(a,b,e-Stryker Orthopaedics; a-TissueLink Medical; b-Zimmer; c-Exactech, SS White, Wright Medical Technology)

INTRODUCTION: Proximal femoral bone loss encountered during hip surgery is a significant and highly variable problem. A distally-fixed modular stem is an option for the treatment of severe proximal femoral bone loss. In this study, we review clinical indications, complications, and radiographic results of a distally-fixed modular stem.

METHODS: A database review at one institution identified 61 patients who had undergone femoral reconstruction with a distally-fixed modular stem. Indications for revision were aseptic loosening (n=32), reimplantation secondary to infection (n=13), periprosthetic fracture (n=7), instability (n=5), implant fracture (n=2), and complex primary with retained hardware (n=2). One patient died before the minimum two-year follow-up, and four were lost to follow-up, which allowed for 56 patients to be reviewed.

RESULTS: The mean duration of follow-up was 3.5 years (range, 24 to 68) for 56 stems. Eleven stems required repeat revision. Seven (13%) required resection arthroplasty secondary to infection. In each of these cases, this was a second attempt at re-implantation for a deep infection. Four patients (7%) required re-revision secondary to subsidence, two of which were classified as Paprosky IIIB, one as Paprosky IV, and one with a Vancouver B2 fracture. At last follow-up, 45/49 stems (90%) were radiographically stable. Dislocation was seen in one (2%) of 56 stems.

CONCLUSIONS: These early results suggest that patients with compromised proximal femoral bone stock are good candidates for a distally-fixed modular stem. Subsidence was comparable to other reports using monolithic and modular tapered stems. The lower dislocation rate observed was likely due to the flexibility of modular components.

124. Minimum Ten-Year Follow-Up of a Second Generation Fully Coated Femoral Component in Primary THR

*David W. Hennessy, B.S. (n)
Iowa City, IA
John J. Callaghan, M.D.
Iowa City, IA
(a,c,e-DePuy)
Steve S. Liu, M.D. (n)
Iowa City, IA

INTRODUCTION: The original AML prosthesis was fully coated and later the manufacturer switched it to ⅝ coating. The second generation Prodigy femoral component was developed to return to full coating of the prosthesis and to provide a medial relief to decrease bone stress shielding. The purpose of this study was to evaluate the minimum ten-year results using this device and to compare the results to the same surgeon's results at ten years using a first generation proximally coated device.

METHODS: One hundred consecutive primary total hip replacements were performed by a single surgeon in 86 patients using the Prodigy (DePuy, Warsaw, Indiana) femoral component between 1994 and 1997. The components were mated with 80 HGI and 20 Duraloc acetabular components. Patients were evaluated with WOMAC ratings, need for revision, and radiographic loosening. The same parameters had been evaluated at minimum ten-year follow-up for the same surgeon's initial 100 consecutive PCA (Stryker, New Jersey) primary THRs and were compared to the present series.

RESULTS: At minimum ten-year follow-up, 71 patients with 83 hips were living. The average clinical follow-up for the living patients was 10.8 years, and the average radiographic follow-up was 9.6 years for this group. No femoral component was revised for loosening, and all femoral components were bone ingrown on radiographs. Eight acetabular components required a liner exchange for polyethylene wear or osteolysis. This compares favorably to the same surgeon's ten-year results with the PCA where six femoral components were revised for wear or loosening and an additional two were radiographically loose.

CONCLUSION: The Prodigy femoral component demonstrated excellent durability at ten years. With the newer cementless stems with a wide variety of sizes, femoral loosening is rarely a clinical problem.

125. Total Joint Arthroplasty After Bariatric Surgery for Morbid Obesity: Complications in the Perioperative Period

*Vijay B. Thangamani, M.D. (n)
Chicago, IL
Lalit Puri, M.D. (n)
Chicago, IL

INTRODUCTION: Gastric bypass prior to hip and knee arthroplasty in the morbidly obese is becoming more prevalent. The purpose of this study was to evaluate postoperative complications in total joint arthroplasty patients who have had prior gastric bypass surgery.

METHODS: An IRB approved retrospective study was performed. We reviewed the demographics, histories, surgical procedures, and the 90-day postoperative course of 18 patients that had undergone total knee or hip arthroplasty who were previously treated with gastric bypass surgery. There were 16 females and 2 males. Twenty procedures were performed as four patients underwent bilateral joint replacements and two patients underwent staged procedures. Twenty knees and 4 hips were replaced.

RESULTS: The average length of stay was 4.25 days. In all of the patients, there was either no clinical suspicion of deep venous thrombosis or a negative duplex ultrasound. No patients required the intensive care unit. One patient required prolonged hospitalization for treatment of ileus. Two patients were later readmitted, one for observation and intravenous antibiotics due to excessive wound drainage and the other for an incision and drainage due to a wound dehiscence. There were no other major complications or adverse events found.

DISCUSSION: Gastric bypass is a popular method of weight loss and can be an effective means of weight reduction in total joint candidates. Overall, we find that patients who have undergone a previous gastric bypass procedure do well postoperatively following total joint replacement, especially if extra vigilance is taken to monitor wound healing.

126. Modular Fluted Tapered Femoral Stems for Revision THA in Severely Proximally Compromised Femurs

*James Howard, M.D. (n)
London, ON, Canada
Tad M. Mabry, M.D.
Rochester, MN
(a-DePuy, Stryker Orthopaedics, Zimmer)
Robert T. Trousdale, M.D.
Rochester, MN
(c-DePuy, a Johnson & Johnson Company)
Daniel J. Berry, M.D. (n)
Rochester, MN

INTRODUCTION: Revision total hip arthroplasty in the setting of marked proximal femoral bone deficiency remains a challenge. The purpose of this study was to evaluate outcomes of revision total hip arthroplasties in patients with proximal femoral bone loss treated with a modular, fluted, tapered femoral stem.

METHODS: Between January 1998 and December 2004, 99 revision THAs in 98 patients were performed using a single modular tapered fluted stem (Link) in selected complex revisions with marked proximal femoral bone loss. During the same time period, a total of 2,817 THA revisions were performed at our institution. There were 50 females and 48 males with a mean age of 67 years. Preoperative bone loss was categorized as Paprosky 3A (24), 3B (52) and 4 (10). Periprosthetic fractures were classified as Vancouver B2 (4) and B3 (9). Preoperative diagnoses included aseptic loosening (57), infection (2 stage) (21), periprosthetic fracture (13), and other (8). The mean follow-up was 35 months (range 24-77 months).

RESULTS: Ninety-four of the 99 stems were in situ and well fixed at last follow-up. Two hips required complete femoral revision for subsidence and three required component resection for infection. Other subsequent operations included nine cases with acetabular or proximal modular body of femoral component revision for instability. Intraoperative femoral fractures/cracks occurred in 18 cases. At final follow-up, 77% of patients had no or mild pain. All 94 stems in situ showed evidence of osseointegration at last radiographic follow-up. No stem fractured.

DISCUSSION/CONCLUSION: Fluted tapered modular stems led to a high rate of osseointegration in a selected complex revision THA population. The most common complication leading to reoperation in this challenging patient population was hip instability.

127. Cementless Acetabular Revision for the Treatment of Massive Pelvic Osteolysis

John C. Clohisy, M.D.
St. Louis, MO
(a,e-Zimmer)
*Scott Paxton, M.D. (n)
St. Louis, MO
William J. Maloney, III, M.D.
Stanford, CA
(a-DePuy, c-Zimmer)

INTRODUCTION: Massive acetabular osteolysis associated with failed THA can represent a challenging reconstructive problem, and the optimal surgical treatment continues to be debated. The purpose of this study was to evaluate the clinical and radiographic results of cementless acetabular revision in the setting of massive acetabular osteolysis.

METHODS: Four hundred thirty-four consecutive hip revision procedures were reviewed, and 38 revisions performed in the setting of massive acetabular osteolysis were identified. Massive acetabular osteolysis was defined as an osteolytic lesion ≥ 4 cm^2 on any radiographic view. The average largest defect seen on any one view was 14.2 cm^2. All hips were revised with a cementless acetabular component fixed with screws and morselized allografting. Four patients were LTF, and three died prior to final follow-up. Thirty-one hips in 29 patients had an average 53 months (minimum 24 months) follow-up and were analyzed retrospectively. Standard clinical and radiographic evaluation was performed.

RESULTS: At an average 53-month follow-up, 27 (86%) of the 31 hips were radiographically stable and clinically successful. The average HHS improved from 54.6 pre-operatively to 82.2 postoperatively ($p<0.001$). Three sockets failed due to aseptic loosening, and one implant failed due to deep infection. The bone graft was graded as incorporated in 20 hips, partially incorporated in 8, and not incorporated in 1.

CONCLUSIONS: In the setting of massive acetabular osteolysis, revision with a cementless shell and impacted morselized allograft is successful in most cases. Hips with severely compromised host bone may be at risk for early failure.

SUMMARY STATEMENT: In the setting of massive acetabular osteolysis, revision with a cementless acetabular component and impacted morselized allograft is clinically successful in most cases.

128. Use of the Extended Trochanteric Osteotomy in Treating Periprosthetic Infection. A 3.5-Year Follow-Up Study

*Brett R. Levine, M.D. (n)
Peoria, IL
Craig J. Della Valle, M.D.
Chicago, IL
(a,e-Zimmer; b-Smith & Nephew, Stryker Orthopaedics)
Scott M. Sporer, M.D.
Chicago, IL
(e-Zimmer)
Aaron G. Rosenberg, M.D.
Chicago, IL
(a,c,d,e-Zimmer)
Wayne G. Paprosky, M.D.
Chicago, IL
(c-Zimmer)

BACKGROUND: The extended trochanteric osteotomy (ETO) has proven useful in complex primary and revision total hip arthroplasty; however, it has not been well described as an approach for managing cases of periprosthetic infection. The goal of this study is to evaluate the efficacy of using an ETO as part of a two-stage exchange procedure.

METHODS: Twenty-three consecutive infected total hip arthroplasties in which an ETO was used as part of a two-stage exchange procedure were retrospectively reviewed. All patients had a minimum of two-year follow-up. Clinical and radiographic pre- and postoperative parameters were evaluated and significance levels documented using a Student's T-test ($p < 0.05$). Kaplan-Meier calculations were performed to generate survivorship curves with revision and recurrence of infection as endpoints.

RESULTS: Postoperative eradication of infection occurred in 20 out of 23 patients (87%). After a mean follow-up of 47.8 months (range, 24 to 84 months), all patients had a stable femoral component that was graded as osseointegrated (19 hips), fibrous stable (3 hips), or a stable cemented stem (1 hip). Healing of the ETO occurred in 22 of the 23 patients (96%) at a mean of 11.5 weeks (range, 8 to 16 weeks). Preoperative modified D'Aubigne and Postel score means of 2.4 for pain and 2.6 for walking ability significantly improved ($p < 0.001$) to 5.3 and 4.9 at latest follow-up.

CONCLUSIONS: The use of an ETO as part of a two-stage exchange arthroplasty can be performed safely and effectively. This technique was successful in eradicating periprosthetic infection in 87% of the cases.

