

## COA Paper Session 13: Sports Upper Extremity •

Moderators Ryan Bicknell, ON, and William D. Regan, BC

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### **Arthroscopic Treatment of Multidirectional Shoulder Instability in Athletes: A Retrospective Analysis of 2 to 5 year Clinical Outcomes**

**Randy Mascarenhas**, University of Manitoba; Champ L. Baker, Hughston Sports Medicine; Alex J. Kline, University of Pittsburgh; Anikar Chhabra, Canyon Orthopaedics; Mathew Pombo, University of Pittsburgh; James P. Bradley, University of Pittsburgh

**Purpose:** There are few reports in the literature detailing the arthroscopic treatment of multidirectional instability of the shoulder. The purpose of this study was to evaluate the results of arthroscopic methods in the treatment of athletes with symptomatic multidirectional instability of the shoulder. **Method:** Forty patients (43 shoulders) with multidirectional instability of the shoulder were treated via arthroscopic means and were evaluated at a mean of 33.5 months post-operatively. The mean patient age was 19.1 years (range 14 to 39). There were 24 male patients and 16 female patients. Patients were evaluated with the ASES and WOSI scoring systems. Stability, strength, and range of motion were evaluated with patient-reported scales. **Results:** The mean ASES score postoperatively was 91.4 out of 100. The mean WOSI post-operative percentage score was 91.1 out of 100. Ninety-one percent of patients had full or satisfactory range of motion, 98% had normal or slightly decreased strength, and 86% of patients were able to return to their sport with little or no limitation. **Conclusion:** Arthroscopic methods can provide an effective treatment for symptomatic multidirectional instability in an athletic population.

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### **Generalized Ligamentous Laxity as a Predisposing Factor for Primary Anterior Shoulder Dislocation**

**Jaskarndip Chahal**, University of Toronto; Tom McCarthy, University of Toronto; Jeff Leiter, Pan Am Clinic, University of Manitoba; Daniel B. Whelan, St. Michael's Hospital, University of Toronto

**Purpose:** To determine whether generalized ligamentous laxity is a predisposing factor for primary traumatic anterior shoulder dislocation in young, active patients. **Method:** Prospective case series with age and sex matched controls. The Hospital Del Mar Criteria was utilized to measure generalized ligamentous laxity. Fifty-seven (n=57) consecutive individuals (age<30) sustaining a primary traumatic anterior shoulder dislocation between 2003 and 2006 were examined for hyperlaxity. The control group was comprised of seventy-two (n=72) undergraduate university students without a prior history of shoulder dislocation or anterior cruciate ligament injury. **Results:** After adjusting for age and sex, the prevalence of hyperlaxity in the study group was 32.8% compared with 10.4% in the control group ( $p<0.01$ ). The prevalence of increased contralateral shoulder external rotation ( $> 85^\circ$ ) was 40.3% in the study group compared with 20.8% in the

control group ( $p < 0.03$ ). Among males, the prevalence of hyperlaxity was 28.3% in the study group and 5.3% in the controls ( $p < 0.01$ ). **Conclusion:** Although several studies have looked at the variables affecting shoulder instability, generalized ligamentous laxity (as measured by validated criteria) has not previously been identified as a predisposing factor for primary traumatic shoulder dislocation. This study demonstrates that generalized joint laxity and increased external rotation in the contralateral shoulder were found to be more common in patients who had sustained a primary shoulder dislocation. These observations may suggest a role for shoulder-specific proprioceptive and strength training protocols in hyperlax individuals participating in high-risk sports. Furthermore, the implications of hyperlaxity on the surgical management of traumatic primary shoulder instability are uncertain.

