Acromioclavicular Joint: The Other Joint in the Shoulder

OBJECTIVE. The purpose of this article is to provide a review of acromioclavicular joint anatomy, describe common pathologies at the joint, and present normal and abnormal postoperative imaging findings after surgical treatments.

CONCLUSION. Knowledge of anatomy with related pathologies, orthopedic trends, imaging findings, and complications, is important in assessing the acromioclavicular joint.

The acromioclavicular joint is a common source of “shoulder pain” aside from the glenohumeral joint and rotator cuff. In the study by Jordan et al. [1], symptomatic acromioclavicular joints were present in 23% of patients undergoing shoulder MRI. Acromioclavicular joint dislocation accounts for approximately 12% of all shoulder injuries [2], which is likely an underestimation because minor injuries are often not reported. Successful radiologic evaluation of the acromioclavicular joint requires an understanding of anatomy and physiologic function, common pathologies, and normal and abnormal postoperative imaging appearance after common orthopedic surgical treatments.

Anatomy of Acromioclavicular Joint

The acromioclavicular joint is a key component of the shoulder girdle that provides connection between scapulohumeral motion and clavicular motion. The clavicle functions as a strut between the upper arm and the axial skeleton. Scapular motion relative to the thorax occurs with simultaneous motion at the acromioclavicular and the sternoclavicular joints with greater motion at the latter [3]. A healthy acromioclavicular joint can undergo up to 6 mm of translation in anterior, posterior, and superior directions under a load [4]. In addition, the acromioclavicular joint rotates 5–8° with scapulothoracic motion and 40–45° with shoulder abduction and elevation [5].

The acromioclavicular joint is a diarthrodial synovial joint between the flat medial surface of the acromion and the convex distal end of the clavicle (Fig. 1). On the frontal view, the acromioclavicular joint can appear to be vertical or downward medially with the clavicle overlapping the acromion by up to 50° [6]. A fibrocartilagenous disk cushions two relatively small joint surfaces while the joint is encased in a thin joint capsule [7]. The exact role of the meniscal disk is unknown. Many disks are incomplete and most are found to be degenerated by the fourth decade of life [6]. No disks were seen in all 28 cadaveric dissections of the acromioclavicular joint by Stine and Vangsness [8]. The acromioclavicular joint has a dual nerve supply from the suprascapular nerve and the lateral pectoral nerve.

Dynamic and static stabilizers maintain the acromioclavicular joint. Dynamic stabilizers include the deltoid muscle anteriorly and trapezius muscle posteriorly. Static stabilizers include the acromioclavicular, coracoclavicular, and coracoacromial ligaments along with the joint capsule. The acromioclavicular ligament is composed of superior, inferior, anterior, and posterior components. Normal acromioclavicular ligament components are each about 2.5 mm in thickness [8]. The acromioclavicular ligament resists 50% anterior and 90% posterior displacement. The superior component (Fig. 2A) is the strongest and is further augmented by merging fibers of the deltrotrapezial fascia [7].

An important static stabilizer is the coracoclavicular ligament. Composed of conoid and trapezoid ligaments (Fig. 2B), the coracoclavicular ligament is responsible for vertical stability of the acromioclavicular joint. The conoid ligament is more posteromedial and provides restraint against anterosuperior clavicle displacement and rotation. The trapezoid ligament is more anterolateral and...
serves as the primary restraint against anteroposterior translational forces [9].

The coracoclavicular ligament is triangular shaped with a broad attachment on the lateral aspect of the coracoid process (Fig. 2C). The coracoacromial ligament inserts onto the tip of the acromion. Along with the acromion, it forms an arch to protect the humeral head from superior subluxation.

Normal Imaging Appearance of the Acromioclavicular Joint

Standard radiography of the acromioclavicular joint includes a frontal view of the shoulder, axillary view, and scapular Y view. The axillary view is important for detection of posterior clavicular displacement and an os acromiale. In addition, Zanca view or stress view may be performed. Zanca view images the acromioclavicular joint in a standing patient with 10–15° cephalic tilt of the x-ray beam to clear the acromioclavicular joint off the scapular spine (Fig. 3A) [6]. Stress view is an anteroposterior view of the bilateral acromioclavicular joints with and without 10–15 pounds (5–7 kg) of weight suspended from each forearm [2] (Fig. 3B). The acromioclavicular interval is normally 1–3 mm in width whereas the coracoclavicular interval should be 11–13 mm [7]. An acromioclavicular interval greater than 6–7 mm or a difference in acromioclavicular interval of greater than 2–3 mm between left and right sides are considered pathologic. A greater than 5-mm difference in the coracoclavicular interval is also considered abnormal. The ligaments should appear thin and low signal intensity on all MR sequences.

