1 FUNCTIONAL OUTCOMES AFTER NONOPERATIVE TREATMENT OF FULL-THICKNESS ROTATOR CUFF TEARS
Gary M. Gartsman, MD*, K. Matthew Warnock, MD, Daniel P. O’Connor, PhD, T. Bradley Edwards, MD, Hussein Elkousy, MD, Texas Orthopedic Hospital, Houston, TX

Purpose: The purpose of this study was to quantify objectively the pain and functional outcomes of a group of patients who received nonoperative treatment for a full-thickness rotator cuff tear.

Methods: We identified 190 patients (192 shoulders) diagnosed by MRI with a full-thickness rotator cuff tear who received nonoperative treatment. The average follow-up after the initial visit was 3.3 years (range, 1 to 7.4). The average age of the patients at the time of follow-up was 67.1 years (SD = 10.9 years). Nonoperative treatment consisted of pain management with analgesics and a home program of exercises to maintain or improve passive range of motion and strength of the periscapular and deltoid muscles. The American Shoulder and Elbow Surgeons scoring system was used to evaluate shoulder function and pain. Multivariate regression analysis was performed to determine which factors were related to the total ASES score, ASES pain score, and ASES Activities of Daily Living (ADL) score at follow-up. Results: The average total ASES score was 70.2 (SD = 24.0) in the involved shoulder and 87.5 (SD = 18.5) in the uninvolved shoulder (p < 0.001). In the multivariate analysis, the presence of muscle atrophy on MRI (p < 0.001) was the only variable that was statistically significantly related to the ASES score at follow-up. Atrophy worsened ASES scores by an average of 17 points. Tendon retraction, multiple tendon involvement, injury to the dominant arm, gender, age and time to follow-up were not statistically significantly related to the ASES scores (p > 0.05). The presence of muscle atrophy on MRI (p = 0.003) was also significantly related to both the ASES pain score (p = 0.029) and the ASES ADL score (p < 0.001). Conclusion: The average ASES score of 70 points after nonoperative treatment of full thickness rotator cuff tears is lower than reported average scores for persons who consider their shoulder normal (94 to 96 points), lower than reported average ASES scores after arthroscopic rotator cuff repair (88 points), and higher than reported average preoperative scores for patients with full thickness rotator cuff tears (31 points). Patients without MRI evidence of atrophy have average ASES scores of 74 points. Time to follow-up was not associated with the ASES scores. Forty per cent of patients without atrophy of an isolated full thickness supraspinatus tear had total ASES scores equivalent to published postoperative ASES scores after arthroscopic rotator cuff repair. Muscle atrophy on MRI is associated with significantly increased levels of pain and functional impairment after nonoperative treatment for a full-thickness rotator cuff tear.

2 DEVELOPMENT OF A NOVEL TISSUE ENGINEERED/GENE THERAPY APPROACH TO TREATMENT OF ROTATOR CUFF TEARS IN A RAT MODEL
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Purpose: This study evaluates a new cell-polymer construct of tendon cells transduced with PDGFb for its ability to augment rotator cuff tendon healing in vivo. In our previous work, we demonstrated a significant metabolic effect on local adjacent tendon cells by secretion of growth factors from gene modified tissue constructs in vitro. Significance: Tears of the rotator cuff are a common soft tissue injury of the musculoskeletal system. These tears heal by formation of inferior repair tissue, which may lead to severe joint dysfunction. A controversy exists over whether rotator cuff tendons heal after surgery. The endogenous healing is poor or insufficient in most rotator cuff tears and especially in large tears. A method that augments the endogenous healing process could be of significant clinical value.

Methodology: Rat supraspinatus tendons were transected surgically and allowed to undergo an inflammatory phase for two weeks, mimicking the clinical situation of a chronic injury. The rats were then re-operated on to repair the original tear. Repair included standard suture realignment as a control or suture repair with the addition of a gene modified tendon (Control) healed with a range from no repair to incomplete restoration of tendon architecture. In the experimentally repaired group, there was near complete to full restoration of tendon architecture. Histological analysis demonstrated restoration of the normal crimp patterning and collagen bundle longitudinal alignment in the experimentally treated animals compared to controls. Conclusion: This study demonstrates the efficacy of a new type of bioactive implant for repair of rotator cuff injuries. The current in vivo model closely mimics the clinical sequelae of tear-inflammation-repair. Additional studies that evaluate other growth factors or combinations of growth factors are underway and are accomplished using the gene modified tissue engineering platform.
Introduction: Repair of the rotator cuff using arthroscopic techniques is becoming increasingly popular, especially as advances in surgical techniques and instrumentation continue to improve. However, recent clinical follow-up studies have demonstrated high failure rates of rotator cuff tears repaired arthroscopically.1,2 Re-establishment of the footprint during rotator cuff repair has been suggested as an important criteria for optimizing healing and fixation strength. The technique of using two rows of suture anchors has been described.3 More recently, it has been shown that double-row suture anchor cuff repair maximizes the contact area of the cuff on the greater tuberosity when compared to single row anchor repair or transosseous tunnel techniques.4 To our knowledge, there have been no studies examining the biomechanical properties of a double-row suture anchor rotator cuff repair. The objective of this study was to biomechanically compare the double-row anchor repair and a conventional single-row repair. Methods: Specimen Preparation: Nine matched pairs of fresh-frozen cadaveric shoulders were used (age: 52 ± 4 years). The supraspinatus tendons were dissected from the scapula and greater tuberosity attachments and the distal 1 cm of supraspinatus tendon was resected to simulate a rotator cuff tear. Within each matched pair, the tendon on one side was repaired using a single row of two suture anchors placed 12.5 mm from the articular margin of the humeral head. In the contralateral shoulder, the tendon was reconstructed using two rows of two suture anchors (four anchors total), with the medial row placed adjacent to the articular margin (Figure 1). The sides were alternated for the single row repair and the double row repair. Biomechanical Testing: After mounting on a custom fixture, each specimen was tested using an Instron materials testing machine. Twelve markers were placed on the clamp, tendon, and bone. Gap formation at the lateral tendon edge and strain over the footprint area were measured using a video digitizing system, while linear stiffness and ultimate failure load were determined from load-elongation curves. Each specimen underwent cyclic loading from 10-180N at 5 mm/sec for 200 cycles. Specimens were then tested to failure at 1 mm/sec and the mode of failure was noted. We tested the hypotheses that the double-row repair is biomechanically superior to a single-row repair in terms of gap formation, strain, ultimate failure load, and stiffness. A paired Student’s t-test was used to compare test data with significance set at p < 0.05. Results: Cyclic loading tests showed that the gap formation for double-row repair was significantly smaller (p<0.01) when compared to single-row repair for the first cycle (1.8 ± 0.6mm versus 3.2 ± 0.9mm, respectively) and the last cycle (4.3 ± 1.6mm versus 7.1 ± 1.6mm, respectively). Moreover, the strain over the footprint area for the double-row repair was nearly one-third (p<0.01) the strain of the single-row repair. The load to failure testing showed that the addition of a medial row of anchors increased ultimate failure load of the repair by 48 percent (Figure 2) and stiffness by 46 percent (Figure 3) (p<0.01). The failure mode was very consistent for the single row group where all 9/9 specimens failed at the suture tendon interface. The double row group showed 5/9 suture tendon interface failures, 2/9 tuberosity fractures and 2/9 clamp failures. Conclusions: For rotator cuff repair, footprint reconstruction using two rows of suture anchors improves its initial strength and stiffness, and decreases the gap formation and strain over the footprint when compared to a standard single-row repair. Further clinical studies are needed to determine if this technique will lead to better healing rates and improved clinical outcomes.

REFERENCES
Kerlan Jobe Orthopaedic Foundation and VA Rehab R&D

4 SUPRASCAPULAR NERVE DYSFUNCTION WITH MASSIVE ROTATOR CUFF TEARS: NOT SO RARE A PROBLEM Jon J. P. Warner, MD*, Mason Porramatikul, MD, Denny Lie, MD, John Costourous, MD, Peter Millett, MD, Tom Holovacs, MD, Massachusetts General Hospital, Boston, MA

Introduction: Prior anecdotal observation has identified suprascapular nerve injury in association with massive rotator cuff tear (MRCT), and anatomical study suggests this is due to traction on the nerve when the torn tendon retracts. No study has examined the incidence of this association. Methods: Over a thirteen-month pe-
rriod 216 patients were evaluated on our Shoulder Service for a diagnosis of rotator cuff tear. Of these, 26 were identified to have a chronic, MRCT in association with moderate to severe fatty muscle atrophy of the supraspinatus and infraspinatus. All had pain as well as marked external rotation and abduction weakness. These patients underwent electromyographic evaluation (EMG). All patients underwent surgical treatment. Results: 14 of 26 patients underwent a partial biceps tendon repair. There were 13 men and 1 woman with a mean age of 56 years. 7 of 14 had an isolated supraspinal nerve injury, 4 had an axillary nerve injury, 2 had an associated upper trunk of brachial plexus injury, and 1 had associated cervical radiculopathy. Six of the 7 patients with an isolated supraspinal nerve injury in combination with their massive RCT underwent surgical treatment. Surgical treatment was based on the degree of functional deficit and consisted of an arthroscopic partial repair of the posterior portion of the tendon tear in 3, complete arthroscopic repair in 1, arthroscopic debridement in 1, and latissimus transfer in 1. In the four who underwent either partial or complete arthroscopic repair, follow-up EMG after six months demonstrated recovery of the supraspinal nerve palsy, and this correlated with complete pain relief and marked improvement of function. Discussion and Conclusion: We observed over a six-month period that 14 of 26 (55%) patients presenting with a massive RCT had associated peripheral nerve injuries, and of these 7 (27%) were isolated supraspinal nerve palsy. This surprisingly high incidence may be a neurogenic explanation for pain and fatty muscle atrophy of the rotator cuff muscles. In the four patients with short follow-up after partial or complete tendon repair clinical recovery is remarkable and this may be due to changes in tension of the nerve along it’s course after tendon repair. Thus, therapeutic nihilism may not be a fair philosophy in these kinds of patients. We conclude that electromyographic study in this subpopulation of rotator cuff tears is indicated in order to identify supraspinal nerve dysfunction which may be reversed through tendon repair.

5 BIPOLAR RADIOFREQUENCY ENERGY ENHANCED REPAIR OF CHRONIC SUPRASPINATUS TEARS IN RATS
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Introduction: Bipolar radiofrequency energy (bRFE) applied to a heated electrode may stimulate neural, fibroblastic cell recruitment and promote healing. The purpose of this study is to determine if bRFE can enhance the surgical repair of chronic supraspinatus tendon tears in a rat rotator cuff model. Methods: Fifty Sprague-Dawley rats were used. Forty-two had bilateral supraspinatus tendon tears created. Eight control rats underwent operative exposure without creating a tear (sham). After 6 weeks, tendon tears were repaired using trans-osseous bone tunnels with or without bRFE treatment of the tendon edge. Treatment rats were sacrificed at 4 (14 rats), 8 (14 rats) and 12 (14 rats) weeks following repair and sham rats (8) at 8 weeks following surgical exposure. All underwent biomechanical and histologic evaluation. Results: Average maximum stress with bRFE augmented repair was greater (8.475 N/m²) than without bRFE (3.95 N/m²) at 12 weeks (p < 0.05). The mode of failure was by humeral fracture in 57.14% (bRFE) versus 14.29% (without bRFE). Sham samples failed by fracture in 100%. Histologically, 8 week tendons were indistinguishable from controls. Conclusion: The use of bRFE to augment the repair of chronic supraspinatus tendon tears resulted in histologically equivalent tendons compared to controls with superior mechanical properties. The mechanism of failure in the bRFE group was more than 4 times more likely to occur by fracture compared to tendon failure in the non-bRFE group. It appears that the repair of a chronic rotator cuff tear augmented with bRFE induces a more effective response than traditional repair alone.

