

causes increased mechanical stress that has been associated with altered bony morphology. There have been no clinical studies assessing the characteristics of the biceps tendon in relation to humeral torsion in professional baseball pitchers. This study was used to examine humeral torsion in those pitchers presenting with abnormal versus normal biceps tendons.

**Methods:** A bilateral ultrasound examination was performed on 30 pitchers from one professional baseball club. The biceps was characterized as normal if the biceps appearance was hyperechoic and uniform thickness. It was abnormal if the biceps was subluxed or dislocated from the groove, the tendon was thickening with abnormal echo texture, the tendon presented with a halo sign or demonstrating fluid distension around the sheath. The reliability for humeral torsion measures was acceptable with ICC's =.99 and SEM=1.3. The inter rater reliability for characterization of the biceps tendon was Kappa =.89. A one-way ANOVA was performed to determine the difference in humeral torsion between those with abnormal versus normal biceps tendons.

**Results:** Eighty percent of the dominant biceps tendons were characterized as abnormal. The dominant shoulders with abnormal biceps tendons had a significantly more antetorsion on the dominant side than those presenting with normal biceps. ( $15.1 \pm 9.7$  vs.  $5.4 \pm 11.1$ ;  $P = 0.05$ ).

**Conclusion:** Eighty percent of the dominant shoulders in professional baseball pitchers had abnormal biceps. Professional pitchers with abnormal biceps also displayed less humeral retrotorsion compared to pitchers with normal biceps. Recently we have shown that pitchers with less humeral retrotorsion are more at risk for shoulder pain. The lack of humeral retrotorsion and associated pathological imaging of the biceps may represent subclinical findings in these pitchers. Our results suggest future studies should examine the influence of humeral torsion and biceps abnormalities in professional pitchers.

### **Effectiveness of a Preseason Prevention Program on Arm Injury Risk Factors: An Randomized Control Trial in Adolescent Pitchers**

**SS-28**

April 15, 10:05 AM

MICHAEL KISSENBERTH, M.D., PRESENTING AUTHOR

CHARLES THIGPEN, PH.D., P.T., A.T.C.

LANE BAILEY, P.T., D.P.T., PH.D., C.S.C.S.

THOMAS NOONAN, M.D.

RICHARD HAWKINS, M.D.

ELLEN SHANLEY, PH.D., P.T.

**Introduction:** Deficits in posterior shoulder flexibility and strength have been identified as risk factors for pitching injuries. This study assessed the effectiveness of a preseason prevention program to resolve these deficits in adolescent pitchers.

**Methods:** Pitchers ( $n=143$  age= $15.7 \pm 1.2$ ; height= $165.0 \pm 43.8$ cm; weight= $72.2 \pm 12.6$ kg) participating in team activities were block randomized by school to intervention (INV  $n=88$ ) or control (CON  $n=76$ ). INV received

an ATC supervised program (3x/week for 8-weeks). The CON had their usual training. All pitchers participated in a 4-week interval-throwing program immediate to the start of practice. Pre-post supine bilateral ER, IR, and HA ROM and strength were assessed using a digital inclinometer with the scapula stabilized at  $90^\circ$  of abduction. Muscle testing was used for strength assessments via held dynamometer with arm at the side and in supine  $90^\circ/90^\circ$  then normalized to body weight (BW). Injuries were recorded over the subsequent baseball season. Two trials were averaged to calculate deficits (non-dominant-dominant) and pre-post change to determine if the program to ameliorate baseline deficits. A one-way ANOVA compared change scores between groups and a 2-way ANOVA (group by injury) compared change scores influence on injury ( $\alpha=0.05$ ).

