better at identifying patients who actually had rotator cuff tears, while MRI with contrast was better at identifying patients who were truly free of rotator cuff tears. MRI with contrast displayed slightly better ability for positive labral tear identification and for determining a true negative test. MRI with contrast was superior for identifying patients who actually had a labral tear, however standard MRI was better at identifying patients who were truly free of labral tears. In conjunction with a comprehensive clinical examination, whether an MRI is ordered with or without contrast should largely be determined by the shoulder surgeon's perception of which tissues are involved, the capacity for the diagnostic imaging technology to better delineate clinical examination findings, and consideration for reducing healthcare costs.

A Comparison of Supination and Elbow Flexion Strength in Patients with either Proximal Biceps Release or Biceps Tenodesis (SS-40). *John R. Shank, MD, Steven B. Singleton, MD, Michael Kissenbertn, MD, Michael Torry, PhD, and Richard J. Hawkins, MD*

Objective: Arthroscopic proximal biceps tenotomy and tenodesis are two techniques used to treat symptomatic patients with biceps pathology. We have found little functional difference between patients who have had biceps release versus tenodesis, and have observed that patients with biceps release recover quicker. No studies have evaluated strength in patients who have had an elective proximal biceps release. The purpose of this study was to establish normal data for flexion and supination and compare this to groups of patients who have had either a biceps tenodesis or release.

Methods: Patients and control subjects volunteering for this study were between the ages of 20 and 70 and had either: 1) no previous shoulder surgery or other shoulder pathology (Control group) or 2) be fully recovered from shoulder surgery and at least 6 months postoperation from either biceps release or tenodesis. Subjects were classified into three groups, those with normal shoulders, those having proximal biceps release, and those having proximal biceps tenodesis. Supination and elbow flexion isokinetic strength was measured at 60 and 120 degrees per second with a Cybex dynamometer. The difference in torque between the dominant and nondominant extremities in supination and pronation and elbow flexion and extension for the normal shoulders were used as a control. The difference in torque between the surgical shoulder (biceps release or biceps tenodesis) and the non-surgical shoulder, taking into account arm dominance, were calculated and used as the criterion measure. Torque differences between the three groups of patients were compared statistically using an analysis of variance.

Results: Seventeen biceps release, 20 biceps tenodesis and 30 age, gender and BMI matched controls subjects were tested for supination and elbow flexion strength of both arms. Comparison between groups utilizing an ANOVA showed no significant strength difference in either elbow flexion or forearm supination in control, release, and tenodesis groups.

Conclusion: Results of this study suggest that both biceps tenotomy and tenodesis are useful in painful proximal biceps pathology. While there is no statistically significant difference in postoperative strength measurements, there was a trend towards weaker forearm supination strength in patients undergoing biceps tenotomy. We postulate tenodesis of the long head of the biceps tendon in the athlete or those requiring maximal forearm supination strength.

Failure Stength of Arthroscopic Biceps Tenodesis Repairs: Suture Anchor vs. P.I.T.T. Technique (SS-41). *Mark W. Rodosky, MD, Ryan Costic, MS, Emilio Lopez-Vidriero, Patrick Smolinski, PhD, Lars Gilbertson, PhD, and Freddie H. Fu, MD*

Purpose: The purpose of this study is to evaluate the biomechanical properties of two arthroscopic biceps tenodesis repairs during failure loading.

Methods: A load-to-failure protocol was performed on twelve fresh cadaveric humerus (50 ± 6 years old) with the isolated biceps tendon intact using a materials testing machine. The biomechanical properties were determined for two biceps tenodesis fixations: suture anchor fixation ($n=6$) and the PITT technique ($n=6$). The intact biceps tendon was grasped with a custom sinusoidal clamp and attached via a universal joint to the crosshead of a material testing machine while the humerus was fixed to the testing base. A uniform load was applied parallel to the humeral shaft. A preload of 5N was applied to the intact tendon to find a reference position for the tendon before repair. After repair, the tendon was detached from its humeral insertion and a load-to-failure protocol was performed. The ultimate load and stiffness of both repairs were determined from the load-displacement curves and compared with an unpaired Student's t-test with significance set at $p<0.05$.

Results: The suture anchor and PITT techniques had ultimate loads of 161 ± 40 N and 147 ± 35 N and stiffness of 19.6 ± 7.0N/mm and 14.4 ± 2.0N/mm. No significant differences could be detected; however, a power analysis determined that more specimens could yield a difference for stiffness. During loading, both repairs had typical

load-displacement curves into the linear region of the curve followed by a constant increase in displacement and steady load till suture pullout at the end of the biceps tendon.