6 ARTHROSCOPIC CORACOID DECOMPRESSION: CORRELATION OF CLINICAL OUTCOME AND POST-OPERATIVE MRI FINDINGS
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Objective: The purpose of this study is to correlate clinical outcomes and post-operative MRI findings after arthroscopic coracoid decompression. Materials and Methods: Twenty-six patients, including 18 males and 8 females with a mean age of 44.3 years, underwent an arthroscopic coracoid decompression as an isolated procedure or a combined procedure. Diagnosis was based on clinical examination, MR findings, and response to coracohumeral injection. Twenty patients (76.9%) demonstrated subscapularis and/or biceps pathology on pre-operative examination. Fifty percent of the group was randomized to have a post-operative axial MRI scan. Coracoid index (CI), coracoid overlap (CO), and coracohumeral distance (CD) were measured on pre- and post-operative scans. Results: Mean follow-up was 29.4 months (range 24-40). Mean pre-operative CI, CO, and CD measurements were 9.3mm, 17.49mm, and 11.52mm, respectively. Post-operative scan measurements yielded significant differences (p < 0.05) in CI (mean 5.17mm), CO (mean 13.33mm), and CD (mean 13.21mm). Subscapularis pathology improved in 12/13 patients (92.3%) who underwent post-operative MRI. Twenty-two of 26 patients (84.7%) returned to their previous level of work or athletics and average post-operative VAS for pain was 1.3. Twenty-five of 26 patients (96.2%) were satisfied with their outcome. Conclusion: Arthroscopic coracoid decompression yields satisfactory clinical outcomes in patients with coracoid impingement.

7 POSTEROSUPERIOR LABRAL REPAIR AND PARALABRAL CYST DECOMPRESSION: RESULTS OF ALL-ARTHROSCOPIC TREATMENT
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Posterosuperior labral tears with associated paralabral cysts may cause pain and functional disability, with potential compression of the supraspinatus nerve branch at the spinoglenoid notch. We report the results of all-arthroscopic treatment of this lesion.

Methods: Ten consecutive patients with symptomatic, MRI-proven posterosuperior labral tears and paralabral cysts underwent arthroscopic labral repair and arthroscopic transcapsular decompression of the cyst. Absorbable anchors with nonabsorbable sutures and glenohumeral capsulotomy with decompression of the cyst and excision of the cyst wall were performed in all cases. Mean age was 41 years (range 27 to 56). Eight (80%) suffered traumatic injury (6 were workers’ compensation injuries). Seven (70%) demonstrated infasinatus atrophy and weakness. Six (60%) had electromyographic documentation of supraspinatus nerve compression at the spinoglenoid notch. Mean follow-up was 22 months (range 18-27 months). Results: Mean ASES score improved from 56 preop (range 30-72) to 93 postop (range 86-100). Range of motion was equal to normal side in all, except for 3 with glenohumeral arthritis. Infraspinatus atrophy was present in 1 patient (10%) and had improved from preop exam. No patient demonstrated clinical evidence of infraspinatus weakness. Pain averaged 1.2 (0=no pain; 10=worst pain). Satisfaction averaged 9.1 (0=unsatisfied; 10=completely satisfied). Nine (90%) returned to previous level of function, including 5 (83%) with workers’ compensation claims. Discussion: All-arthroscopic posterosuperior labral repair combined with paralabral cyst decompression appears successful in eliminating pain and restoring function to the involved shoulder. Infraspinatus muscle weakness from compression at the spinoglenoid notch appears clinically reversible after surgical treatment.
8 ARTHROSCOPIC DEBRIDEMENT IN THE MANAGEMENT OF GLENOHUMERAL OSTEOARTHRITIS: LONG-TERM FOLLOW-UP
Stephen C. Weber, MD*, Jeffrey I. Kaufman, MD, Sacramento Knee and Sports Medicine, Sacramento, CA

Arthroscopic debridement for osteoarthritis has shown optimistic results in several recent studies with short-term follow-up. Long-term outcome is an area of debridement on glenohumeral arthritis remains unknown. Forty patients with a primary diagnosis of osteoarthritis presented over a 12 year period; thirty-five patients were available for follow-up greater than two years. Mean age was 57.8 years, mean follow-up 4.97 years [2 to 14 years]. Results were assessed with ASES, UCLA and SST scores with Pearson-Spearman correlation coefficients generated for age, gender, insurance type, and radiographic score. While good initial response to debridement was noted at the three month point in 78% of patients based on UCLA scores, only 28% of patients showed good or excellent results at long term follow-up. All patients showed significant radiographic progression of disease. Six patients converted to total shoulder replacement over the course of the study, with two pending arthroplasty. Survivorship analysis showed an 85% five year survivorship using arthroplasty as an end-point.

Outcome correlated with radiographic grade at surgery (p=0.02). While arthroscopic debridement provides short term relief in many patients, long term relief is not common, and interval progression is nearly universal, often requiring shoulder replacement at an age where arthroplasty is not desirable despite debridement. The long-term outcome of arthroplasty is not ideal in the younger patient, and arthroscopic debridement remains a viable option for the younger patient with glenohumeral arthritis. It however shows less long-term relief of symptoms, and does not significantly alter progression of disease. Patients with glenohumeral arthritis should be cautioned that short term relief with arthroscopic debridement and the norm, and progression of disease is not commonly affected by arthroscopic debridement.

9 RESULTS OF REVERSED PROSTHESIS IN GLENOHUMERAL JOINT ARTHRITIS ASSOCIATED WITH ROTATOR CUFF TEAR
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Introduction: Combined glenohumeral arthritis and rotator cuff tear lead to painful shoulder impairment. Non-constrained prostheses result in limited functional improvement or are contraindicated. This study reports results of the reverse prosthesis in which the principle is to restore shoulder function relying solely on the deltoid muscle. Material and Methods: 45 patients were operated consecutively with a reverse prosthesis (Delta) and were followed clinically and radiographically at a mean of 38 months (24-72). Three groups were analyzed: osteoarthrosis with massive cuff tear (21 cases), fracture sequelae with migration or nonunion of tuberosities (5 cases), and revision shoulder arthroplasty with deficient rotator cuff (19 cases). Results: A significant improvement in both forward active elevation (from 55° to 121°) and Constant score (from 17 to 59 points). There was no improvement in active external rotation (7° to 11°) and active internal rotation (51 to 51). 78% of patients were satisfied and 67% little or no pain. At last follow up, Constant score and satisfaction (Constant and ASES scores were all significantly better in osteoarthrosis with massive cuff tear group than in the revision group (p=0.01, 0.004, and 0.002). Complication and revision rate were higher in the revision group (47% and 26%). Glenoid notching was present in 24 patients (74%). The presence or size of this notch has no influence on the clinical results. No glenoid loosening were present even if the notch was above the inferior screw (28%). Conclusion: In patients with combined glenohumeral arthritis and rotator cuff tear, reverse prosthesis improve function, restore forward active elevation but not active rotations. Improvements are superior in osteoarthrosis with massive cuff tear.

Results are less predictive and complication/revision rates are higher in fracture sequelae and revision surgery.

10 RADIOGRAPHIC EVALUATION OF AN INNOVATIVE PEGGED GLENOID COMPONENT
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Many methods have been advocated for securely and durably fixing the glenoid component. Preservation of the subchondral plate, concentric spherical reaming of the glenoid cavity, enhanced biomaterials, mismatching of the diameters of the glenoid and humeral head, and new glenoid designs have been tried. As an alternative to conventional fixation by cementing an all-polyethylene glenoid prostheses or utilizing a tissue in-growth metal backed prosthesis we evaluated the effectiveness of inserting a minimally cemented all-polyethylene peg component. The component had a large central peg with four circumferential fins and three short, peripheral pegs. The central peg was designed to provide durable fixation through tissue ingrowth from the cancellous bone in the glenoid vault while the peripheral pegs were cemented in order to provide secure initial fixation. We reviewed the initial postoperative radiographs of 104 patients with glenohumeral arthroplasty who had been managed with total shoulder arthroplasty by four different surgeons. Follow-up ranged from 6 to 36 months with a mean of 12 months. Fourteen patients were excluded because of inadequate radiographs, leaving 90 (87%) shoulders available for review. The method of Lazarus was used to grade the degree of radioluency around the glenoid component as well as the efficacy of component seating on host subchondral bone. Subchondral bone density and the region of the uncemented central peg was evaluated on most recent follow-up with a three grade scale based upon increased, unchanged, or decreased density compared with initial post operative radiographs. Results: Radioluencies were demonstrated in 19 (21%) glenoids. On a numerical scale (0 indicating no radioluency and 5 indicating gross loosening), the mean radioluency score was less than 0.5. Incomplete seating was noted in 38 glenoids. Of these, 32 had incomplete contact between the prosthesis and the bony glenoid involving less than 25% of the prosthesis and 6 had 25-50% incomplete contact. The radiographic appearance of increased bone density and grater like projections of bone between the flanges of the central peg were noted in 59 (67%) shoulders. No change in density was seen in 27 and a decrease was noted in 4. Conclusion: Radioluency and component seating evaluation of a new glenoid implant design compared favorably with published reports of pegged components. Additionally, 59 of 90 shoulders demonstrated increased bone density into and around the central flanged peg. This finding was reminiscent of the radiographic findings in a published report which histologically documented osseous integration of a similar implant used in a canine weight bearing animal model. The preliminary implications of component durability and potential for higher rates of long-term clinical success are encouraging.

11 COMPONENT POSITIONING AND HARDWARE FAILURE IN THE REVERSE GLENOHUMERAL PROSTHESIS
Raymond M. Griswol, MD, Sergio Gutierrez, BS, Mark Franklin, MD [b, c, d, e-Encore]*, Florida Orthopaedic Institute, Temple Terrace, FL

Reverse Shoulder arthroplasty has regained popularity in the treatment of glenohumeral arthritis with a deficient rotator cuff. However, failure of the prosthesis at the glenoid attachment site is a concern. The purpose of our study was to determine the optimal angle of implantation of the baseplate of a Reverse Shoulder Prosthesis (RSP, Encore Medical). A two-tailed study was employed: 1) a biomechanical analysis compared forces and micro-motions in glenoid components attached to twelve foam blocks (30
pounds per cubic foot) at 0 degrees, and 15 degrees of superior and inferior tilt, 2) a radiographic analysis, using a computer-guided goniometer to retrospectively compare baseplate-to-scapular spine angles in six failed and non-failed patients using Grashey view radiographs. Results in both biomechanical and radiographic evaluation demonstrate that stability of attachment of the glenoid component is dependent upon its position. The 15 degrees of inferior tilt to the 0 degree case lead to excessive forces, tear forces, and microfracture, and compared with the 0 degrees and 15 degrees superiorly tilted baseplate. Clinical radiographic analysis showed that failed prostheses had a mean baseplate-to-scapular spine angle of 84.5 degrees while those that did not fail had a mean angle of 73.7 (p less than 0.05). Inferiorly tilting the component can minimize mechanical failure of the glenoid component in a reverse prosthesis.

12 CORRECTION OF PREOPERATIVE HUMERAL POSTERIOR SUBLUXATION IN TOTAL SHOULDER ARTHROPLASTY

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Introduction: The purpose of this study is to determine if osteoarthritic shoulders with pre-operative posterior subluxation can be re-centered following total shoulder arthroplasty (TSA). Methods: Thirty-one consecutive patients requiring TSA were retrospectively reviewed using plain radiographs. Sixteen were found to have type B or C glenoids with concurrent posterior humeral subluxation based on the humeral head index (HHI) as described by Walch. Mean follow up was 26 months (range, 15.4-2). Techniques used to re-center the head included anterior capsulectomy and anterior eccentric reaming in all patients, use of dual radii glenoids and decreased humeral version in 8 patients, offset humeral heads in 5 patients, and a posterior plication suture in 1 patient. Each radiographic assessment included glenoid type, retroversion, and pre- and post-operative index of humeral head subluxation and was conducted by two independent observers. Results: All patients with preoperative posterior subluxation of the humeral head were corrected to a central position. For the thirteen patients with type B glenoids, the posterior subluxation index was significantly improved from 64.0 preoperatively to 50.2 postoperatively (p<0.001). Patients with type C glenoids demonstrated that the posterior subluxation index improved from 56 to 49; however this did not reach statistical significance (p=0.18). Correlation analysis revealed no effect of preoperative retroversion or amount of pre-operative subluxation on postoperative correction of the HHI. Conclusion: This study demonstrates that posterior humeral subluxation in patients with osteoarthritis can be corrected with appropriate surgical technique.