Congenital Variations

There are variations to the shape of the acromion, which is mainly differentiated by the contour of the inferior surface. Type 1 is flat, and type 2 is concave. Type 3 is for a hooked or beaked appearance anteriorly, and type 4 has an upturned inferior surface. Types 3 and 4 are thought to decrease the supraspinatus outlet and are associated with impingement (Fig. 4).

The acromion has four ossification centers: preacromion, mesoacromion, meta-acromion, and basiacromion (Fig. 5A). These ossification centers fuse by 25 years of age [10]. In 1–15% of the population, one or more ossification centers fail to fuse, resulting in an os acromiale. When an os acromiale is present, 60% will be bilateral and will most commonly occur at the junction of meso- and metaacromion. On a frontal view radiograph, an os acromiale can be easily missed; the axillary view or an axial CT image is key in the diagnosis (Fig. 5B).

Os acromiale syndrome is a symptomatic ossicle due to micromotion between the os and the acromion. This abnormal micromotion may lead to pseudoarthrosis. Imaging findings of pseudoarthrosis at the os are similar to osteoarthritis at the acromioclavicular joint. CT shows subchondral sclerosis, subchondral cystic change, and osteophyte formation at the pseudoarthrosis. MR findings include bone marrow edema of the ossicle and degenerative change at the pseudoarthrosis (Figs. 5C and 5D) [11]. The os acromiale is also implicated in pain related to shoulder impingement, either from osteophytic spurs at the pseudoarthrosis or deltoid muscle contraction pulling the ossicle inferriorly onto the rotator cuff. The first line of treatment is nonoperative and includes rest, ice, and antiinflammatory medicine. Surgical options include débridement of the small ossicle, fixation of the ossicle to the acromion with hardware (Fig. 6), and débridement of the acromial undersurface.

Trauma to the Acromioclavicular Joint

Acromioclavicular joint injuries occur most commonly in men (8:1 ratio) in their third decade of life during contact sports (e.g., football, rugby) or heavy overhead manual labor [12]. The superficial location makes the acromioclavicular joint more vulnerable to direct trauma. Among National Collegiate Athletic Association football players, acromioclavicular joint injuries (> 96% Rockwood grade III or higher) accounted for 32% of all shoulder injuries [13]. Indirect trauma is less common and occurs with falls on outstretched hands. Acromioclavicular joint separation is categorized using the Rockwood classification [14] (Table 1).

Type I involves a sprain or partial tear of the acromioclavicular ligament with a normal acromioclavicular interval, which is occult on nonstress radiographs. Type II (Fig. 3) has torn acromioclavicular and intact coracoclavicular ligaments with less than 100% elevation of the clavicle in relation to the acromion. Type III (Figs. 7A and 7B) injuries show complete disruption of both the acromioclavicular and coracoclavicular ligaments, with greater superior displacement of the distal clavicle. Types IV to VI occur in more severe injuries. Type IV (Fig. 7C) occurs when the distal clavicle moves posteriorly into the trapezius muscle. This type is often missed on frontal radiographs and can be associated with concomitant anterior dislocation of the proximal clavicle at the sternoclavicular joint. Type V is a more severe form of type III with a more superiorly displaced clavicle. Type VI (Fig. 7D) is rare and

