The influence of the acromioclavicular joint degeneration on supraspinatus outlet impingement and the acromion shape

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INTRODUCTION

In the subacromial space, subacromial bursa and rotator cuff tendons are engaged between the humerus and coracoacromial arch. Anatomic changes of the acromion, coracoacromial ligament, or acromioclavicular joint can reduce the volume of the supraspinatus outlet and expose underlying soft tissue to increased mechanical wear and degeneration.

Impingement is a cause of rotator cuff tears.1 It occurs between the undersurface of the anterior third of the acromion and the rotator cuff, and involves the coracoacromial ligament and the acromioclavicular joint. Acromion shapes are classified as flat, curved, and hooked (types I, II, and III).2,3 Rotator cuff tears are most commonly associated with the type-III distal clavicular excision is recommended, even in cases with an asymptomatic acromioclavicular joint, so as to prevent further osteophyte formation.

Key words: acromioclavicular joint; clavicle; rotator cuff; shoulder impingement syndrome

ABSTRACT

Purpose. To assess the anatomic association of acromioclavicular joint degeneration to supraspinatus outlet impingement and the acromion shape.

Methods. Sagittal oblique magnetic resonance images of 49 shoulders in 49 patients were reviewed. 29 of them (mean age, 59 years) underwent surgery for impingement with or without rotator cuff tear (group 1), whereas the 20 controls (mean age, 27 years) were treated for shoulder instability without rotator cuff disease or acromioclavicular joint derangement (group 2). The supraspinatus outlet and the acromion shape of the 2 groups were compared.

Results. The difference in the mean supraspinatus outlet between groups 1 and 2 was 11% (514 vs 577 mm², p=0.095) and between the subgroup (of group 1) with full thickness rotator cuff tears and group 2 was 17% (481 vs 577 mm², p=0.036). Six of the acromions in group 1 were type III (hooked) compared to none in group 2.

Conclusion. In severe acromioclavicular degeneration,
acromions. The supraspinatus outlet is the opening between the acromion, coracoacromial ligament, coracoid, acromioclavicular joint, and glenoid, and through which the supraspinatus passes.\textsuperscript{4} Narrowing/impingement of the outlet is the primary cause of most rotator cuff tears.\textsuperscript{4}

In the aetiology of impingement, most anatomic studies focused on one component of the coracoacromial arch—the acromion—and its morphology in relation to rotator cuff tears. Few addressed the influence of the acromioclavicular joint on the supraspinatus outlet. In a study measuring the anatomic characteristics of the coracoacromial arch in relation to the humeral head, the supraspinatus outlet decreases 22.5\% in specimens with rotator cuff tears.\textsuperscript{5} Contribution of acromioclavicular joint osteophytes encroaching on the supraspinatus outlet was considered an acquired problem and the influence of acromioclavicular joint anomalies to rotator cuff diseases was not studied.

We assessed the anatomic association of acromioclavicular joint degeneration to supraspinatus outlet impingement and the acromion shape.

**MATERIALS AND METHODS**

Magnetic resonance images (MRIs) of 49 shoulders in 49 patients treated between January 2002 and January 2004 were reviewed. 29 of the patients underwent surgery for impingement with or without rotator cuff tear (group 1), whereas the 20 controls were treated for shoulder instability without rotator cuff disease or acromioclavicular joint derangement (group 2).

In group 1, of 21 men and 8 women aged 35 to 85 (mean, 59) years, all had small-to-medium size tears of <3 cm. 15 had full thickness rotator cuff tears (15 supraspinatus and one infraspinatus tears); 4 had partial thickness rotator cuff tears with impingement; and 10 had impingement refractory to conservative treatment including physical therapy and non-steroidal anti-inflammatory medications. No patient had severe acromioclavicular joint degeneration or large rotator cuff tear. Diagnosis was confirmed by arthroscopy.

In group 2, of 14 men and 6 women aged 16 to 44 (mean, 27) years, 12 were treated for traumatic Bankart lesions and 8 for multi-directional instability refractory to physical therapy. Diagnosis was confirmed with positive sulcus sign tests and the presence of diffuse capsular laxity. MRI and arthroscopy revealed no acromioclavicular joint derangement or rotator cuff injury.