13 THE THERMAL ENVIRONMENT AROUND VARIOUS CEMENTED GLENOID COMPONENTS

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Introduction: The incidence of glenoid radiolucent lines at the bone-cement interface remain a concern in shoulder arthroplasty. Osteonecrosis of glenoid bone adjacent to setting cement is one proposed theory as to the development of these radiolucent lines, yet little evidence is actually available. This study evaluates the temperature gradient around three types of cemented glenoid components. Materials and Methods: A power analysis performed determined the necessary sample size to be five specimens in each arm of the study. Five cadaveric scapulae were utilized for each of the three types of glenoid components tested: Group I - Keel Component; Group II - Five Peg Glenoid, Group III - Three peg/anchor peg designs (DePuy). The scapulae were potted vertically with the prepared glenoid concavity suspended just above a 37°C water bath (to simulate body temperature and surgical conditions). Thermocouples (0.1mm, Omega Engineering) were placed into 0.3 mm drill holes to an approximate depth of 5mm at the cement interface, 1mm, 2mm, and 3mm from introduced cement. Data was also obtained at 5 mm from the bone cement interface in Group I (keel). Polymethylmethacrylate, bone cement (Endurance, DePuy) was pressurized into each of the keeled or peg holes with a Tumey syringe via conventional surgical technique. The glenoid implant was then inserted. The temperature versus time data was then recorded using Windaq software (Dataq) and DI-1000TC (Dataq) instrumentation. A temperature of 40°C was considered to place the adjacent bone at risk of osteonecrosis. Results: The highest temperatures were reached with Group I (keel) corresponding to a larger volume of cement adjacent to bone. The maximum cement temperature for Groups I, II, and III were 81°C, 51°C, and 46°C respectively. Temperatures greater than 40°C were reached at distances 1mm and 2mm from the bone cement interface in both groups I and II. Temperatures greater than 40°C were not observed in group II beyond 1 mm from the bone cement interface. Group I specimens tested demonstrated temperatures exceeding 40°C at the bone cement interface, 1mm, 2mm, 3mm, and 5mm distances. The average duration of sustained temperatures greater than 40°C at the bone cement interface were 6.6, 4.0, and 1.4 minutes for Groups I, II, and III respectively. Discussion: Temperatures of 40°C or higher were indeed encountered at the bone-cement interface and at distances of 1mm, 2mm, 3mm, and 5mm (in group I) with current cemented glenoid component designs. Group I with the keel design displayed a thermal profile with the highest risk of thermal injury with temperatures exceeding 40°C even at the 5mm data point. Volume of cement and subsequent surface area of cement remain important variables. The extreme temperatures observed around Group I (keel) components are thought to be due to a large volume of cement with limited relative surface area to dissipate heat resulting in a markedly more rapid increase in temperature and maximum temperature achieved as compared to the other two groups. The three peg/anchor peg design displayed the thermal profile with the least risk of osteonecrosis due to thermal injury where temperatures did not exceed 40°C beyond the 1 mm distance from the bone cement interface.

14 PRACTICAL GUIDELINES FOR GLENOID REAMING IN SHOULDER ARTHROPLASTY

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Introduction: Our purpose is to define the amount of eccentric posterior glenoid wear which can be corrected by anterior glenoid reaming. Methods: Eight scapulae were studied. Measurements included; anterior-posterior width, superior-inferior height, and the best-fit pegged Osteonics Solar glenoid prosthesis size. A center pin was placed orthogonal to the articular surface and a 5 degree wedge from the posterior glenoid was removed to simulate eccentric wear. The anterior glenoid was then reamed to correct the deformity. This was repeated to simulate a 10, 15, 20, and 25 degree deformity. Results: Anterior reaming to correct a 10 degree posterior deformity resulted in a decrease in anteroposterior glenoid diameter from 26.7 ± 2.5 mm to 23.8 ± 3.1 mm (p=0.006). In 4 of 8 specimens, placing a glenoid prosthesis was not possible after correcting a 15 degree deformity because of inadequate bony support (2), peg penetration (1) or both (1). A 20 degree deformity was correctable in only 2 of 8 specimens and only after downsizing the glenoid component size. Conclusions: Anterior glenoid reaming to correct eccentric posterior wear of 10 degrees or more results in significant narrowing of the anteroposterior glenoid width. A 15 degree deformity has only a 50% chance of successful correction by anterior reaming.
The accuracy of various tests for posterior shoulder instability

Table I

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<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
<th>AC</th>
<th>LR</th>
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<td>Voluntary Instability</td>
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<td>0.97</td>
<td>0.80</td>
<td>2.72</td>
</tr>
<tr>
<td>Algorithm A (cutoff = 1)</td>
<td>0.92</td>
<td>0.79</td>
<td>0.15</td>
<td>1.00</td>
<td>0.80</td>
<td>4.45</td>
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<td>Algorithm A (cutoff = 2)</td>
<td>0.83</td>
<td>0.89</td>
<td>0.23</td>
<td>0.99</td>
<td>0.88</td>
<td>7.35</td>
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<td>Algorithm A (cutoff = 3)</td>
<td>0.75</td>
<td>0.92</td>
<td>0.27</td>
<td>0.99</td>
<td>0.91</td>
<td>9.09</td>
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<tr>
<td>Algorithm A (cutoff = 4)</td>
<td>0.67</td>
<td>0.97</td>
<td>0.44</td>
<td>0.99</td>
<td>0.95</td>
<td>19.40</td>
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</table>

PA, Posterior apprehension; PD, posterior drawer; PPV, positive predictive value; NPV, Negative predictive value; AC, Accuracy; LR, likelihood ratio.

15 POSTERIOR SHOULDER INSTABILITY: DIAGNOSIS ACCURACY OF PHYSICAL TESTS


Introduction: The goal of this study was to evaluate the diagnostic value of common clinical examinations for posterior shoulder instability which has not been previously reported. Materials and Methods: 308 patients who subsequently underwent diagnostic arthroscopy and shoulder surgery were prospectively examined for signs of posterior instability. All patients underwent a preoperative physical examination which included: (a) posterior apprehension sign for the presence of pain, subluxation, or apprehension; (b) posterior laxity testing using a posterior drawer sign with the patient supine; (c) evaluation of the voluntary component of instability. Of this cohort, 12 underwent a posterior stabilization for symptomatic instability and 296 were utilized as the control group for statistical analysis. A diagnostic score was developed using standard scale development techniques, including multivariate logistic regression and ROC (receiver operator characteristic) curves. Results: Overall sensitivity of the tests was low (less than 50 percent for all tests), while specificity was high (better than 80 percent for all tests). A diagnostic score was developed combining the five best independent predictors of posterior shoulder instability: voluntary instability (p < 0.001), the subluxation (p < 0.001) and pain (p < 0.05) components of the posterior apprehension sign, and the pain (p < 0.2) and symptom reproduction (p < 0.001) components of the posterior drawer sign. This combined score ranged between 0 and 6, and a cutoff value of 2 resulted in sensitivity and specificity of 83 and 89 percent, respectively (Table I). Conclusion: While most signs for posterior instability are not sensitive, a newly devised scoring system can make the diagnosis in over 83 percent of cases.

16 ACHILLES TENDON ALLOGRAFT AUGMENTATION IN REVISION SURGERY FOR GLENOHUMERAL INSTABILITY

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Introduction: The purpose of this study is to prospectively evaluate the use of an Achilles tendon allograft in patients with failed instability surgery that have anterior soft tissue deficiency and for which a repeat operation is indicated. Methods: Over an 8-year period (1993-2001), the senior author has treated 26 patients with anterior subscapularis and capsular deficiency and recurrent anterior/inferior instability with an Achilles tendon allograft to augment or substitute for the incompetent or absent anterior soft tissues. The average age was 24 years and the average follow-up 41 months (25-95 months). The average number of previous instability procedures was 2.2 and the average time from the last failed procedure until the index operation was 11 months, on average. Postoperative function was assessed using the ASES score. Preoperative and postoperative range of motion, pain and patient satisfaction were also assessed. Results: The average ASES score improved from 22 preoperatively to 86 postoperatively and the VAS pain score from 8.9 to 2.1. Eighty-eight percent of patients were satisfied with the procedure and considered their shoulder to be stable for activities of daily living, work and most recreational activities. The average AFE postoperatively was 155 degrees and the average AER was 50 degrees. Three patients had recurrent dislocation of the glenohumeral joint and one spontaneous redislocation at 13 months. Conclusion: Patients with anterior soft tissue deficiency following failed surgical procedures for instability can be treated successfully with an Achilles tendon allograft augmentation in most cases.

17 EFFECTS OF CAPSULAR PLICATION AND ROTATOR INTERVAL CLOSURE IN A SIMULATED MULTIDIRECTIONAL INSTABILITY MODEL

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Introduction: Multidirectional instability involves instability in the anterior, posterior, and inferior directions. Historically, surgical treatment has focused on reducing redundant capsular volume using an open inferior capsular shift.1 This approach requires tenotomy and reattachment of the subscapularis tendon. More recently, arthroscopic capsular plication combined with rotator interval closure has been used with increasing regularity. This technique combines access to the entire capsule with the ability to perform specific and individualized procedures on limited areas of capsule, glenohumeral ligaments, and the rotator interval. Although several successful clinical studies have been reported for this technique no biomechanical evaluation of its effects has been reported. The purpose of this study was to use a simulated multidirectional instability model to biomechanically assess the effect of capsular plication combined with rotator interval closure on glenohumeral translation, rotational range of motion (ROM), and humeral head position. Methods: Seven fresh frozen cadaveric shoulders were tested. A custom shoulder translation testing jig was created to measure glenohumeral translation and rotation in multiple planes. The jig allowed six degrees-of-freedom for positioning the glenohumeral joint. A compressive load of 22 N was applied perpendicular to the glenoid throughout testing. Humeral rotational ROM, glenohumeral translations and humeral head position were measured in two positions, apprehension (90° shoulder abduction...
18 ARTHROSCOPIC ROTATOR INTERVAL CLOSURE: ANALYSIS OF GLENOHUMERAL RANGE OF MOTION AND TRANSLATION

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BACKGROUND: The effect of arthroscopic rotator interval closure on glenohumeral range of motion and translation is not well understood, as is the ideal location or number of sutures required. HYPOTHESIS: The number and position of arthroscopic rotator interval closure sutures and their placement will have a significant effect on glenohumeral range of motion and anteroposterior translation. STUDY DESIGN: Repeated measures design laboratory study. METHODS: Using a custom testing apparatus, range of motion was measured in twelve fresh-frozen cadaveric shoulders, and anteroposterior translation in abduction and neutral rotation was measured in nine. Specimens with vented capsules were initially tested without sutures and then tested after a random sequence of interval closures using: 1) an isolated medial suture at the level of the glenoid; 2) an isolated lateral suture 1 cm lateral to the glenoid; or 3) both sutures. RESULTS: ANOVA demonstrated that interval closure had a significant effect on decreasing forward flexion (P < 0.001), external rotation (P < 0.001) and anteroposterior translation (P < 0.001) of the abducted shoulder. A single lateral suture resulted in a 4.3° loss of external rotation which was less than a single medial suture (9.1°, P = 0.06), and significantly less than use of two sutures (11.2°, P = 0.004). The single lateral suture was significantly more effective at reducing anterior translation than the single medial suture (P < 0.02), and was comparable to the use of two sutures (P = 0.63). CONCLUSIONS: Arthroscopic interval closure produced significant decreases in range of motion and anteroposterior translation. A medial suture may greatly decrease external rotation by tethering of the coracohumeral ligament. The single lateral suture showed the least reduction in range of motion. The lateral suture reduces glenohumeral translation more than the medial suture and was equivalent to two sutures. CLINICAL RELEVANCE: Closure of the rotator interval with a single suture placed 1 cm lateral to the glenoid margin limits glenohumeral translation while minimizing loss of motion.
19 PATIENTS’ PREOPERATIVE EXPECTATIONS PREDICT THE OUTCOME OF ROTATOR CUFF REPAIR* 

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Introduction: No previous studies have investigated the relationship between patients’ expectations of shoulder surgery and the outcome of rotator cuff repair (RCR). We hypothesize that preoperative expectations are predictive of RCR outcomes. 