129. Perioperative Testing for Sepsis in Revision Total Hip Arthroplasty

Mark F. Schinsky, M.D.
Chicago, IL
(a-Zimmer)
*Scott M. Sporer, M.D.
Chicago, IL
(e-Zimmer)
Craig J. Della Valle, M.D.
Chicago, IL
(a,b,e-Zimmer; b-Smith & Nephew, Stryker Orthopaedics)
Aaron G. Rosenberg, M.D.
Chicago, IL
(a,b,c,d,e-Zimmer; e-TissueLink Medical)
Joshua J. Jacobs, M.D. (n)
Chicago, IL
(a,e-Medtronics, Wright Medical Technology, Zimmer; a-AST, Spinal Motion)
Richard A. Berger, M.D. (n)
Chicago, IL
(c,e-Zimmer)
Wayne G. Paprosky, M.D.
Chicago, IL
(c-Zimmer)

INTRODUCTION: While multiple tests exist to try and determine if a total hip arthroplasty (THA) is infected, few studies have applied a consistent algorithm to determine the utility of the various tests available. The purpose of this study was to evaluate the utility of commonly available tests for determining periprosthetic infection in patients undergoing revision THA.

METHODS: Two hundred thirty-five consecutive THAs were evaluated by one of two experienced surgeons for the presence of infection and underwent reoperation. All patients were evaluated using a consistent algorithm with the following considered as consistent with infection: an elevated ESR and CRP, synovial fluid white blood cell count >3,000, synovial fluid differential >65% polymorphonuclear (PMN) cells, and histopathology section with >10 PMNs per high-powered field. Sensitivity, specificity, negative predictive value (NPV), positive predictive value (PPV), and accuracy were determined. Cases were considered infected if two of the following three criteria were met: positive intraoperative cultures, gross purulence found at the time of reoperation, or positive histopathology.

RESULTS: Thirty-one cases were excluded due to the presence of a draining sinus, inability to obtain or unanalyzable synovial fluid, or incomplete data leaving 204 THAs with data for evaluation. Fifty-five cases were judged to be infected. The synovial fluid cell count had the highest sensitivity, specificity, PPV, NPV, and accuracy of the tests studied.

DISCUSSION: Synovial fluid cell count is the most useful perioperative testing modality for determining the presence of periprosthetic sepsis in patients undergoing revision THA.

MAOA BREAK-OUT SESSION #12
MISCELLANEOUS
April 19, 2008

130. The Effects of MRI on Surgical Staples

*Paul R. Sensiba, M.D. (n)
Dayton, OH
Brian Imbrogno, B.S. (n)
Dayton, OH
Alison Manternach, R.N.
Dayton, OH
(a-AORN, MVH Foundation)
David Griffith, M.D. (n)
Dayton, OH
Michael J. Prayson, M.D.
Dayton, OH
(a-Canica, DAGMEC, I Flow, OTA, Synthes; a,b-Smith & Nephew)

INTRODUCTION: Surgical staples are routine in closure of surgical incisions. Staples allow for expeditious closure and removal compared to suture materials. Concern exists, however, in obtaining an MRI scan when staples are present. The study analyzes common issues related to MRI scanning in the presence of surgical staples.

MATERIALS/METHODS: Thirty pig feet had one-inch surgical incisions repaired with five surgical staples (Ethicon Proximate 35). Two parameters were analyzed: skin surface temperature change and staple displacement. Once placed, each skin staple position was marked for later referencing. A surface temperature laser device (Fluke 62 Mini) recorded pre-scan skin surface temperature. A 35-minute MRI scan was performed with a 1.5 Tesla magnet and standard knee coil for each pig foot. Immediately afterwards, the skin surface temperature and displacement measurements were recorded. A paired T-test was utilized to analyze the pre- and post-scan data.

RESULTS: The mean pre-scan temperature was 16.4° Celsius (SD: 0.7°). The median pre-scan temperature was 16.4° (range: 14.6° to 18.2°). After scanning, the mean temperature was 16.0° Celsius (SD: 0.6°). The median post-scan temperature was 15.8° (range: 15.0° to 17.6°). The skin surface temperature showed a significant drop of 0.4° Celsius ($p=0.001$). No change in staple position was noted for any of the pig feet.

CONCLUSIONS: This study demonstrated no recordable increase in skin surface temperature or displacement of staple position after a standard extremity MRI scan. Based on the findings of this study, MRI scanning in the presence of surgical staples appears safe.

131. Time Exposure to C-Arm Drape Contamination

*Paul G. Peters, M.D. (n)
Dayton, OH
Richard T. Laughlin, M.D.
Dayton, OH
(a-Smith & Nephew, Synthes)
Alison Manternach, R.N.
Dayton, OH
(a-AORN, MVH Foundation)
Ronald L. Markert, Ph.D. (n)
Dayton, OH
Kyle L. Randall (n)
Dayton, OH
Michael J. Prayson, M.D.
Dayton, OH
(a-Canica, I Flow, OTA, Synthes; a,b-Smith & Nephew)

Dr. Peters is the recipient of the Carl L. Nelson, M.D. Physician in Training Award.

INTRODUCTION: Surgical site infection remains a common concern in orthopedic surgery. A multitude of factors contribute to colonization of the operative site, not all of which are controllable. This study investigates the time-dependent contamination of sterile C-arm covers as a potentially modifiable risk factor during routine fracture surgery.

METHODS: A consecutive fracture case study was performed from the two senior authors' orthopedic practices. Cultures were obtained from the top and side of the image intensifier cover after initial draping and every 20 minutes until the end of the operation. Survival time analysis was performed to evaluate the median time to first contamination.

RESULTS: Twenty-five cases were enrolled with a mean operative time of 107 ± 41 minutes and an average people/hour/case of 9.8 ± 1.5. The median survival time was 40 minutes (95% CI =12 to 68 minutes). There was 8% contamination upon initial draping, 44% at 20 minutes, 52% at 40 minutes, 72% at 60 minutes, and 80% by 80 minutes. Of the 25 cases, only 4 did not become contaminated during the surgery. Those cases with a higher people/hour presence in the room did not correlate to an earlier rate of contamination, with a Spearman correlation coefficient of 0.18 ($p = 0.44$). The bacteria detected were Staphylococcus (59%), Corynebacterium (31%), Micrococcus (7%), and other (3%). There were no postoperative wound infections reported.

CONCLUSIONS: A rapid and significant rate of contamination for C-arm drapes during orthopedic fracture surgery was recorded. Based on these findings, the surgeon should not touch the C-arm cover to manipulate the machine. If contact with the C-arm cover is necessary, then a change of gloves is warranted to minimize contamination risk.

132. Variability in Hip Range of Motion on Clinical Examination

Mir H. Ali, M.D. (n)
Rochester, MN
Mark W. Pagnano, M.D.
Rochester, MN
(a-Stryker; a,c-DePuy, Zimmer)
*Robert T. Trousdale, M.D.
Rochester, MN

BACKGROUND: Most studies regarding successful outcome of total hip arthroplasty rely on clinical examination parameters, particularly comparison of the preoperative and postoperative ranges of motion. The goal of this study was to determine the interobserver and intraobserver reliability of physical examination in determining hip range of motion.

METHODS: A power analysis was performed in order to determine the number of patients required to demonstrate a difference in 20° of range of motion with 80% certainty. Twenty normal, asymptomatic hips were examined for range of motion; including flexion, extension, abduction, adduction, internal, and external rotation. A second group of 20 hips with moderate to severe degenerative joint disease of the hip and a third group of 20 hips was composed of patients > 12 months after a total hip arthroplasty were examined similarly. These 60 patients were examined by two experienced surgeons and by three orthopedic surgery residents/physician assistants. Range of motion was recorded on a standardized form. The two experienced examiners repeated their clinical exams in 20 patients to help determine the intraobserver reliability.

RESULTS/CONCLUSIONS: Intraclass correlation coefficients (ICCs) indicated moderate interobserver agreement in estimates of clinical hip motion (ICC for hip flexion = 0.56 ± 0.12, for hip abduction = 0.48 ± 0.13). ICCs also suggest only moderate intraobserver reliability in measurements of hip motion (ICC for hip flexion = 0.62 ± 0.14, hip abduction = 0.44 ± 0.20). More reliable and accurate methods are needed to measure clinical hip motion before and after total hip arthroplasty.

133. Interprosthetic Femur Fractures – Treatment with Locked Plating

*Amanda D. Marshall, M.D. (n)
San Antonio, TX
Alexander P. Sah, M.D. (n)
Boston, MA
Daniel M. Estok, M.D. (n)
Boston, MA
Walter W. Virkus, M.D.
Chicago, IL
(e-Stryker Orthopaedics)
Scott M. Sporer, M.D.
Chicago, IL
(a,e-Zimmer)
Craig J. Della Valle, M.D.
Chicago, IL
(a,e-Zimmer; b-Smith & Nephew, Stryker Orthopaedics)

INTRODUCTION: Interprosthetic femoral fractures (between an ipsilateral THA and TKA) pose many challenges to the orthopedic surgeon. These include gaining fixation around well-fixed implants, maintaining fixation in osteoporotic bone, and achieving union in the setting of compromised blood supply. Various studies have reported favorable results with the use of locking plates; however, no study to date investigates its performance for this difficult-to-treat subgroup of interprosthetic fractures.

METHODS: Twenty patients at two institutions were identified as having an interprosthetic femur fracture. All patients underwent fixation with a single locking plate. All constructs had locking screws both proximal and distal to the fracture site, with seven patients having cable augmentation. No strut grafting was required. Fresh frozen cancellous allograft was used in five cases. Clinical evaluation and radiographs at latest follow-up were obtained.

RESULTS: The patients averaged 75 years of age with average 13.4 month follow-up. Patients were allowed weight-bearing as tolerated on average 9.1 weeks after fixation. All fractures went on to union at average 13.8 weeks. All fractures healed with less than 5° of angulation. Knee flexion averaged 87° postoperatively. All patients returned to their preoperative ambulatory capacity. No revision surgeries have been required.

DISCUSSION AND CONCLUSION: In the setting of inter-prosthetic fractures where fracture stabilization can be challenging, locking plates are advantageous constructs because they provide rigid fixation with numerous locking screw length options to avoid well-fixed prostheses and allow additional cable fixation. They are, therefore, able to provide a reliable method of achieving union in this challenging subset of periprosthetic fractures.

134. The Accuracy of Preoperative Digital Templating in Primary Total Hip and Knee Arthroplasty

Brett R. Levine, M.D. (n)
Peoria, IL
*Carl A. Deirmengian, M.D. (n)
Philadelphia, PA
Thomas J. Mulvey, M.D.
Peoria, IL
(e-Zimmer)

INTRODUCTION: The use of digital templating is becoming more prevalent in the practice of orthopedic surgery. The accuracy of preoperative hip and knee arthroplasty templating software has recently been reported as inaccurate. The goal of this study is to report the accuracy of digital templating using the Advanced Case Plan™ (Stryker Imaging, Flower Mound, TX) system.

METHODS: Radiographs of 170 consecutive patients were templated (60 total hip and 110 total knee arthroplasties) using Advanced Case Plan™ digital software system. A 25.4-millimeter metallic sphere was utilized as a calibrating marker, placed at the level of the greater trochanter for hips and along the anterior thigh for knees. Anteroposterior hip and lateral knee radiographs were templated preoperatively and compared to the actual implants used at the time of surgery. Statistical analysis was performed to evaluate accuracy of this templating system. Patient height, weight, and BMI were analyzed to determine if these variables altered the accuracy of digital templating. Accuracy of the metallic sphere marker was validated by measuring the size of femoral heads on 25 postoperative radiographs (reviewer was blinded to the actual size).

RESULTS: Digital templating was accurate in 57% of total hip arthroplasty and 64% of total knee arthroplasty cases. In 90% of total hip arthroplasties and 97% of total knee arthroplasties, preoperative templating was within one size of the final implant. Calibrating the image with a metallic sphere was found to be highly accurate, predicting the correct size within 1.5 mm in all 25 cases (7 hemiarthroplasties and 18 total hip arthroplasties) with previously implanted components.

CONCLUSION: Digital templating can be quite accurate after a short learning curve. Optimal marker placement and standardization of obtaining radiographs is crucial for accurate templating.