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### **Prospective Outcomes Following Arthroscopic Bankart Repair Using a Bioabsorbable Tack**

**David Sheps**, University of Alberta; Fiona Styles-Tripp, University of Alberta; Kyle Kemp, University of Alberta; Scott Wiens, University of Alberta; Lauren Beaupré, University of Alberta; Robert A. Balyk, University of Alberta

**Purpose:** Arthroscopic stabilization for post-traumatic anterior glenohumeral instability is designed to minimize soft tissue dissection while achieving similar or improved outcomes relative to open techniques. This study's purpose was to determine the rate of post-operative recurrent instability and evaluate health related quality of life (HRQL) and shoulder range of motion (ROM) following arthroscopic Bankart repair using a bioabsorbable knotless implant. **Method:** Forty-three patients were prospectively evaluated following arthroscopic anterior stabilization to assess for recurrent instability, HRQL, and shoulder ROM. Assessments were performed pre-operatively and 3, 6 and 12-24 months postoperatively. The HRQL measures included the Western Ontario Shoulder Instability Index (WOSI), the American Shoulder and Elbow Surgeons Score (ASES), and the Constant Score. Repeated measures ANOVA was utilized to evaluate ROM and HRQL. **Results:** The mean WOSI score improved from  $45.67 \pm 17.99$  pre-operatively to  $83.16 \pm 18.58$  at final follow-up. The mean ASES scores improved from  $80.1 \pm 13.06$  pre-operatively to  $92.25 \pm 15.08$ , while the Constant score improved from  $77.52 \pm 16.11$  pre-operatively to  $85.18 \pm 26.76$ . At final follow-up, 4 of 43 patients (9.3%) had experienced recurrent instability. For these 4 subjects, the WOSI score was significantly lower at final follow-up than those who did not experience recurrent instability ( $61.73 \pm 5.76$  versus  $84.38 \pm 16.94$ ). The ASES and Constant scores at final follow-up were not significantly different between these two groups. **Conclusion:** Arthroscopic anterior stabilization using a bioabsorbable tack led to a recurrent instability rate similar to previous reports, and resulted in improved HRQL and shoulder ROM. The WOSI score was better able to detect problems in HRQL related to instability than either the ASES or Constant score.

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## **Does the Western Ontario Shoulder Instability (WOSI) Index Distinguish Between Operative and Non-operative Patients with Shoulder Instability: A Case-control Study**

**Nicholas G.H. Mohtadi**, University of Calgary; Jocelyn N. Fredine, University of Calgary; Heather N. Hannaford, University of Calgary; Denise S. Chan, University of Calgary; Treny M. Sasyniuk, LifeMark Health

**Purpose:** Shoulder instability is a common problem affecting patients in their most active years resulting in an impact on their quality of life. The WOSI is a validated, disease-specific (shoulder instability) evaluative quality of life measure. It has not been tested for its ability to discriminate between those who require surgical care and those who do not. The purpose of this study is to determine if the WOSI can discriminate between surgical and non-surgical patients and between patients with different types of shoulder instability.

**Method:** Sixty patients with a confirmed diagnosis of shoulder instability were included as cases. Twenty had documented multidirectional instability requiring surgery: Group 1 Surgical MDI - 20 patients had documented recurrent traumatic anterior dislocations requiring surgery: Group 2 Surgical Anterior - 20 patients were first time anterior dislocators who were followed for a minimum one year who had no further recurrences and did not require surgery: Group 3 Non-Surgical First Time Anterior - The cases were compared to 60 age and gender matched control patients with no history of shoulder problems: Group 4 Control - WOSI scores were analyzed using a one-way ANOVA. **Results:** The WOSI scores were as follows: Group 1 Surgical MDI- mean 30.5 (95% CI 23.1-37.8); Group 2 Surgical Anterior-mean 39.8 (95% CI 33.1-46.5); Group 3 Non-Surgical First time Anterior-mean 76.2 (95% CI 66.4-86.0) and Group 4 Control- mean 96.6 (95% CI 95.8-97.4). Based on the 95% Confidence Intervals, there were statistically significant differences between the two surgical groups (Group 1 Surgical MDI and Group 2 Surgical Anterior) compared to the non-surgical patients (Group 3 Non Surgical First Time Anterior) and the controls ( $P=0.000$ ). There is a trend to discriminate between the two surgical groups ( $P=0.079$ ).

**Conclusion:** The WOSI Index clearly discriminates between surgical and non-surgical patients with shoulder instability, and the control population with normal shoulders. There is a trend to discriminate between MDI and recurrent anterior traumatic dislocators.

