**Optimal Fixation for Horizontal Medial Malleolus Fractures**

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**Introduction:** This study evaluated the mechanical properties of four different fixation methods of horizontal fractures of the medial malleolus.

**Methods:** Identical horizontal osteotomies were created in synthetic distal tibiae using a jig. The specimens were randomly assigned to one of the four fixation groups (n = 10 per group) - plate: a contoured 2.0 mm mini-fragment 10-hole T-plate secured to the distal tibia using four 40.0 mm x 2.4 mm cortical screws; tension band: a standard figure-of-eight tension band was fashioned with 18-gauge wire and secured distally with two 2.0 mm diameter Kirschner wires placed parallel to each other; parallel screws: two 40 mm length, 4.0 mm diameter cancellous screws were placed parallel to each other; divergent screws: two 40 mm length, 4.0 diameter screws were placed with approximately 35° of divergence. The specimens were then tested using offset axial tension at 10 mm/minute until 2 mm of displacement occurred.

**Results:** The average stiffness was 177.7 +/- 26.2 N/mm for the plate group, 124 +/- 15.9 N/mm for the tension band group, 141.2 +/- 23.9 N/mm for the parallel group, 112 +/- 22.2 for the divergent group. The average stiffness of the plate construct was significantly greater than any of the other constructs. The average force at 2 mm of displacement was 362 +/- 72.2 N for the plate group, 266.7 +/- 43.0 N for the tension band group, 291.7 +/- 47.1 N for the parallel group, and 230.5 +/- 44.0 N for the divergent group. The average force at 2 mm of displacement was significantly greater with the plate construct than any other construct. The average force at 2 mm of displacement of the tension band, parallel, and divergent groups were not significantly different from each other.

**Conclusion:** Using a contoured 2.0 mm mini-fragment T-plate as the method of fixation resulted in a stiffer construct that required more force for 2 mm of displacement when used to stabilize an osteotomy model of a horizontal medial malleolus fracture.

**Caudal Pedicle Screw Compression Optimizes Thoracic Kyphosis Correction: A MicroCT and Biomechanical Analysis of Pedicle Morphology and Screw Failure**

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**Introduction:** As surgeons perform cantilever correction maneuvers in the spine, it is common to have pedicle screws pullout or displace while placing corrective forces on the construct. Currently, surgeons either compress against the cephalad aspect of the pedicle, or vice versa. The purpose of this study was to evaluate the bone density/trabecular width of the thoracic pedicle and correlate that with its resistance against compressive loading utilized during correction maneuvers in the thoracic spine (i.e. cantilever bending).

**Methods:** Fourteen fresh-frozen cadaveric vertebrae (n = 14) were examined by MicroCT to determine bone volume / total volume ratio (% BV/TV) within the cephalad and caudal aspects of the pedicle. Specimens were sectioned in the sagittal plane. Pedicles were instrumented according to the straightforward trajectory on both sides. Specimens were then mounted and loading to failure was performed perpendicular to the screw axis (either the cephalad or the caudal aspect of the pedicle).
Results: Mean failure when loading against the caudad aspect of the pedicle was statistically, significantly greater (454.5 + 241.3 N versus 334.79 ± 158.43 N) than for the cephalad pedicle. In concordance with the failure data more bone was observed within the caudal half of the pedicle (87.6% ± 3.5% versus 84.3% ± 6.0%) compared to the cephalad half.

Discussion and Conclusion: Our results suggest that the caudal aspect of the pedicle is denser and stronger compared to the cephalad cortex. In turn, the incidence of intra-operative screw loosening and/or pedicle fracture may be reduced if the compressive forces (cantilever bending during deformity correction) placed upon the construct are applied against the caudal portion of the pedicle.

Open Reduction and Intramedullary Nail Fixation of Closed Tibia Fractures

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Introduction: Indirect reduction and intramedullary nailing of closed fractures of the tibial shaft can be challenging. Fracture displacement as well as interposed bone and soft tissue can preclude anatomic reduction and prevent the passage of an intramedullary nail. When fractures cannot be accurately reduced and stabilized utilizing closed or percutaneous techniques, a formal open reduction can be performed. The purpose of this study was to evaluate the safety and efficacy of a formal open reduction prior to intramedullary nail fixation of the tibial shaft.

Methods: Using the trauma database at a level-I trauma center, 230 tibia fractures treated using intramedullary nail fixation over a period of 10 years by 3 fellowship trained orthopaedic trauma surgeons were identified. Closed fractures not associated with compartment syndrome and treated with formal open reduction prior to intramedullary nailing met inclusion criteria for this study. These fractures were matched based on AO/OTA fracture classification with a retrospective cohort of fractures treated with closed reduction and intramedullary nailing. Medical records were reviewed for evidence of complications and radiographs evaluated for healing and final alignment. Descriptive statistics were used for frequency and mean analysis and univariate analysis was performed.

Results: Eleven of 230 fractures met inclusion criteria for this study. These were compared with cohort of 21 fractures treated with closed reduction and intramedullary nailing. All fractures in the open reduction group united within 5 degrees of anatomic alignment in all planes. There were no infections or nonunions. In the closed reduction group, all fractures also healed within 5 degrees of anatomic alignment. There was one deep infection and one nonunion. Univariate analysis revealed that none of the differences between the study groups were significant.

Discussion and Conclusion: Closed reduction and intramedullary nailing remains the treatment of choice for most significantly displaced fractures of the tibial shaft, but there are circumstances in which this technique is not appropriate. In these situations, open reduction with respectful handling of the soft tissue envelope is as safe and effective as the closed technique.

Scrub Cap Contamination

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Introduction: Operating room sterility is controlled via scrubbing of the hands and donning surgical gowns and gloves. The area above the neck remains nonsterile and brushing of two heads over a wound may produce an iatrogenic infection. To examine this theory we tested take home surgical scrub caps against disposable scrub caps and simulated a casual brush in the operating room.

Methods: Twenty take home non-laundered surgical scrub caps were obtained from the orthopaedic resident population. One investigator donning sterile surgical attire in the operating room performed a replication of a casual brush measuring 6 inches between two non-laundered scrub caps 18 inches above a blood auger plate. After incubation for 48 hours a quantitative analysis of colony forming units (CFUs) was measured. This was repeated with the same caps after being laundered in their owner’s home. Disposable scrub caps that tie behind the head were used as a comparison. Six control plates were opened in the operating room for 30 seconds.

Results: Mean CFUs after incubation were as follows: disposable 0.86 ± 2.5 CFUs, home non-laundered 0.75 ± 1.5 CFUs, and home laundered 0.1 ± 0.31 CFUs. Chi square statistical analysis was used to compare observed and expected results
from each group measured against the control. Analysis of variance was used to compare the three means.

**Discussion and Conclusion:** There is no statistically significant difference between the quantity of CFUs formed between disposable, home non-laundered, and home laundered scrub caps. Although there was no statistically significant difference, mean comparison between the groups showed the take home laundered scrub caps formed the least amount of CFUs and disposable scrub caps formed the most.

**Temporal Assessment of Osteochondral Allograft (OCA) Transplants with T2 Mapping and Delayed Gadolinium-Enhanced MRI of Cartilage (dGEMRIC) at 1 and 2 Years**

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**Introduction:** We evaluated the biochemical health of transplanted OCA cartilage using dGEMRIC and T2 mapping and correlated those results with patient reported outcomes.