Sagittal oblique T1- or T2-weighted MRIs at a 90° angle to the long axis of the supraspinatus tendon were reviewed by 3 observers. The supraspinatus outlet was measured using MRIs centred at the acromioclavicular joint. The acromion shape was classified using MRIs just lateral to the acromioclavicular joint.\textsuperscript{6} MRIs were digitised for computer processing, with uniform distance, orientation, and macro settings. A 10-mm long measurement bar was added.

For measurement of the supraspinatus outlet, the most posterosuperior aspect of the coracoid (point 1), the most anteroinferior aspect of the clavicle (point 2), and the most posteroanterior aspect of the acromion (point 3) were marked (Fig. 1). Lines were drawn between points 1 and 2, and 1 and 3. The space between points 2 and 3 including the inferior cortical surface of the clavicle, the inferior acromioclavicular joint capsule (and osteophytes), and the inferior cortical surface of the acromion was traced. By digitally contrasting signal intensities at the inferior capsule and cortical border, the non-linear surface

![Figure 1](image-url)  
Figure 1  The most posterosuperior aspect of the coracoid (1), the most anteroinferior aspect of the clavicle (2), and the most posteroanterior aspect of the acromion (3) are marked. The supraspinatus outlet is the enclosed space between points 1, 2, and 3. (a) A 51-year-old man with a supraspinatus tear of the right shoulder showing encroachment on the supraspinatus outlet by the acromioclavicular joint. (b) A 17-year-old man with multi-directional instability of the right shoulder showing no encroachment on the supraspinatus outlet.
between points 2 and 3 that outlined degenerative changes was traced. The enclosed space between points 1, 2, and 3 was the supraspinatus outlet (Fig. 1).

To classify the acromion shape, the quantitative method originally used for radiographic assessment of acromial morphology was adapted. Four anatomic reference points were marked: the most anterior (A) and posterior (B) points of the inferior cortex of the acromion, the point of the perpendicular line (drawn from the midpoint on line AB) meeting the inferior acromion cortex (C), and the centre of the humeral head (O). Type I (flat) was defined as point C lying on line AB, type II (curved) as line OA ≥ line OC, and type III (hooked) as line OA < line OC (Fig. 2). In type-III acromions, the centre of the humeral head was closer to the distal inferior cortex (shorter line OA) than the caudal cortex (longer line OC).

By comparing the supraspinatus outlet areas between groups 1 and 2 using 2-tailed T-test, the encroachment of acromioclavicular degeneration was quantified. The association between acromioclavicular degeneration and the acromion shape was also assessed. A p value of <0.05 was considered statistically significant.

RESULTS

The difference in the mean supraspinatus outlet area between groups 1 and 2 was 11% (514 vs 577 mm², p=0.095) and between the subgroup (of group 1) with full thickness rotator cuff tears and group 2 was 17% (481 vs 577 mm², p=0.036) [Table 1]. All patients in group 1 had acromioclavicular degeneration indicated by the smaller supraspinatus outlet. This degeneration was most prominent in the presence of acromioclavicular osteophytes in the subgroup with rotator cuff tears indicating an even smaller area. Six of the acromions in group 1 were type III (hooked) compared to none in group 2 (Table 2), probably owing to degenerative changes over time. The sample proportion of type-III acromions was much higher in group 1, but the sample size was too small to justify a significant result. More severe degeneration of the acromioclavicular joint was correlated with smaller supraspinatus outlets and higher proportion of type-III acromions.

DISCUSSION

For appropriate treatment of the symptomatic rotator cuff, it is important to identify the architectural changes
in shoulder anatomy and the area of impingement and the offending aspect of the coracoacromial arch. Treatment of rotator cuff disease should include evaluation of the acromioclavicular joint, as its degeneration affects the magnitude of encroachment. The impingement by acromioclavicular osteophytes must be aggressively cleared during subacromial decompression with rotator cuff repairs.

In a study examining 170 autopsy specimens, of 32 specimens with rotator cuff tears, 54% had distally pointing acromioclavicular osteophytes.8 Bony spurs of the anterior acromial process were also encountered, but less frequently than the acromioclavicular osteophytes. In severe acromioclavicular degeneration, distal clavicular excision in combination with anterior acromioplasty is recommended,1,4 even in cases with an asymptomatic acromioclavicular joint, so as to prevent further osteophytes formation.

REFERENCES