135. Modified Core Decompression Technique Using a Synthetic Bone Graft Substitute for Osteonecrosis of the Femoral Head

*Robert K. Heck, Jr., M.D.
Memphis, TN
(e-Wright Medical Technology)
Michael D. Neel, M.D.
Memphis, TN
(e-Wright Medical Technology)

The purpose of this study was to evaluate the preliminary results of a modified core decompression technique using a synthetic bone graft substitute for osteonecrosis of the femoral head.

After performing core decompression through a percutaneous lateral approach, a unique expandable reaming device was used to remove a segment of necrotic bone. This was followed by backfilling the defect with an injectable, hard setting, calcium sulfate-calcium phosphate composite. A consecutive series of 25 patients with 38 treated hips consisting of 2 Ficat Stage I, 27 Stage II, and 9 Stage III hips, 30 of which were symptomatic at time of treatment, were included in this preliminary analysis.

At an average follow-up of 8 months (range: 4-14 months), pain had partially or completely subsided in 24 hips, 8 asymptomatic hips had not developed pain, and 6 continued to experience pain. Two stage III hips were treated with femoral head resurfacing due to persistent pain as well as radiographic progression of the disease. One stage II hip was revised to a THA due to persistent pain despite lack of radiographic progression.

Based on the initial mechanical strength as well as the osteoconductive properties of this composite bone graft substitute, it is speculated that the presence of the graft allows the body to restore natural cancellous bone architecture and prevent further progression of the disease. Furthermore, the efficacy of the procedure is likely enhanced by the unique reamer which allows the surgeon to perform a thorough debridement of the necrotic tissue through a percutaneous portal. The ease of this procedure also makes it an attractive option for treatment of osteonecrosis of the femoral head in an outpatient surgery center. Although these results are preliminary, the decreased pain and lack of radiographic disease progression in this patient population are very encouraging and should be studied further.

136. ♦Clinical Experience with rhBMP-2: Lessons Learned from the First 99 Cases

*B. Matthew Hicks, M.D.
Fort Wayne, IN
(a,e-Medtronic)
David A. Coats, M.D. (n)
Fort Wayne, IN

rhBMP-2 (INFUSE Bone Graft) is a powerful osteoinductive agent, and recent clinical data suggests that it can be an acceptable alternative to autograft in orthopedic trauma. After obtaining IRB approval, a retrospective review was undertaken of all patients treated with BMP-2 by a single surgeon from October 2002 until February 2007. Ninety-nine cases were identified, which included the treatment of 38 tibias, 30 femurs, 17 humeri, 8 clavicles, 1 ankle, and 5 forearms. There were 72 nonunions among this group, and 26 patients had significant cortical bone loss. Biphasic calcium phosphate granules were used in conjunction with the rhBMP-2 to help fill the bony void. Radiographs and charts were reviewed to determine clinical success. The average age was 49.8 years (15-93). Co-morbidities of the patients included tobacco use/smoking (29 patients), diabetes mellitus (18 patients), NSAID/Steroid use (16 patients), previous osteomyelitis (7 patients), and regular alcohol consumption (20 patients). After initial treatment with rhBMP-2, 84 of the 99 cases (85%) achieved clinical success. Twelve of the 15 failed patients received a second application of rhBMP-2 and 8 of those are now clinically healed. There were no complications associated with this repeat use of rhBMP-2. Tobacco use had a significant negative effect on clinical success, with 53% of the failures occurring among smokers. None of the other co-morbidities effected clinical success. We present here the data from a single surgeon's consecutive series of rhBMP-2 treated patients. These data support the use of rhBMP-2 in the treatment of these difficult cases.

137. A Novel Radiographic Technique for Determining Retroversion of the Humeral Prosthesis in Shoulder Arthroplasty

Steven B. Lippitt, M.D. (n)
Akron, OH
Vivek Sahai, M.D. (n)
Akron, OH
Andrew J. Schoenfeld, M.D. (n)
Akron, OH
*Bradley A. Pierce, M.D. (n)
Akron, OH
Joseph Caldwell, II, M.D. (n)
Akron, OH

INTRODUCTION: Incorrect humeral component retroversion is one variable that may lead to an unsatisfactory outcome in shoulder arthroplasty. It is difficult to accurately determine humeral retroversion in a patient who presents after prior arthroplasty. This study describes a technique for determining retroversion in a common humeral arthroplasty system.

METHODS: A sequential series of radiographs were obtained for Global Advantage humeral components (DePuy) in 5° rotational increments from 0° to 90°, facilitating the generation of a humeral stem version template. Humeral components were then press fit into 8 cadaveric specimens in varying degrees of retroversion (range 0°-60°). The corresponding component retroversion was then calculated by computer-aided measurement (+/- 2°) and the recorded values were blinded. Two radiographs, one in neutral (0°) and another in 30° external rotation, were obtained for each specimen. Blinded examiners compared the cadaveric hemiarthroplasty x-rays to the study x-ray templates to determine the humeral component retroversion.

RESULTS: Templates demonstrated visually identifiable differences in the geometric profile of the prosthetic stem as it was rotated. Important changing features included the stem fins, fin holes, and stem collar. The two x-ray technique helped when retroversion was 60° or greater. The method proved to be accurate with 31/32 (97%) reported measurements correct (equal or < 5°) and only one measurement between 5-10° of the actual specimen retroversion. Two-factor ANOVA revealed no significant difference between the actual values and observer responses ($p<0.001$). The level of interobserver agreement between groups showed no significant variability. The template appeared independent of which modular head component size or orientation was used.

CONCLUSIONS: This study introduces a novel technique of determining humeral component retroversion by comparing a developed template to two plain radiographs taken at different rotations. This technique is readily applicable to clinical practice in any surgeon's office and, in the future, designers might consider readily identifiable component features that might assist in identifying version.

138. Patient Satisfaction with an Organized Joint Camp Approach in Total Hip and Knee Arthroplasty

*Casey D. Johnston, M.D. (n)
Omaha, NE
Erik T. Otterberg, M.D. (n)
Omaha, NE
C. Michael Kelly, M.D. (n)
Omaha, NE
T. Kevin O'Malley, M.D. (n)
Omaha, NE
Samuel P. Phillips, M.D. (n)
Omaha, NE

INTRODUCTION: The demand for total joint replacements is predicted to increase dramatically in the coming decades. In order to meet the needs of higher numbers of patients and a more demanding patient population, steps need to be taken to ensure patients are satisfied with the experience of undergoing total joint arthroplasty (TJA). The concept of an organized multidisciplinary (joint camp) approach to TJA has been proposed to increase patient satisfaction. The purpose of this paper is to report patient's satisfaction with the experience of undergoing TJA in a joint camp setting.

MATERIALS AND METHODS: From 2000 to 2007, 3,111 patients underwent TJA (hip and knee) by the senior authors (CMK, TKO, SPP, ETO). These patients underwent a hospital system based total joint camp. All patients were seen preoperatively by a combination of nurse specialists and physical therapists that provided extensive education. During the course of the hospitalization, all patients were admitted to a separate wing of the hospital and underwent a standardized, multidisciplinary postop course. 1,266 of the 3,111 patients treated during the study period were randomly selected to complete an independently administered survey regarding their satisfaction with the experience.

RESULTS: In several key categories, our joint camp patients ranked their care as excellent. In addition to overall satisfaction, key categories included staff caring and teamwork, patient safety, and the likelihood of recommending it to a friend or loved one. The number of excellent answers in these categories rank in >97th percentile for all hospital discharges across all specialties in a large number of participating hospitals nationwide.

CONCLUSION: The concept of a joint camp as an approach to total hip and knee arthroplasty care in a large hospital setting is successful and is met with high patient satisfaction.

139. How Can Patients Assist Us with Long-Term Surveillance?

Terence J. Gioe, M.D.
Minneapolis, MN
(a-DePuy)
*Jasvinder Singh, M.D. (n)
Minneapolis, MN
Donald A. Pomeroy, M.D. (n)
Louisville, KY
Kathleen Suthers, M.S.
Warsaw, IN
(e-DePuy)

INTRODUCTION: Can patients reliably record their own American Knee Society (AKS) scores and knee range-of-motion (ROM) measurements as part of long-term TKA surveillance?

MATERIALS AND METHODS: Two hundred fifty-four consecutive TKA patients (290 knees) routinely followed as part of prospective studies were mailed an AKS questionnaire. For ROM, patients were asked to compare their operated knee(s) to lateral knee photographs showing knee ROM in 10° increments. Patients were then seen in clinic and their ROM and AKS score measured. Pearson's correlation coefficient examined the patient-assessed values to those completed by the M.D. A priori rules for comparison: (1) We considered differences ≤10° as a "good match"; (2) We considered a difference of ≤5° a "perfect match"; (3) A difference of >10° was considered an "imperfect match".

RESULTS: The absolute average ROM difference between patient/M.D. measurements was 12.1± 9.8° (range, 0-65°); a "perfect match" was seen for 95/286 knees (33%), a "good match" for 79/286 knees (28%), and an "imperfect match" for 112/286 knees (39%). Correlation coefficients between patient/M.D. assessment were moderate-high (flexion = 0.60; extension = 0.40; ROM = 0.99) and statistically significant ($p<0.001$ for all). The absolute average difference between patient/M.D. reports of the AKS pain score was 10.4 ±13.5 points (range, 0-50 points). The correlation coefficient between patient/M.D. assessed AKS pain score was moderate-marked (0.41) and significant ($p<0.001$).

CONCLUSION: The variation between patient/M.D. reported pain scores was greater than the variation between patient/M.D. recorded ROM. Since AKS factors 1 point for every 5° ROM, the average AKS Knee Score would be affected in our study, on average, by 2 points. By contrast, the observed 10.4-point average difference in pain score has substantial impact. Although our patient-generated ROM measurements do not appear to substantially alter the score, further studies are needed to understand and refine such patient self-measurement tools. Differences between patient and physician-recorded responses must be resolved as part of long-term TKA surveillance.

MAOA POSTER PRESENTATIONS – 2008 ANNUAL MEETING
#1-32

PEDIATRICS

1. Open Reduction and Plate Fixation of Pediatric Supracondylar Humerus Fractures: Technical Tip

Gregory L. DeSilva, M.D. (n)
Tucson, AZ
*William M. Hakeos, M.D. (n)
Royal Oak, MI

INTRODUCTION: Displaced T-condylar fractures of the distal humerus are rare and not well described in the orthopedic literature. The purpose of this poster is to provide a technical tip we have found useful in the treatment of these fractures.

METHODS: We identified four pediatric patients who underwent ORIF of supracondylar humerus fractures using dual column plate fixation.

RESULTS: Four patients (2 boys, 2 girls) had an average age 9.8 years (range, 7-13 years) at the time of surgery. Fractures were classified as AO/OTA C1 or C2 in all cases. There were no cases of intra-articular comminution (C3). One patient required an olecranon osteotomy while the other three cases were treated by a paratricipital approach. All patients were treated with dual column, orthogonal plate fixation. In all cases, a medial precontoured reconstruction plate (Zimmer, Warsaw, IN) was utilized. In all cases, the most distal hole from the plate was cut from the plate allowing proper fit around the medial epicondyle.

DISCUSSION: When treating displaced T-condylar, we recommend recognizing these as adult-type fractures amenable to open reduction and plate fixation. The ossification center of the medial condyle is visualized at age 5-8 years for girls and 7-9 years for boys. This condyle's growth ends at approximately age 14 for girls and 17 years for boys. Thus, we have found that a medial pre-contoured reconstruction plate (Zimmer, Warsaw, IN) fits very well along the contour of the still growing elbow while the most distal hole, which is designed to wrap around an adult sized medial epicondyle, can be easily cut off since the growth of the medial condyle is incomplete. The medial column plate placed along with a posterior lateral column plate allows for stable fixation and early range of motion fulfilling basic AO principles. We feel that this technical tip using readily available hardware will be helpful to the surgeon encountering this challenging fracture.