**Methods:** Eight patients with focal grade 4 ICRS articular cartilage defects of the femoral condyle were treated with single cylindrical OCA grafts. They were prospectively evaluated with dGEMRIC and T2 mapping at one and two years. The KOOS and IKDC subjective scores were obtained at baseline, one, and two years. Regions of interest (ROI) were drawn in repair (RC) and control (NC) cartilage. For T2 mapping, ROI were drawn in the deep and superficial layers of RC and NC. Raw T1 values were used to calculate several established dGEMRIC indexes including: relaxation rate (R1), change in relaxation rates ($\Delta R_1$) before and after contrast, and a relative change ratio between RC and NC for each ROI ($\Delta R_1\text{Rel}$).

**Results:** All patients reported significant improvement from baseline IKDC scores and all five subsets of the KOOS at 1 and 2 years. 6/8 patients had an increase in the $\Delta R_1\text{Rel}$ from one to two years. No correlations were apparent between the dGEMRIC $AR_1\text{Rel}$ and the IKDC score ($R = -0.20$) and the KOOS pain score ($R = -0.36$). Comparing NC and RC showed prolonged T2 values were seen in the superficial zone at 1 and 2 years. Qualitative analysis of T2 maps showed native cartilage at the OCA interface, circumferential to the graft, had fibrous tissue formation in 3/7 patients at 1 year and 4/7 patients at 2 years.

**Discussion and Conclusion:** No correlation was observed between patient reported outcomes and the $\Delta R_1\text{Rel}$. Quantitative T2 mapping and dGEMRIC demonstrated OCA cartilage undergoes some level of degeneration at 1 year and 2 years post implantation. The appearance of fibrous tissue formation at the OCA interface corroborates histological studies of OCA transplantation.

**Gender Differences in Non-Union and Malunion Following Midshaft Tibia Fractures**

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**Introduction:** Midshaft tibia fractures can cause lifelong disability. They occur predominately in males and treatment options vary. The purpose of this study was to compare 5 treatments for midshaft tibia fractures and to evaluate the treatment for non-union and malunion given gender.

**Methods:** Patients who underwent treatment for midshaft tibia fractures from 2004-2009 were identified by CPT code using a commercially available online database of private insurance billing records. Treatments included external fixation, intramedullary nailing, open treatment with internal fixation, closed treatment with and without manipulation/reduction. Records were cross referenced for non-union, malunion, and gender.

**Results:** In total, 23,418 patients were identified. Non-union developed in 209 (1%) patients and malunion in 52 (0.2%). ORIF yielded the highest incidence of non-union (2.5%). Incidence of non-union following external fixation was 2.3%, and following intramedullary (IM) nailing was 2.2%. Four patients (0.8%) in the external fixation group and 28 (0.5%) in the IM nailing group developed malunion. Of all males undergoing external fixation, 4 (1.1%) suffered non-union, whereas 8 (4.7%) of all females undergoing external fixation suffered non-union. Fourteen (1.1%) males and 2 (0.3%) females in the open treatment with internal fixation group developed malunion.
Discussion and Conclusion: Gender differences may exist in midshaft tibia fracture outcomes. Our study demonstrated a significant difference in gender with respect to non-union in the external fixation group and in malunion in the ORIF group. Further studies should examine this gender disparity.

**Combined Transplantation of Human Neuronal and Mesenchymal Stem Cells Following Spinal Cord Injury**

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**Introduction:** Transplantation of human fetal neural stem cells (hNSCs) has previously shown significant functional recovery after spinal cord contusion in a rat model. Other studies have indicated that human mesenchymal stem cells (hMSCs) can home to areas of damage and cross the blood brain barrier. We hypothesized that acute administration of hMSCs combined with subacute hNSCs would enhance functional recovery in spinal cord injury.

**Methods:** Female adult Long-Evans hooded rats underwent laminectomy at the T10 level. A moderate spinal cord contusion at the T10 level was induced by use of the MASCIS Impactor. 4 groups were identified for this study. Group 1 received hMSCs intravenously (IV) immediately after spinal cord injury (acute) and returned 1 week later (subacute) for injection of hNSC directly at the site of injury. Group 2 received hMSC IV acutely and cell media directly subacutely. Group 3 received cell media IV acutely and hNSC subacutely. Group 4 received cell media IV acutely and cell media subacutely. Subjects were assessed functionally following injury and then weekly for 6 weeks using the BBB Locomotor Rating Score.

**Results:** Twenty four subjects were utilized in this study, 6 subjects in each group. A statistically significant functional improvement was seen in the MSC+NSC group and the NSC-only group compared with control (\(p = 0.027\) and 0.042, respectively), but the MSC-only group did not demonstrate a significant improvement over control (\(p = 0.145\)). Comparing the MSC+NSC group and the NSC-only group, there was no significant difference (\(p = 0.357\)).

Discussion and Conclusion: The subacute transplantation of hNSCs into the contused spinal cord of a rat led to significant functional recovery when injected either with or without the acute IV administration of hMSCs. Neither hMSCs-alone nor the addition of hMSC to hNSC treatment resulted in significant functional improvement.

**Biomechanical Evaluation of Mean Articular Screw Distance and Medical Calcar Support in Proximal Humerus Fractures Treated with Locked Plating**

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**Background:** Medial calcar reduction in proximal humerus fractures is important for preventing varus collapse. It remains unknown whether inferior-medial screw support alone is sufficient to prevent varus collapse and the biomechanical implications of the distance from screw tips to subchondral bone.

**Methods:** Nine paired fresh frozen humerii were divided into intact medial calcar (+MC) or missing medial calcar (-MC) groups through surgical neck osteotomies. Osteotomies were reduced and fixated with a proximal humeral locking plate prior to cyclic varus loading. Specimen survival, varus angulation, screw penetration through articular cartilage, and mean articular distance of the screw (MADS) (distance from screw tip to subchondral bone) on fluoroscopic imaging was recorded. Logistic regression, linear regression, Chi-squared, and Student’s t-test analyses were utilized with an alpha value of 0.05 set as significant.

**Results:** Eight of 9 (89%) –MC specimens failed during cyclic loading versus 3 of 9 (33%) +MC specimens (\(p = 0.047\)). Total cycles endured were greater in the +MC group (3,587 vs. 1,606; \(p = 0.06\)) while varus angulation was significantly increased in the –MC group (23.4 vs. 11.6 degrees; \(p = 0.04\)). There were no cases of screw penetration though the articular surface in any case. Linear regression showed significance in correlating MADS and varus angulation during cyclic loading. A MADS of 5 mm correlated with a 7.8% failure rate in +MC specimens.

**Conclusions:** Inferior locking screws do not fully biomechanically compensate for lack of medial calcar support and
decreased MADS correlated with a lower risk of biomechanical failure.

### Early Failure of Anterior Pelvic Ring Fixation

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**Introduction:** The purpose of this study is to present a series of patients with pelvic ring injuries who experienced pubic symphysis plate failure within 7 weeks and report associated injury and patient factors.

**Methods:** Through a retrospective review of a prospectively collected trauma database, 126 patients sustained a pelvic ring injury treated with anterior and posterior ring fixation were identified from December 2009 to December 2011. Surgical intervention included open pubic symphysis stabilization with a flexible 3.5 millimeters (mm) reconstruction plate and percutaneous iliosacral screws. Patients were toe-touch weight bearing on the injured side. Each patient’s chart and radiographs were reviewed for pertinent information listed below.

**Results:** Fourteen patients sustained early failure of their anterior ring (11.1%). All patients were male. Average age was 49.3 years. AO/OTA classification showed 11 patients with 61-B1.1 injuries, 2 patients with C1.2 injuries, and 1 patient with a 61-B2.2 injury. 13 patients were classified as APC-II injuries and 1 patient sustained an APC-III injury. Mechanism of injury in the early failure patients was 42% equestrian and 29% fall from height. Time until anterior plate failure was 29 days. 13 of 14 plates (93%) failed through the parasymphyseal holes. Average displacement at time of radiographic failure was 12.4 mm. Average increased displacement noted at final clinical follow-up was 2.6mm. 2 patients required revision surgery. Four patients were noted to be non-compliant prior to failure.

