COMPARISON OF GLENOHUMERAL MECHANICS FOLLOWING A CAPSULAR SHIFT AND ANTERIOR TIGHTENING

*Sugalski, M T; *Wang, V M; *Pawluk, R J; *Levine, W N; *Pollock, R G; *Bigliani, L U (A-A,C-Zimmer); *Mow, V C (A-NIH, NSF, OREF, Whitaker Foundation)

+Columbia Presbyterian Medical Center, 622 West 168th Street, Department of Orthopaedic Surgery, PH-11 East, New York, NY 10032, 212-305-5974, Fax: 212-305-4040, mts16@columbia.edu

This study compares the glenohumeral forces, kinematics, and mechanics produced by the anterior-inferior capsular shift and unidirectional anterior tightening to unaltered normal shoulders.

Introduction: The capsular procedure for glenohumeral (GH) instability has been widely advocated, but few quantitative studies have compared normal joint mechanics to those associated with the capsular shift and unidirectional anterior capsular tightening. This study utilizes a new experimental model to compare 3-D GH translations and joint reaction forces in normal shoulders undergoing both an anterior tightening and a capsular shift.

Methods: Six normal fresh-frozen cadaveric shoulders (average age: 52; range: 34 to 67) were tested on a custom rig utilizing a coordinate measuring machine (CMM) for kinematic measurements and a six-axis load transducer (JR3 Inc.) to measure joint reaction forces. Each shoulder was tested in three configurations: (1) normal (unaltered anatomy) joint, (2) anterior tightening and (3) anterior-inferior capsular shift. Shoulders were actively elevated in the scapular plane in 30° increments from 0° to maximal elevation in three humeral rotations: ER (external rotation), NR (neutral rotation), and IR (internal rotation). The humeral head and glenoid cartilage surfaces were precisely quantified using stereophotogrammetry (SPG).

Results: In comparison to normal joints, the anteriorly tightened shoulders demonstrated: (a) significant (p < 0.05) loss of maximum elevation (135 ± 16° max) and external rotation, (b) a shift of the humeral head postero-inferiorly (1.38 ± 1.60 mm, p < 0.05), and (c) more posteriorly-directed reaction forces, during early and midrange of motion. In contrast, the capsular shift (159 ± 9° max elevation) demonstrated a similar range of motion as the normal joint (167 ± 8° max elevation) without any apparent loss of ER, while kinematics and reaction forces were not significantly different (p > 0.05) from those of the normal joint.

Discussion and Conclusion: These results support the clinical observation that the capsular shift is a more anatomic repair which reproduces normal joint mechanics. However, anteriorly tightened shoulders resulted in a loss of elevation and significant postero-inferior humeral head translation with a more posteriorly-directed joint force. This model, relating GH translations and joint reaction forces, may improve our understanding of the surgical treatment of joint instability and the pathogenesis of secondary osteoarthritis.