TABLE 1: Rockwood Classification of Acromioclavicular Joint Injury

<table>
<thead>
<tr>
<th>Type</th>
<th>Acromioclavicular Ligament</th>
<th>Coracoclavicular Ligament</th>
<th>Acromioclavicular Dislocation</th>
<th>Deltotrapezial Fascia</th>
<th>Joint Capsule</th>
<th>Radiography</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Sprained</td>
<td>Intact</td>
<td>None</td>
<td>Intact</td>
<td>Intact</td>
<td>Widening of acromioclavicular joint with stress</td>
</tr>
<tr>
<td>II</td>
<td>Torn</td>
<td>Intact</td>
<td>&lt; 50% Acromioclavicular subluxation</td>
<td>Intact</td>
<td>Torn</td>
<td>Wide acromioclavicular joint</td>
</tr>
<tr>
<td>III</td>
<td>Torn</td>
<td>Torn</td>
<td>100% Superior subluxation</td>
<td>Intact</td>
<td>Torn</td>
<td>Wide acromioclavicular and coracoclavicular joints; superior position of distal clavicle by less than 50% shaft width</td>
</tr>
<tr>
<td>IV</td>
<td>Torn</td>
<td>Torn</td>
<td>100% Posterior subluxation</td>
<td>Torn</td>
<td>Torn</td>
<td>Distal clavicle posterior to acromion</td>
</tr>
<tr>
<td>V</td>
<td>Torn</td>
<td>Torn</td>
<td>&gt; 100% Superior subluxation</td>
<td>Torn</td>
<td>Torn</td>
<td>More superiorly displaced clavicle than type III</td>
</tr>
<tr>
<td>VI</td>
<td>Torn</td>
<td>Torn</td>
<td>100% Inferior dislocation</td>
<td>Intact</td>
<td>Torn</td>
<td>Distal end of clavicle lies inferior to acromion</td>
</tr>
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</table>
is characterized by inferior displacement of the distal clavicle with respect to the acromion. MR images show discontinuity of normally low-signal-intensity acromioclavicular and coracoclavicular ligaments, surrounding soft-tissue edema, and bone marrow edema in the subjacent bone.

In addition to direct palpation, loading the joint using a cross-arm adduction test is diagnostic of acromioclavicular joint injury. If shrugging the shoulder reduces the acromioclavicular joint, then the deltatorespial fascia is intact, thereby distinguishing a type III from a type IV injury [7].

The acromioclavicular joint can also be injured as part of distal clavicular fractures [15] (Neer classification in Fig. 8). Type II fractures (10–30% of all clavicle fractures) are unstable due to coracoclavicular ligament disruption and are associated with a high rate of delayed or nonunion [15, 16].

**Treatment of Acromioclavicular Joint Injury**

Rockwood type I and II acromioclavicular joint injuries are treated conservatively with activity modification, ice, and nonsteroidal antiinflammatory drugs followed by physical therapy. Nonoperative treatments can fail and patients can present with residual joint instability, osteoarthritis, pain, and distal clavicular osteolysis [7]. Navy recruits with type I and II injuries treated nonoperatively showed residual symptoms (36–48%) and positive physical examinations (43–77%) [17].

Treatment of type III injuries is more controversial and includes both nonoperative and operative therapies. In a recent meta-analysis of type III injuries, there was no statistically significant benefit for surgical therapy versus nonoperative therapy [18]. Severe injuries (types IV to VI) are treated with surgical repair. Since the late 19th century, more than 60 different surgical approaches have been developed to treat acute and chronic acromioclavicular joint dislocation. The choice of a specific type of surgical repair depends on patient demographics, acuity of injury, and surgeon preference.

**Anatomic Acromioclavicular Joint Reconstruction**

Historically, surgical therapy concentrated on anatomic reconstruction of the acromioclavicular ligament. Use of rigid fixation with pins, screws, and wires were complicated by hardware migration into the lung, spinal canal, and carotid artery [19]. Distal clavicle excision (Mumford procedure) was originally performed to prevent the development of posttraumatic arthritis [20].

For Neer type IIB and III distal clavicular fractures, hook plates are commonly used because of advantages such as easy implantation technique and early postoperative mobilization [21]. The lateral edge of the hook plate “hooks” underneath the acromion and keeps the lateral clavicle reduced (Fig. 9). Disadvantages include the need for hardware removal, subacromial osteolysis, and wound complications. More rare complications include rotator cuff impingement and peri-hardware fractures [7].

**Imaging the Acromioclavicular Joint**

Distal clavicular osteolysis was first described as osteolysis in the distal clavicle after trauma in 1936 [23]. Since then, distal clavicular osteolysis has also been described in scenarios without acute trauma. Recently these “atraumatic” cases have been hypothesized to be due to occult subchondral fractures [24], most likely related to repeated microtraumas such as weightlifting. Distal clavicular osteolysis must be distinguished from other causes of distal clavicular destruction, including inflammatory causes such as rheumatoid arthritis (Fig. 11C), hyperparathyroidism, and scleroderma [25]. The differential diagnosis also includes lytic metastasis and hematogenously spread osteomyelitis. On radiographs, distal clavicular osteolysis shows destruction of the distal clavicle with small subchondral cysts and erosions and associated subchondral sclerosis along with a normal acromial articular surface. MRI shows loss of the normal low-signal-intensity cortical margin of the clavicle along with bone marrow edema. Subchondral or periosteal bone marrow edema with acromioclavicular joint synovitis can be seen. The acromion should be devoid of bone marrow edema, a distinguishing feature from septic arthritis and degenerative change.