SPINE

2. HEALOS® Synthetic Bone Graft Combined with Marrow Aspirate as a Substitute for Autologous Iliac Crest Bone Graft in Posterolateral Lumbar Instrumentation and Fusion: A Retrospective Radiographic Analysis

Gregory A. Hoffman, M.D.
Fort Wayne, IN
(a-DePuy)
*David A. Coats, M.D.
Fort Wayne, IN
(a-DePuy)
Jennifer Tobin, P.A. (n)
Fort Wayne, IN

BACKGROUND: Posterolateral spinal fusion is indicated for various conditions of the thoracic and lumbar spine. Potential sources of graft material include autograft, allograft, and bioengineered materials. To date, the gold standard of graft material remains autologous iliac crest bone graft (ICBG). However, there are significant costs and morbidities associated with the harvesting, preparation, and implementation of iliac crest autograft. It would, therefore, be beneficial to the patient to offer an efficacious alternative to the use of autologous ICBG.

METHODS: Our retrospective analysis consisted of two groups of patients. The first arm of the study involved 34 patients who underwent instrumented lumbar posterolateral fusions utilizing a HEALOS/marrow aspirate implant. Based on AP lumbar radiographs obtained at least ten months postoperatively, lateral mass fusions were evaluated by an independent radiologist and graded based on the degree of formation of bridging bone. We then compared the results to a control group of 33 patients who underwent similar intertransverse fusions utilizing ICBG.

RESULTS: We found a significantly higher rate of Class III (complete, bilateral) fusions in the ICBG group of our study compared to individuals who had received the HEALOS/marrow aspirate graft (88% versus 44%). Additionally, there were five patients (15%) found to have absent (Class I) fusions in the HEALOS/marrow aspirate group, compared to none in the ICBG group. Average time of follow-up was similar between the two arms of our study (19.1 months HEALOS/aspirate group; 21.9 months ICBG group).

CONCLUSIONS: While HEALOS combined with marrow aspirate does show the capability of forming complete bilateral fusions, the rate of success is considerably lower than that of autologous ICBG fusions. It is beyond the scope of this study to determine whether failures were due to inadequate osteoconductive properties of HEALOS or rather insufficient osteoinductive properties of marrow aspirate. More research is recommended in this area, perhaps with HEALOS in combination with another osteoinductive agent.

3. A Cadaver Spine Study of the Effect of Positional Changes on the Accuracy of Manual and Digital Radiographic Measurement of Spinal Landmarks

Robert M. Campbell, M.D. (n)
San Antonio, TX
*Abilio A. Reis, M.D. (n)
San Antonio, TX
Aakash Gajjar, M.D. (n)
San Antonio, TX
Lane J. Cooper, M.D. (n)
San Antonio, TX

It has been assumed that a six foot tube to x-ray plate distance minimizes beam divergence and magnification error for radiographs of the spine, and that digital radiographic measurements are more accurate for measurement than manual, but no study to our knowledge has validated these assumptions.

A cadaver spine was mounted in a fixture. Wires of known length were imbedded transversely in the interpedicular spaces. The T1-12, L1-5, and T1-L5 distances were measured. Radiographs were taken at standard tube/plate distance, performed at 2.5 cm, 4.5 cm, 6.5 cm, and 8.5 cm distances of spine to the plate. The images were measured manually by micrometer and digitally.

For spinal lengths, there was an average 4.3% magnification error rate for manual micrometer radiographic measurement compared to 5.7% for the digitally measured radiographs ($p<0.001$). The average magnification error was 2.7% for the 2.5 cm distance radiographs and 7.0% for the 8.5 cm group ($p<0.001$).

For the interpedicular distances, there was an average 3.3% magnification error rate for manual micrometer measurement compared to 4.2% for the digitally measured radiographs ($p=0.002$). The average magnification error was 1.6% for the 2.5 cm distance radiographs and 5.6% for the 8.5 cm group ($p<0.001$).

Manual measurement of radiographic spinal lengths by micrometer is more accurate than digital measurement, but there is still a magnification error of 4.3%. Increasing the distance between spine and plate increases the magnification error. Interpedicular distance measurements also have the same problem with magnification error.

MISCELLANEOUS

4. Ligament and Tendon Reconstruction Using an Acellular Regenerative Tissue Matrix

*Steve V. Nguyen, M.D.
Orlando, FL
(a,e-Wright Medical Technology)

INTRODUCTION: There are several areas in which ligament and/or tendon repair is not feasible or yields poor clinical results. Such areas include chronically torn tendons and complex tears involving multiple ligaments. The purpose of conducting this study was to evaluate the safety and efficacy of reconstructing such ligaments and/or tendons using an acellular, human dermal matrix which has pre-clinically shown rapid revascularization and cellular repopulation.

METHODS: Twenty-one male and 13 female patients (mean age 48.7 years) who were treated with the allograft for ligament and/or tendon injuries or for chronic non-healing conditions in the knee, shoulder, elbow, wrist, and fingers were followed for up to 16 weeks. Objective measures (freedom from re-operation) and subjective measures (new onset of unresolved postoperative pain) of outcomes were reviewed.

RESULTS: Of the 34 patients, 30 were determined to have successful outcomes, 2 patients demonstrated failure in the knee ligament reconstruction (developed heterotopic ossification and required secondary reconstruction of the graft sites), and 2 other patients with comorbid conditions (one requiring graft removal) developed infections not related to the presence of the allograft. Of the 30 successful patients, 20 were followed through 16 weeks or beyond, 6 patients were followed through 8-16 weeks, and 4 were followed through 2-4 weeks.

CONCLUSIONS: The overall treatment success rate of 88% and absence of any reported allergic reactions or development of early arthritis suggests that this allograft is a safe and efficacious treatment for augmentation of historically challenging tendon and ligament repairs.

HIP

6. Emergent Versus Elective Revision Total Hip Arthroplasty

D. Gordon Allan, M.D. (n)
Springfield, IL
*Aundrea D. Rainville, M.D. (n)
Springfield, IL
Jacob Sams, B.S. (n)
Springfield, IL
Julie Bullard, R.N. (n)
Springfield, IL
Joseph C. Milbrandt, Ph.D. (n)
Springfield, IL

INTRODUCTION: As the number of total hip arthroplasty (THA) procedures increase, a greater number of revisions will be performed as emergency cases. However, no studies have been designed to examine hospital outcomes based upon categorization of the revision procedure as emergent versus elective. The current study was designed to describe and compare patient demographics and hospital outcomes for patients undergoing emergent versus elective THA.

METHODS: A retrospective review of revision THA patients was completed for all cases performed from January 2000 - December 2006. Demographic, hospitalization, and surgical information were collected. Patients were placed into two groups based upon admission categorization as emergent or elective. Group comparisons were made using the Fischer's Exact test (categorical data) and t-tests (means).

RESULTS: Three hundred forty-two revision THA patients were identified (n=291 elective, 51 emergent). Average age and the % females were significantly higher in the emergent group (69.9 years, 72%) when compared to the elective group (62.7 years, 54%). Emergent revisions resulted in an average hospital stay significantly higher than that observed for elective revision (8.3 versus 3.8 days, p=0.0027). Emergent revision patients were also more likely to be discharged to a skilled nursing facility (57% versus 34%, p=0.0026). No significant difference was observed in mortality between the two groups (1% versus 2%).

CONCLUSION: Outcomes were significantly poorer in patients undergoing emergent revision THA compared to elective revision THA. This finding could be used to further develop planning for rehabilitation and discharge at the time of admission. However, further study is necessary to determine whether the observed outcome differences could be attributed to patient characteristics or other unrecognized risk factors that may be predictors of poor outcome in the emergent THA population.

7. Combined ORIF and THA for Acute Management of Acetabular Fractures in the Elderly

*Jason Caron, M.D. (n)
Minneapolis, MN
Andrew H. Schmidt, M.D.
Minneapolis, MN
(a-Medtronic, Synthes; a,b,e-Smith & Nephew;
b-DePuy, FH Orthopedics; d-Twin Star, Inc.)

PURPOSE: Acetabular fractures with osteoporosis, impaction, and comminution have a poor prognosis. In elderly patients with such injuries, acute THA may facilitate recovery and avoid reoperation. This study reports the complications and functional outcomes of a consecutive series of 29 elderly patients treated acutely with combined ORIF and THA for displaced acetabular fractures.

METHODS: A retrospective review of one surgeon's experience from 1996-2007 in treating selected acetabular fractures with combined ORIF and THA was done. The series included 13 males and 16 females. The average age was 66 years. Fractures were posterior wall in 12, anterior wall in 2, anterior column in 1, anterior column-posterior hemi-transverse in 5, posterior column in 1, posterior column-posterior wall in 3, T-type in 1, and transverse-posterior wall in 4. Two patients had an anterolateral approach, 2 had combined ilioinguinal posterior approaches, and 25 a posterior approach. All but three cups were uncemented. Most patients had autologous bone grafting using the resected femoral head (20/29). Patients were assessed clinically, radiographically, and with the SF-12 and Oxford Hip Scores.

RESULTS: Average follow-up was 31 months (0-116 months). Six patients died from unrelated causes. All fractures united. There were four early and no late complications, including one deep infection and one hematoma both requiring debridement, one episode of pulmonary compromise, and one early cup loosening requiring revision at eight weeks. There were no neurovascular injuries and no cases of clinically significant heterotopic ossification. The average SF-12 physical component score was 43.6 (range 10-62), and the average Oxford Hip Score was 16.7 (range 13-29) indicating good to excellent results.

CONCLUSION AND SIGNIFICANCE: Plate fixation of the acetabulum combined with acute THA in elderly patients is a safe, viable treatment option with good to excellent functional outcomes and obviates the need for two separate operations. Functional outcome scores are equivalent to those after primary THA for osteoarthritis.

8. Inflammatory Laboratory Markers in Periprosthetic Hip Fractures

Christophe Chevillotte, M.D. (n)
Rochester, MN
Mir H. Ali, M.D. (n)
Rochester, MN
Daniel J. Berry, M.D.
Rochester, MN
(a,c-DePuy; a-Stryker Orthopaedics, Zimmer)
Mark W. Pagnano, M.D.
Rochester, MN
(a-DePuy, Stryker Orthopaedics, Zimmer)
*Robert T. Trousdale, M.D. (n)
Rochester, MN

BACKGROUND: There is no data available to guide treatment in patients who present with a periprosthetic fracture in the face of elevated serological (ESR, CRP) markers. The goal of this study was to determine the prevalence of increased serologic inflammatory in patients with periprosthetic fracture. We also set out to determine their use in predicting deep joint infection.

METHODS: Two hundred six patients with periprosthetic hip fractures from 2000 to 2006 were studied. They all had WBC with differential, ESR, and CRP obtained in the emergency room on initial evaluation and surgical pathology and deep cultures at the time of revision.

Statistical analysis was performed to determine the prevalence of increased inflammatory markers in the presence of periprosthetic fracture, the average level of increase, as well as the predictive value of these laboratory tests in predicting culture-positive and/or surgical/pathology positive deep joint infection. Results were expressed as the percentages for categorical variables and the mean +/- SD for continuous variables, unless otherwise stated.

RESULTS: WBC was increased in 17% of this population, ESR increased in 33.6%, and CRP increased in 54.8%. The predictive value for these markers for infection (defined as an intraoperative positive culture) was poor (9.1%, 18.6%, and 20.97% respectively). Most often these markers are elevated due to the patient's other medical comorbidities and/or the inflammatory response to the fracture.

