

# Analysis of the Capsule and Ligament Insertions About the Acromioclavicular Joint: A Cadaveric Study

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**Purpose:** The purpose of this study was to analyze the capsular and ligamentous insertions about the acromioclavicular (AC) joint to determine the amount of bone that can be removed without destabilizing the joint. **Methods:** We dissected 28 cadaveric shoulders. The AC ligament insertions were measured under loupe magnification with a digital caliper on the acromial and clavicular sides on the anterior, posterior, superior, and inferior edges. We measured the distance to the coracoacromial (CA) and coracoclavicular ligaments. In addition, the axial and coronal angle of the AC joint was measured. **Results:** The AC joint capsular insertion on the acromion begins, on average, 2.8 mm (range, 2.3 to 3.3 mm) from the medial acromion and begins on the lateral clavicle a mean of 3.5 mm (range, 2.9 to 3.9 mm) from the distal clavicle. The mean capsular width ranged from 1.6 to 2.9 mm. The mean distance from the medial acromion to the CA ligament insertion was 3.5 mm. The mean axial angle of the AC joint was 51°, with a 12° coronal angle. The mean distance from the lateral clavicle to the start of the trapezoid ligament was 14.7 mm, and that to the conoid ligament was 32.1 mm. **Conclusions:** An anatomic-based recommendation for safe AC joint resection is that 2 to 3 mm of the medial acromion and 3 to 4 mm of the distal clavicle can be resected without removing the AC capsular insertions. The trapezial and CA attachments are in close proximity to the AC capsular insertions. Medial resections greater than 15 mm will begin to take down the trapezoid ligament. Arthroscopic bone resection should be directed into the AC joint at approximately 50° in the axial plane and 12° in the coronal plane for safe symmetric resection. **Clinical Relevance:** These anatomic measurements suggest that AC joint resections (5 to 7 mm) with 2 to 3 mm from the acromial side and 3 to 4 mm from the clavicular side will not disrupt the stabilizing ligaments of the AC joint after distal clavicle resection. **Key Words:** Acromioclavicular joint—Acromioclavicular ligaments—Mumford—Coracoacromial ligament.

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Indications for distal clavicle excision include chronic painful instability, post-traumatic arthritis, chronic symptomatic osteolysis, and chronic idiopathic osteoarthritis.<sup>1,2</sup> In addition, patients with instability of the distal clavicle often also need ligament reconstruction of the coracoclavicular (CC) ligaments with or with-

out supplementation.<sup>2</sup> Open distal clavicle excision was simultaneously described by Mumford<sup>3</sup> and Gurd<sup>4</sup> in 1941. Published recommendations since these original descriptions have recommended distal clavicle excision ranging from 0.5 to 2.5 cm.<sup>1-3,5-14</sup> Arthroscopic resection has become preferred by many surgeons with a potential advantage of less soft-tissue disruption.<sup>5,12,14,15</sup> Both direct and bursal approaches have been described.<sup>16</sup> Several clinical studies have reported postoperative instability, pain, or weakness after distal clavicle resection.<sup>2,6,9,11</sup> It is important to excise enough bone from the distal clavicle to adequately relieve pain but to leave enough of the ligamentous insertions to provide stability in all planes.

The acromioclavicular (AC) joint anatomy and supporting ligamentous structures have been described historically by Urist<sup>17</sup> in 1946, followed by DePalma<sup>18</sup>

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in 1963. Recent cadaveric and biomechanical studies have further delineated the specific roles of the AC ligaments as well as the CC ligaments.<sup>10,19,20</sup> Only 2 studies have looked specifically at the insertions of the AC capsule and ligaments in relation to the AC joint. Boehm et al.<sup>7</sup> performed cadaveric dissections on 36 cadaveric shoulders and measured only the distance from the lateral end of the clavicle to the insertion of the superior AC ligament. Renfree et al.<sup>21</sup> measured the ligamentous insertions within the AC joint in 3 cadaveric shoulders, looking specifically at the superior AC ligament at both the clavicular and acromial edges.