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## **The Unstable Painful Shoulder (UPS): As a Cause of Pain from Unrecognized Instability in the Young Athlete**

**Ryan Bicknell**, Queen's University; Chris Chuinard, University of Nice; Scott Penington, University of Nice; Frédéric Balg, University of Nice; Pascal Boileau, University of Nice

**Purpose:** Shoulder pain in the young athlete is often a diagnostic challenge. It is our experience that this pain can be related to a so-called “unstable painful shoulder” (UPS), defined as instability presenting in a purely painful form, without any history of instability but with anatomical (soft tissue or bony) ‘roll-over’ lesions. The objectives are to describe the epidemiology and

diagnostic criteria and to report the results of surgical treatment. **Method:** A prospective review was performed of 20 patients (mean age  $22 \pm 8$  years). Inclusion criteria: a painful shoulder and “roll-over lesions” on imaging or at surgery. Exclusion criteria: a dislocation/subluxation; associated pathology; previous shoulder surgery. **Results:** Most patients were male (60%), athletes (85%) and involved the dominant arm (80%). All patients denied a feeling of instability and only complained of deep, anterior pain. Most had a history of trauma (80%). All patients had rehabilitation without success and 30% had subacromial injections. All had to stop sports. Most (85%) had anterior or inferior hyperlaxity. All had pain with an anterior apprehension test and relieved by relocation test. ‘Roll-over’ lesions included: labrum detachment (90%), capsular distension (75%), HAGL lesion (10%), glenoid fracture (20%) or Hill-Sachs (40%). Time from symptoms to surgery was  $25 \pm 23$  months. All patients had arthroscopic treatment. Mean follow-up was  $38 \pm 14$  months. Eighteen patients (90%) were very satisfied/satisfied. None had pain at rest, but one (5%) had pain with apprehension test. There was no change in elevation, external or internal rotation ( $p > 0.05$ ). There were no cases of instability. Rowe and Duplay scores improved ( $p < 0.05$ ). **Conclusion:** Instability of the shoulder can present in a purely painful form, without any history of dislocations or subluxations. Diagnosis can be difficult, and should be suspected in young patients and athletes. Most patients have deep anterior pain and pain with apprehension test. ‘Roll-over’ lesions are necessary to confirm the diagnosis. Arthroscopic repair is effective.

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### **Increasing Simulated Hill Sachs Lesion Size Decreases Glenohumeral Stability**

Scott Kaar, St. Louis University; Stephen Fening, Cleveland Clinic Foundation; **Morgan Jones**, Cleveland Clinic Foundation; Rob Colbrunn, Cleveland Clinic Foundation; Anthony Miniaci, Cleveland Clinic Foundation

**Purpose:** We hypothesized that glenohumeral joint stability will decrease with increasingly larger humeral head defects. **Method:** Humeral head defects were created in 9 cadaveric shoulders to simulate Hill Sachs defects. Defects represented  $1/8$ ,  $3/8$ ,  $5/8$ , and  $7/8$  of the radius of the humeral head. Secondary factors included abduction angles of 45 degrees and 90 degrees, and rotations of 40 degrees internal, neutral, and 40 degrees external. Specimens were tested at each defect size sequentially from smallest to largest and at each of 6 conditions for all abduction and rotation combinations. Using a 6 degree-of-freedom robot, the humeral head was translated at 0.5 mm per second until dislocation in the anteroinferior direction at 45 degrees to the horizontal glenoid axis. **Results:** ANOVA demonstrated significant factors of rotation ( $p < 0.001$ ) and defect size ( $p < 0.001$ ). In 40 degrees external rotation, there was significant reduction of distance to dislocation compared with neutral and 40 degrees internal rotation ( $p < 0.001$ ). The  $5/8$  and  $7/8$  radius osteotomies demonstrated decreased distance to dislocation compared to the intact state ( $p < 0.05$  and  $p < 0.001$  respectively). There was no difference found between abduction angles. Post hoc analysis determined significant differences for each arm

position. There was decreased distance to dislocation at the 5/8 radius osteotomy at 40 degrees external rotation with 90 degrees of abduction ( $p<0.05$ ). For the 7/8 radius osteotomy at 90 degrees abduction, there was decrease distance to dislocation for neutral and 40 degrees external rotation ( $p<0.001$ ). For the same osteotomy at 45 degrees abduction, there was decreased distance to dislocation at 40 degrees external rotation ( $p<0.001$ ). With the humerus internally rotated, there was never a significant change in the distance to dislocation. **Conclusion:** Glenohumeral stability decreases at a 5/8 radius defect and was most pronounced in 40 degrees external rotation and at 90 degrees abduction. At a 7/8 radius humeral defect, there was further decrease in stability at both neutral and external rotation. Internal rotation always maintained baseline glenohumeral stability.