**Conclusion:** Anterior ring fixation failure before 7 weeks is not uncommon. Equestrian injuries represent a high percentage of early failures. Further displacement after initial failure was not substantial. Early fixation failure is not an absolute indication for revision surgery. Patient education is critical to help ensure postoperative compliance. Robust posterior ring fixation may minimize further displacement. Functional outcome studies are needed to determine the long-term outcome of patients with early failure.

### Plateau-Patella Angle in Evaluation of Patellar Height in Osteoarthritis

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**Introduction:** Patellar height has been measured using ratios from the lateral knee radiograph such as the Insall-Salvati, Caton-Deschamps, and Blackburne-Peele ratios. The patella-plateau angle (PPA), recently introduced as a new and simpler method of measuring patellar height, has the advantage of simplicity as it involves a single angular measurement without calculations. This method has not been validated in knees with osteoarthritis. The purpose of this study was to assess the applicability of the PPA in knees with moderate to severe osteoarthritis as a measurement for patellar height.

**Methods:** Three hundred one patients who underwent total knee arthroplasty at our institution were identified and radiographs prior to surgery were evaluated. Three observers, with different levels of orthopedic training, measured PPA, Insall-Salvati, Caton-Deschamps, and Blackburne-Peele indices on a subset of fifty consecutive patients. Two observers evaluated the entire cohort. Intraobserver agreement for the patella-plateau angle and interobserver agreement between all ratios were calculated.

**Results:** The mean PPA for the entire cohort was 25.33 and 25.62 for the two observers. The intraobserver reliability concordance correlation coefficient (CCC) was 0.92. The CCC for the interobserver reliability was the highest for the PPA compared to the other ratios. The interobserver reliability increased with the experience of the observer in all four measurements.

**Discussion and Conclusion:** The patella-plateau angle is a rapid and reliable way to evaluate patellar height in the osteoarthritic population. The measurement demonstrated a higher interobserver reliability in comparison to the previously described methods.
A Safe Protocol for Regional Anesthesia in Tibia Fractures

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Introduction: Local anesthetics provide consistent pain relief during surgical fracture treatment, but may delay compartment syndrome diagnosis. We implemented a protocol in patients with tibia fractures assessed to be at moderate or low risk of compartment syndrome. This study describes the protocol and reports its safety with an initial patient cohort.

Methods: A retrospective chart review was completed from May 2007 through December 2009. Patients are divided by surgeon into risk groups for compartment syndrome - high, moderate, and low risk. High risk patients receive no regional anesthesia. For the moderate risk group, the anesthesiologist provides a sciatic and/or saphenous nerve catheter with short acting local anesthetic infusion (lidocaine 1.5% or ropivacaine 0.2%). If any signs of compartment syndrome arise on postoperative neurovascular checks, the infusion is stopped. After 30 minutes, the regional anesthetic has worn off and the physician can examine the limb unencumbered by any nerve block. Low risk patients have their catheter loaded with high dose ropivacaine 0.5%.

Results: Three hundred seventy-four tibia fractures were treated during the study period. Sixty-one fractures in 50 patients received a regional anesthetic. The group includes 18 plateau, 2 shaft, and 41 distal tibia fractures. Risk factors for compartment syndrome were collected. Thirty-seven patients with moderate risk factors had a low dose ropivacaine infusion. A high dose, long acting regional block was used in 24 low risk patients. The incidence of compartment syndrome was zero.

Discussion and Conclusion: Regional anesthesia may be safely utilized for intraoperative and postoperative analgesia. Preferential use of infusion catheters with low dose ropivacaine rather than long lasting single shot blocks allow for more accurate dosing of the regional anesthesia and the ability to turn the block ‘on’ or ‘off’ as needed for pain control or compartment syndrome assessment.

PASTA Bridge — A New Technique in PASTA Repairs: A Biomechanical Evaluation of Construct Strength vs. Suture Anchors

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Introduction: To verify the biomechanical strength of our new technique for PASTA lesion repairs: the PASTA Bridge.

Methods and Materials: A 50% articular-sided partial tear of the supraspinatus tendon was created on six matched pairs of fresh frozen cadaver shoulders. From each matched pair, one humerus received a PASTA repair using one 4.5 mm titanium Corkscrew FT with a horizontal mattress suture while another received a PASTA Bridge. For the PASTA Bridge, a percutaneous 2.4 mm BioComposite SutureTak was placed twice for the anterior and posterior anchors. A strand of suture from each anchor was tied in a similar manner as the “double pulley” method. The opposing two limbs were tensioned and fixated laterally with a 4.75 mm BioComposite SwiveLock. Each sample was pre-loaded to 10N followed by cyclic loading between 10 and 100N, at 1 Hz, for 100 cycles. Post cycling, the samples were loaded to failure at a rate of 33 mm/sec. Load and position data were recorded at 500 Hz, and the mode of failure was noted for each sample. Displacement and strain was calculated using video tracking and individual marks on the supraspinatus.

Results: There were no significant differences between the two repairs in ultimate load, strain at the repair site, or strain at the margin. The modes of failure were tendon tearing mid-substance, humeral head breaking, muscle body tearing from the tendon, or tendon tearing at the repair site. Visual inspection of the samples post-testing revealed no damage to the anchors or suture damage.

Conclusion: Our PASTA Bridge creates a very strong construct with no significant difference between this and a standard single suture anchor for ultimate load or strain. This technique, in contrast, is a percutaneous, simple procedure requiring no arthroscopic knot tying and carries only a minimal risk of damage.
Prevention of Post-Operative Osteopenia Using IV Pamidronate: A Pilot Study

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Introduction: Post-operative bone mineral loss, especially following cast immobilization and/or non-weightbearing, is a well-known phenomenon in children that can cause fracture. Children with marginal bone density are at greatest risk. This prospective randomized control trial compared the effect of single dose IV pamidronate vs. placebo on post-operative bone mineral density (BMD) loss.

Methods: Children between the ages of 4-18 were recruited for the study: inclusion criteria included a condition predisposing to low bone density, and hip or lower extremity surgery requiring cast immobilization or non-weightbearing for at least four weeks. Dual energy x-ray absorptiometry (DXA) scans of the lumbar spine and bilateral distal femora were done pre-operatively and at least 4 weeks post-operative. Subjects were randomized to receive either a single dose of IV pamidronate (1mg/kg) or placebo, given in the immediate post-operative period. Changes in bone mineral density were compared using the Mann-Whitney test for significance in the lumbar spine. A multivariate general linear model was used to compare the effect of surgery, DXA region, and treatment on BMD.

Results: Twenty-four subjects entered into the study, and 20 completing the protocol. Pamidronate-treated subjects showed a statistically significant difference with a median gain in BMD of 0.029 gm/cm^2 in the lumbar spine compared to the control group, which showed a median loss of 0.025 gm/cm^2. Treatment did not have a significant effect on BMD loss in the distal femur, but trended toward decreased BMD loss (treatment=0.0331 gm/cm^2, control 0.0416 gm/cm^2). There were no complications or adverse reactions.

Discussion and Conclusion: The results of this small pilot study show that single dose post-operative pamidronate is safe and may prevent post-operative BMD loss in at risk children, which may decrease post-operative fracture risk. Further investigation into the use of IV pamidronate in post-operative patients is warranted.

*The FDA has not cleared this drug and/or medical device for the use described in this presentation. (Refer to page 39).