Conclusions: The biomechanical comparison of suture anchor and PITT technique exhibited almost detectable differences in stiffness; however, both the ultimate load and stiffness for both repairs were lower than traditional keyhole fixation. These findings along with the consistent pullout of the suture through the tendon during failure suggests that most important factor for initial strength is not dependent on attachment site but dependent on the fixation of the tendon. Immobilization of the arthroscopic repair could allow for improved biomechanical strength with healing but must be examined in the future.

Rotator Cuff Repair: The Effect of Depth of Suture Passage on Three-Dimensional Repair Site Surface Area and Load to Failure Using Single-Row Anchor Fixation (SS-42). *Allen Deutsch, MD*

Purpose: In this 2-part cadaver study, the effect of the depth of suture passage on resultant repair site surface area coverage and repair strength was evaluated. The hypothesis was that repair site contact area and repair strength would be maximized by increasing the depth of suture passage.

Methods: Part I. Eight fresh-frozen cadaver shoulders were dissected to expose the rotator cuff with the scapula and distal humerus rigidly fixed. A three-dimensional (3D) outline of the intact supraspinatus humeral insertion was digitized using a MicroScribe 3D-X digitizer and Rhinoceros NURBS modeling software. A 2-cm full thickness supraspinatus defect was created. Each specimen underwent 3 repair techniques in randomized fashion using simple sutures and 2 anchors placed at the lateral tuberosity. The only variation between techniques was the depth of suture passage through the cuff: 7-, 15-, and 22-mm from the tendon edge. The 3D outlines of the cuff repair site were digitized after each repair. The effect of each repair technique on 3D repair site surface area was assessed using ANOVA and the Holm-Sidak Method ($p<0.05$). Part II. For biomechanical testing, the supraspinatus tendon of 4 pairs of fresh frozen cadaver shoulders were transected from the humeral head. A simple suture loop of No.2 Fiberwire was passed at 7- and 22-mm from the tendon edge. With the medial edge of the cuff rigidly fixed, tissue was preloaded to 10 N and pulled to failure at 33mm/sec. A paired t-test determined significance between the mean loads to failure between the 7- and 22-mm depths ($p<0.05$).

Results: The mean surface area for the intact footprint was 242 mm2 + 35 mm2. Mean surface area for the 7-, 15-, and 22-mm depths of suture passage were 84 mm2 (35% coverage), 113 mm2 (47% coverage), and 163 mm2 (67% coverage), respectively. The 22-mm depth of suture passage resulted in significantly greater coverage of the footprint compared with the 7-mm and 15-mm depths ($p<0.001$). The average load to failure for the 22-mm depth (233N) was significantly greater than the 7-mm depth (113N) ($p<0.05$).

Conclusion: This study demonstrates that 3D repair site surface area and load to failure are directly proportional to the depth of suture passage through the cuff. Suture passage through a more medial depth of cuff tissue resulted in a biomechanically stronger repair with coverage of a larger area of the native cuff footprint. For single-row anchor fixation, this may improve healing and help prevent structural failure of the repair.

Arthroscopic Repair of Massive Rotator Cuff Tears (SS-43). *Bettina Kniesel, and Gerhard Bauer, MD, Prof.*

Purpose: Does a complete or partial arthroscopic repair of massive rotator cuff tears lead to improvement in function, pain and patients satisfaction?

Methods: Between December 2002 and February 2005, we prospectively enrolled 53 patients (36m;17f; average age 65.8y) with massive cuff tears and performed an arthroscopic repair using the margin convergence technique. Cuff repair was done with side to side sutures using a #2 fiber wire (Arthrex), and we did a tendon to bone repair with suture anchors (bio Corkscrew, Arthrex) whenever possible. Inclusion criteria were a minimum humeroacromial distance of 5mm, a massive cuff tear, a functional subscapularis tendon, and a symptomatic defect in an active patient. Postoperative controls were performed so far on 39 patients Ø6.6 months after surgery (FU 1) and on 21 patients Ø15.4 months after surgery (FU 2). Pre- and postoperative grading was done according to the modified constant score.

Results: There were no early postoperative complications. All patients replied with "yes" when asked if they would undergo surgery again given the same situation. The average constant score increased significantly from 48.3 ± 16.5 points ($n=53$) to 81.4 ± 12.2 points ($p<0.0001$) at FU 1 and to 88.2 ± 9.3 points at FU2. The subjective pain assessed using the VAS rating from 0-10 points decreased significantly ($p< 0.0001$) from 7.6 ± 1.3