Methods: 125 patients who underwent repair of a chronic rotator cuff tear by a single surgeon were studied prospectively. Each patient completed the Simple Shoulder Test (SST); Disability of Arm Shoulder and Hand (DASH); three visual analogue scales (VAS) for shoulder pain, shoulder function, and quality of life; and the Short Form 36 (SF-36) both preoperatively and one year postoperatively. Preoperative expectations were quantified using six questions from the Musculoskeletal Outcomes Data Evaluation and Management Systems (MODEMS) as previously reported. Results: Greater preoperative expectations correlated with better postoperative performance on the SST, DASH, each VAS, and SF-36 (p ranges 0.0001 to 0.03), and greater improvement from baseline on the DASH and SF-36 (p ranges 0.0001 to 0.018). A rigorous multivariate analysis demonstrated increased firing of their anterior and middle deltoid, and subscapularis activity than symptomatic patients (36%MVC vs. 23%MVC). During the carrying task, asymptomatic patients demonstrated significantly less upper trapezius muscle activation than the symptomatic patients (18%MVC vs. 37%MVC). During shoulder elevation tasks, asymptomatic patients had significantly greater supraspinatus, infraspinatus, and upper trapezius muscle activation compared to asymptomatics. During forward elevation with an 8 lb. weight, asymptomatic patients showed significantly increased activation of the subscapularis (32%MVC vs. 21%MVC) as well as the anterior (60%MVC vs. 48%MVC) and middle deltoid (54%MVC vs. 32%MVC) when compared with symptomatic patients.
22 SMALL INTESTINE SUBMUCOSA FOR TREATMENT OF ACUTE ROTATOR CUFF TEARS
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Introduction: This study was conducted to investigate the histologic and biomechanical behavior of small intestine submucosa in an acute repair in rat model. Methods: A rat model for the study of rotator cuff pathology has been developed in our laboratory and was utilized in this study. A rotator cuff defect approximately 4 mm x 4 mm was created in a rat supraspinatus tendon and acutely repaired using porcine small intestine submucosa. Twenty-four rats were utilized for biomechanical testing at 2, 8, and 16 weeks post-repair with 8 animals at each time point. Sections were prepared and stained with Hematoxylin and Eosin and evaluated for cell type and tissue organization at each time period. Twenty animals were utilized for biomechanical testing at 8 and 16 weeks (10 in each group). The controls for the biomechanical testing were animals where the supraspinatus tendon was detached and immediately reattached and sacrificed at 16 weeks. Results: Histologic evaluation demonstrated infiltration of the graft with multiple PMN's and disorganization of the extracellular matrix substrate at 2 weeks. At the 8 week time point, there was a predominance of mononuclear cells randomly distributed throughout a disorganized matrix. At 16 weeks, the cells had elongated, resembling fibroblasts, and aligned longitudinally within a more organized matrix, which appeared tendon like. The cross-sectional areas for the small intestine submucosa groups were significantly decreased when compared to the 16 week acute repair group. Biomechanical testing demonstrated no difference between the 8 and 16 week small intestine submucosal acute repair group and the 16 week acute repair group for stiffness and maximum load. There was a trend for the 16 week small intestine submucosa acute repair group to have a decreased percent relaxation when compared to the 16 week acute repair group. Discussion and Conclusions: A significant number of rotator cuff tears fail to heal despite appropriate surgical management. In an attempt to address the biology of rotator cuff healing, a number of products are coming to market that alter the biologic environment of the healing rotator cuff tendon. Little is known about the in vivo behavior of these products. This study describes the histologic and biomechanical behavior of a small intestine submucosal patch in an acute rotator cuff repair rat model. The cellular and extracellular events suggest that the over time the cell population and the extracellular matrix becomes tendon like and the biomechanical properties are no different than an acute repair at 16 weeks.

23 DELAY UP TO 12 WEEKS BEFORE SSP ATTACHMENT DOES NOT AFFECT ENTHESIS RESTORATION—AN EXPERIMENTAL COMPARATIVE HISTOLOGIC STUDY IN RABBITS
*Hans K. Uhthoff, MD (a-ASES)*, Yoichi Koike, MD, Guy Trudel, MD, Bone and Joint Research Laboratory, University of Ottawa, Ottawa, Ontario, Canada

Objective: To find out whether a 6 or a 12 week delay before SSP tendon attachment to bone affects the formation of the enthesis when compared to immediate attachment. Materials and Methods: The supraspinatus entheses of 30 rabbits were resected unilaterally and the tendon stump attached to the humerus either immediately (Group I, n=8), or after a 6 week delay (Group D6, n=8) or after a 12 week delay (Group D12, n=14). Between resection of the enthesis and delayed attachment (groups D6 and D12) the tendon stumps were enveloped in a Durapore membrane to prevent spontaneous attachment. All animals were sacrificed 12 weeks after attachment surgery. Experimental and contralateral shoulders were processed for histology. On standardized histologic sections of the enthesis we measured the number of non-chondrocytes and of chondrocytes, as well as the percentage of chondrocytes aligned in rows. Areas of positive Toluidine Blue (TB) staining indicating presence of proteoglycan and areas of polarized light diffraction indicating spatially aligned collagen fibers were also determined. Results: Between groups I, D6, and D12, there was no statistically significant difference in the number of non-chondrocytes (102±21, 64±14, 57±10), number of chondrocytes (170±9, 159±10, 182±10), the percentage of chondrocytes aligned in rows (69±6%, 69±2%, 68±3%), the areas stained positively with TB (12.3±0.9 mm2, 2.0±0.4 mm2, 2.0±0.3 mm2), and the areas of aligned collagen fibers (99±12x10^3um^2, 77±16x10^3um^2, 74±20x10^3um^2), respectively (all p>0.05). As for contralateral enthesis, the number of non-chondrocytes was 7±1, the number of chondrocytes 158±7, percent of chondrocytes aligned in rows 80±2%, area stained positively with TB 4±0.1mm^2, and the area of aligned collagen fibers was 194±13x10^3um^2. Conclusion: A delay of attachment up to 12 weeks does not affect the histologic variables that characterize SSP enthesis restoration. The results support our contention that successful healing after SSP repair depends more on contribution from the bony side rather than from the tendon side. Therefore the status of the tendon is of less importance than the creation of a bony trough.

24 TREATMENT OF ACUTE TRAUMATIC ELBOW INSTABILITY WITHOUT MEDIAL COLLATERAL LIGAMENT REPAIR
Chris Forthman, MD*, David Ring, MD, Jesse B. Jupiter, MD (a-AO Foundation), Massachusetts General Hospital, Boston, MA

Background: Surgeons treating acute traumatic elbow instability have been slow to adjust from the traditional focus on the medial collateral ligament (MCL) to the increasing importance placed on the lateral collateral ligament (LCL). We reviewed the treatment of elbow fracture-dislocations without medial collateral ligament repair. Methods: Thirty-four patients with acute elbow trauma requiring operative treatment to restore stability were treated by a single surgeon according to a standard protocol and evaluated an average of 21 months after injury. The protocol consists of repair of the ulna and coronoid, repair or replacement of the radial head, and repair of the LCL. Repair of the LCL was reserved for elbows that remain unstable after these initial measures. Results: The LCL origin had been avulsed and was reattached to the lateral epicondyle in all 34 patients. Only one patient had MCL repair due to persistent intraoperative instability. Only one patient had a second procedure for instability, which was related to a malpositioned radial head prosthesis. A stable, mobile (average 101° of arc) and functional LCL was restored in all patients, five of whom required additional procedures for capsular contracture or heterotopic bone. Conclusions: In acute traumatic elbow instability, the lateral soft tissue failure occurs consistently as an avulsion of the LCL origin and (variably) the common extensor musculature from the lateral epicondyle. Using this damage to access and repair the articular fractures and then repairing the lateral soft tissues back to the lateral epicondyle restored stability in nearly all of the patients. MCL repair is rarely necessary in the treatment of complex acute elbow instability.

25 INTRAOPERATIVE INJECTION OF BOTULINUM TOXIN-A (BOTOX) FOR PREVENTION OF POST-TRAUMATIC ELBOW STIFFNESS
*Mechele Rosenwasser, MD (a-Allergan)*, Ian Chen, BS, Scott Crow, BS, Themistocles Protopsaltis, MD, Jonathan Lee, MD, Trauma Training Center, Dept of Orthopaedic Surgery, Columbia University Medical Center, New York, NY

Introduction and Aims: Post-traumatic elbow stiffness with extension deficit is a complication of elbow fractures. Jupiter et al. defines a good result in operatively treated intercondylar humeral fractures as an extension deficit of 30° with flexion to 120°. Spasm of elbow flexors after surgery limits the range of motion achievable during rehabilitation. We hypothesize that intraoperative injection of botulinum toxin A (Botox) will cause a transitory weakness of the
elbow flexors, thereby preventing elbow stiffness, by facilitating more effective rehabilitation therapy. This will lead to a greater range of motion and functional ability. Method: Patients experiencing a traumatic fracture or fracture dislocation about the elbow, including intra- and extra-articular distal humerus fractures, proximal ulna and radius fractures, and Monteggia fracture/dislocations, were enrolled in the study. Fractures were treated with open reduction and internal fixation according to standard operative techniques. Subjects were randomized to receive an intraoperative injection of Botox or normal saline. The treatment group received 100 units of Botox into the brachialis and 100 units into the biceps (divided between the two heads). Overall outcome was assessed between 2 and 6 months with Broberg-Morrey and DASH questionnaires and range of motion measurements. Results: Seven women and five men with an average age of 60 years (range 24-91) have been enrolled in the study. One patient dropped out of the study. All operatively treated fractures healed. Biceps and brachialis function returned to normal by three months. Patients with distal humerus fractures in the Botox group at 3 months all regained extension with an average deficit of 16° (SD 4) while the control group had an average extension deficit of 33° (SD 7). The average arc of motion at 3 months for the Botox and control group was 112° (SD 14) and 65° (SD 14), respectively (p=0.011). Botox did not influence elbow rotation and all patients with distal humerus and proximal ulna fractures had pre-morbid pronation and supination. Both groups had a “fair” Broberg-Morrey score at 3 months. At 6 months, the Botox group had a “good” score of 83, while the control group had a “fair” score of 72. Functional outcome with the DASH at 3 and 6 months was not statistically different between the two groups (mean of 40 at both time points). No adverse events were associated with the Botox injections. Conclusion: Botox injections prevent biceps and brachialis muscle spasm possibly changing the paradigm of post-operative recovery of motion, whereby extension is now achieved earlier than flexion. The increased terminal extension supports intramuscular Botox injections as an adjunct therapy in the treatment of elbow fractures and fracture dislocations to prevent post-traumatic elbow stiffness.

26 LATERAL EPICONDYLITIS: AN EVALUATION OF THREE METHODS OF OPERATIVE TREATMENT
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Background: Many procedures have been described in treating recalcitrant lateral epicondylitis with good success. There is nothing in the literature that compares open, arthroscopic, and percutaneous treatments for lateral epicondylitis. Purpose: To compare three operative methods of treatment for lateral epicondylitis—open, arthroscopic, and percutaneous. Study Design: Retrospective case series Methods: Over a five year period, all patients with recalcitrant lateral epicondylitis operated on by the same surgeon were evaluated. The patients failed a minimum of 3 months of conservative care, including cortisone injections, physical therapy and modalities, nonsteroidal anti-inflammatory medicines, and counterforce bracing. The procedures were nonrandomized, and the decision of which was to be performed was made jointly by the patient and surgeon. There were no factors that excluded patients from undergoing one procedure over another. The patients were followed for a minimum of two years postoperatively. Pre- and intra-operative concomitant pathology was noted. All complications and necessary further care were noted. The outcomes were evaluated with the Andrews-Carson score and visual analog scores for pain at rest, worst pain, and pain with activity. Results: During a seven year period, 114 patients underwent operative intervention for recalcitrant lateral epicondylitis. The study population included 24 percutaneous, 44 arthroscopic, and 41 open procedures. The average age of the patients was 45.7 years old (range 25-73). The duration of conservative care was 13.2 months (range 3-60 months). The average number of conservative measures utilized was 3.5 (range 1-5). The average number of cortisone injections is 1.35 (range 0). The average post-operative follow-up was 47.8 months (range 24-133 months). The pre-operative Andrews-Carson score was 160.3 (range 125-170). The post-operative Andrews-Carson score was 195 (range 135-200). The difference between the pre- and post-operative scores was significant (P=0.001). There were no significant differences among the three study populations regarding age, gender, dominance, conservative measures utilized, cortisone injections, recurrences, complications, VAS scores, and post-operative Andrews-Carson scores. However, there was a significant difference in duration of conservative care and pre-operative Andrews-Carson score. The duration of conservative care was less for the percutaneous group than it was for the arthroscopic or open groups. Also, the pre-operative Andrews-Carson scores were less in the percutaneous group (164.4) than the arthroscopic (158.5; P=0.003) and open (159.7; P=0.015) groups. There was no difference between the arthroscopic and open groups (P=0.559). Recurrences, as defined as further intervention out of the realm of normal post-operative protocols, occurred in 2 arthroscopic releases (4.6%) and 5 open releases (12.2%). There were no recurrences in the percutaneous group. All recurrences were successfully treated with cortisone injections. Failures, as defined as the need for further operative intervention or poor outcomes, occurred in 3 percutaneous (12%), 1 arthroscopic (2.3%) and 2 open (4.9%) groups. Each percutaneous failure was successfully revised by open releases. The one arthroscopic and two failed open releases did not improve, these results were related to a dystrophy in one and complex regional pain syndrome in the other, open and arthroscopic release. There were no associated pathologies or procedures performed on the percutaneous releases. The arthroscopic release group had 18 of 44 with intra-articular pathology that was addressed at the time of arthroscopy (41%). Other concomitant pathology, procedures about the elbow and operative extremitiy, treated at the time of arthroscopy occurred in 9 of 44 (20.4%). The concomitant pathology treated at the time of release for the open group was 8 of 41 (19.5%). When examining these procedures and their influence on the post-operative Andrews-Carson score, no difference was noted. This is true for both intra-articular pathology and concomitant pathology on the ipsilateral extremity. Conclusions: Open, arthroscopic, and percutaneous treatment of lateral epicondylitis offer three highly effective ways for the clinician to address this common clinical problem. Clinical Relevance: Treatment of recalcitrant lateral epicondylitis is effectively treated by open, arthroscopic, or percutaneous methods.

