Higher Critical Shoulder Angle and Acromion Index Are Associated With Increased Retear Risk After Isolated Supraspinatus Tendon Repair at Short-Term Follow Up

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Purpose: To evaluate the effect of critical shoulder angle (CSA), acromion index (AI), and glenoid inclination (GI) on the postoperative healing rate after arthroscopic supraspinatus tendon repair. **Methods:** Patients after arthroscopic repair of a symptomatic, unilateral, single-tendon, full-thickness supraspinatus tear in whom nonoperative management had failed were retrospectively reviewed. Magnetic resonance imaging (MRI) studies were obtained 6 months postoperatively and were evaluated by 2 independent observers. Repair integrity was classified as either intact or torn. Preoperative true anteroposterior radiographs were used to measure CSA, AI, and GI. **Results:** Fifty-seven patients were evaluated 6 months postoperatively. The mean patient age at surgery was 54.7 ± 7.7 years. On MRI studies, 41 patients (71.9%) had an intact repair and 16 patients (28.1%) had a full-thickness retear. There were no significant differences between the intact and retear group in regard to patient age ($P = .648$), initial tear size ($P = .205$), or fatty degeneration ($P = .508$). The mean CSA for the retear group (37° ± 4°) was significantly higher than that in the intact group (35° ± 3°; $P = .014$). If the CSA was >38°, the odds ratio of having a retear was 3.78 (95% confidence interval 1.05 to 13.58; $P = .042$). Average AI for the retear group (0.73 ± 0.09) was significantly higher than that in the intact group (0.69 ± 0.06; $P = .049$). The mean GI was 17° ± 6° for the intact group and 16° ± 6° for the retear group ($P = .739$). **Conclusions:** At short-term follow-up, higher CSA and AI significantly increased the retear risk after arthroscopic supraspinatus tendon repair. CSA >38° increased the retear risk almost 4-fold. Overall GI was elevated but did not correlate with failure rate. **Level of Evidence:** III, case control study.

Rotator cuff repair is associated with high failure rates among patients with certain risk factors, particularly age, initial tear size, and fatty infiltration.[1-6] In addition, there appears to be a morphologic predisposition associated with cuff failure. Clinical studies have documented distinct anatomic variants of the scapula, such as a wide lateral acromial offset and increased glenoid inclination (GI).[7-11]

The critical shoulder angle (CSA), a radiographic measurement combining both parameters, has been

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The University of Connecticut Health Center/UConn Musculoskeletal Institute has received direct funding and material support from Arthrex. The company had no influence on study design, data collection, or interpretation of the results or the final manuscript. The authors report the following conflicts of interest or sources of funding: K.B. reports personal fees as a consultant for Arthrex, outside the submitted work. A.B.I. reports personal fees as a consultant for Arthrex, outside the submitted work. R.A.A. reports receiving a research grant from Arthrex and an educational and research grant from Depuy-Mitek, and is a consultant for Biorez. A.D.M. reports grants and personal fees as a consultant for Arthrex, outside the submitted work. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received January 4, 2018; accepted May 15, 2018.

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0749-8063/1810/$36.00

https://doi.org/10.1016/j.arthro.2018.05.029

found to be a strong predictor for degenerative rotator cuff tears.[11-14] Gerber et al.[15] showed that CSAs >38° substantially increase the ratio of joint shear to joint compression forces (instability ratio) and lead to compensatory supraspinatus tendon overload.

However, evidence in the literature is minimal and conflicting in regard to the correlation between these radiographic measurements and the risk of retear after rotator cuff repair.[4,16,17]

The purpose of the present study was to evaluate the effect of CSA, acromion index (AI), and GI on the postoperative healing rate after arthroscopic supraspinatus tendon repair.

Our hypothesis was that higher CSAs would be associated with increased retear rates.

Methods

Patient Selection

We retrospectively identified patients who underwent arthroscopic repair of a single-tendon, full-thickness supraspinatus tear between October 2008 and April 2012. The local institutional review board provided approval for the study. Inclusion criteria were patient age between 18 and 70 years; a symptomatic, unilateral, single-tendon, full-thickness supraspinatus tear; and failed conservative management, which included treatment with nonsteroidal anti-inflammatory drugs, subacromial injections, activity modifications, and a course of physical therapy. These subjects were identified from a previous series of arthroscopic repair patients with shoulder magnetic resonance imaging (MRI) obtained 6 months postoperatively.[18] Exclusion criteria were a history of shoulder surgery; concomitant pathology; type 1 diabetes; autoimmune, neuromuscular, or degenerative joint disease; or operative findings including massive rotator cuff tears extending into the infraspinatus, subscapularis, or teres minor, coexisting labral pathology, or evidence of degenerative disease not seen previously in the preoperative period.

In all patients, tendon repair was performed by a single surgeon (A.D.M.) in an arthroscopic double-row technique with PEEK (polyether ether ketone) anchors (Arthrex, Naples, FL). Subacromial decompression (anterior acromioplasty) was performed on all study participants by removing the anteroinferior surface of the acromion from the medial articular margin to the anterolateral corner. The anterior edge was not recessed beyond its normal anatomic state, creating a type 1 flat acromion. Bone from the lateral end was not removed. In cases of biceps disease, a subpectoral biceps tenodesis was performed according to a technique described previously.[19,20]

Clinical Scores

Preoperative and 6-month postoperative outcome measures were assessed using the Western Ontario Rotator Cuff index, American Shoulder and Elbow Surgeons score, Constant score, Simple Shoulder Test, Single Assessment Numeric Evaluation, and visual analog scale.

Radiographic Assessment

MRI studies were obtained preoperatively and 6 months postoperatively. All studies at the 6-month follow-up were completed using a 1.5-T MRI (Philips Medical Systems, Best, Netherlands). Both a board-certified musculoskeletal radiologist and an orthopedic surgeon (R.A.A.) independently evaluated the preoperative and 6-month postoperative MRI scans. The classification system of Patte[21] was used to quantify the amount of tendon retraction using coronal images in the T1 format. Fatty infiltration was evaluated with the criteria established by Goutallier et al.,[22] which classifies infiltration into 4 categories on the basis of the number of fatty streaks within the muscle belly on sagittal and coronal views. Repair integrity was classified as either intact or torn (full-thickness retear, Sugaya types IV and V[23]).

Preoperative standardized true anteroposterior radiographs were used, provided that there was no double contour >50% of glenoid height or an inverted teardrop pattern at the upper glenoid rim.[24] All radiologic data was stored on a picture archiving and communication system (IntelliSpace PACS, Philips Healthcare, Amsterdam, Netherlands) workstation, and the provider's image analysis software was used to measure CSA, AI, and GI.

CSA, AI, and GI were assessed by 2 board-certified orthopedic surgeons (B.S. and D.M.) independently and blinded to the MRI results. All measurements were performed according to previous publications.[11,12,25] CSA was measured between a line connecting the superior and inferior bony margins of the glenoid and a line from the inferior bony margin of the glenoid to the most inferolateral point of the acromion[12] (Fig 1). The AI was calculated by dividing the distance from the glenoid plane to the lateral border of the acromion by the distance from the glenoid plane to the lateral aspect of the humeral head[11] (Fig 2). GI was measured as described by Maurer et al.,[25] which is the beta-angle subtracted from 90° (Fig 3). The beta-angle is formed at the intersection of a line drawn through the floor of the supraspinatus fossa and a line through the glenoid fossa.

Statistical Method

A power analysis was conducted to determine the threshold for detecting a difference in failure rates in a sample size of 57 patients. A sample size of 55 patients