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ORIGINAL ARTICLE

Higher critical shoulder angle increases the risk of retear after rotator cuff repair

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Background: No evaluation has been done on the relationship of the critical shoulder angle (CSA) with retear after rotator cuff repair. Our purpose was to evaluate whether a higher CSA is associated with retear after rotator cuff repair.

Methods: This was a retrospective review of 76 patients who had undergone rotator cuff repair with postoperative ultrasound examination. Ultrasound findings were graded no retear (NT), partial-thickness (PT) retear, or full-thickness (FT) retear. Preoperative radiographs were used to measure CSA, glenoid inclination, lateral acromion angle, and acromion index.

Results: Average age was 61.9 years (45.3-74.9 years). On ultrasound examination, 57 shoulders (74.0%) had NT, 11 (14.2%) had PT retears, and 8 (10.3%) had FT retears. There was no significant difference in retear rate by age, gender, or tension of repair. Average CSA was significantly lower for the NT group at 34.3° ± 2.9° than for the FT group at 38.6° ± 3.5° ($P < .01$). If CSA was >38°, the odds ratio of having an FT retear was 14.8 ($P < .01$). In addition, higher CSA inversely correlated with postoperative American Shoulder and Elbow Surgeons scores ($P < .03$). Average glenoid inclination was significantly lower in the NT group at 12.3° ± 2.7° compared with 17.3° ± 2.6° in the FT group ($P < .01$). If glenoid inclination was >14, the odds ratio of having a FT retear was 15.0 ($P < .01$).

Conclusion: At short-term follow-up, higher CSA significantly increased the risk of an FT retear after rotator cuff repair. Also, increasing CSA correlated with worse postoperative American Shoulder and Elbow Surgeons scores. This radiographic marker may help manage expectations for rotator cuff tear patients.

Level of evidence: Level III; Retrospective Cohort Design; Treatment Study

Keywords: Critical shoulder angle; rotator cuff repair; retear; glenoid inclination; rotator cuff tear; lateral acromion index

Rotator cuff tears are a common pathologic process seen by orthopedic surgeons. Numerous factors have been associated with increased risk of rotator cuff tear, including age, smoking, and activity level.[3,10,15] First introduced by Neer, scapular anatomy has also been correlated with degenerative tears.[15,16] This scapular morphology pertains to both the acromion and glenoid. More recent evidence has focused on the link between glenoid inclination (GI) and rotator cuff tears.[7,20] Despite these data, not all studies have found such associations with these measurements.[13,18] As a result, more

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consistent measurements combining both glenoid and acromion elements would be ideal.

More recently, Moor et al introduced the concept of the critical shoulder angle (CSA) for identifying patients with high propensity for rotator cuff disease.[13] The CSA is the angle created between superior and inferior bone margins of the glenoid and the most lateral border of the acromion (Fig. 1). The benefit of using the CSA is that it combines the lateral extension of the acromion and the inclination of the glenoid fossa into a single quantifiable measurement. By integrating the 2 independent risk factors, it is potentially a better predictor of the development of degenerative tears.[7,12,17] Once it was introduced, studies demonstrated its strong relationship with rotator cuff tears.[4,14] In addition, the literature has quantified measurement ranges, suggesting that patients with CSAs from 35° to 39° are at the highest risk for rotator cuff disease.[13,18]

Given the CSA's strong correlation with degenerative tears, further investigation to biomechanically explain this association has been performed. The first study by Gerber et al demonstrated increased supraspinatus tendon load and compressive forces with CSAs >38°.[6] In addition, Moor et al found that CSAs >35° significantly altered joint forces and resulted in an increased risk of superior humeral translation.[12]

Previously, other measurements, such as acromion index, have been found to be a risk factor for tear progression and retear after repair.[8] Interestingly, though, whereas previous studies have proved the association between CSA and degenerative rotator cuff tears, no study has evaluated its effect on postoperative healing after rotator cuff repair. Gerber et al suggested this concept of poor healing and high retear rate in their biomechanical study,[6] but no further analysis was done. Given the dearth of literature on the association between CSA and retear rates, we proposed to further investigate this. Our hypothesis was that higher CSAs would be associated with increased retear rates after arthroscopic rotator cuff repair.

Figure 1 The critical shoulder angle (*CSA*).

Materials and methods

Seventy-six consecutive arthroscopic rotator cuff repair patients were retrospectively reviewed at our institution. All patients had failed to respond to nonoperative management, including a trial of physical therapy, nonsteroidal anti-inflammatory drugs, and activity modification. Exclusion criteria were lack of appropriate preoperative radiographs, absence of postoperative ultrasound scans, and revision surgery. The inclusion criterion was any isolated supraspinatus tear that required surgical treatment. In addition, all tears were Harryman classification type IB. Tension of repair was decided by the surgeon's interpretation of the repair, and it was graded poor, normal, or high tension.

All patients underwent postoperative ultrasound examination at 6 months of follow-up to evaluate tendon integrity. A musculoskeletal trained radiologist read all ultrasound scans. Ultrasound healing was graded as no retear (NT), partial-thickness (PT) retear, or full-thickness (FT) retear. An independent observer blinded to the ultrasound results evaluated all preoperative imaging. Preoperative true anteroposterior radiographs taken with the arm in neutral were used to measure CSA, glenoid inclination, lateral acromion angle, and acromion index.

CSA was measured as defined by Moor et al, using a line connecting the superior and inferior bone margins of the glenoid and an intersecting line drawn from the inferior bone margin of the glenoid to the most lateral border of the acromion[13] (Fig. 1).

GI was measured as defined by Maurer et al,[11] which was calculated as 90° subtracted from the B-angle. The B-angle is formed by the intersection of a line through the floor of the supraspinatus fossa and the glenoid fossa (Fig. 2).

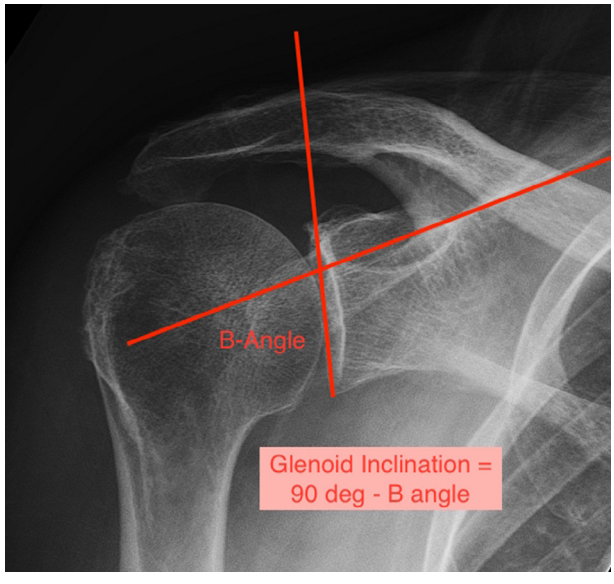

Figure 2 The B-angle measurement is demonstrated. Glenoid inclination was calculated as 90° subtracted from the B-angle.