**Septic Joint**

Infection in the acromioclavicular joint is rare but must be considered when acute pain, fever, and joint effusion are present [26]. Most commonly, septic arthritis of the acromioclavicular joint is related to trauma, recent surgery, or hematogenous seeding. In acute cases, a joint effusion may be the only sign and is later followed by bony destruction on both sides of the joint, bone marrow edema, and adjacent soft-tissue edema (Fig. 12).

**Osteoarthritis**

Small joint surface areas and an often-incomplete fibrocartilagenous disk at the acromioclavicular joint under high loads during every day activities are thought to lead to early osteoarthritis. Other risk factors include prior trauma or distal clavicular osteolysis (Fig. 13). The fibrocartilagenous disk, a meniscal homolog, begins to degenerate early, by age 20 years [27]. As in other joints, radiologic signs of osteoarthritis do not always correspond with patient symptoms. Acromioclavicular joint pain has been associated with variable findings, such as bone marrow edema [28] or superior capsular distention [29]. Symptomatic acromioclavicular joint osteoarthritis is also frequently associated with other pathologies in the shoulder, including rotator cuff tears (81%), labral tears (33%), and biceps tendinosis (22%) [30].

Enlarging osteophytes of a degenerative acromioclavicular joint, possibly in combination with chronic friction from a high-riding humeral head in patients with rotator cuff tears, can result in defects in the inferior or articular portion of the acromioclavicular joint capsule [31]. The defect allows glenohumeral synovial fluid to decompress across a degenerated acromioclavicular joint and escape superiorly through the acromioclavicular joint in the form of a ganglion cyst. On MRI and ultrasound, cysts may be uniloculated or multiloculated fluid-signal-intensity masses (hypoechogenic ultrasound) with a neck communicating with the acromioclavicular joint.
(Fig. 14). Internal debris and a thick wall are often present.

Treatment of acromioclavicular joint osteoarthritis starts with nonoperative therapy. Anesthetic or steroid injections are often diagnostically useful, and therapeutic (discussed further in the next section). Common surgical therapy is distal clavicular excision, such as the Mumford procedure. Distal clavicular excision has had equally positive results when performed in an open or arthroscopic approach. Excessive resection of the clavicle leads to anteroposterior instability because of ligamentous injury [32] likely due to disruption of the superior acromioclavicular ligament complex [33]. Currently, resection less than 1 cm is recommended by many authors [34]. A recent in vitro study showed improved joint stability after symmetric acromioclavicular joint resection (5 mm from either side of joint) versus distal clavicular resection (1 cm) [33].

**Imaging-Guided Procedures for the Acromioclavicular Joint**

Imaging-guided procedures for the acromioclavicular joint include joint injections (with anesthetics or steroids), joint aspiration, and ganglion cyst aspiration or injection. Needle guidance can be performed with fluoroscopy or ultrasound (Fig. 15). With fluoroscopy, the needle can be advanced perpendicular to the joint and skin, aiming for the center of the joint. Because of its small size, no more than 4–5 mL of fluid should be placed within the joint space. Ultrasound guidance is more accurate than injection by palpation. With ultrasound, both in- and out-of-plane approaches can be used to access the joint (Figs. 15B and 15C). Out-of-plane is useful when there is little overlying soft tissue for a full needle throw. Hyperechoic steroid and hypoechoic anesthetic will be seen distending the joint under realtime ultrasound. Both procedures should be performed under sterile technique. In a study by Strobel et al. [35] of 50 acromioclavicular joint injections, 38% achieved pain relief, and caudal osteophytes and capsular hyper trophy were MRI predictors of response. Potential complications include infection and bleeding. Aspiration of ganglion cysts arising from the acromioclavicular joint may require 16- to 20-gauge needle sizes because of the viscous nature of cyst fluid.

**Conclusion**

Knowledge of anatomy, common pathologies, and normal postoperative imaging assessment and findings of complications are important for providing a meaningful radiologic evaluation of the acromioclavicular joint.