CONCLUSIONS: This study suggests that increased inflammatory lab values in a patient with a periprosthetic fracture are not a good indicator for deep periprosthetic infection.

9. Intraobserver and Interobserver Reliability in the Assessment of Plain Radiographs in the Adult Hip

John C. Carlisle, M.D. (n)
St. Louis, MO
Derek Shia, M.D. (n)
St. Louis, MO
Luke Zebala, M.D. (n)
St. Louis, MO
Patrick Morgan, M.D. (n)
St. Louis, MO
Heidi Prather, D.O. (n)
St. Louis, MO
Devyani Hunt, M.D. (n)
St. Louis, MO
*John C. Clohisy, M.D.
St. Louis, MO
(a,e-Zimmer)

BACKGROUND: Different radiographic measurements have been described as indicators of developmental hip dysplasia (DDH) or femoroacetabular impingement (FAI), yet there is limited information regarding the reliability of these measurements in the adult hip. This study is designed to determine the interobserver and intraobserver reliability of selected measurements commonly utilized to assess structural abnormalities of the adult hip.

METHODS: We performed a blinded review of 45 sets of radiographs from asymptomatic controls, symptomatic DDH hips, or symptomatic femoroacetabular impingement hips. Data points included the lateral center-edge angle (CEA), vertical-center-anterior angle (VCA), head-neck offset ratio (HNOR), angle alpha, Tönnis angle, Tönnis osteoarthritis grade, film quality assessment, and a diagnosis. Five observers with varied experience reviewed all cases. Intraobserver and interobserver reliability was established using interclass correlation coefficients (ICC). Agreement regarding diagnosis was performed using the unweighted kappa coefficient.

RESULTS: Excellent intraobserver reliability (ICC>0.75) was found for the following: CEA 0.88, VCA 0.88, Tönnis angle 0.83, HNO (frog lateral) 0.78, angle alpha (frog lateral) 0.76, HNO (cross table lateral) 0.75, and angle alpha (cross table lateral) 0.76. Film quality assessment and diagnosis had good intraobserver reliability (simple kappa 0.65 and 0.66, respectively). Intraobserver reliability for osteoarthritis grade was poor (weighted kappa 0.57). For all data points, interobserver reliability was poor, with 95% confidence intervals spanning below 0.55.

CONCLUSIONS: While the described measurements for DDH and FAI are largely reproducible for a given reader, these measurements are not reliable across readers and have limitations in making a reliable and consistent final diagnosis.

SUMMARY STATEMENT: Radiographic measurements for parameters of DDH and FAI are reproducible for a given reader, but are not reliable between different readers.

10. Periacetabular Osteotomy for the Treatment of Mild Acetabular Dysplasia

Ganesh Kamath, M.D. (n)
St. Louis, MO
*John C. Clohisy, M.D.
St. Louis, MO
(a,e-Zimmer)
Young-Jo Kim, M.D.
Boston, MA
(a-OREF, Siemens Medical)
Scott Rosenfeld, M.D. (n)
Boston, MA
Perry L. Schoenecker, M.D. (n)
St. Louis, MO
Michael Millis, M.D. (n)
Boston, MA

INTRODUCTION: The surgical management of mild acetabular dysplasia and associated intra-articular disease is controversial. Treatment options include reconstructive osteotomy to address structural abnormalities or hip arthroscopy to focus on intra-articular problems. The purpose of this study was to evaluate the results of periacetabular osteotomy (PAO) in the treatment of symptomatic, mild acetabular dysplasia.

METHODS: We performed a retrospective review of 582 consecutive periacetabular osteotomies from two institutions. Patients treated for symptomatic, mild (LCEA > 14°) acetabular dysplasia were identified. Minimum two-year follow-up was required. Twenty-nine patients (29 hips) met these criteria and are the focus of this report. Clinical outcome was evaluated with Harris Hip Score and/or the WOMAC. Standard radiographic analysis was performed.

RESULTS: Average patient age was 33.1 years (range, 19-51); 27 patients were female. Average follow-up was 3.8 years (range, 2.0-7.1). No patients were lost to follow-up. All 29 patients had good or excellent clinical outcome by HHS or WOMAC scoring. Average LCEA improvement was from 16.0° to 35.4° ($p<0.0001$). ACEA improved from 11.6° to 34.5° ($p<0.0001$). Nineteen hips had no progression of OA, 9 progressed one Tönnis grade, and one progressed two grades. No patients required THA. Complications included one nonunion and one deep infection. Both of these had an eventual good clinical outcome.

CONCLUSIONS: Our results indicate that a PAO can provide precise deformity correction and major improvement in clinical symptoms for patients with mild acetabular dysplasia. We consider the periacetabular osteotomy an effective surgical option that may optimize hip mechanics and survivorship.

SUMMARY STATEMENT: PAO can provide reliable deformity correction and major improvement in clinical symptoms for patients with mild acetabular dysplasia.

11. Multi-Center PAO Study for Patients 40 and Older

*John C. Clohisy, M.D.
St. Louis, MO
(a,e-Zimmer)
Ganesh Kamath, M.D. (n)
St. Louis, MO
Young-Jo Kim, M.D. (n)
Boston, MA
(a-OREF, Siemens Medical)
Scott Rosenfeld, M.D. (n)
Boston, MA
Perry L. Schoenecker, M.D. (n)
St. Louis, MO
Michael Millis, M.D. (n)
Boston, MA

BACKGROUND: Periacetabular osteotomy is an effective joint-preserving intervention in DDH. We evaluated outcomes of PAO in patients older than 40 years.

METHODS: Thirty-two hips in 27 patients with DDH met inclusion criteria of age 40 or greater at surgery and minimum two-year follow-up. Mean age was 44 years (range 40-51). Mean follow-up was 5 years (range 2–10). Anterior center-edge angle (ACE), lateral center-edge angle (LCE), and Tönnis grade were measured on preoperative and latest postoperative radiographs. Clinical evaluation was either WOMAC or HHS.

RESULTS: 30/32 hips (94%) were preserved at an average of five years after surgery. Two hips (6%) required THA (4 and 10 years). 27/30 (90%) preserved hips had “excellent” or “good” final WOMAC or HHS grade. 3/30 (10%) preserved hips had “poor” WOMAC or HHS grade. Mean improvement in WOMAC pain score was 8 ($p<0.01$) and in HHS was 23 ($p<0.01$). Mean LCE and ACE preoperatively was 5 and 7; postoperatively was 32 and 30. There was no difference in pre- or postoperative LCE or ACE between preserved hips and failures. Mean pre-operative Tönnis grade for preserved hips was 1 and for failures was 2. One patient had sciatic nerve palsy and nonunion and was lost to follow-up at six months. One patient had nonunion that was revised successfully.

CONCLUSIONS: Ninety percent of painful dysplastic hips in patients over 40 were preserved and less symptomatic mean five years after PAO. There was a trend toward worse preoperative Tönnis grade in hips that failed.

12. Does Radiographic Osteoarthritis Grade Correlate with Articular Cartilage Findings at Hip Arthroscopy?

Jeff Nepple, M.D. (n)
St. Louis, MO
*Ryan M. Nunley, M.D. (n)
St. Louis, MO
John C. Clohisy, M.D.
St. Louis, MO
(a,e-Zimmer)

INTRODUCTION: Plain radiography is an essential aspect of evaluating early hip disease. Tönnis osteoarthritis grading is commonly used to assess the severity of articular degenerative changes. We investigated the Tönnis classification in predicting the presence and severity of acetabular articular cartilage disease in patients treated with hip arthroscopy.

METHODS: We retrospectively reviewed 400 consecutive hip arthroscopies (one surgeon). The Tönnis osteoarthritis grade was obtained from the AP pelvis and compared to arthroscopic findings from the operative note and arthroscopic image review. Four hips were excluded for inadequate records.

RESULTS: Three hundred twenty-four hips were classified radiographically as Tönnis 0 (normal), 70 were Tönnis I (mild OA), and 2 were Tönnis II (moderate OA). 18.1% of hips had an abnormal Tönnis grade. Patients with an abnormal Tönnis grade were older (41.8 versus 34.8 years, $p<0.001$). Abnormal Tönnis grade was associated with any chondromalacia (grade 1-4), moderate-severe chondromalacia (grade 3-4), and grade 4 chondromalacia (all, $p<0.001$). Abnormal Tönnis grading was not sensitive to detecting any chondromalacia or serious chondromalacia (23.2% and 31.1%, respectively). The specificity of abnormal Tönnis grading ranged from 84.6-92.7%. The positive predictive value of abnormal Tönnis grading in detecting any chondromalacia and serious chondromalacia was 87.5% and 72.2%, respectively. The negative predictive value of a normal Tönnis grade was 35.5% for any acetabular chondromalacia.

CONCLUSIONS: The Tönnis OA grading system is not a sensitive measure of articular cartilage integrity, yet an abnormal Tönnis grade should raise a high degree of suspicion for moderate to severe acetabular chondromalacia.

13. What is the Efficacy of Nonoperative Treatment for Early, Intra-Articular Hip Disease?

Devyani Hunt, M.D. (n)
St. Louis, MO
Heidi Prather, D.O. (n)
St. Louis, MO
*John C. Clohisy, M.D.
St. Louis, MO
(a,e-Zimmer)
Marcie Harris-Hayes (n)
St. Louis, MO

INTRODUCTION: Early, intra-articular hip disease (labral tears, chondromalacia, chondral flaps) is a major cause of hip dysfunction and may be a precursor to osteoarthritis. The effectiveness of nonoperative treatments for these disorders is under-investigated. The purpose of this study was to prospectively analyze the efficacy of a nonoperative treatment protocol for patients with early, intra-articular hip disease.

METHODS: Forty-eight consecutive patients (48 hips, 37 females) with an average age of 36 years (range, 13-53) with signs and symptoms of early intra-articular hip disease were included. Patients with a major structural hip deformity were excluded. Treatment emphasized physiotherapy, NSAIs, activity modification, and intra-articular injection when indicated. Outcome measures were recorded after three months of treatment and included a numeric pain score (NPS), the WOMAC index (WOMAC), the UCLA Activity Score (UCLA), Harris Hip Score (HHS), Non-Arthritic Hip Score (NAHS), and Patient-Specific Functional Score (PSFS).

RESULTS: Four (8%) patients failed the nonoperative protocol and opted for surgical intervention. Fourteen patients had incomplete three-month data, leaving 30 patients (30 hips) for analysis. Minor clinical improvement was detected with the NPS (average 1.3 points), WOMAC (4.2 points), and PSFS (0.91 points) (all, $P<0.05$). No difference was detected with the HHS and NAHS ($P = 0.44$ and 0.21, respectively). A significant mean decrease in activity (1.2 points) was detected with the UCLA score ($P<.02$).

CONCLUSION: Patients with early intra-articular hip disease reported inconsistent improvements in pain, function, and activity level in response to nonoperative treatment.

SUMMARY STATEMENT: Patients with early intra-articular hip disease reported inconsistent improvements in pain, function, and activity level in response to nonoperative treatment.

14. Wear Rates of Oxidized Zirconium Femoral Heads on Cross-Linked Polyethylene

Curtis W. Hartman, M.D. (n)
Omaha, NE
*Kevin L. Garvin, M.D.
Omaha, NE
(c-Biomet)
Connie Feschuk, R.N. (n)
Omaha, NE
Nathan Murdoch, B.S. (n)
Omaha, NE

INTRODUCTION: Polyethylene wear and its consequences for total hip arthroplasty have lead to the development of alternative bearing surfaces. Oxidized zirconium and cross-linked polyethylene are new orthopedic materials developed for this purpose. Oxidized zirconium femoral heads articulating with highly cross-linked polyethylene have undetectable wear rates in hip simulators. To date, no data have been published on the in vivo wear rates of oxidized zirconium hips articulating with cross-linked polyethylene. We hypothesize that linear wear rates in our series of oxidized zirconium on cross linked polyethylene will be significantly lower than published wear rates of traditional metal on polyethylene or metal on cross linked polyethylene.