27 A FOLLOW-UP OF SURGICAL TREATMENT OF TYPE III AC DISLOCATIONS
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Objective: A retrospective follow-up study was completed to determine if the currently used modified Weaver-Dunn treatment for type III AC dislocations was successful after a term of physiotherapy and recovery. Methods: A retrospective follow-up study was completed with 18 consecutive patients who had experienced a traumatic type III AC dislocation. They were surgically treated using a modified Weaver-Dunn procedure by the same surgeon with constant technique. Results: Average time from injury to operative date was 17 months. Mean follow-up time was seventeen months (8 months - 5 years). At an average of three months post-op, four participants already had stretched out their repair and had a step along their clavicle. Depending on whether one defines failure by patient satisfaction or clinical/radiological findings, failure rates varied from 37 - 50%. At the time of the follow-up study, at least 50% had stretched out their reconstruction although many continued to have good pain relief and function. This was determined by radiological criteria on an AP x-ray of the shoulder (>100%
superior displacement of the clavicle related to the acromion.

Conclusions: Type III AC dislocations remain a difficult problem. Surgical treatment remains controversial and there is no clear answer in the literature. New successful solutions are needed to treat this challenging injury, including possible stronger reconstructive techniques. Alternative techniques are being considered using a stronger tissue construct.

28 OUTCOMES FOLLOWING CLOSED REDUCTION AND PERCUTANEOUS PINNING OF PROXIMAL HUMERUS FRACTURES
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Summary Statement: This study demonstrates the reliable outcomes and effectiveness of the treatment of selected proximal humerus fractures with closed reduction and percutaneous pinning.
Purpose: The purpose of this study was to report the outcomes of percutaneous fixation for displaced proximal humerus fractures.
Methods: Thirty-six patients from three institutions were treated over a five-year time period. The average age of the patients was 60 years. There were twelve 2-part surgical neck fractures, nine 3-part surgical neck and greater tuberosity fractures and sixteen valgus-impacted type 4-part fractures. All patients were treated with closed reduction and percutaneous fixation and followed clinically and radiographically for a minimum of one year following surgery.
Results: Thirty-three patients were available for follow-up. The average duration of follow-up was 22 months (range 12-60 months). All fractures demonstrated radiographic union after the primary surgery. 30 patients were satisfied with the procedure. The average pain score on a 10 point VAS was 3.2 (range 1 to 8). Average postoperative active range of motion was 138 degrees of elevation, 42 degrees of external rotation and internal rotation to the L3 level. The mean postoperative American Shoulder and Elbow Surgeons score was 56 (range 35 to 85). The type of fracture had no influence upon functional outcome. Two patients were revised to a humeral head hemiarthroplasty secondary to avascular necrosis and painful collapse of the humeral head. One patient developed joint contracture necessitating arthroscopic capsular release. Conclusions: Closed reduction and percutaneous fixation of selected proximal humerus fracture results in high rates of fracture union and good clinical results with a low rate of complications. Mild residual shoulder pain and restriction of function are common.

29 PROGNOSTIC FACTORS AFFECTING PATIENT-ORIENTED FUNCTIONAL OUTCOME FOLLOWING SURGICAL TREATMENT OF HUMERAL SHAFT NONUNION*
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Purpose: Nonunion of the humeral shaft can be extremely disabling with profound effects on a patient’s independent functioning. The purpose of this study was to evaluate the functional outcome and identify prognostic factors that influence the healing time of surgically treated humeral shaft nonunions.
Methods: We performed a retrospective analysis and identified fifty-three consecutive patients treated surgically at a Level One Trauma Center for nonunion of the humeral shaft. Six patients had died, three refused to participate, six were lost to follow-up, and thirty-eight patients (18 males and 20 females, mean age 55 years) were evaluated at a mean follow-up of 60 months. The mechanisms of injury were a fall (24 patients), motor vehicle accident (11 patients) and an industrial accident (3 patients). All patients with atrophic nonunion (31) were surgically treated with compression plating and bone grafting; 7 patients with hypertrophic nonunion were treated with plating alone. All patients underwent a comprehensive assessment including the completion of the Short Form 36 (SF-36), the Disabilities of Arm, Shoulder and Hand (DASH), and the Short Musculoskeletal Functional Assessment (SMFA), as well as the determination of the Constant shoulder and Mayo elbow scores. Results: On the basis of their smoking habits during the time to union (time from operation to radiographic union), patients were classified as ‘non-smokers’ or ‘smokers’. Seventeen (44.7%) patients were smokers and twenty-one (55.3%) were non-smokers. The demographic characteristics of the two groups were similar. All nonunions united with the mean time to union of 16.2 weeks for non-smokers and 25.1 weeks for smokers (<0.001). All nonunions united within 35 weeks of surgery. Time to union was negatively associated with the Physical Function portion of the SF-36 (p = 0.01), the DASH (p = 0.01), and the Arm and Hand Function part of the SMFA (p = 0.005). The only other factor that had a significant negative effect on the functional outcome scores was the presence of one or more comorbid factors (SF-36, p < 0.001; DASH, p < 0.001; SMFA, p < 0.001). Patient-oriented and surgeon based scores were found to correlate well (range r = 0.545 to r = 0.916, p < 0.001 for all combinations). Conclusions/Significance: These results indicate that time to consolidation of operatively treated humeral shaft nonunions was significantly longer in smokers versus non-smokers. Increased time to union was also associated with lower patient-reported functional outcome scores. The long-term functional outcome following surgical treatment of humeral shaft nonunions is dependent upon the time to consolidation. Smoking is a significant remediable risk factor for delayed union following surgical repair. Given the adverse effects of smoking on bony union, orthopaedic surgeons should emphasize abstention during the full rehabilitation period.

30 THE INCIDENCE OF DEEP-VEIN THROMBOSIS FOLLOWING SHOULDER ARTHROPLASTY: A PROSPECTIVE, OBSERVATIONAL STUDY*
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Introduction: Venous thromboembolic complications following reconstructive shoulder arthroplasty may be more common than previously recognized and have been the focus of recent concern among shoulder surgeons. The purpose of this prospective, observational study is to document the incidence of deep-vein thrombosis (DVT) and related venous thromboembolic (VTE) complications in this patient population.
Methods: Sixty-five consecutive reconstructive shoulder arthroplasty procedures (45 TSA, 20 HA) in 29 males and 36 females, were prospectively enrolled into this study between August 2003 and March 2004. Patients on routine pre-operative anticoagulation therapy were excluded. Known risk factors for venous thromboembolic disease were recorded using a previously published risk assessment form prior to each surgical procedure. All patients underwent four-limb surveillance color flow Doppler ultrasound imaging two days post surgery and the presence and location of DVT was recorded. Post-operative symptomatic or fatal pulmonary emboli were also noted. Historical, operative, and peri-operative factors associated with an increased risk for developing thromboembolic disease following shoulder arthroplasty were studied using SPSS statistical software.
Results: The incidence of DVT in this cohort of 65 patients was 12.3%. We documented 9 DVT’s (4-upper extremity, 5-lower extremity) in 8 patients. There were 3 ipsilateral and no contralateral UEC DVT’s (subclavian/axillary vein [3], axillary/brachial vein [1]). There were 4 ipsilateral and one contralateral LE DVT (peroneal vein [4], posterior tibial and peroneal vein [1]). The incidence of PE was 1.5% (symptomatic nonfatal bilateral pulmonary emboli by Spiral CT scan two days after surgery in one patient with subclavian/
axillary vein thrombosis. Risk factors associated with VTE disease in this patient population include history of previous DVT, PE, cancer, multiple major medical diseases, and prolonged operative time. Conclusions: This is the first study to report the incidence of DVT following reconstructive shoulder arthroplasty. Our results demonstrate that the incidence of DVT in this patient population is not insignificant (12.3%), and clearly higher than that in the general population (0.05%). This prospective study indicates that VTE disease, including symptomatic pulmonary embolism, can occur following shoulder arthroplasty procedures and shoulder surgeons should be aware of this potential complication. Further studies are needed to determine the role of routine DVT chemoprophylaxis in shoulder arthroplasty patients.

REFERENCES

31 MONITORING OF PERIPHERAL NERVE FUNCTION DURING SHOULDER ARTHROPLASTY USING CONTINUOUS INTRAOPERATIVE NERVE MONITORING
Gerald R. Williams, Jr, MD*, Kenneth Rogers, PhD, ATC, Matthew Ramsey, MD, Charles Getz, MD, David Silverberg, MD, Sameer Nagda, MD, University of Pennsylvania–Orthopaedics, Philadelphia, PA

Neurologic injury following shoulder arthroplasty has been reported at 1-4%. However, the true incidence may be higher since injury is currently identified clinically. This study utilized continuous intraoperative nerve monitoring to identify the incidence, pattern, and predisposing factors for nerve injury during shoulder arthroplasty. Continuous intraoperative monitoring of the brachial plexus was performed on 30 consecutive patients undergoing shoulder arthroplasty. Intraoperative compromise of nerve function was defined as loss of motor latency greater than 25% of baseline. Arm and retractor position were recorded and adjusted to relieve tension. Patients with intraoperative nerve dysfunction underwent diagnostic EMG at least 3 weeks postoperatively. Fifteen patients (50%) had nerve dysfunction during surgery. Twelve of fifteen patients (80%) had dysfunction while abducted, extended, and externally rotated (ER). Repositioning of the extremity and/or retraction resulted in return of nerve signal in 11 patients (73%). Postoperative EMG was positive in 75% of patients who did not have a return to normal motor latency intraoperatively. Nerves affected included: Mixed Plexopathy (61%), Axillary (17%), Ulnar (17%), and Radial (5%). Prior shoulder surgery and passive ER <10° were associated with an increased incidence of nerve dysfunction (p < 0.05). The incidence of nerve injury during shoulder arthroplasty is likely greater than reported. The arm should be maintained in the extreme positions required for humeral preparation and glenoid exposure as little as possible. Patients undergoing revision procedures and exhibiting decreased motion (< 10° ER) are at higher risk for nerve injury and may be considered for routine nerve monitoring.

32 ANTIBIOTIC MIXED METHYL METHACRYLATE COVERED PROSTHETIC IMPLANT FOR THE TREATMENT OF DEEP INFECTIONS IN SHOULDER ARTHROPLASTY
Lynn A. Crosby, MD*, Wright State University School of Medicine Department of Orthopaedic Surgery, Dayton, OH

Introduction: Deep infections of a hemi- or total shoulder arthroplasty are an extremely difficult condition to treat effectively. Usually the infection is treated at the expense of the tissue envelope, and the patients are left with little options after they have successfully eradicated their infection. This is a retrospective review of the successful treatment of deep infections involving an arthroplasty of the shoulder with methylmethacrylate impregnated with an antibiotic and then covering a normal prosthetic stem. Methods: Twelve patients (ages 60-82) with deep chronic infections of an arthroplasty of the shoulder were treated with removal of the implant, extensive debridement, placement of an antibiotic (vancomycin) impregnated into methylmethacrylate and covering a prosthetic stem and IV antibiotics for six weeks. Nine patients were then converted to standard prostheses after confirmation of eradication of their infection. Three patients were satisfied with their current function and refused further surgery. Results: All patients were infection free at follow-up averaging 22 months (12-40). Significant improvements (P < 0.05) were seen for pain VAS (9 to 2) and ASES (18-72). Outpatients were overall satisfied with their pain relief and function but still had limitations of activity of daily living. Conclusion: Aggressive treatment is necessary in the treatment of deep chronic infections of a shoulder arthroplasty. We recommend the use of a methylmethacrylate coated antibiotic prosthetic stem for the treatment of this condition. This aids in maintaining the soft tissue envelope, prevents severe scarring formation to help maintain some function ability of the shoulder once reconstruction is performed.