EOS Imaging of Human Pelvis: Reliability, Validity, and Controlled Comparison with Plain Radiography

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Introduction: The new 3-D imaging technique demonstrates a unique modality combining low radiation with high image quality. As its applications for pelvic imaging is likely to progress with time we performed a pilot study to evaluate validity and reliability of this technique for assessing pelvic and acetabular morphology.

Methods: A human cadaveric pelvis model was utilized to perform consecutive conventional and 3-D imaging radiographs in 5° intervals of sagittal tilt and axial rotation (range: -15° to 15°). Within each image, six measurements were obtained: 1) verticaland, 2) horizontal distance between mid-point of sacrococcygeal joint and mid-point of the upper border of the symphysis, 3) inter-ASIS distance, 4) inter-facetal distance at S1, 5) Sharp's, and 6) Tönnis angle. In addition, coxa profunda and cross-over signs were identified. Findings with both imaging techniques were correlated with each other and with true linear measurements taken from the pelvis. For reproducibility assessment, all measurements were performed by two independent investigators and one observer repeated all measurements. Both investigators were blinded to the true linear measurements obtained from the cadaver model.

Results: We noted a strong correlation between conventional and 3-D imaging radiography (Pearson correlation range: 0.644 - 0.998) and high intra-/inter-observer reproducibility for both modalities (intra-class-correlation range: 0.795 - 1.000). The coxa profunda evaluation reached 100 % agreement for intra- and inter-observer whereas the agreement on the presence of cross-over-sign was marginally less with the intraobserver (96.2 %) and the inter-observer (92.3 %) comparison. Due to distortion caused by magnification with conventional radiographic imaging we also noted significant differences between the two modalities affecting linear measurements (p < 0.05).

Conclusions: The 3-D imaging technique is reliable for assessing pelvic and acetabular morphology, thus proving to
be a serious alternative to plain radiography for primary imaging in the pediatric population and potentially adults as well.

**Clinical Relevance:** This pilot study provides the basis for further prospective in-vivo studies that are essential to substantiate current plain radiographic indices, parameters and grading systems.

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**Prevalence of Spondylolisthesis and Concomitant Adolescent Idiopathic Scoliosis**

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Kathy Blanke

**Introduction:** The association of spondylolisthesis and adolescent idiopathic scoliosis (AIS) has never been thoroughly evaluated. Failure to appropriately identify a concomitant spinal disorder may result in inappropriate treatment and suboptimal outcomes. We set out to determine the prevalence of patients with both spondylolisthesis and AIS.

**Methods:** A prospective, multicenter database and radiographs were reviewed. All available radiographs were evaluated for the presence of AIS and spondylolisthesis. Patients were analyzed in three groups, which included: Group I – AIS patients requiring fusion (n = 1132); Group II – symptomatic spondylolisthesis requiring fusion (n = 66); and Group III – asymptomatic spondylolisthesis (n = 149).

**Results:** The radiographs for 1,266 patients were reviewed. In Group I, adequate radiographs were available for 1076 patients, and 47 (4.38%) were found to have concomitant spondylolisthesis. In Group II, adequate radiographs were available for 48 patients, and 14 (29.2%) were found to have concomitant true scoliosis, as well as 9 (13.6%) with sciatic scoliosis. In Group 3, adequate radiographs were available for 142 patients, and 28 (19.7%) were found to have concomitant true scoliosis, as well as 13 (9.2%) with sciatic scoliosis.

**Discussion and Conclusion:** Our results suggest symptomatic and asymptomatic spondylolisthesis are associated with concomitant scoliosis in approximately 20-30% of patients. Therefore, routine scoliosis evaluation should be considered in patients presenting with symptomatic and asymptomatic spondylolisthesis. In contrast, prevalence of AIS requiring fusion with concomitant spondylolisthesis was relatively uncommon (4.38%).

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**Soft Tissue Shadow on Lateral Cervical Spine Radiograph Does Not Predict Development or Severity of Chronic Dysphagia**

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Jung U. Yoo, MD

**Introduction:** Dysphagia is commonly reported in the early postoperative period following anterior cervical spine surgery. Although prevertebral soft tissue swelling (STS) has been hypothesized as a potential risk factor for development of chronic dysphagia, this has not been previously studied. This study is a longitudinal radiographic evaluation of the STS and its relationship to the problem of chronic dysphagia in patients undergoing anterior cervical surgery.

**Methods:** We retrospectively reviewed the medical records and radiographs of patient who underwent elective anterior cervical surgery from our institution during the period of 2008-2011. Patients with preoperative dysphagia were excluded. To be included in the study, the follow up of greater than 6 months and lateral cervical radiographs at preoperative, immediate postoperative, 6 week and 3 month were required. Soft tissue shadow was measured at the lower endplates of C2 and C6. Presence and severity of dysphagia was evaluated prospectively using previously published Bazaz-Yoo Scale.

**Results:** Sixty-seven patients met the inclusion criteria. Soft tissue shadow was greatest at immediate postoperative x-ray measuring 10.9 ± 4.7 mm at C2 and 18.9 ± 5.5 mm at C6 from preoperative measurements of 4.5 ± 1.7 mm and 14.5 ± 3.7 mm, respectively. By 6 weeks, these measurements returned to baseline levels. The prevalence of dysphagia was 73% (21% mild, 39% moderate, and 13% severe). There were no statistically significant differences in the measurements between patients with and without dysphagia. Also there were no significant differences in soft tissue shadow between mild, moderate and severe dysphagia patients.
Discussion and Conclusion: Although marked increase in the STS in the immediate postoperative period may be responsible for dysphagia in the acute stage of recovery, soft tissue shadow at immediate postoperative period, 6 weeks or 3 months does not predict the presence or severity of chronic dysphagia.

**Poster 17**

**Correction of Lumbar Hypolordosis with Smith-Petersen Osteotomy and Transforaminal Interbody Fusion**

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**Introduction:** The Smith-Petersen osteotomy (SPO) and pedicle subtraction osteotomy (PSO) represent polar alternatives in the correction of lumbar hypolordosis. SPO is a simple technique that yields less potential correction, whereas PSO provides substantial correction, but with greater technical difficulty and operative risk. The purpose of this study was to evaluate the radiographic results of coupling a Smith-Petersen osteotomy with a transforaminal lumbar interbody fusion (SPO + TLIF) for the correction of lumbar hypolordosis.

**Methods:** We retrospectively reviewed the medical records and radiographs of patients who underwent SPO + TLIF to correct lumbar hypolordosis. Operative and perioperative data was collected. The Cobb angle was used to measure the overall lumbar lordosis and focal lordosis at the osteotomy level on lateral lumbar radiographs. Radiographic measurements were made on preoperative, postoperative, one year and two year films.

**Results:** Fourteen patients underwent SPO + TLIF with an average age of 64 years (47–77). Eleven patients had both one-and two-year follow-up. The average focal correction at the osteotomy level at one and two years was 13.6 ± 7.7 degrees and 13.4 ± 6.1 degrees. The average correction in overall lumbar lordosis at one and two years was 17.6 ± 11.9 degrees and 15.1 ± 10.6 degrees. Blood loss averaged 2132 ml, operating time averaged 452 minutes, and hospital stay averaged 9.7 days. Five patients experienced complications, which included excessive blood loss, unplanned termination of procedure, wound infection, epidural hematoma and cardiac arrhythmia.

**Discussion and Conclusion:** We achieved an average increase in focal lordosis of 13.4 degrees at two years using SPO + TLIF. Although five patients experienced complications, all underwent more extensive procedures at the time the osteotomy was performed. Our results indicate that SPO + TLIF may represent an intermediate option in the correction of lumbar hypolordosis.