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### **Load and Failure Behavior of 6 Arthroscopic Knots and 8 High Strength Sutures**

**R. Cole Beavis**, University of Saskatchewan; F. Alan Barber, Plano Orthopedic and Sports Medicine Center; Morley A. Herbert, Advanced Surgical Institutes

**Purpose:** New high-strength sutures demonstrate high failure loads, but may be more likely to slip compared with polyester sutures. The purpose of this study was to determine the knot security and ultimate failure load of 8 common sutures tied with 6 arthroscopic knots. The hypothesis was that knots tied using high-strength sutures would not slip and demonstrate greater tensile strengths than polyester suture. **Method:** Eight different sutures (Ethibond, FiberWire, ForceFiber, Hi-Fi, MagnumWire, Maxbraid, Orthocord and Ultrabraid) were tied with 6 arthroscopic knots (Duncan, Revo, San Diego, SMC, Tennessee and Weston.) Knots were backed up with 4 reversed half-hitches on alternating posts. Each suture-knot combination was tied 10 times for a total of 480 knots tested. Cyclic testing was performed followed by loading to failure. Mode of failure, ultimate failure load and force during slippage was recorded. **Results:** FiberWire demonstrated the highest failure load (259.70N $\pm$ 85.81) and Ethibond the lowest (143.92N $\pm$ 16.56) ( $p<0.05$ ). Knots tied with Ethibond slipped 22.4% of the time compared with 31.7%-40.0% for high-strength sutures. Frequent slippage occurred with Duncan loops (97.5%) and Weston knots (86.3%) while the SMC (1.3%) and Revo knots (3.6%) rarely slipped ( $p<0.05$ ). Mean failure loads were highest for the Revo (280.99N  $\pm$  57.01) and SMC knots (274.89N  $\pm$ 57.90) compared with all others ( $p<0.05$ ). **Conclusion:** Our results demonstrate that knots tied with Ethibond were least likely to slip and yielded a more consistent (narrow standard deviation) but overall lower ultimate tensile strength than all of the high strength sutures. Early slippage of some knots tied with high-strength suture was responsible for greater variability with some failing at sub-maximal loads. The Duncan loop and Weston knots were the most likely to slip.

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### **Enhancing SLAP repairs with Fibrin-PRP Clots**

**Alan M. Hirahara**, Private Practice; **Kyle Yamashiro**, Results Physical Therapy; **Russell Dunning**, Results Physical Therapy

**Purpose:** To evaluate failure rates of SLAP repairs with and without a fibrin-PRP clot. **Method:** 141 patients received a fibrin-PRP clot, placed arthroscopically between the labrum and bone prior to tying our sutures in repairing the SLAP lesion. Thirty-nine patients were repaired without use of a fibrin-PRP clot. Arthroscopic fixation was performed using a bioabsorbable suture anchor (Bio-SutureTak, Arthrex). The fibrin-PRP clot was made from autologous blood, using the Plasmax Plus system (Biomet). Patients were evaluated clinically with ASES scores, range of motion, time to discharge, and return to work. Repeat MRA or surgery was performed for people having persistent pain or complaints at four to six months post-operatively to evaluate healing. **Results:** Four out of thirty-nine (10.3%) control patients failed to heal and required revision surgery. One out of 139 (0.7%) study patients failed to heal ( $p = 0.008$ ). Pain scores decreased from pre-op to 1 to 3 to 6 months in both groups but significantly greater in the study group (7.1, 5.2, 3.0, 1.6) compared with the control group (7.1, 6.0, 4.8, 3.1) ( $p = \text{NS}, \text{NS}, < 0.001, < 0.05$ ). ASES society scores increased steadily from pre-op to 1 month to 3 months to 6 months in both groups. The control group increased from 35.9 to 36.9 to 56.3 to 72.7. The study group increased from 43.1 to 45.2 to 71.0 to 81.9 and were significantly different ( $p = \text{NS}, < 0.05, < 0.001, 0.06$ ). The average days to discharge in the study group was significantly improved at 119.1 days from 213.5 in the control group ( $p < 0.001$ ). Time to return to work decreased from control to the study group 121.7 days to 57.1 days ( $p < 0.01$ ). ROM increased in both groups non-significantly from pre-op to 3 months follow up in the study group. **Conclusion:** The results of this study show that the fibrin-PRP clot enhances the healing of the labrum to the glenoid. We have significantly fewer failures, less pain, quicker time to discharge, and faster functional recovery. By suturing a fibrin-PRP clot between the labrum and glenoid, recovery and healing of the tear occurs quicker and more reliably.