33 INTERSCALENE BLOCK (ISB) FOR SHOULDER/UPPER ARM SURGERY: A PROSPECTIVE EVALUATION OF 693 CONSECUTIVE CASES FOR SIDE EFFECTS/COMPLICATIONS
Gordon W. Nuber, MD*, Mark K. Bowen, MD, Radha C. Sukhani, MD, Mark C. Kendall, MD, Northwestern University Medical School, Chicago, IL

Introduction: A high incidence of failures (13%), 24hr IV analgesic use (92%) and major complications (3%) was reported in a retrospective evaluation of 218 patients receiving ISB. These relatively small numbers of ISBs were performed between 2 community hospitals over a 3-year period (approximately 35 ISBs/year/institution). Several factors influence the efficacy and risk associated with ISB, foremost among these being appropriate selection of patients, local anesthetic drugs, safe technique and, most importantly, experience of the practitioner. This prospective observation study evaluated the efficacy and risk (minor and major complications) associated with ISBs in a busy (> 600 ISB/year) practice. Methods: Following IRB approval and written consent, 693 consecutive adult patients undergoing shoulder/upper arm surgery under ISB over a 1-year period participated. After sedation (midazolam 2.5mg IV), a nerve stimulator assisted ISB was performed with levobupivacaine 0.6% with epinephrine 1:200,000, 0.5 ml/kg (40 ml max). An independent investigator assessed the evolution of side effects, complications and postoperative neurologic sequelae up to 4 weeks. Telephone assessments for neurologic sequelae were done at 24-48 hrs, 2 wks and 4wks. Symptomatic patients were further assessed q 1 - 2wks until complete resolution of symptoms. Duration of analgesia, IV analgesic use, nausea/vomiting over 24 hours, and unanticipated hospital admissions secondary to side effects and/or complications of ISB were recorded. Results: ISB was successful in 97% of cases; a supplemental block was performed postoperatively in all except 6 patients who failed preoperative block. Intraoperative supplementation consisted of either general anesthesia (58%) or IV sedation (42%) patients. Duration of analgesia was 17 ± 5 hours. IV
analgesics over the first 24 hours were required in 14%, and vomiting occurred in 18% of patients. Eighty percent of patients were discharged home and no unanticipated admission occurred due to side effects/complications of ISB. Table I outlines the evolution of side effects/complications and interventions. Conclusion: In a large series of patients, ISB was a safe and effective technique of perioperative anesthesia and analgesia for shoulder/upper arm surgery. Self limiting sensory symptoms were reported by 6% of patients, and 2 cases of reversible motor deficits were unrelated to the ISB procedure.

**REFERENCE**

Table 1

<table>
<thead>
<tr>
<th>Side effect/complications</th>
<th>Incidence [n (%)]</th>
<th>Symptom duration (range)</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horner’s syndrome</td>
<td>535 (78)</td>
<td>12–24 hrs</td>
<td>None</td>
</tr>
<tr>
<td>Hoarseness</td>
<td>282 (40)</td>
<td>12–24 hrs</td>
<td>None</td>
</tr>
<tr>
<td>Postoperative coughing</td>
<td>38 (5.5)</td>
<td>8–12 hrs</td>
<td>Substitution to thick liquids/semisolids</td>
</tr>
<tr>
<td>Dyspnea*</td>
<td>70 (6.9)</td>
<td>0</td>
<td>Incentive spirometry</td>
</tr>
<tr>
<td>Pneumothorax</td>
<td>0</td>
<td>0</td>
<td>None</td>
</tr>
<tr>
<td>Systemic toxicity</td>
<td>1 (0.1)</td>
<td>0</td>
<td>IV propofol</td>
</tr>
<tr>
<td>Hyposthesia/paresthesia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block site</td>
<td>6 (1)</td>
<td>4–6 wk</td>
<td>None</td>
</tr>
<tr>
<td>Surgical site</td>
<td>11 (1.5)</td>
<td>4–12 wk</td>
<td>None</td>
</tr>
<tr>
<td>Hand (median nerve)</td>
<td>16 (2.2)</td>
<td>2–8 wk</td>
<td>None</td>
</tr>
<tr>
<td>Hand/forearm (ulnar nerve)</td>
<td>5 (0.8)</td>
<td>6–8 wk</td>
<td>None</td>
</tr>
<tr>
<td>Posterior auricular nerve</td>
<td>7 (1.0)</td>
<td>3–12 wk</td>
<td>None</td>
</tr>
<tr>
<td>Mild dyesthesias block site</td>
<td>10 (1.3)</td>
<td>2–6 wk</td>
<td>None</td>
</tr>
<tr>
<td>Motor weakness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herniated C5 disk</td>
<td>1</td>
<td>8 wk</td>
<td>Electromyoneurography, MRI/epidural steroids</td>
</tr>
<tr>
<td>Ant ronseous nerve palsy</td>
<td>1</td>
<td>30 wk</td>
<td>Electromyoneurography, surgical decompression</td>
</tr>
</tbody>
</table>

*Reported by patients with BMI 33 ± 5.

**Discussion/Conclusion:** This study demonstrated an overall complication rate of 10.6 percent following arthroscopic rotator cuff repair and represents the only identified study assessing complications specifically following arthroscopic rotator cuff repair. Persistent postoperative stiffness was the most common complication and emphasizes the fact that an all arthroscopic approach does not statistically significantly reduce its occurrence compared to open rotator cuff repair studies. However, the overall complication rate compares favorably to studies assessing outcomes after open or mini-open repair.

**34 COMPLICATIONS FOLLOWING ARTHROSCOPIC ROTATOR CUFF REPAIR**

Larry D. Field, MD*, Kenneth J. Brislin, MD, Felix H. Savoie III, MD, Mississippi Sports Medicine & Orthopaedic Center, Jackson, MS

Introduction: Arthroscopic rotator cuff repair has become much more commonly performed, and the short term and mid term results following arthroscopic repair have proved comparable to open repair in several studies. However, there has been a paucity of literature regarding the complications associated with arthroscopic repair. The purpose of this study was to determine the complication rate for a consecutive group of patients undergoing arthroscopic rotator cuff repair.

Methods: A retrospective chart review of 263 consecutive patients undergoing arthroscopic rotator cuff repair between January, 2003 and June, 2003 was carried out. Twenty-eight patients (10.6%) developed a postoperative complication. There were no intraoperative complications.

Results: The average age of the patients with complications was 61 years (26-76 years), and there were 10 men and 18 women in this group. Of the 28 patients, 23 were diagnosed with significant stiffness. Stiffness was considered a complication only when it persisted for 3 months or more following surgery and was defined as less than 100 degrees of passive forward flexion, less than 10 degrees of passive external rotation, and/or less than 30 degrees of external rotation at 90 degrees abduction. Other complications included deep vein thrombosis (1), reflex sympathetic dystrophy (1), persistent pain (1), infection (1), and death (1). The postoperative stiffness resolved adequately in all but one patient at an average of 4.7 months. This patient subsequently underwent an arthroscopic capsular release at 4 months postoperatively.

Discussion/Conclusion: This study allowed the greatest range of motion of any joint in the body. Stabilization of this joint requires soft tissue constraints, both static and dynamic. Capsuloligamentous effects are most efficient at the extremes of range of motion when they are taught. Dynamic stabilizers are crucial in preventing glenohumeral translation especially in the midrange when ligaments are not tight. The concept of concavity compression was illustrated by Lippitt et al by observing decreased glenohumeral translation with increasing compressive forces. The act of throwing requires a coordinated balance of muscular activity and capsuloligamentous restraints that tax the extreme ranges of motion when they are taught. Dynamic stabilizers are crucial in preventing glenohumeral translation especially in the midrange when ligaments are not tight. The concept of concavity compression was illustrated by Lippitt et al by observing decreased glenohumeral translation with increasing compressive forces. The act of throwing requires a coordinated balance of muscular activity and capsuloligamentous restraints that tax the extreme ranges of motion of this joint. Stresses have been calculated as humeral angular velocities up to 7550 deg/sec and rotational torques up to 67 Nm. Disruption of this concerted effort with extreme stresses can lead to shoulder instability, rotator cuff tears, SLAP lesions, and secondary impingement. The purpose of this study was to assess the effects of muscular forces on the path of glenohumeral articulation (PGA) and the glenohumeral joint forces using a human cadaveric shoulder model.

Methods: Eight fresh
Figure 1 Humeral rotational range of motion.

Figure 2 Path of glenohumeral articulation.

frozen cadaveric shoulders were tested in 90° of shoulder abduc-
tion in the scapular plane using a custom shoulder jig with a six
degree-of-freedom load cell and a microscribe digitizing system.
The muscles were loaded with a pulley system used to approximate
the muscle force vector towards the center of the muscle belly. The
deltoid was loaded with 80 N. The infraspinatus and teres minor
were loaded together with 42 N. The supraspinatus, subscapularis,
pectoralis major, and latissimus dorsi were each loaded with 42 N.
Glenohumeral joint forces and PGA were measured under three
conditions with the final state simulating a thrower’s shoulder.
These included an intact state, an anterior capsular stretched state
in which external rotation was increased atraumatically by 15-20% of
the original range of motion, and posterior capsular plicated state
designed to decrease internal rotation by 5-10%. The humeral
rotational range of motion was measured from maximum external
rotation to maximum internal rotation for each state and the gleno-
humeral joint forces and the PGA were quantified. Statistical anal-
ysis was performed using repeated measures ANOVA and Tukey
post hoc test. Results: The goal of increasing external rotation in the
stretched state was achieved with an average increase of 13°
while, internal rotation increased 1°. Internal rotation was de-
creased an average of 9° in the plicated state decreasing external
rotation 5°. This shift in humeral rotational range of motion in
external direction confirmed the simulation of the thrower’s shoul-
der (Figure 1). Humeral head center position with respect to the
external direction confirmed the simulation of the thrower’s shoul-
der rotation 5°. This shift in humeral rotational range of motion
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external direction confirmed the simulation of the thrower’s shoul-

Discussion: When comparing the PGA from external rotation to internal rotation capsuloligamentous effects can be shown throughout the humeral rotational range of motion but only approach statistical significance at the extremes where the static stabilizers make their greatest contribution. The concavity compression stability effect afforded by the muscular forces was well demonstrated with this cadaveric model. Previous investigations which did not load the muscles showed greater variation in the PGA. In this study, the PGA did not vary greatly and the forces about the GH joint did not vary significantly in the differing states. This suggests that the muscles have a strong influence on glenohumeral joint stabilization in throwers. A limitation of this study is conceded by the knowledge that the dynamic stabilizers were represented as constant forces. EMG analyses have demonstrated that the muscles exhibit varying forces both eccentric and concentric through the throwing motion. We speculate that the proposed superior impingement occurs secondary to the shoulder muscles functioning to maintain glenohumeral joint balance and congruency.

REFERENCES

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36 THREE DIMENSIONAL SCAPULAR KINEMATICS IN INJURED AND NON INJURED SUBJECTS, AND IN SYMMETRICAL AND ASYMETRICAL SUBJECTS

W. Ben Kibler, MD*, Brady L. Tripp, MEd, ATC, Tim L. Uhl, PhD, ATC, PT, Lexington Clinic Sports Medicine Center, Lexington, KY

Introduction: Alteration of dynamic scapular motion is seen frequently in association with shoulder injury. Accurate methods of clinical assessment would aid in evaluation and treatment of these alterations. One method of clinical assessment of scapular motion is observation of bilateral scapular motions for patterns of symmetrical or asymmetrical movement. Previous studies have shown that evaluation of movement in single planar patterns is only moderately reliable, and that assessment of movement in multi-planar patterns improved sensitivity and positive predictive value. More information is needed to link these observational assessments with the actual biomechanical motions in normal and symptomatic subjects. This study compared the magnitude, symmetry, and consistency of biomechanically determined 3-dimensional scapular motion between injured and non-injured subjects and compared these findings in subjects assessed with a clinical system based on determination of symmetry versus asymmetry. Subjects: Fifty-two subjects (21 non-pathologic, 31 pathologic) volunteered for participation. Diagnoses of pathologic subjects included: rotator cuff impingement or tendinopathy (N=10), labral (N=6), glenohumeral instability (N=6), and scapular muscular disorder (N=9). Methods: One orthopedic surgeon classified each subject as displaying either symmetric or asymmetric scapular motion during a clinical assessment. Investigators used an electromagnetic tracking device to measure bilateral scapular kinematics, taping receivers to the
posterior acromial angles of both scapula and a reference receiver to the sternum. Participants performed five repetitions of elevation in the plane of the scapula up to 150° of humeral elevation. Investigators divided each trial into two distinct phases, arm elevation and arm lowering; then normalized each phase. Scapular movement in internal/external rotation, upward rotation, and anterior/posterior tilt was measured. Separate coefficient of multiple determination values were calculated for each subject and each plane of scapular motion to assess consistency and symmetry of scapular motion ($r^2$). These CMD values represent inter-trial consistency and bilateral symmetry of both the magnitude and velocity of scapular motion. Kruskal-Wallis tests were used to evaluate differences between groups. Results: Injured versus non-injured: Injured subjects displayed significantly less overall inter-rotation (p = 0.028), less scapular external rotation at maximal arm elevation (p = 0.009), less scapular external rotation on maximal arm elevation (p = 0.028), and less overall upward rotation (p = 0.001). CMD values demonstrated significant differences in between trials consistency, with injured subjects displaying more inconsistency in motions of scapular internal rotation (p = 0.005) and upward rotation (p = 0.048). No differences were seen in this population in anterior/posterior tilt. Symmetry versus asymmetry: Asymmetric subjects displayed less overall internal/external rotation (p = 0.03). CMD values demonstrated that asymmetric subjects showed less between trials consistency in scapular internal rotation and upward rotation (p<0.05) CMD values demonstrated no significant differences between injured and non injured subjects based on assessment of symmetry versus asymmetry. Conclusions and Clinical Implications: This study demonstrates that there are significant differences in magnitude and consistency of multi-planar scapular motion between injured and non injured subjects, but that assessment and classification based on determining comparable asymmetry of motion does not identify injured versus non injured patients. The data suggest that clinical assessment of scapular motion as part of the shoulder exam should focus on the intrinsic characteristics of the motion of the involved scapula rather than a comparison to the opposite side. This would include evaluating the consistency of repetition of the movement of the scapula with arm movement and the movement of the medial border of the scapula, as a guide to assess internal rotation and upward rotation.