METHODS: Fifty-five total hips were performed in 54 patients (29 males, 25 females) using an oxidized zirconium femoral head (Smith & Nephew) articulating with a highly cross-linked polyethylene liner (Zimmer). The average age was 53 years (range 31-68 years). The average BMI was 29.5 (range 17-49). Harris Hip Scores, WOMAC, and SF-36 data were recorded preoperatively and at the most recent follow-up. Radiographs of the hip were evaluated for evidence of wear, loosening, and osteolysis.

RESULTS: At a minimum follow-up of two years, all patients returned for clinical and radiographic follow-up. The average length of follow-up was 30 months (range 24-48 months). The Harris Hip scores improved from 51 (range 26-75) preoperatively to 97 (range 66-100) at the two-year follow-up. Radiographs did not show evidence of loosening, osteolysis, or wear.

DISCUSSION: The early two-year results have revealed no complications with the use of this alternative bearing. Longer follow-up will be important to determine the material's durability.

15. Intraoperative Radiographic Assessment for Predicting Postoperative THA Cup Position

*Kevin M. MacDonald, M.D. (n)
Madison, WI
Chris A. Mueller (n)
Madison, WI
John P. Heiner, M.D. (n)
Madison, WI
Richard L. Illgen, M.D.
Madison, WI
(e-Zimmer)
Matthew W. Squire, M.D. (n)
Madison, WI

INTRODUCTION: To our knowledge, no investigations have confirmed that cup position measured on intraoperative radiographs accurately predicts the postoperative cup position on standardized postoperative radiographs. This investigation compares the acetabular abduction and anteversion angles measured on intraoperative radiographs with those measured on standardized postoperative radiographs.

METHODS: The intraoperative and postoperative radiographs of 91 patients were reviewed. Cup abduction angle was measured by drawing a line tangential to the acetabular teardrops or ischial tuberosities and then drawing a second line through the long axis of the acetabular cup. Acetabular version was calculated using the method described by Hassan which required the following three measurements: diameter of the acetabular cup (D), the distance to a point along this diameter from the edge of the cup (m), and the distance of a line 90° to the diameter originating at point m and ending at the edge of the acetabular cup (h). These three measurements were inserted into the following formula: anteversion = $\sin^{-1}$ $[(h/D)/(m/D-m^2/D^2)^{½}]$. For each THA, the above radiographic measurements were made by two observers on three separate occasions (six measurements per radiograph).

RESULTS: Approximately 10% of the abduction values measured on intraoperative radiographs were at least 10° different than measured on the postoperative radiograph for the same patient. Approximately 30% of the anteversion values measured using intraoperative radiographs were at least 10° different than measured on the postoperative radiograph for the same patient.

DISCUSSION: This study indicates that care must be taken when trying to predict postoperative acetabular component position from intraoperative radiographs.

16. Two-Incision Minimally Invasive Total Hip Arthroplasty After Failed Hip Fracture Fixation

Randall J. Otto, M.D. (n)
St. Louis, MO
Berton R. Moed, M.D. (n)
St. Louis, MO
*Thomas J. Otto, M.D. (n)
St. Louis, MO

INTRODUCTION: Total hip arthroplasty is often the preferred operative management option after failed surgical treatment of a femoral neck or acetabular fracture. The purpose of the present study was to evaluate the use of the two-incision minimally invasive (MIS-2) total hip arthroplasty technique in this salvage situation.

METHODS: Between February 2004 and November 2005, eight patients with post-traumatic osteoarthrosis after open reduction and internal fixation of an acetabular fracture and six patients with failed fixation of a femoral neck fracture underwent MIS-2 total hip arthroplasty (mean age 53 years; range, 37 to 82). Thirteen patients were followed for a mean of 24.7 months (range, 18 to 39). One patient was lost to follow-up at 12 months. All patients were evaluated for postoperative complications, component alignment and position, and patient outcome using the Harris Hip score.

RESULTS: The mean Harris Hip score increased from 50 points (range, 29 to 73) preoperatively to 81 points (range, 54 to 100) postoperatively (p=0.003). Acetabular components had a mean of 44° of inclination (range, 35 to 50) and 21° of anteversion (range, 11 to 30). All cases had satisfactory fit and fill and axial alignment of the femoral component. There were no leg length inequalities. One patient had a dislocation and one patient had an intraoperative femur fracture and early loss of acetabular fixation. One patient required femoral revision for failure of bony ingrowth at 15 months.

CONCLUSION: MIS-2 total hip arthroplasty is an effective technique that may eliminate the need for standard or extensile surgical approaches for salvage of failed acetabular or femoral neck fracture surgery. Larger studies with longer follow-up are needed to determine the overall long-term success of this treatment method.

17. Mortality During and After Total Hip Arthroplasty (THA) Using a Contemporary Cementing Technique

*Rafael J. Sierra, M.D. (n)
Rochester, MN
John A. Timperley, M.D., FRCS
Exeter, United Kingdom
(a-Stryker Orthopaedics)
Graham A. Gie, M.D., FRCS
Exeter, United Kingdom
(a-Stryker Orthopaedics)

INTRODUCTION: In December 2006, the Pennsylvania Patient Safety Reporting system published a report on six intraoperative cardiac arrests in patients undergoing THA with cement. This phenomenon, called “bone cement implantation syndrome” occurs rarely, but has a high mortality rate and is critically associated to cementing technique. The aim of this study is to report the mortality associated with a contemporary cementing technique during total hip arthroplasty.

METHODS: 9,082 primary cemented THA were implanted from 1988 to 2005. We identified all patients that had died within 30 days from surgery. When available, the post-mortem results were reviewed with special attention to the status of the cardiovascular and pulmonary systems. This technique calls for *prolonged pressurization* throughout the cementing process preventing blood from the femur exiting into the femoral canal. A clean “no blood” interface between the cement and bone is crucial for preventing fat embolization and for a lasting interlock between these interfaces leading to durable results.

RESULTS: Twenty-one patients died within 30 days from their primary THA (prevalence 0.23%). There was one intraoperative death in a 92-year-old female (prevalence 0.01%). The post-mortem report was consistent with fat embolism. Two additional patients died the same day of surgery from cardiac processes. The process of cementation cannot be linked to these deaths as there was no evidence of pulmonary fat embolism or cement at the time of post-mortem examination.

DISCUSSION: Cement continues to be a safe and effective form of anchoring components in THA. Sudden death during cemented THA with a current contemporary cementing technique and a specialized anesthetic protocol is nearly zero and has successfully lead to implantation of thousands of Exeter THAs.

18. Ischial Spine into the Pelvic Cavity: A New Sign for Acetabular Retroversion on Plain Radiographs

Fabian Kalberer, M.D. (n)
Zurich, Switzerland
*Rafael J. Sierra, M.D. (n)
Rochester, MN
Sanjeev S. Madan, M.D., FRCS (n)
Sheffield, United Kingdom
Dominik C. Meyer, M.D. (n)
Zurich, Switzerland
Reinhold Ganz, M.D. (n)
Zurich, Switzerland
Michael Leunig, M.D. (n)
Zurich, Switzerland

INTRODUCTION: Femoroacetabular impingement is now considered a pre-arthritic hip condition. It frequently occurs in patients with subtle anatomic abnormalities of the acetabulum, “acetabular retroversion”, which is seen as the “cross-over sign” (COS) on standard x-rays. The objective of this study is to assess the correlation between the COS and an easily visible landmark which is the ischial spine within the pelvic cavity, and to discuss its possible implications in the diagnosis and management of patients with acetabular disorders.

METHODS: The AP pelvic x-rays of 1,010 patients who were seen at the authors’ institution for a painful hip over a 16-year period were reviewed. Those x-rays that did not meet standardized criteria were excluded leaving 149 AP radiographs (298 hips) for analysis. The COS, indicative of acetabular retroversion, was recorded for each hip. An easily visible landmark, the prominence of the ischial spine (PRIS) into the true pelvis was also recorded and measured. Interobserver and intraobserver variability was assessed.

RESULTS: The presence of the PRIS as diagnostic of acetabular retroversion showed a sensitivity of 91% (95% CI: 0.85 to 0.95%), a specificity of 98% (95% CI: 0.94 to 1.00%), a positive predictive value of 98% (95% CI: 0.94 to 1.00%) and a negative predictive value of 92% (95% CI: 0.87 to 0.96%). There was good and very good interobserver and intraobserver reliability for measurements of the COS and PRIS, respectively.

DISCUSSION: The highly relevant direct correlation between the PRIS and the COS demonstrates that retroversion is not only a periacetabular phenomenon, but that the affected inferior hemipelvis is retrotorted entirely. These patients do not truly have a “hypoplastic posterior wall” or “prominence of the anterior wall”, and this finding may influence management of acetabular disorders.

19. Computed Tomography to Assess Acetabular Loosening Prior to Revision Hip Arthroplasty

*Vijay B. Thangamani, M.D. (n)
Chicago, IL
Jonathan R. Pribaz, B.S. (n)
Chicago, IL
Lalit Puri, M.D. (n)
Chicago, IL
S. David Stulberg, M.D. (n)
Chicago, IL
Richard L. Wixson, M.D.
Chicago, IL
(a,b,c,e-Stryker Orthopaedics)

Advanced imaging modalities such as high-resolution computed tomography (CT) are often used to assess problematic total hip arthroplasties, with particular emphasis on extent of osteolysis. The purpose of this study was to determine if CT can be used as a tool to diagnose or confirm metal-backed acetabular loosening.

An IRB approved retrospective study was performed. Thirty-five consecutive revision hip arthroplasties without clear radiographic evidence of acetabular aseptic loosening were identified and their hospital and clinic charts reviewed. All 35 patients had preoperative CT scans based on an algorithm developed at our institution specifically aimed at evaluating patterns and amounts of osteolysis.

In seven cases, acetabular loosening was found intraoperatively and subsequent acetabular revisions were performed at that time. Retrospective review of the CT scans confirmed loosening in all 7 cases with evidence of acetabular ingrowth in the remaining 28 cases.

CT scans can be of great value in assessing osteolysis after hip arthroplasty. We have found that careful review of CT scans can result in high sensitivity and specificity when diagnosing loose acetabular components when radiographs cannot confirm this.

20. Applying the New Paradigm for Treatment of Osteonecrosis: Initial Experience

Bernard N. Stulberg, M.D.
Cleveland, OH
(a,e-Stryker Orthopaedics; e-Exactech)
*Jayson D. Zadzilka, M.S. (n)
Cleveland, OH

INTRODUCTION: Recently, a “new paradigm” for the treatment of osteonecrosis (ON) was suggested by Hungerford. Steinberg stage I and II (pre-collapse) ON patients should be treated with conservative measures that do not violate femoral geometry while total hip arthroplasty using newer bearing materials should be considered for Steinberg stage IV (post-collapse) and beyond.

METHODS: This strategy has been employed by the senior author since 2000 and results have been favorable.

RESULTS: Twenty-six hips (19 patients) have been treated with core decompression and/or bone grafting when the surface of the femoral head was documented to be intact. Out of these 26 hips treated conservatively, 6 hips required further treatment and 20 (77%) did not. Twenty-two total hip arthroplasties (19 patients), 1 femoral head resurfacing, and 2 hemiarthroplasties (1 patient) have been used to treat ON in the post-collapse stages. One of these hips has been revised for incomplete femoral fixation, a 96% survival rate at an average follow-up of 22 months (range: 2-74 months). The average Harris Hip Score for these patients at the most recent follow-up is 87.