**Poster 18**

**Tether Location in Adolescent Idiopathic Scoliosis by 3-D CT Analysis**

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**Introduction:** Adolescent idiopathic scoliosis (AIS) progresses rapidly during growth and always has rotation. Both of these strongly suggest the presence of a tether. This study was to attempt to identify any existing midline tether by the analysis of AIS CT scan data.

**Methods:** Eleven AIS and 8 normal CT scans were analyzed. Six midline points A through F were selected and corrected to the same horizontal plane for each vertebral body and converted to X, Y , and Z points. The distances for each point from each vertebral body to the next were calculated then summed. The point (A through F) with the shortest total distance would be the closest any existing tether. The shortest distance was considered the baseline length and was subtracted from the total lengths for all 6 points. Thus the shortest length would be zero. The remaining lengths for all of the points for all of the AIS CT scans were summed and placed on a bar graph showing the cumulative remaining lengths for all of the AIS patients.

**Results:** The controls showed a little random noise. The AIS results strongly, graphically pointed to the point just posterior to the ligamentum flavum on the spinous process as having the shortest length was therefore the closest to the midline tether.

**Discussion and Conclusion:** This analysis not only confirms the presence of a tether in AIS, it localizes it to a very specific location. This analysis was possible because a tether will also act as an axis of rotation, and it is the rotation that changes the measured lengths of the various points to being greater than the baseline length measurement. The question is now how to best confirm this observation, and if confirmed, how should it affect treatment.
**Poster 19**

**Minimally Invasive Total Knee Arthroplasty: A Retrospective Review of Function and Survival Stratified by BMI**

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**Introduction:** A less invasive surgical approach is thought to provide additional benefits to the total knee arthroplasty (TKA) patient. Expected benefits would be; shorter hospital stay, less knee pain, quicker rehabilitation, and good long-term results with function. Studies have shown that performing TKA on high BMI patients may increase mobility, leading to improved quality of life. The purpose of this study is to determine whether the outcomes of a minimally invasive TKA in the high BMI patient are as good as, or better than those patients of ideal BMI.

**Methods:** One hundred forty patients underwent minimally invasive surgical (MIS) total knee arthroplasty. We used the median parapatellar approach. BMI was used to stratify patients into one of three categories: high BMI (30 or greater), overweight (25-29.9), or normal weight (18.5-24.9).

Measured parameters included hospital stay length, pain ratings (VAS), American Knee Society Scores, and, SF-12 surveys. Outcomes were assessed preoperatively, at 3 months, 6 months, 1 year, and 2 years.

**Results:** The MIS-TKA patients with high BMI had a shorter length of stay, when compared with the patients from the overweight and normal weight categories. These patients also exhibited slightly less knee pain and higher Knee Society scores at several of the time intervals. When the results for other parameters were not better for the MIS-TKA patients with high BMI, they were close to the results for patients in the overweight and normal weight categories. Pain medication frequency was also, on average, less for the MIS-TKA patients in both the high BMI and overweight categories.

**Conclusion:** Many of the outcomes for the high BMI patient receiving a MIS-TKA were just as good, and at some intervals better, than those for the patients of ideal BMI. Our findings suggest that MIS TKA is an option for patients with high BMI.

**Poster 20**

**Demographic Differences in Adolescent- and Adult-Diagnosed Acetabular Dysplasia Compared to Infantile Developmental Dysplasia of the Hip**

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**Introduction:** Acetabular dysplasia is a common cause of hip pain that can lead to premature osteoarthritis (OA). This study explores whether demographic characteristics of patients diagnosed with acetabular dysplasia (AD) in adolescence and adulthood differ from those who are diagnosed with developmental dysplasia of the hip (DDH) in infancy.

**Methods:** Chart review identified 633 patients who underwent periacetabular osteotomy for dysplasia from August 1991 to January 2008. Excluding patients with syndromal conditions and 80 patients lacking contact information, 421 patients received a questionnaire regarding birth and family history; 324 (70.3%) completed the survey.

**Results:** Respondents were divided into two groups according to whether they had a history of DDH in infancy (97 patients) or were diagnosed in adolescence/adulthood (227 patients). Statistically significant differences were found in gender distribution (female: DDH = 97.9%, AD = 85.9%), affected limb (left hip: DDH = 42.3%, AD = 26.0%), bilaterality (DDH = 25.8%, AD = 39.2%), and breech presentation (DDH = 26.6%, AD = 9.6%). Over 50% of all respondents had a first-degree family member with hip disease and over 40% with premature hip OA. Affected family members of patients with AD were significantly more likely to have had hip replacement by age 65 (54.2% vs. 25.0%).

**Discussion and Conclusion:** This study confirms there are significant demographic differences between patients diagnosed with hip dysplasia in infancy versus adolescence/adulthood, which supports the hypothesis that these may represent distinct forms of dysplasia. In both, there is a familial tendency toward hip disease with a higher incidence of arthroplasty in the AD group’s family members. These findings warrant further epidemiological and genetic study. Periacetabular osteotomy is effective if performed before there is substantial joint damage. Infant DDH is diagnosed with neonatal exam, but AD diagnosis is delayed until symptoms develop.
This study supports screening for AD in younger family members of patients with hip OA to facilitate early detection of at-risk hips.

**Arthroscopic Hip Labralization**

Dean K. Matsuda, MD

**Summary:** Arthroscopic hip labralization is a relatively simple and fast procedure without harvest morbidity that can be performed in patients requiring rim reduction with early encouraging outcomes.

**Introduction:** Arthroscopic hip labral reconstruction has been used in the management of the non-salvageable labrum in hopes of restoring labral function and enhancing hip preservation. Optimal candidates may be relatively young active patients without significant coxarthrosis. For patients with non-salvageable labrae that are older and/or have somewhat more chondral damage, we have developed an arthroscopic alternative to labral debridement or reconstruction. By preserving articular cartilage in the region of labral deficit with meticulous rim trimming, the resultant undermined free chondral margin (“pseudolabrum”) may immediately restore a fluid seal function and may theoretically enhance hip preservation.

**Methods:** All patients from our database that underwent arthroscopic hip labralization met our inclusion criteria of cam-pincer FAI diagnosis and the index procedure plus acetabulo- and femoroplasty with completed preoperative and post-operative nonarthritic hip scores (NAHS) with minimum 1 year follow-up. There was 100% participation. Patients were also queried as to satisfaction and electronic medical record review was performed. Our preliminary clinical outcomes and surgical technique video are presented.

**Results:** Six patients (1 male, 5 female) of average age 47 years (range 37-54) with pre-operative diagnoses of cam-pincer femoroacetabular impingement with average follow-up of 21 months (range 12-35) underwent arthroscopic hip labralization along with acetabulofemoroplasty. Patient satisfaction was high (4 highly satisfied, 2 satisfied). Pre-operative NAHS averaged 52 (range 24-77) and post-operative NAHS averaged 90 (range 76-100) with an average improvement of 38 (range 9-63)(statistically significant). There were no complications, revision surgeries or conversions or scheduled conversions to total or resurfacing arthroplasties.

**Discussion:** By restoration of the labral fluid seal effect for symptomatic improvement and theoretical hip preservation, arthroscopic labral reconstruction is emerging with encouraging outcomes. Patients with severe anatomic and/or functional labral insufficiency deemed borderline candidates for reconstruction may benefit from hip labralization as an attractive option to labrectomy or reconstruction. It is a relatively simple and quick procedure without harvest morbidity that can be performed in patients undergoing rim reduction while offering the potential for immediate fluid seal restoration. Further investigation is merited to determine if our findings are durable, hip-preservative, and comparable to those of labral reconstruction if studied with similar cohorts.