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### **Injury of the Suprascapular Nerve During Arthroscopic Repair of Superior Labral Tears: An Anatomic Study**

**Holman Chan**, University of Alberta Hospital; **Martin Bouliane**, University of Alberta Hospital; **Lauren Beaupré**, University of Alberta Hospital

**Purpose:** Due to its proximity to the glenohumeral joint, the suprascapular nerve may be at risk of iatrogenic nerve injury during arthroscopic labral repair. Our primary objective is to evaluate the risk of suprascapular nerve injury during standard drilling techniques utilized in arthroscopic superior labral repairs. Secondly, we evaluated the correlation between this risk and scapular size. **Method:** Forty-two cadaveric shoulders were dissected to isolate their scapulae. A surgical drill and guide was used to create suture anchor holes in 3 locations in the superior rim of the glenoids as typically done in arthroscopic superior labral repairs. The orientation of these drill holes correspond to common shoulder arthroscopic portals. The

suprascapular nerve was then dissected from the suprascapular notch to the spinoglenoid notch. The presence of drill perforations through the medial cortex of the glenoid vault was recorded along with the corresponding hole depth and distance to the suprascapular nerve. **Results:** Medial glenoid vault perforations occurred in 8/21(38%) cadavers with a total of 18/126(14%) perforations. The suprascapular nerve was in line of the drill path in 5/18(28%) perforations. Female specimens and smaller scapulae had a statistically higher risk of having a perforation ( $p < 0.05$ ). **Conclusion:** The results of this anatomic study suggest that there is a substantial risk of medial glenoid vault perforation. When a perforation does occur, the suprascapular nerve appears to be at high risk for injury especially with more posterior drill holes. The risk is significantly higher in females and in smaller scapulae.

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### **Biomechanical Analysis of Osteochondral Autograft Insertion Pressures**

**R. Cole Beavis**, University of Saskatchewan; F. Alan Barber, Plano Orthopedic and Sports Medicine Center; Morley A. Herbert, Advanced Surgical Institutes

**Purpose:** To evaluate the insertion forces required to seat osteochondral plug grafts and the accuracy of plug harvest and seating using three unique instrumentation systems. Our hypothesis was that the systems would have different insertion forces. **Method:** The COR (Depuy-Mitek), Mosaicplasty (Smith & Nephew) and OATS (Arthrex.) Instrumentation systems and recommended surgical techniques were used to harvest, transfer, and implant grafts. To simulate the in-vivo surgical setting, multiple-impacts with a mallet were applied to the instruments. Ten tests each were performed for all systems in both rigid polyurethane foam blocks and porcine femur models. Plug length after harvest and final graft position were manually measured. Insertion forces were recorded using a load cell (Omega Engineering) affixed to the insertion tamp. The area under the force curve recorded by the transducer for each blow was then summed to yield the total force required to seat each graft. Means and standard deviations were then calculated and Tukey's test was used to determine significant differences between the means. **Results:** The COR system demonstrated significantly lower mean insertion forces in both polyurethane foam blocks and porcine models when compared with the OATS and Mosaicplasty systems. Graft harvest with Mosaicplasty led to greater harvest length inconsistency than with other systems tested. OATS grafts were more likely to be left proud. **Conclusion:** The COR system produced significantly lower insertion forces during graft insertion. COR and OATS yielded consistent harvest lengths. The majority of OATS grafts were left proud which would require additional impaction force to fully seat the graft.