DISCUSSION: This strategy has proven effective to date, but suggests the need to further refine conservative treatments for pre-collapse ON.

21. Cementless Acetabular Revision Using a Modern Porous-Coated Component at 5 to 11 Year Follow-Up

Robert W. Wysocki, M.D. (n)
Chicago, IL
*Craig J. Della Valle, M.D.
Chicago, IL
(a,b,e-Zimmer; b-Smith & Nephew, Stryker Orthopaedics)
Aaron G. Rosenberg, M.D. (n)
Chicago, IL
(a,b,c,d,e-Zimmer)
Richard A. Berger, M.D. (n)
Chicago, IL
(a,c-Zimmer)
Steven Gitelis, M.D. (n)
Chicago, IL
Joshua J. Jacobs, M.D. (n)
Chicago, IL
(a,e-Medtronic, Spinal Motion, Wright Medical Technology, Zimmer; a-AST)
Laura Quigley, M.D. (n)
Chicago, IL
(a-Zimmer, Wright Medical Technology, NIH)
Jorge O. Galante, M.D. (n)
Chicago, IL
(a,c-Zimmer)

INTRODUCTION: Previous studies have demonstrated excellent survivorship for cementless acetabular fixation in revision total hip arthroplasty. However, the implants studied are largely no longer in use. The goal of this study was to evaluate the performance of a contemporary cementless acetabular component.

METHODS: One hundred and eighty-nine consecutive acetabular component revisions were performed in 180 patients between 1994 and 2000 with a hemispherical component coated with porous titanium mesh (Trilogy, Zimmer, Warsaw, IN). The patients were followed prospectively with serial radiographs and Harris Hip surveys. The average age at revision was 62 years old.

RESULTS: Twenty patients (21 hips) from the original cohort died before the follow-up period. A total of 160 patients (168 hips) were available for follow-up at a mean of 91 months (range, 60-141 months). No patients were lost to follow-up. Eleven acetabular components (7%) required repeat revision: five (3%) for aseptic loosening, four for infection, one for instability, and one for pelvic fracture. Two hips (1%) required revision of the modular acetabular liner for wear and osteolysis. Six acetabular components (4%) were radiographically classified as definitely loose, six (4%) probably loose, and nine (5%) possibly loose. At final follow-up, 7% of the acetabular components had failed, with failure defined as revision for aseptic loosening or radiographic evidence of definite loosening. Three patients had small (less than 1.0 cm) peripheral osteolysis; two patients had small retroacetabular osteolysis. Three patients had a large (greater than 1.0 cm) area of peripheral osteolysis, six patients had a large area of retroacetabular osteolysis.

DISCUSSION AND CONCLUSION: The results of cementless revision arthroplasty with this modern acetabular component are good overall, but clearly inferior to those of its predecessor after a similar period of follow-up.

22. Five to Seven Year Results of the ADVANCE® Medial Pivot Knee

*Michael J. Anderson, M.D.
Milwaukee, WI
(c-Wright Medical Technology)
Marc Goossens, M.D.
Ghent, Belgium
(e-Wright Medical Technology)
Catherine Van Der Straeten, M.D.
Ghent, Belgium
(e-Wright Medical Technology)

INTRODUCTION: The ADVANCE® Medial-Pivot Knee is designed to mimic the medial-pivot motion of the normal knee through a tibiofemoral articulation which combines medial rotation with controlled A-P translation.

METHODS: Between September 1998 and August 2000, 164 patients were implanted with the ADVANCE® Medial-Pivot Knee, including 158 primary and 6 revision procedures. Five patellae were unresurfaced and one had undergone previous patellectomy.

RESULTS: Of the 164 patients, 9 died due to unrelated causes, 2 underwent revision for infection, 1 underwent revision of a tibial tray that loosened due to trauma, and 7 were lost to follow-up. Phone contact with all seven who were lost to follow-up revealed no reported failures.

Mean age of the returning patients was 76 years with a range of 37 to 89 years. Mean latest follow-up was 70 months (60-84 months). Overall implant survivorship in the 155 patients still living was 98.1%. Preoperative mean Knee Society Score (KSS) and range of motion was 26 points and 91°, respectively, improving at latest follow-up to 92 points and 119°.

DISCUSSION: This series of 164 patients shows excellent survivorship (98.1%) at an average of 70 months postoperative. KSS and range of motion postoperative values improved markedly over preoperative, even in this study population comprised of older patients (mean age 76 years). The results of this study support the rationale of the ADVANCE® Medial-Pivot Knee, namely that medial rotation and controlled A-P translation optimizes function in the replaced knee.

23. Predictors of Bone Loss and Reconstructive Technique in Revision Total Knee Arthroplasty

Bryan Chambers, M.D. (n)
Cleveland, OH
*Alison K. Klika, M.S. (n)
Cleveland, OH
Ho H. Lee, M.D. (n)
Cleveland, OH
David Joyce, M.D. (n)
Cleveland, OH
Priyesh Mehta, B.S. (n)
Cleveland, OH
Viktor E. Krebs, M.D. (n)
Cleveland, OH
(a,b,e-Stryker Orthopaedics, TissueLink Medical;
(b,e-Shukla Medical)
Boris Bershadsky, Ph.D. (n)
Cleveland, OH
Wael K. Barsoum, M.D. (n)
Cleveland, OH

INTRODUCTION: Bone deficiency at revision knee arthroplasty can be technically challenging. Our objective was to develop models to predict intraoperative bone loss management strategies based on the use of augments, using preoperative failure mode, and patient demographics as predictors.

METHODS: Multiple variables were collected in a retrospective review of 227 knee revision cases which required a total stabilized implant. Predictive models using binary logistic regression were developed to predict bone loss at four femoral locations (posterior medial, posterior lateral, distal medial, distal lateral) and the tibia.

RESULTS: The need for distal lateral femoral augmentation was predicted by number of prior revisions (p=0.02), diagnosis of infection (p=0.00), and time from last knee procedure (p=0.00). For the distal medial location, the number of prior revision procedures (p=0.00), diagnosis of infection (p=0.00), time from last knee procedure (p=0.01), and diagnosis of implant loosening (p=0.02) was significant. On the posterior medial aspect of the femur, a diagnosis of loosening (p=0.00), diagnosis of instability (p=0.05) and male gender (p=0.00) were significant. Augmentation of the posterior lateral position was correlated with diagnosis of loosening (p=0.01), and male gender (p=0.00). The number of prior revision procedures (p=0.00) and time from last knee procedure (p=0.02) predicted the use of a thicker polyethylene insert ($\geq$19 mm), indicating medial and lateral tibial deficiencies. Structural allograft was used in only one procedure.

CONCLUSIONS: The models generated may serve as a powerful tool for the surgeon to preoperatively determine what implants and augments are likely to be required for difficult knee revisions.

24. Total Knee Arthroplasty in Patients with Fibromyalgia has a High Complication Rate

*Michele R. D'Apuzzo, M.D. (n)
Rochester, MN
Miguel E. Cabanela, M.D.
Rochester, MN
(a,c,e-Stryker Orthopaedics)
Robert T. Trousdale, M.D. (n)
Rochester, MN
Rafael J. Sierra, M.D. (n)
Rochester, MN

INTRODUCTION: Fibromyalgia has been defined as a constellation of complaints including diffuse chronic pain and the presence of tender points. When presenting with knee arthritis as well, some surgeons may consider these patients poor candidates for joint replacement because of their history of chronic pain and high incidence of associated psychiatric disorders which could lead to poor TKR results. The results of TKR in this patient population have not been reported previously.

METHODS: Between 1990 and 2001, 169 primary total knee arthroplasties were performed at our institution in 130 patients with a diagnosis of fibromyalgia. Ninety-two percent were female. Eighty-nine percent had degenerative joint disease as primary diagnosis, and the average age at the time of surgery was 64 years. The patients were followed clinically for a mean of 6.9 years, and they were followed radiographically for a mean of 5.1 years.

RESULTS: Postoperatively, there were 65 complications after 52 procedures (38%). Of these, 40 were medical complications or did not require reoperation, and 25 were surgical complications which required a reoperation. Ten knees required revision arthroplasty (6%) and 11 knees required a manipulation (6.5%) to improve motion. Soft tissue complaints were common, but only one patient had persistent postoperative pain despite well-fixed implants.

DISCUSSION: There was a high prevalence of complications in these patients with fibromyalgia who underwent TKR. Disabling and generalized pain, which is common in this patient group, may make rehabilitation more difficult leading to poor gain in motion. Nonetheless, total knee arthroplasty proved to be reliable for alleviating pain in the affected joint in the majority of patients.

25. The Lateral Compartment in Knees with Isolated Medial and Patellofemoral Compartment Arthritis: A Histologic Analysis of Articular Cartilage

Todd Moen, M.D. (n)
Chicago, IL
*Lalit Puri, M.D. (n)
Chicago, IL

BACKGROUND: The decision to perform a tissue-sparing arthroplasty, such as a unicompartmental or bicompartmental knee arthroplasty, is based on the assumption that the tissue to remain in the knee is healthy and free of osteoarthritis. The determination of the extent, or lack thereof, of osteoarthritis in the knee is based primarily on radiographic findings. To our knowledge, there has never been a study directly examining the articular cartilage of a radiographically normal-appearing compartment in a knee with osteoarthritis in other compartments. The purpose of this study was to examine, at a histologic level, in patients with radiographic evidence of isolated medial and patellofemoral osteoarthritis and a normal lateral compartment, the extent of osteoarthritis in the lateral compartment.

METHODS: Twenty patients with radiographic evidence of medial and patellofemoral osteoarthritis and a radiographically disease-free lateral compartment were identified. This was done with Kellgren-Lawrence scoring of the individual compartments. These patients then underwent a tricompartmental total knee arthroplasty. The resected lateral femoral condyle and lateral tibial plateau were evaluated to evaluate the microscopic extent of osteoarthritis. This was done by histologic grading using the Histologic/Histochemical Grading System of Mankin.

RESULTS: The average Kellgren-Lawrence score for the lateral compartments was 1.2 +/- 0.4, consistent with “doubtful” for the presence of osteoarthritis. The average Mankin Scores for the lateral compartment tissue was 2.5 +/- 0.8, which is consistent with “mild” osteoarthritic changes.

DISCUSSION: This study shows that in patients with radiographic evidence of isolated medial and patellofemoral compartment osteoarthritis, and a radiographically normal lateral compartment, that there is mild osteoarthritis present at a microscopic level. The clinical significance of this finding is unknown, and further investigation is warranted.

26. Computer Assisted Total Knee Arthroplasty: A Novel "Pinless" Technique to Reconstruct a Neutral Mechanical Axis

*Lalit Puri, M.D.
Chicago, IL
(e-Stryker Orthopaedics)
Todd Moen, M.D. (n)
Chicago, IL
Nasim Rana, M.D. (n)
Chicago, IL
Richard L. Wixson, M.D.
Chicago, IL
(a,b,c,e-Stryker Corporation)

INTRODUCTION: Computer-Assisted Total Knee Arthroplasty (TKA) has been shown to improve clinical outcomes by allowing for more accurate coronal alignment of the components, less variance, and fewer "outliers" than traditional reconstruction techniques. Most computer-navigation systems utilize rigidly-fixed trackers placed on both the femur and tibia in conjunction with a computer workstation and navigation software to determine the mechanical axis of the extremity intraoperatively, in real time. The purpose of this study was to report an initial single-surgeon experience with a novel navigation system that utilizes a "pinless" technique with trackers mounted at the articular surface, not rigidly-fixed to the femur and tibia.