**Conclusion:** Arthroscopic hip labralization offers an attractive option to labrectomy and labral reconstruction with early encouraging outcomes in select patients with severe labral insufficiency.

**Protrusio Acetabuli: Contraindication or Indication for Hip Arthroscopy?**

Dean K. Matsuda, MD

**Introduction:** Protrusio acetabuli has been considered a contraindication for hip arthroscopy. “Insurmountable” technical challenges relating to traction, hip access, and posterior acetabular procedures have been cited as reasons for limiting the surgical management of severe global pincer femoroacetabular impingement to more invasive open methods. As a rare and most extreme form of global pincer femoroacetabular impingement, we present the case of a 33-year-old man with bilateral symptomatic global pincer and cam femoroacetabular impingement. The purpose is to show the ability to perform femoroacetabular impingement surgery of severe deformities previously considered impossible to treat via completely outpatient arthroscopic means with successful preliminary outcomes.

**Methods:** We describe key arthroscopic steps permitting central compartment access, subtotal acetabuloplasty, labral reconstruction, and femoroplasty of the right hip, followed by later subtotal acetabuloplasty, labral refixation, and femoroplasty of the left. Pre-operative and 2-year post-operative nonarthritic hip score (NAHS) are reported for the right protrusio hip treated with arthroscopic intervention.

**Results:** The patient reported a 54-point post-operative increase in NAHS (34 to 88) at 2 years post-surgery and very
high satisfaction. Post-operative radiographs showed reduction of anterior, posterior, and superior overcoverage, the latter assessed with a 14 degree improvement in the right CEA (56 to 42) and improved anterior femoral offset without progressive joint narrowing or femoral head medialization.

**Discussion / Conclusion:** Albeit challenging, global pincer impingement, even acetabular protrusion, may be successfully managed with dual-portal outpatient hip arthroscopy. The modified midanterior portal enables central compartment access and extended posterior "reach" in the arthroscopic management of this most extreme form of global pincer FAI, potentially making this contraindication a historical one while respectfully challenging the "global" recommendation for open surgery in this setting. Although a rare condition, by documenting the successful management of the most severe form of global pincer FAI, lesser global deformities may now be considered for outpatient arthroscopic intervention.

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**Early Experience with Unlinked Patellofemoral and Unicompartmental Knee Arthroplasty**

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**Introduction:** The success of UKA in patients with medial or lateral tibiofemoral OA of the knee has been well documented. For those patients who do not meet the criteria for UKA due to excessive patellofemoral disease, the procedure of choice has been total knee arthroplasty. There is an increasing population of patients who are keen to avoid total knee arthroplasty but have arthroplasty level disease in 2 compartments. By resurfacing only the 2 involved compartments, we achieve the goals of addressing the areas of arthritic involvement while preserving the opposite asymptomatic tibiofemoral compartment and cruciate ligaments.

**Materials and Methods:** From 5/7/2010 to 12/9/2010 there were 8 patients who met the indications for 2-compartment knee arthroplasty and were also interested in avoiding total knee arthroplasty. There were 5 males and 3 females. Three patients underwent surgery at a hospital as an inpatient and 5 were done as outpatient procedures at an ASC (ambulatory surgery center). A fixed bearing unicompartmental knee system was used for the tibiofemoral (UKA) portion and a knee cap implant was used for the patellofemoral portion (PFA).

**Results:** There were no complications in either group. By 4 weeks postoperative all patients were ambulating well without walking aids. Tourniquet time average was 85 minutes. Those patients having the procedure done as an outpatient stayed an average of 90 minutes postoperatively while those having the procedure done in the hospital stayed an average of 3 days postoperatively. At minimum one year follow-up, all patients had good or excellent clinical scores, no evidence of disease progression or component failure radiographically, and had not undergone additional surgery on the knee.

**Conclusion:** Unlinked 2-compartment knee arthroplasty (UKA with PFA) is an intriguing alternative to TKR in younger more active patients who have 2 compartments with arthroplasty level arthritis of the knee. The early good results of this cohort suggest that this approach is worth continued use but with carefully selected patients and close follow up to track survivorship of implants and monitor for disease progression.

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**Evaluation of Trends in the Surgical Treatment of Meniscus Tears**

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**Introduction:** Arthroscopic meniscectomy of the knee is one of the most common orthopaedic procedures performed. The purpose of this study was to investigate current trends in arthroscopic meniscectomy and meniscal repair across time, gender, age, and regions in the United States.

**Methods:** Patients who underwent arthroscopic meniscectomy (CPT code 29881/29880) and arthroscopic meniscal repair (CPT code 29882/29883) were identified using a national database of insurance records during years 2004-2009. CPT codes 29881 and 29882 were cross-referenced with ICD-9 codes 836.0 (medial) and 836.1 (lateral) to determine treatment site. Factors identified for each patient included gender, age group, and region in the United States.

**Results:** From 2004 to 2009 there were 187,607 cases of arthroscopic medial or lateral meniscectomy and repair identified. Ninety-six percent of patients underwent a meniscectomy compared to repair. Over the time period, there was no change in the rate of medial meniscectomy and a small but
statistically significant decrease in rate of lateral meniscectomy. The rate of medial meniscal repair decreased over time while no significant change was observed in the rate of lateral meniscal repair. Meniscectomy was most commonly performed in patients aged 50-59 years. Conversely, meniscus repairs were most frequently observed in patients aged 10-19 years. All procedures were performed more frequently in males, and this difference was greatest with meniscal repair (63% male; 37% female) compared to meniscectomy (53% male; 47% female). Overall, there were no significant differences in regional trends.

**Conclusion:** In arthroscopic knee surgery, meniscectomy is much more common than repair and is more common in older age patients. Conversely, repair of a medial or lateral meniscus tear was more common in the younger age groups. Despite advances in meniscal repair techniques and devices, the analysis did not show an overall increase in meniscal repair compared to meniscectomy over the study period.

**Complication Rates for Spinal Fusion are Associated with a Number of Perioperative Factors, but Their Influences are Dependent on ASA Classification**

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**Introduction:** Major medical complications are frequent occurrences in spinal arthrodesis and often lead to poor results. We have systematically examined our patients undergoing an elective thoracic/lumbar fusion to establish the prevalence of medical complications and associated risk factors.

**Methods:** Our retrospective study reviewed the clinical course of 709 patients undergoing spine fusion surgeries between 2007 and 2011. We evaluated the rate of major medical complications within the 30-day postoperative period with respect to American Society of Anesthesiologists (ASA) score, age, sex, operative time, number of levels, EBL, fluids, and intra-operative vital signs (temperature, mean arterial pressure, heart rate).

**Results:** The major determining factor was ASA classification. The overall rate was 20% for ASA 3-4 and 7% for ASA 1-2. The factors such as operative time, total levels, EBL and fluids were only important for ASA 3-4 patients. They did not influence the rates for ASA 1-2 patients. For example, the rate in the ASA 1-2 group rose from 5.2% for 1 level fusion to 7.7% for 9-22 levels, while the ASA 3-4 group rose from 5.8% to 29.4%. Similarly, the rate for the operative time of 1-3 hours was low for both groups (7% and 13% for ASA 1-2 and ASA 3-4), but when the operative time was >6 hours, the rate for the ASA 1-2 group remained low (10%), while the ASA 3-4 group markedly increased (30%). There was no statistically significant difference in the rates for sex, mean arterial pressure or heart rate. However, lower intra-operative body temperature was associated with a lower rate for ASA 3-4 patients.