37 A COMPARISON OF EXPECTATIONS OF SHOULDER SURGERY BETWEEN SURGEON AND PATIENT
David S. Morrison, MD*, Michael W. Grafe, MD, Jonathan W. Myer, MD, Mark Ghamasy, PhD, Memorial Orthopaedic Surgical Group, Long Beach, CA

It is difficult to determine the expectations of patients preoperatively and they may not be the same as the surgeons. If the expectations of the surgeon and patient are significantly different, then the selected procedure may not be appropriate for the patient. We prospectively evaluated the surgical expectations of 110 consecutive patients. The surgeon and the patient each completed a separate 21-item HSS Shoulder Surgery Expectations Form. All participants were blinded. Responses were evaluated with respect to type of surgery (arthroscopic subacromial decompression, arthroscopic acromioclavicular joint arthroplasty, rotator cuff repair, and total shoulder arthroplasty) and survey question. Statistical analyses were performed with a visual analogue scale (VAS) and a questionnaire. A p-value of less than 0.05 was considered significant. The surgeon and the patient expected different results from the surgical procedures. This difference mainly comes from the greater importance that the patients have in a surgical procedure returning to pre-injury levels while the surgeon rarely thought that was likely. In addition, patients expect to be able to perform vigorous activities, such as sports, especially in the patients that have the most significant anatomical pathology: rotator cuff tears and glenohumeral arthritis. The surgeon places more importance in outcomes related to less vigorous activity such as self care, psychological well-being, and ability to interact with other people. This study demonstrates a significant difference between a surgeon’s expectations and the patient’s expectations from surgery. Patients invariably expect more from the surgery than does the surgeon, this despite extensive preoperative patient education. Although this optimism may be psychologically beneficial to the patient it is apparent that many patients have unrealistic expectations which surgery will not address.

38 ACCURACY OF INTRA-ARTICULAR SHOULDER INJECTION IN PATIENTS WITH ADHESIVE CAPSULITIS
Benjamin S. Shaffer, MD*, Heather Williams, MD, DC Sportsmedicine Institute, Washington, DC, *George Washington University Department of Orthopaedics

Background/Objective: Intra-articular corticosteroid injections are a well-established adjunct in the treatment of Adhesive Capsulitis. In theory, therapeutic benefit ought to be directly related to intra-articular placement. Given the decreased volume of the glenohumeral joint in the setting of Adhesive Capsulitis, such accurate injection may be challenging. Yet no studies have examined the accuracy or optimal technique of intra-articular injection. The purpose of this study was to prospectively examine the accuracy of three in-office intra-articular injection techniques in a cohort of patients with Adhesive Capsulitis. Methods: Intra-articular injection accuracy was assessed in a prospective series of 30 consecutive patients with Hannafin Stage II (painful, stiff) Adhesive Capsulitis. Patients with symptoms of less than 3 months duration, a history of significant trauma or proximal humeral fracture, full thickness rotator cuff tear, or glenohumeral arthritis were excluded. All injections were performed by one orthopaedic surgeon, using a 22-gauge 2.5 inch-long spinal needle through one of three commonly used shoulder portals: Posterior, Supraclavicular [Neuvaer portal] and Anterior. Upon presumed joint entry, each patient received an injection consisting of 2cc’s Depomedrol (40 mg/cc), 3 cc’s Lido- caine (1% Plain), and 3cc’s Isover 300 [Bracco Diagnostics, Princeton New Jersey]. AP and axillary radiographs were obtained immediately following the injection to determine injection accuracy. A board-certified radiologist, experienced in musculoskeletal interpretation, blinded to the method of injection, reviewed each film series. Injection accuracy was characterized as intra-articular (IA), partially intra-articular (PIA), or extra-articular (EA). Pain level was determined both before and 2 weeks following the injection, using a visual analogue scale (VAS) and a prescription pain medication. Results: Thirty-one consecutive patients underwent injection. One patient was excluded, due to a vaso-vagal reaction, precluding timely post-injection radiographs, for a total of 30 patients. Of 10 posterior injections, 1 was IA, 1 partially IA, and 8 EA, for an accuracy rate of 15%. Of 10 supraclavicular injections, 7 were IA, 1 PIA, and 2 EA, for an accuracy rate of 75%. Of 10 anterior injections, 9 were IA and 1 was PIA, for an accuracy rate of 95%. Anterior injections proved more accurate than suprACLAVICULAR, which were more accurate than posterior injections (P<.05). With respect to pain, all patients noted improvement.
(minimal 20%), with an overall average decrease of their pain by VAS of 39%. There was no statistically significant difference in pain improvement amongst the three injection techniques, with average VAS improvement for posterior 45%, supraclavicular 39% and anterior 32%. There was no significant relationship between injection approach, intra-articular accuracy, and pain improvement. **Conclusion:** This study showed that accuracy of intra-articular injections in the treatment of Adhesive Capsulitis is technique-dependent. Only the anterior approach permitted reproducible targeting of the glenohumeral joint in most patients. Injection from a posterior approach was highly inaccurate. Because corticosteroid injections were very effective in relieving pain regardless of injection accuracy, subjective improvement in these patients cannot be solely attributed to intra-articular placement.

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**POSTERS**

1. **THREE-DIMENSIONAL ANALYSIS OF THE BICIPITAL GROOVE AND THE IMPLICATIONS FOR PROXIMAL HUMERUS FRACTURE PROSTHETIC DESIGN**

Laurent Angibaud*, Joseph D. Zuckerman, MD (c-Exactech Incorporated), Pierre-Henri Flurin, MD, Thomas Wright, MD, NYU Hospital for Joint Diseases Department of Orthopaedic Surgery, New York, NY

**Introduction:** Humeral head replacement for proximal humerus fractures is a commonly performed procedure despite variable outcomes. Tuberosity complications are important predictors of outcome. The purpose of this study was to evaluate the three-dimensional (3-D) anatomy of the bicipital groove (BG) to ascertain its reliability as a landmark for tuberosity reconstruction. **Materials and Methods:** 49 dried cadaveric humeri were analyzed using a 3-D Coordinate Measuring Machine (CMM). The anterior offset (AO) and lateral offset (LO) of the BG was quantified at four levels (proximal to distal). **Results:** For the proximal BG, mean AO was 7.3 ± 2.8 mm (2.1 to 13.9 mm); distally the mean AO was 7.2 mm ± 1.2 mm (3.9 to 11.2 mm). AO was considerably less variable distally although mean values were fairly constant at all four levels (range 7.2 to 7.6 mm). Proximally, the BGLO was 8.2 ± 2.1 mm (4.5 to 13.2 mm); distally the mean LO was 5.9 ± 1.6 mm (2.3 to 9.4 mm). The LO was variable from proximal to distal and followed a “reverse S” shape. **Discussion:** The BG location is an important anatomic landmark particularly with respect to the location of the tuberosities and should be reflected in the design of a humeral fracture prosthesis. By placing the fin of the prosthesis in the anterolateral position as determined by this study, it can be used as an anatomic reference point for reattachment of the greater and lesser tuberosities.

2. **THE EFFECTIVENESS OF STATIC PROGRESSIVE SPLINTING FOR POST-TRAUMATIC ELBOW STIFFNESS**

Job Doornberg, MS*, David Ring, MD, Jesse B. Jupiter, MD (a-AO Foundation), Massachusetts General Hospital, Boston, MA

**Introduction:** Elbow stiffness is one of the most common complications of elbow trauma. When exercises fail to restore motion, surgery is considered. A program of static progressive splinting is often used in an attempt to avoid surgery when a standard exercise program is no longer improving motion. It remains unclear how often splinting obviates the need for surgery. **Methods:** Over a 3-year period, 21 consecutive patients with a post-traumatic elbow contracture were treated with static progressive elbow splinting after a standard exercise program was no longer achieving gains in motion. The initial injury was a fracture of the distal humerus in 8 patients, the radial head in 7 patients, the olecranon in 4 patients, with associated radial head and distal humerus fractures in one, a Monteggia fracture in one, and a simple dislocation of the elbow in one patient. 2 patients were treated after the injury alone, 1.1 were treated after operative treatment of the initial injury, 3 after operative contracture release and one patient was treated with static progressive splinting after a total elbow arthroplasty. Splinting was initiated an average of 39 days after injury alone or 50 days after operative treatment. **Results:** The flexion arc improved from 71 degrees (45 to 115 degrees) prior to splinting to 113 degrees (range 40 to 150 degrees) after splinting. Prior to the initiation of splinting only 3 patients (14%) of patients had a functional arc of motion (defined as 30 to 130 degrees of splinting). After splinting, 15 patients (71% percent) of 21 patients had a functional arc of motion. Only 2 patients ultimately requested an elbow contracture release to attempt to gain additional motion. **Conclusion:** Static progressive splinting can help gain additional motion when standard exercises prove inadequate. Operative treatment was avoided in over three-fourths of patients.

3. **VENOUS THROMBOEMBOLIC COMPLICATIONS FOLLOWING RECONSTRUCTIVE SHOULDER ARTHROPLASTY: A RETROSPECTIVE REVIEW OF 1564 CASES**

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**Introduction:** The purpose of this study is to report the incidence of acute perioperative symptomatic venous thromboembolic (VTE) complications following reconstructive shoulder arthroplasty at a single academic institution over an eight-year period. The hypothesis of this study is that the incidence of VTE complications following shoulder arthroplasty is significant and greater than previously suspected. **Methods:** Between January 1995 and July 2003, 1564 patients underwent hemiarthroplasty-(HA) or total shoulder arthroplasty-(TSA) at our institution. The hospital and office records of these patients were retrospectively reviewed and all patients diagnosed with a thromboembolic complication perioperatively were identified. Thromboembolic complications were defined as deep-vein thrombosis (DVT) or symptomatic or fatal pulmonary embolism (PE). Risk factors predisposing to VTE disease were assessed in all patients who met study criteria. **Results:** The incidence of acute perioperative symptomatic VTE complications was 0.45% (7-females; age-69, 55-78). There were (6)-PE (symptomatic-4, fatal-2). DVT was documented (MR-venogram/USG) in two cases (posterior-tibial/peroneal (1), axillary and bilateral-peroneal (1)). Tachycardia (2), dyspnea (2), or sudden cardiovascular collapse (2) was the major presenting complaint. There was (1)-symptomatic DVT (ipsilateral popliteal and pelvic) in a patient complaining of lower-extremity pain and swelling. VTE complications occurred following TSA-(5) [osteoarthritis-3, post-traumatic AVN-1, failed HA-1] and HA-(2) [acute fracture-2] on the first-(2), second-(4), or third-(1) postoperative day. Five-patients had known risk factors for VTE disease [malignancy-(3), prolonged (>3hr) operative time-(3), acute trauma-(2), extensive preoperative travel-(2), previous DVT-(1)]. **Conclusions:** The incidence of acute perioperative symptomatic VTE complications following reconstructive shoulder arthroplasty is relatively low (0.45%). However, contrary to popular belief, this study demonstrates that significant VTE complications can occur in this patient population. Pulmonary embolus should be strongly considered in patients complaining of tachycardia or dyspnea following reconstructive shoulder arthroplasty surgery.
4 MINIMALLY INVASIVE TOTAL SHOULDER ARTHROPLASTY: A CADAVERIC STUDY *
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Introduction: The traditional exposure for Total Shoulder Arthroplasty (TSA) is a 17 cm deltopectoral incision. Recently, minimally invasive surgery for the knee and hip has been explored and has been successful in reducing perioperative morbidity and improving patient satisfaction. The purpose of this study was to evaluate a minimally invasive approach to TSA utilizing a 6 cm incision in cadaver shoulders. We hypothesized that sufficient exposure for surgical releases, humeral osteotomy, and glenoid resurfacing could be achieved using a minimally invasive technique without undue stress to the soft tissue or local neurovascular structures. Material and Methods: A TSA was performed through a minimally invasive technique in ten cadaver shoulders. The incision was made from the center of the coracoid and extended distally for 6 cm within the deltopectoral interval. The presence or absence of arthritic changes was noted as well as the status of the rotator cuff. Results: A TSA was performed through a 6 cm minimally invasive incision in all ten cadaver shoulders. The incision was not lengthened in any specimen nor was there any skin or soft tissue donor site morbidity. The retractors were small blades. The premise of minimally invasive surgery is to reduce the trauma of surgery while maintaining the perceived high levels of safety, efficacy, and durability. This study demonstrates that it is technically possible to perform a TSA through a minimally invasive 6 cm incision.