METHODS: Thirty consecutive patients underwent a TKA using a novel "pinless" navigation system. At four weeks postoperatively, coronal alignment was assessed with long-standing AP radiographs. Comparison was made with a representative cohort of 30 consecutive patients who underwent a TKA with traditional manual alignment. The Navigated and Traditional groups were compared with the student's paired t-test.

RESULTS: The average alignment for the Navigated group was 0.3° +/- 1.6° valgus. Variance was 2.5. The average alignment for the Traditional group was 1.0° +/- 2.0° varus. Variance was 4.0. Three traditional knees had a coronal mechanical axis of 4° valgus. All Navigated knees were within 3° of neutral alignment. These results approached, but did not achieve, statistical significance

DISCUSSION: This study reports an initial single-surgeon experience of a novel "pinless" navigation technique for TKA. These results suggest that this technique is a safe and effective means to reconstruct a neutral mechanical axis. Further investigation is warranted, and ongoing.

27. The Influence of Sequential Debridement in TKA on the Flexion Axis Using Computer-Aided Navigation System

*Mark I. Morishige, M.D.
Wichita, KS
(a,b-Stryker Orthopaedics)
David A. McQueen, M.D. (n)
Wichita, KS
(a,e-Stryker Orthopaedics)
Gregory P. Ballard, M.D. (n)
Wichita, KS
Alexander Chong, MSAE, MSME (n)
Wichita, KS
Francis W. Cooke, Ph.D. (n)
Wichita, KS

BACKGROUND: Proper alignment and stability of femoral and tibial components is a critical factor affecting the long-term success of total knee arthroplasty (TKA). The effect of osteophyte debridement, bony cuts, and soft tissue releases on the functional flexion axis of the knee can be assessed by evaluating the three-dimensional kinematic behavior following each step of a TKA. Using a navigated knee system with dedicated software, the functional flexion axis (helical axis) can be determined after each sequence.

METHODS: Five paired fresh-frozen cadaveric specimens were used with a CT scan performed on each specimen identifying implanted fiducial markers. Kinematic data were recorded during each step of sequential osseous cuts and soft tissue releases for both an unloaded and loaded limb by each of three surgeons.

RESULTS: The functional helical (flexion/extension) axis was identified for all specimens. The internal/external rotation angle (θ) of the helical axis differed from the transepicondylar axis from -8.3° to +6.7° for the unloaded condition. θ ranged from -7.2° to +7.4° with distraction. Bony cuts and soft tissue releases had no effect on θ until resection of the proximal tibia, which increased θ to -0.3° to +9.7°. Implantation of the CR prosthetic components subsequently reduced θ to -7.3° to +4.0°.

CONCLUSION: The principal conclusions were: (a) Soft tissue releases have minimal effect on θ of the helical axis except for resection of the proximal tibia. (b) Implantation of the CR prosthesis reduced θ close to that of the intact knee. (c) In a minority of knees, the helical axis did not exactly coincide with the transepicondylar axis. Inter-specimen and left/right variability of θ were significant, while inter-investigator variability and an applied distraction force were insignificant.

28. A Critical Evaluation of Femoral Interference Screw Placement in Anterior Cruciate Ligament Reconstruction

*Anup A. Shah, M.D. (n)
San Antonio, TX
Michael M. Heckman, M.D.
San Antonio, TX
(c-Biomet)

BACKGROUND: Multiple modes of femoral fixation for the treatment of the ACL-deficient knee exist. Commonly, femoral interference screws are used and are often buried to accommodate a graft-tunnel mismatch.

HYPOTHESIS: Recessed femoral interference screws cause graft excursion and intercondylar roof and anterior notch impingement.

METHODS: Four fresh-frozen knee specimens were obtained. ACL reconstruction was performed using BPB autografts. Femoral fixation with interference screws and an endo button was performed. The knees were numbered as follows:

Knee #1: buried femoral interference screw
Knee #2: screw at bone-joint interface
Knee #3: endo button fixation
Knee #4: control

Sagittal computer tomography scans of each knee were taken at 0, 30, 60, and 90 degrees of flexion with constant graft tension.

RESULTS: Each of the three reconstructed ACL knee specimens revealed satisfactory graft placement in the distal femur. As the knee specimens were extended from 90° of flexion to 0° of extension, increased graft excursion and obvious graft impingement was seen in knee #1. These findings were not seen in knees #2-4.

CONCLUSION: Graft excursion, impingement, increased contact pressures, and additional bone resection are potential consequences when burying femoral interference screws in ACL reconstruction. These often result in graft injury.

CLINICAL RELEVANCE: When faced with a graft tunnel mismatch with interference, screw fixation, creation of a tibial trough, or alternative mode of fixation should be performed.

29. Early Postoperative Matched Pair Comparison of Unicompartmental Knee Arthroplasty versus Total Knee Arthroplasty

*John J. Stefancin, M.D. (n)
Cleveland, OH
Kristy Olivo, P.A. (n)
Cleveland, OH
Mark I. Froimson, M.D. (n)
Cleveland, OH

Isolated medial compartment arthritis of the knee that has failed nonoperative treatment can be managed surgically with either unicompartmental knee arthroplasty (UKA) or total knee arthroplasty (TKA). We retrospectively reviewed the inpatient and early postoperative records of 50 medial UKAs against a matched cohort of 50 TKAs who had only medial compartment arthritis on radiographs. We evaluated the following parameters: age, type of anesthesia, tourniquet time, estimated blood loss (EBL), length of hospital stay, discharge disposition, inpatient total equianalgesic morphine requirements, and initial postoperative visit range of motion. Average age of UKA group was 68 years old (range 55-88) and 70 years old for the TKA group (range 52-87). Average inpatient hospital length of stay was 2.15 days and 3.7 days for the UKA and TKA groups, respectively. Eighty-nine percent of UKA patients were discharged to home, versus only 28% for the TKA cohort. The average amount of inpatient equianalgesic morphine was 37.84 mg for the UKA patients, and 68.65 mg for the TKA patients. Mean initial postoperative visit was at 4.2 weeks for the UKA and 5.0 weeks for the TKA patients, respectively. Active assisted range of motion at the first postoperative visit ranged from 2-113° for the UKAs and 5-95° for the TKAs. Mean tourniquet time was 65.8 minutes (range 53–95) and 69 minutes (range 56-89) for the UKAs and TKAs, respectively. Average estimated blood loss was 73 cc for the UKAs (range 30-100 cc) and 140 cc for the TKAs (range 100-250). In this study, we were able to document that UKA patients faired better than TKA patients when assessed by hospital length of stay, morphine usage, discharge disposition, range of motion at early and late follow-up, and time to independent ambulation. Improvement in such parameters was associated with significant cost reduction pertaining to the episode of care. Patient satisfaction was high in both patient groups, but more patients in the UKA group resumed activities deemed vigorous. Furthermore, UKA patients show superior early range of motion, better stair climbing ability, and more normal knee kinematics due to preservation of the cruciate ligaments. When patients are considering the relative merits of UKA versus TKA, such early functional results, in addition to estimates of long-term survivorship, can help inform their decision as to which procedure is most likely to meet their needs. This study reflects the excellent inpatient and early follow-up results of UKAs. Through stringent patient selection, UKAs can provide a cost effective, highly successful alternative to TKAs with superior short-term results and long-term results approaching that of TKAs.

30. Using Surgical Navigation in Revision TKA

Bernard N. Stulberg, M.D.
Cleveland, OH
(a,e-Stryker Orthopaedics; e-Exactech)
*Jayson D. Zadzilka, M.S.
Cleveland, OH
(a-Stryker Orthopaedics)

INTRODUCTION: It has been well documented that surgical navigation can provide a more predictable outcome related to component placement and overall alignment of the leg for primary total knee arthroplasty (TKA). It is also a useful tool for soft-tissue balancing in primary TKA. However, information related to revision TKA with surgical navigation is very limited.

METHODS: The senior author has used surgical navigation to perform revision TKA in 12 cases to date which were reviewed retrospectively.

RESULTS: Three cases of mid-flexion instability associated with a single knee design were identified. Preoperative alignment was satisfactory in all three cases. Therefore, with the guidance of the navigation system, exploration was performed. The posterior cruciate ligament was released and several different insert sizes of a more conforming design were trialed. Stability was achieved and documented.

DISCUSSION: Surgical navigation can be a useful tool when performing revision TKA. It can be used to identify and document the source of a problem. It can also be useful for soft-tissue balancing and realignment of the knee joint, providing documentation of final alignment and stability.

UPPER EXTREMITY

31. Pulmonary Embolism Following Arthroscopic Rotator Cuff Repair

*Samuel C. Hoxie, M.D. (n)
Rochester, MN
John W. Sperling, M.D. (n)
Rochester, MN
Robert H. Cofield, M.D. (n)
Rochester, MN

Previous studies have provided data on the prevalence of pulmonary embolism following shoulder arthroplasty and proximal humerus fracture repair. However, there is no information on the risk of pulmonary embolism following the surgical management of rotator cuff tears. A review of 1,176 operative procedures for rotator cuff tears between January 1, 2001, and December 31, 2005, was performed to identify patients who developed a pulmonary embolism postoperatively.

Three patients developed a pulmonary embolism diagnosed by computed tomography angiography. The overall incidence was 0.26%. None of the patients died as a result of the pulmonary embolism.

The data from this review indicates that the incidence of pulmonary embolism following rotator cuff repair surgery is low, but not zero. The most common presenting symptoms of pulmonary embolism were chest pain, shortness of breath, and hypoxia. This study should raise the surgeon's awareness about this possible complication following rotator cuff repair surgery.

32. Modular Humeral Prosthesis Dissociation: A Biomechanical Retrieval Analysis

Michael F. Iossi, M.D. (n)
Dayton, OH
*Lynn A. Crosby, M.D.
Dayton, OH
(a,d,e-Exactech; a-Smith & Nephew, Synthes)
Danielle L. Miller, B.S. (n)
Dayton, OH
Ronald Markert, Ph.D. (n)
Dayton, OH
Tarum Goswami, D.Sc. (n)
Dayton, OH

BACKGROUND: Component dissociation is a complication unique to modular prosthetic implants and one that has been reported for a single manufacturer's implant. Proposed mechanisms include difficulty achieving and difficulty maintaining a well-seated taper-lock.

The purpose of this study was to determine and compare the pulloff strengths of retrieved implants from more than one manufacturer as well as to compare these values to literature estimates of forces acting across the glenohumeral joint during activities of daily living.

METHODS: The pulloff strength (load to dissociation) was tested for nine implants from four manufacturers. Ten trials of manual impaction followed by controlled distraction with an Enduratech testing machine were performed for each of the nine implants. Load to dissociation data was then compared to previously published values of biomechanical pulloff strength as well as to literature values for forces across the glenohumeral joint during ADLs.

RESULTS: The mean and 95% confidence intervals across all implants and all trials (n=90) was 1554 (116) with range 723-2730. Statistically significant differences existed between individual implants, but these differences did not trend toward being manufacturer dependent.

The overall mean load to dissociation in the present study was much lower than previously published values of 2996 and 3133 N. On the other hand, distractive loads in the current study were much higher than published maximum compressive load estimates of 577.6 N (75% BW for 78.5 kg person) across the glenohumeral joint during activities of daily living.

CONCLUSIONS: The distractive forces required to dissociate these well-seated prostheses are greater than predicted compressive glenohumeral joint forces during ADLs. It is doubtful that dissociation in vivo is due to a pure distractive force on a well-seated prosthesis. The limited data available does not support the assertion that one manufacturer's implant has an overall weaker taper that predisposes to dissociation. Additional work on combined distractive/rotational force evaluation is in progress.

♦ 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).

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