**Discussion and Conclusion:** This study demonstrates that the ASA score is a strong predictor of risk following elective thoracic/lumbar arthrodesis, and all other factors must be evaluated not as independent factors, but dependent factors to ASA score.

**Responsiveness of Performance-Based Knee Function Tests in Patients Following Arthroscopic Meniscectomy**

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**Introduction:** Patient questionnaires are currently used to evaluate for knee dysfunction associated with knee injury and osteoarthritis. As questionnaires can be subject to psychosocial factors, they may not accurately reflect underlying joint function. A prior study established the reproducibility of 9 performance-based knee function tests. This study examines the responsiveness of the performance-based tests following arthroscopic meniscectomy.

**Methods:** A battery of 9 performance-based tests was designed to evaluate knee movements essential to everyday living. The battery includes active and passive range-of-motion (ROM), stair ascent, stair descent, sit-to-stand, step-
ups, step-downs, star lunges, and 6-minute treadmill travel. Thirty-five patients undergoing arthroscopic partial meniscectomy completed the test twice, 1 week preoperatively and 6 weeks postoperatively. At each visit, patients also completed the Knee Injury and Osteoarthritis Outcome Score (KOOS). Wilcoxon rank sum test was used to compare mean change and Spearman correlations were computed to compare the magnitude of change in knee function tests and KOOS subscales between the two visits.

Results: Patients were on average 44±13 years-old, BMI 27.2 ±4.8 kg/m2, and 71% male. All performance-based tests improved significantly 6 weeks after partial meniscectomy. Active and passive ROM improved the least, each with a 4% increase. The greatest improvement in performance was observed with stair descent (13%) and sit-to-stand (15%). Similarly all KOOS subscales improved significantly following surgery. KOOS Pain scores improved 32%, Symptoms 32%, Activities of Daily Living 22%, Sports and Recreation 48%, and Quality of Life 65%. Correlations between the change in KOOS Activities of Daily Living and performance-based tests were weak (r ranging 0-0.41).

Discussion and Conclusion: All 9 performance-based knee function tests are responsive to patients undergoing partial meniscectomy. The weak correlation between improvements in performance-based tests and questionnaires indicates these measures may reflect distinct information about actual joint mechanics versus patient perception of knee-related function.

Novel Surgical Treatment for Sacroiliitis

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Introduction: At the turn of the 20th century, the sacroiliac joint (SIJ) was often diagnosed to be the primary pain generator of low back pain (LBP). In many cases, this was successfully treated with an open fusion of the SI joint. Recently, interest in the SI joint as a LBP generator has renewed, and surgical treatment options have improved. Sembrano and Polly (2009) reported that the SIJ is a pain generator in approximately 15% of patients with LBP. This retrospective study reports on the early findings of SIJ pain patients treated with an MIS procedure to promote fusion of the SI joint.

Methods: Five patients with pre- and post-operative pain and function scores, and post-operative satisfaction scores were followed for up to one year. Each patient was diagnosed for SIJ pain using a consistent diagnostic algorithm. Patients were then treated with porous plasma-coated MIS implants placed laterally across the SIJ through an incision of approximately 3 cm. Patients were followed for up to one year and mean pre-operative and post-operative pain scores were compared using a paired t-test at each time point with a level of significance of 0.05 (p < 0.05).

Results: 4 patients were female, and 1 was male. Post-operative pain and function scores were significantly lower at each time point (p < 0.05). For example, when asked “How much pain are you in at this time?” (scale 1-10), at 12 months the scores improved from 7.2 to 3.3. Additionally, at least 80% of the patients were satisfied.

Discussion and Conclusion: The findings of this retrospective study suggest that SI joint arthrodesis using an MIS approach is an effective treatment for patients with diagnosed SI joint pain. These findings reinforce awareness that the SI joint is a common symptom generator in LBP patients and, with proper diagnosis, patients can be effectively treated with an MIS approach.

Suspensory Fixation for Subpectoral Biceps Tenodesis: A Biomechanical Study

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Introduction: This study aims to evaluate the safety and biomechanical properties of suspensory fixation of proximal biceps tenodesis using a button. We compared the load to failure, stiffness and mode of failure in human cadaveric shoulders using a subpectoral location. Finally, we dissected out the axillary and radial nerves to evaluate the safety of this technique.

Methods: Twenty eight fresh-frozen human cadaver forequarters with a mean age of 52 comprised the study group. The specimens were randomly divided into 4 experimental groups. Group 1 was the unicortical intramedullary button group with tenodesis performed with a tension-slide technique. Group 2 was the interference screw group. Group 3 was fixed with a bicortical. Group 4 combined a bicortical button with the addition of an interference screw. Mechanical testing was performed. After pre-loading each sample for 2 minutes at 5N, each sample was then cycled in tension between 5 and 70N, for 500 cycles, at 1 Hz. Load to failure at 1mm/sec was then
performed. The mode of failure, ultimate load, yield load, stiffness and displacement were determined or calculated. Calculations of the distance between the axillary and radial nerves with respect to the cortical button were also calculated.

**Results:** There was no statistically significant difference amongst groups in terms of age, ultimate load, stiffness or displacement (figure 3). Suture/tendon interface failure was the most commonly observed mode of failure. The axillary nerve was close to the bicortical button in several of the specimens, and in many cases was directly lying on the button.

**Discussion and Conclusion:** Given its technical simplicity, equivalent biomechanical properties and small stress riser, surgeons should consider suspensory unicortical fixation as a practical and safe alternative to the interference screw while performing a subpectoral biceps tenodesis.

**Revision Total Knee Arthroplasty Using a Mobile Bearing System**

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**Introduction:** During revision TKA, augments, stems, and sleeves are routinely necessary to substitute for missing bone and optimize fixation to the remaining bone. Constrained articulations may be required to stabilize incompetent ligaments. Mobile bearings can reduce interface stress which leads to loosening. A robust, integrated revision system which incorporates all of these features facilitates intraoperative customization of the construct to the unique circumstances of each revision, and may optimize outcomes.

**Methods:** Forty revision TKAs were performed in 38 patients (21 males, 17 females) using a knee replacement with a self-aligning rotating platform bearing. Mean age was 67 years (R 50-86), and BMI was 30 (R 23-44). The diagnosis was aseptic loosening in 20, stiffness/instability/malalignment in 9, failed UKA in 6, and infection in 5.

**Results:** Every patient’s status is known. Average follow-up is 3.65 years (R 0.53-8.1) with 28 knees at a minimum 2 years. Two patients with well-functioning implants died. Three knees have failed. One knee became infected, and was reimplanted after a two-stage protocol. One patient became chronically infected with a draining sinus, but expired before revision. One patient suffered an irreducible bearing spinout, requiring open reduction, subsequent distal femoral replacement for loosening, and is now awaiting femoral revision for recurrent loosening. Knee Society and WOMAC scores improved respectively from 45 (R 9-74) and 60 (R 34-70) preoperatively to 78 (R 47-100) and 31 (R 0-79) postoperatively. All primary components were implanted in 4 knees, and all revision components in 32 knees, including 4 distal femoral replacements. Two knees received a primary femoral and revision tibial component, and one isolated femoral revision was performed. Thirty-two posterior stabilized, 2 semi-constrained, and 4 hinged polyethylene inserts were utilized.

**Discussion and Conclusions:** This mobile bearing revision TKA system provides a versatile and complete continuum of implant options to solve bone and soft tissue deficiency across a broad spectrum of severity, enabling the surgeon to intraoperatively customize the implant to the needs of the patient. Clinical outcomes are excellent, particularly given this complex patient cohort.