Biomechanical studies have shown that the AC capsule and ligaments act as a primary constraint for posterior displacement and posterior axial rotation of the clavicle.<sup>19</sup> Further studies have confirmed that the AC ligaments and capsule provide anterior-posterior stability whereas the CC ligaments provide superior-inferior stability.<sup>10,13,20</sup>

The purpose of this study was to better define the capsular and ligamentous insertions about the AC joint on both the clavicular and acromial sides to determine how much bone can safely be removed from the distal clavicle and medial acromion without removing or injuring these important stabilizing structures.

## METHODS

Twenty-eight cadaveric shoulders were dissected and macroscopically examined. Six shoulders were excluded because of evidence of AC injury or lack of necessary structures. The age and gender of the specimens were unknown. Each specimen was prepared by removing the skin and muscular attachments of the

deltoid, pectoralis major, subclavius, and trapezius. All specimens were soaked in hydrogen peroxide for better visualization. The AC joint, CC ligaments, and coracoacromial (CA) ligaments were preserved. The AC joint was incised from anterior to posterior, making it possible to visualize the insertion of the AC joint capsule on the medial acromion and the lateral clavicle from inside the joint. A digital caliper (accuracy to 0.02 mm) combined with the use of 3.5× loupe magnification was used to determine anatomic measurements at 2 independent times by the same examiner. Measurements were made on the anterior, posterior, superior, and inferior edges on the acromial and clavicular sides of the AC joint (Fig 1). In addition, the proximity and width of the CA ligament were measured in relation to the AC joint surface. The distance from the lateral end of the clavicle to the lateral and medial extents of the trapezoid and conoid ligaments was measured.

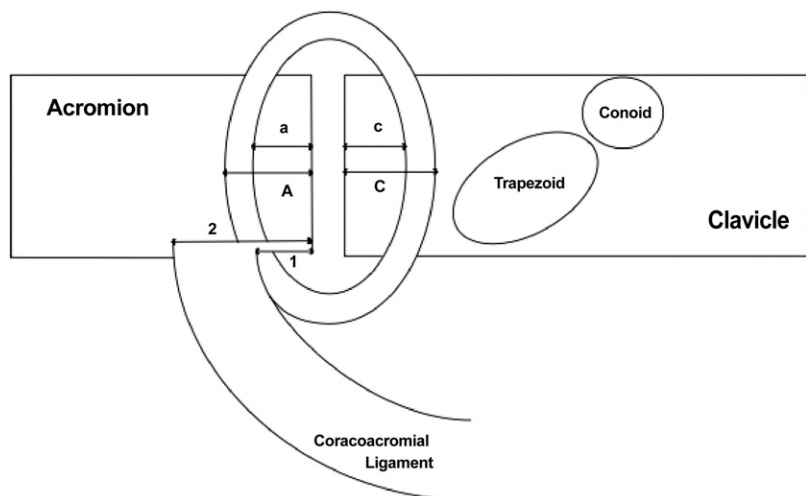
The angle of the AC joint in relation to the shaft of the clavicle in 2 planes was measured with a 1-mm-wide metal ruler placed inside the AC joint. The angle created by the ruler and the center axis of the shaft of the clavicle was measured with a goniometer (Fig 2).

## RESULTS

Three specimens had evidence of significant osteophyte formation on all edges of the AC joint. All other specimens had no significant findings of AC arthrosis. No specimens displayed an intra-articular disk.

As shown in Table 1, the mean distance from the medial acromion to the lateral intra-articular capsular insertion (a) was 3.3 mm (range, 2.2 to 6.1 mm), 2.3

**FIGURE 1.** Capsule and ligament measurements of right-sided AC joint. CA ligament measurements include the distance from the medial acromion to start of the CA ligament insertion (1) and from the medial acromion to the end of the CA ligament insertion (2) along the inferior border of the acromion. The close proximity of the CA ligament with the anteroinferior aspect of the AC joint should be noted. A, distance from medial acromion to end of capsuloligamentous insertion; a, distance from medial acromion to lateral intra-articular capsular insertion; C, distance from lateral clavicle to end of capsuloligamentous insertion; c, distance from lateral clavicle to medial intra-articular capsular insertion.



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