**Results:** The INV group displayed a greater reduction in IR deficit (INV= $7.3^\circ \pm 11$ ; CON= $1.8^\circ \pm 9$ ;  $F(1,106)=5.1$ ,  $P=0.01$ )  $P=0.05$ ) and HA deficit (INV= $3.3^\circ \pm 13$ ; CON= $-2.4^\circ \pm 11$ ;  $F(1,106)=6.7$ ,  $P=0.01$ ) compared to the CON group. The INV group also maintained their dominant ER-0:IR-90 ratio (INT= $-1.6 \pm 5\%$  BW; CON= $-3.5 \pm 5\%$  BW;  $F(1,106)=2.1$ ,  $P=0.09$ ) compared to the CON group. There were 19 arm injuries over the subsequent season (INV=11; CON=8 arm injuries). Control group pitchers with an injury did not decrease their HA deficit (Uninjured= $3.0^\circ \pm 10$ ; Injured= $-9.5^\circ \pm 14$ ;  $F(1,106)=3.3$ ,  $P=0.03$ ) or their IR deficit went on to suffer an injury (Uninjured= $-1.7^\circ \pm 8$ ; Injured  $8.5^\circ \pm 13$ ;  $F(1,106)=3.8$ ,  $P=0.02$ ). There were no other differences between or among groups ( $P>0.05$ ).

**Conclusion:** Adolescent pitchers displayed clinically meaningful improvements in posterior shoulder flexibility (HA and IR) and maintenance of their ER:IR ratio during an Athletic Trainer supervised preseason program. The improvements were associated with decreased injury risk over the course of the subsequent season.

### **Post-operative Alpha Angle Not Associated with Outcomes 5 Years following Hip Arthroscopy for FAI**

**SS-29**

April 15, 1:30 PM

SANJEEV BHATIA, M.D., PRESENTING AUTHOR

KAREN BRIGGS, M.P.H.

MARC PHILIPPON, M.D.

EDUARDO SOARES, M.D.

**Introduction:** The alpha angle is currently the most used parameter for defining cam type femoroacetabular impingement (FAI). The purpose of this study was to determine if post-operative alpha angle is a predictor of patient outcomes 5 years following hip arthroscopy for FAI. Our hypothesis was that post-operative alpha angle (AA) would not influence clinical outcomes in patients with FAI.

**Methods:** 230 patients had primary hip arthroscopy for FAI. Average age was 38 (range 18 to 69). All patients had preoperative and post-operative alpha angles recorded. At 5 years following arthroscopy, all patients completed

a questionnaire that included the modified Harris Hip score (MHHS), WOMAC, HOS ADL, HOS Sport, SF12 and patient satisfaction. This study was IRB approved. Patients were grouped based on their postoperative AA:  $<55^\circ$  ( $n=158$ ) and  $>55^\circ$  ( $n=56$ )

**Results:** The average preoperative AA was  $73^\circ$  (range  $50^\circ$  to  $105^\circ$ ) and the postoperative AA was  $48^\circ$  (range  $30^\circ$  to  $100^\circ$ ). The post-operative AA did not correlate with any outcome measure. The average preoperative alpha angle in the  $<55^\circ$  group was  $72^\circ$  and in  $>55^\circ$  group the average was  $76^\circ$  ( $p=0.024$ ). At average follow-up of 5.5 years (range 5 to 7) there were no significant differences in outcomes between groups. The average mHHS was  $52(\pm 8)$  in the  $<55^\circ$  and  $53(\pm 6)$  in the  $>55^\circ$  group; WOMAC was  $10(\pm 11)$  in the  $<55^\circ$  and  $8(\pm 10)$  in the  $>55^\circ$  group; HOS ADL was  $90(\pm 13)$  in the  $<55^\circ$  and  $92(\pm 11)$  in the  $>55^\circ$  group; HOS Sport was  $78(\pm 25)$  in the  $<55^\circ$  and  $82(\pm 21)$  in the  $>55^\circ$  group. Median patient satisfaction was 9 (range 1 to 10) in both groups.

**Conclusion:** There were no significant difference between any outcome score based on correction to  $55^\circ$  at 5 years. While alpha angle has been shown to be an excellent preoperative diagnostic tool, the postoperative angle does not correlate with midterm outcomes or the development of osteoarthritis.

### The Economic Impact of Acetabular Labral Tears: A Cost-Effectiveness Analysis Comparing Hip Arthroscopy and Structured Rehabilitation Alone

#### SS-30

April 15, 1:35 PM

PARTH LODHIA, M.D., PRESENTING AUTHOR

CHENGCHENG GUI, B.S.