**The Use of Gelatin Hemostatic Matrix to Reduce Post-Operative Bleeding After Total Knee Arthroplasty**

John Velyvis, MD

**Introduction:** Total knee arthroplasty places patients at risk for significant blood loss and hematoma formation. Surgeons may choose to utilize an intra-articular drain to diminish hematoma in the knee. Control of post-operative bleeding is an important aspect of patient care and outcomes. One appropriate solution is to reduce the loss of blood during and after the operation. The present study was designed to evaluate the hemostatic efficacy of the use of gelatin hemostatic matrix in patients managed with total knee arthroplasty.

**Methods:** In this study of primary total knee arthroplasty, 83 consecutive patients received 10mL of the gelatin hemostatic matrix and these patients were compared with 100 consecutive patients who received no Floseal. In both groups, the standard means of hemostasis were applied. In the treatment group, a gelatin hemostatic matrix was applied to the internal aspects of the operative field before skin closure. All operations were performed in a bloodless field with use of a pneumatic tourniquet. All patients received coumadin as thromboprophylaxis...
starting the day after the operation. Blood loss during the operation was evaluated by measuring the volume in the suction apparatus and by estimating the amount of lost blood in the swabs at the end of the operation. The apparent postoperative lost blood was determined by measuring the volume in the suction drain canisters. All blood transfusions, preoperative and postoperative hemoglobin levels were recorded.

Results: There were no statistically significant differences between the groups for age, gender, operative side, estimated intra-operative blood loss, type of anesthesia, inpatient days, or preoperative hemoglobin. No adverse events occurred related to the use of the gelatin hemostatic matrix. Patients receiving the gelatin hemostatic matrix had a lower probability of getting a transfusion ($p = 0.004$). The probability of a blood transfusion was 5.5% in the control group and 0.5% in the treatment group. The volume of blood in the intra-articular drains was significantly reduced in the gelatin hemostatic matrix group ($p < 0.00001$). The mean value in the control group was 430.83mL and in the treatment group 120.54mL.

Discussion and Conclusion: The use of a gelatin hemostatic matrix is an effective and safe means with which to reduce blood loss and blood-transfusion requirements after total knee arthroplasty.

Physical Activity Does Not Correlate with HRQL Scores in Patients with Degenerative Lumbar Conditions

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Introduction: Degenerative disorders of the lumbar spine have been shown to have a negative effect on the health related quality of life, however the effect on physical activity has not been studied with objective measurement tools. We aimed to quantify activity levels in a population with lumbar spine disorders using accelerometry and to correlate activity levels with commonly used HRQL scores. The hypotheses were 1) Patients with lumbar spine disorders have a low level of activity and 2) Activity levels and patient-reported HRQL scores correlate in this population.

Methods: Adults with lumbar spine disorders scheduled for surgical treatment were enrolled in this study. Participants wore an accelerometer for 12 hours daily, three consecutive days prior to their scheduled surgery. The Oswestry Disability Index (ODI), the SF-36 Physical Component Summary Score (PCS) and the EuroQual-5D questionnaire (EQ-5D) were collected prior to surgery. The duration (average min/day) of moderate-vigorous physical activity (MVPA) was determined for each patient and then correlated the outcome scores using the Spearman Rank Correlation coefficient.

Results: Eighty-one patients with an average age of 63.8 had complete data. The average duration of MVPA for the group was 8.6 min/day (range 0-68.8, SD 17.8, median 3.5). The average ODI, SF-36 PCS, and EQ-5D scores were 46.8, 29.24, and 0.51, respectively. There was no correlation between duration of MVPA and ODI ($\rho = -0.248$, $p = 0.038$), SF-36 PCS ($\rho = 0.306$, $p = 0.015$), or EQ-5D ($\rho = 0.228$, $p = 0.05$). However, the average duration of MVPA was correlated to the SF-36 Role Physical Function score ($\rho = 0.363$, $p = 0.004$).

Conclusions: The only score that was correlated to activity was the SF-36 PF score and this was a weak correlation. The majority of this population only achieved 20% of the recommended amount of MVPA. Physical fitness should be addressed prior to surgery and targeted during rehabilitation.
Mesenchymal Stem Cell and Bioactive Substrate Administration on a Suture Delivery Vehicle Confers Early Strength to Rat Achilles Tendon Repairs In Vivo

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Purpose: Exogenously administered mesenchymal stem cells and chemical stimulants, such as growth factors and bioactive substrates, are known to enhance the rate of tendon healing. Biomolecules have been successfully delivered using suture delivery vehicles, eluting growth factors over time. Using a suture delivery vehicle, the additional manual step of chemical agent administration can be obviated. We sought to evaluate the histologic and biomechanical effect of delivering both cells and bioactive substrates on a suture delivery vehicle in comparison with sutures coated with bioactive substrates alone.

Methods: Bone marrow-derived stem cells (BMSCs) were harvested from Sprague-Dawley rat femora. Experimental (cell and substrate-coated, CS) group sutures were precoated with intercellular cell adhesion molecule 1 (ICAM-1) and poly-L-lysine, and seeded with labeled BMSCs. Control (substrate only-coated, SO) group sutures were coated with ICAM-1 and poly-L-lysine only. Utilizing a matched-paired design, bilateral Sprague-Dawley rat Achilles tendons were transected and randomized to CS or SO repairs. Tendons were harvested at 4, 7, 10, 14 and 28 days and subjected to biomechanical assessment.

Results: Labeled cells were present at repair sites at all time points. CS suture repairs displayed superior strength compared to SO repairs at 7 days. Although there was no significant difference at the other time points, there was a trend toward improved strength with CS suture repair at 4 days, 10 days, and 28 days. There was no observed difference in repair strength at 14 days.

Conclusions: Based on our results, bioactive CS sutures enhance repair strength in at the 1-week time point. This effect is less evident in later stages.

Clinical Relevance: The strength nadir of a repair occurs at 1 week. Bioactive suture repair may provide a clinical advantage by “jump starting” the repair process during this strength nadir. Improved early strength may in turn allow earlier unprotected weight bearing and mobilization.

Intraoperative Neurophysiological Monitoring in Anterior Lumbar Interbody Fusion (ALIF) Surgery

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Introduction: Somatosensory evoked potential (SSEP) and motor evoked potentials (MEP) are frequently used to monitor neurological function during spinal deformity surgery. However, there are few studies regarding the utilization of intraoperative neuromonitoring (IONM) during anterior lumbar interbody fusion (ALIF). This study presents the authors’ experience with IONM in ALIF.

Methods: A retrospective review of all patients undergoing ALIF with IONM from November 2008 to July 2010 was performed. Positive and negative predictive values based on positive alerts and occurrence of post operative neurological deficit were calculated. Factors including gender, operative time, and number and levels of interbody fusion were analyzed as risk factors for inter-operational alerts.

Results: A total of 80 consecutive patients who underwent ALIF were studied. All 80 patients had SSEP and 45 patients had MEP as part of the intraoperative neuromonitoring. The remaining 35 patients did not have MEP due to neuro muscular blockade requested by the exposure surgeon. No intraoperative changes in MEP were found. Nine (11.2%) patients experienced intraoperative changes in SSEP; none of these patients had new neurological deficits post-operatively. Increased risk of SSEP changes was seen in patients undergoing fusion of both L4/5 and L5/S1 ($p = 0.024$). No correlation was found between age and positive SSEP changes ($p > 0.05$). Positive predictive value of SSEP was 0%, negative predictive value of SSEP was 100%.

Discussion and Conclusion: SSEP false positives occur relatively frequently intra-operatively during ALIF. No patients with positive intraoperative SSEP changes demonstrated new post-operational deficits. The duration of surgery and fusion of both L4/5 and L5/S1 were significant risk factors for SSEP changes leading to intraoperative alerts.