5 USE OF A NOVEL GLENOID PROSTHESIS IN PATIENTS WITH EXCESSIVE GLENOID BONE WEAR
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Introduction: The normal humeral head to glenoid surface mismatch (4:1) can be accentuated by glenoid wear. We analyzed our series of a variable dual radius glenoid component used to accommodate differences in glenoid and humeral surface area, while allowing stable glenoid fixation. Methods: There were fifteen patients, ten female and five male with osteoarthritis. A significant reduction in glenoid bone available for component fixation due to wear was identified radiographically and confirmed intraoperatively. Ten patients had posterior eccentric wear and five had concentric wear. The mean age was 69 years (range 60-86). The mean follow up was 33 months (range 24-41). Eleven pegged and four keeled components were used. All components had an outer (non-articular) diameter at least 6 mm smaller than the inner (articular) diameter. Patients were assessed by clinical examination, ASES score and plain radiographs. Results: Fourteen patients had significant improvement in pain, clinical examination and functional scores (93%). Of these fourteen patients, eleven (79%) had complete component seating and the other three (21%) had >90% seating. One patient (9%) had an incomplete, non-progressive radiolucent line and remains asymptomatic. The one unsatisfactory result had an anterior glenoid fracture which required revision to a trabecular metal glenoid with a satisfactory result. Conclusion: A variable dual radius glenoid component is a reliable alternative in patients with increased humeral head to glenoid surface mismatch. Stable fixation of the glenoid component was achieved despite limited glenoid bone stock.

6 ARTHROSCOPIC SUTURE ANCHOR VERSUS OPEN BANKART REPAIR IN TRAUMATIC GLENOHUMERAL INSTABILITY
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One hundred forty four patients presented with recurrent anterior shoulder instability and were previously reported with a mean of 36-month follow-up. These patients were re-evaluated at an average of 7.2 years follow-up to assess the long-term outcome of arthroscopic versus open repair. All patients had traumatic unidirectional instability with Bankart lesions confirmed at surgery. Patients selected treatment based on data available regarding preoperative morbidity and recurrence rates at the time of their preoperative appointment. One hundred two patients (106 shoulders) selected open repair and 42 patients (43 shoulders) arthroscopic suture anchor repair. There were no significant complications in either group other than dislocation. Perioperative morbidity was significantly decreased in the arthroscopic group. External rotation was improved in the arthroscopic group by a small but statistically significant amount (5 degrees, p<0.05). There were four documented early recurrences in the open group (3.9%) (reoperation rate 2.8%) and seven in the arthroscopic group (16.3%) (reoperation rate 11.6%) (chi square = 11.9, p=0.01); this increased to eight dislocations in the open group (7.5%) and ten in the arthroscopic group (23%) at final follow-up. While return to sports was the norm for open repairs, elite level throwing sports were significantly more likely to be pursued after arthroscopic repair than with open repair (p<0.05). Long-term data regarding the outcome of arthroscopic versus open stabilization has not been previously reported. Recurrence rates based on short-term follow-up will underestimate long-term recurrence rates. While both techniques showed additional dislocations with time, open repair continued to show less recurrent instability than arthroscopic suture anchor repair.

7 WHAT ARE THE LIMITS OF GLENOID IMPLANTATION IN ECCENTRIC GLENOID EROSION?
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Introduction: The technique of glenoid preparation and implantation in total shoulder replacement has developed so that implantation and cementing methods are standardized. Eccentric posterior glenoid erosion is a common pattern of bony deficiency seen in osteoarthritis and power reaming in order to reshape the glenoid and restore a neutral version are generally recommended. No limits, however, have ever been placed on the degree of eccentric erosion which can be accommodated and still allow for sufficient bone stock in order to implant a glenoid component. Purpose: To define the limits of eccentric glenoid erosion which can be corrected by reaming to neutral and allow secure placement of a glenoid component. Methods: Five cadaver scapula without evidence of prior surgery, arthritis, or glenoid dysplasia were dissected to remove all soft tissue. The glenoid and humeral head sizes were measured in order to select the proper size glenoid component. The scapula were then prepared using a cannulated reamer system (Centerpulse, Winterthur, Switzerland) in order to correct glenoid erosion created. The glenoid was then prepared using a cannulated reamer system (Centerpulse, Winterthur, Switzerland) in order to correct glenoid retroversion to neutral and shape the glenoid for the component. A pegged glenoid component of appropriate size was then inserted based on initial measurements of the humeral head and glenoid. A second CT scan then confirmed correction of glenoid version to neutral and also evaluated fit of the component into the glenoid vault. Results: In all five experimental cases glenoid version was corrected to neutral and at least one peg of the four penetrated the glenoid vault. In one case 3 of 4 pegs penetrated the glenoid vault. In one case where a 20° retroversion was surgically corrected there was a fracture of the anterior glenoid vault with reaming. And in another case, though a medium size glenoid was appropriate for the diameter of the humeral head a small glenoid was the only size which could fit on the remaining glenoid surface after reaming. Conclusion: Glenoid retroversion of 15° cannot be satisfactorily corrected by simply reaming in order to lower the ante rior edge of the glenoid and restore neutral version. This results in narrowing of the glenoid vault and risks penetration of the pegs of a glenoid component. This might affect security of cement fixation. In such cases alternative methods to restore glenoid orientation and anatomy, such as bone grafting, should be considered.
8 ARTHROSCOPIC CORACOIDPLASTY
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Subcoracoid impingement syndrome is a cause of anterior shoulder pain. It is less common than subacromial impingement. We report the results of arthroscopic coracoidplasty for subcoracoid impingement syndrome. Materials and Methods: Eight shoulders (4 males, 4 females) at an average of 47 yrs (34-57) underwent arthroscopic coracoidplasty for anterior shoulder pain. Avg. follow-up was 1.5 yrs (1.2-2). All had pain lateral to tip of the coracoid. All had pain reproduced with horizontal adduction at shoulder height coupled with internal rotation. Excluded were any cases with posterior capsular tightness, previous capsulorrhaphy, or subscapularis tears. All patients on imaging had an encroaching coracoid and prominent lesser tuberosity. Coracoid impingement was confirmed by tangential line from glenoid articular surface on axillary view. The acromial contour in 7 patients (77%). Two patients (22%) demonstrated superior translation of the distal clavicle less than 50% of clavicular width. Discussion: This technique of ACJ reconstruction appears to control posterior clavicular translation during active motion and is successful in restoring normal shoulder function. Radiographic contour of ACJ was normal or near-normal in all patients.

9 ACROMIOCLAVICULAR JOINT CAPSULAR RECONSTRUCTION WITH AUTOGENOUS SEMITENDINOSIS HAMSTRING GRAFT FOR TYPE V DISLOCATIONS
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Type V acromioclavicular joint (ACJ) dislocations can be severely disabling and recalcitrant to treatment secondary to instability of the distal clavicle. We report results using a novel technique for ACJ reconstruction. Methods: Nine consecutive patients with symptomatic Type V ACJ dislocation underwent surgical treatment using the same technique: (1) distal clavicle excision; (2) intramedullary transfer of the coracoclavicular ligament; (3) coracoclavicular reconstruction using absorbable suture braid and ipsilateral semitendinosis graft through drill hole in the clavicle and "figure 8" around coracoid; and (4) ACJ capsular reconstruction with remaining semitendinosis graft fixed with transosseous sutures to acromion and posterior clavicle. Mean age was 40 years (range 22-53). All suffered traumatic injuries. Operative technique involved ablation of soft tissue off the undersurface of the coracoid. Arthroscopic resection with a burr of the lateral coracoid with beveling to open up the subcoracoid space was performed similar to acromioplasty technique. No conjoined tendon was detached. Results: The post-op scores improved significantly [p<.05]: ASES = 95 [±5.02]; SST = 10.3 [±6.2]; VAS pain = .6 [5.1]. The avg. time to return to work and sport was 4.2 months. There were no complications or re-operations. Conclusions: Coracoid impingement syndrome while uncommon, is a cause of anterior shoulder pain. Arthroscopic coracoidplasty allowed for assessment of, and successful treatment of subcoracoid impingement pathology.

10 UNCEMENTED GLENOID COMPONENT AUGMENTED WITH PRIMARY BONE GRAFT IN TOTAL SHOULDER ARTHROPLASTY, LONG TERM FOLLOW-UP
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Glenoid loosening is the most frequent long-term complication of total shoulder arthroplasty. Cemented polyethylene glenoid components are highly associated with lucent lines, with an incidence of radiographic loosening of between 1.3% and 44%. The purpose of the current study is to see whether the use of a metal-backed plasma sprayed ingrowth glenoid component, augmented with primary bone grafting and screw fixation, can eliminate the problems seen with a traditional polyethylene glenoid component fixed with cement. We prospectively analyzed the results of all patients who had a total shoulder arthroplasty with an uncemented metal-backed glenoid between 1990 and 2000. A total of 69 shoulders in 57 patients were available for evaluation. All shoulders were at least two years out from their surgical procedure. Radiographic and clinical follow-up averaged 5.7 years (range 2 to 12 years). Radiographs were obtained at yearly intervals and assessed for component position, the presence of lucent lines, and any evidence of loosening. Clinical examination focused on range of motion, strength testing, and the patient's subjective assessment of pain. Results were based on Neer's original criteria. In 66 shoulders (96%) there were no radiographic lucent lines around the glenoid. Two shoulders had subsidence of the glenoid with complete lucency around the keel. Both of these patients were failures. One patient had resorption of the glenoid with retroversion of the glenoid component. This patient had a satisfactory outcome. There were 4 broken glenoids (5%). One patient had a fractured glenoid tray but an excellent clinical result 11 years out from surgery. Two shoulders with broken glenoids were failures and were revised: one to a cemented glenoid and one to another uncemented glenoid. The revised uncemented glenoid has a satisfactory result 8 years from revision. In both of these cases the keel of the component had solid bone ingrowth, but the tray had broken. The fourth patient had significant medical contraindications to further surgery. He has pain, grinding, and an unsatisfactory result. Therere 5 patients with fractured screws (7%). All screw breakage occurred between 6 and 8 years out from surgery, and all had excellent clinical results. There were three patients with radiographic evidence of screw loosening. All of these patients were 5 to 8 years out from surgery with excellent clinical results. Clinical results according to Neer's criteria were: 72.5% were excellent, 17.5% were satisfactory, and 10% were unsatisfactory. The results of total shoulder replacement with an uncemented metal-backed glenoid component augmented with screw fixation and primary cancellous bone graft appear to be excellent in mid and long-term follow-up. The only drawback appears to be prosthetic breakage. Clinically, the overwhelming majority of patients were pain free, had near normal range of motion and had no evidence of glenoid loosening at an average of 5.7 years following surgery. Radiographic analysis demonstrated lucent lines in 3% of patients at an average of 10 years out from surgery. There were only two patients with evidence of clinical loosening. We believe that primary total shoulder arthroplasty performed with a metal-backed cementless glenoid component offers an excellent alternative to more conventional methods of glenoid resurfacing. With re-design of the metal backing tray to prevent breakage, this option should offer better long-term results than a cemented polyethylene component.