SIVASHANKAR CHANDRASEKARAN, M.B.B.S., F.R.A.C.S.

CARLOS SUAREZ-AHEDO, M.D.

DOUGLAS DISCHL, M.D.

BENJAMIN DOMB, M.D.

**Introduction:** Hip arthroscopy is a successful procedure to manage acetabular labral tears and concurrent hip pathology, which if left untreated, may contribute to hip osteoarthritis (OA). It is essential to analyze the economic impact of this treatment option. This study assessed the cost-effectiveness of arthroscopic repair compared to structured rehabilitation alone for labral tears.

**Methods:** A cost-effectiveness analysis of hip arthroscopy compared to structured rehabilitation for symptomatic labral tears was performed using a Markov decision model over a lifetime horizon. Direct costs (in 2014 USD), utilities of health states (in quality-adjusted life years [QALYs] gained), and probabilities of transitioning between health states were estimated from a literature review. Costs were estimated using national averages of Medicare reimbursements, adjusted for all-payers in the US. Utilities were estimated from Harris Hip Scores. Cost-effectiveness was assessed using the incremental cost-effectiveness ratio (ICER). One-way and probabilistic sensitivity analyses were performed to determine the effect of uncertainty.

**Results:** For a cohort representative of hip arthroscopy patients at our facility, arthroscopy was more costly (additional \$2653) but generated more utility (additional 3.94 QALYs), compared to rehabilitation. The mean ICER was \$754/QALY, well below the conventional willingness-to-pay (WTP) threshold of \$50,000/QALY. Arthroscopy is expected to be cost-effective for 94.5% of patients. Although arthroscopy decreased in cost-effectiveness with increasing age, it remained cost-effective for patients in the second to seventh decades of life. Lifetime incidence of symptomatic hip OA was twice as high for patients treated for rehabilitation compared to arthroscopy. The preferred treatment was sensitive to the utility following successful hip arthroscopy, although the utility at which arthroscopy becomes less cost-effective than rehabilitation is far below our best estimate.

**Conclusion:** Hip arthroscopy is more cost-effective resulting in lower incidence of symptomatic OA than structured rehabilitation alone, when treating symptomatic labral tears of patients in the second to seventh decades of life.

### Clinical Outcomes of Hip Arthroscopy: A Prospective Survival Analysis of Primary and Revision Surgeries in a Large Mixed Cohort

#### SS-31

April 15, 1:40 PM

PARTH LODHIA, M.D., PRESENTING AUTHOR

BENJAMIN DOMB, M.D.

CHENGCHENG GUI, B.S.

MARK HUTCHINSON, M.D.

SHANE NHO, M.D., M.S.

MICHAEL TERRY, M.D.

**Introduction:** Recent hip arthroscopy literature has focused on revision hip arthroscopies and conversion to total hip arthroplasty (THA) or hip resurfacing (HR). This study reports a survival analysis at minimum two-year follow-up after hip arthroscopy and compares clinical outcomes of primary versus revision hip arthroscopy.

**Methods:** From February 2008 to June 2012, data were prospectively collected on all primary and revision hip arthroscopies. Patients were assessed pre- and post-operatively with four patient-reported outcome (PRO) measures: modified Harris Hip Score (mHHS), Non-Arthritic Hip Score (NAHS), Hip Outcome Score-Activities of Daily Living (HOS-ADL), and Hip Outcome Score-Sport Specific Subscales (HOS-SSS). Pain was estimated on the visual analog scale (VAS). Patient satisfaction was measured on a scale from 0 to 10. Secondary procedures were recorded.

**Results:** Of 1000 primary arthroscopy patients and 117 revision arthroscopy patients treated, 931 (93.1%) and 107 (91.5%), respectively, were available for follow-up and included in our study. At two-year follow-up, mHHS, HOS-ADL, HOS-SSS, NAHS, and VAS were 79.4, 82.2, 65.6, 79.9, and 2.9, respectively for primary arthroscopy