**References**

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![Diagram of the acromioclavicular joint](image)

**Fig. 1**—Drawing shows anatomy at acromioclavicular joint.

![MR images](image)

**Fig. 2**—Normal appearance of static stabilizers of acromioclavicular joint.
A–C, MR images show acromioclavicular ligament (white arrow, A), coracoclavicular ligament consisting of conoid (white arrow, B) and trapezoid (black arrow, B) components, and coracoacromial ligament (white arrow, C).
Fig. 3—Acromioclavicular joint radiography.
A, Zanca image of acromioclavicular joint in 34-year-old man after fall from bicycle shows comminuted extraarticular fracture of distal clavicle. B, Nonstress image of right acromioclavicular joint in 44-year-old man shows widening of acromioclavicular joint but normal coracoclavicular distance. C, Stress view in same patient as in B shows increased widening of acromioclavicular joint and now abnormal widening of coracoclavicular joint.

Fig. 4—Acromial morphology.
A–C, Sagittal T2-weighted fat-saturated image (A) shows type 1, sagittal T1-weighted image (B) shows type 2, and sagittal T1-weighted image (C) shows type 3.
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Fig. 5—Os acromiale.
A, Drawing shows four ossification centers in distal acromion.
B, Axial CT image in 55-year-old woman shows unfused ossification center separated, representing os acromiale.
C, Axial T2-weighted fat-saturated MR image in 50-year-old woman shows os acromiale with pseudoarthrosis with native acromion. Bone marrow edema and degenerative change are present.
D, Coronal T2-weighted fat-saturated image in same patient shows os in inferiorly impinging supraspinatus tendon.

Fig. 6—Os acromial treatment for symptomatic os in 51-year-old woman.
A and B, Postsurgical radiograph (A) and CT image (B) show screw and wire fixation.
Fig. 7—Rockwood classification of acromioclavicular separation. 

A and B, Sagittal T2-weighted fat-saturated image in 54-year-old woman (A) shows disruption of coracoclavicular ligament whereas coronal T2-weighted fat-saturated image in 33-year-old man (B) shows tear of superior and inferior components of acromioclavicular ligament with bone marrow edema in acromion and soft-tissue edema. Findings are consistent with type III injury. 

C, Axial radiograph in 28-year-old man shows posterior displacement of clavicle consistent with type IV injury. 

D, Anteroposterior radiograph in 27-year-old man shows inferior displacement of clavicle, seen in type VI injury.

Fig. 8—Drawings show Neer classification of distal clavicular fractures.
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**Fig. 9**—Hook plate for distal clavicle fracture.  
A, Radiograph shows normal appearance with hook (arrow) flush with undersurface of acromion in 66-year-old man.  
B, Radiograph of blade hook plate in 55-year-old woman shows unhooking of plate from undersurface of acromion.  
C, Radiograph in same patient as in A now shows periprosthetic fracture (arrow) adjacent to medial aspect of blade hook plate after plate placement.

**Fig. 10**—Anatomic coracoclavicular reconstruction.  
A and B, Anteroposterior radiograph (A) in 30-year-old woman shows coracoclavicular reconstruction with semitendinosus allograft and #5 fiberwire fixated by two biotenodesis screws with distal clavicle excision, which went on to fail, as seen in radiograph (B) with widening of acromioclavicular and coracoclavicular intervals.  
C and D, Anteroposterior radiograph (C) in 39-year-old woman shows tightrope repair with endobuttons. Subsequent radiograph (D) shows failure of coracoclavicular reconstruction with acromioclavicular and coracoclavicular interval widening and migration of clavicular endobutton into widened hole in distal clavicle.
Fig. 11—Distal clavicular osteolysis.
A, Anteroposterior radiograph in 32-year-old male weightlifter shows erosion of distal clavicle.
B, Axial T2-weighted fat-saturated MR image in same patient shows bone marrow edema only in distal clavicle, with erosion of distal clavicle cortex.
C, Anteroposterior radiograph in 54-year-old woman with rheumatoid arthritis shows advanced distal clavicular destruction. Also note severe glenohumeral joint space narrowing.

Fig. 12—Acromioclavicular septic joint in 50-year-old man.
A and B, Axial CT image (A) shows erosive changes on both sides of joint, and axial T2-weighted fat-saturated image (B) shows joint effusion and adjacent bone marrow edema.

Fig. 13—Acromioclavicular joint osteoarthritis in 63-year-old man.
A, Coronal T1-weighted image shows osteophytes, joint space narrowing, and subchondral cysts.
B, Long-axis ultrasound image shows osteophytes with calcific deposit on clavicular end, likely hydroxyapatite deposit. There is associated moderate joint effusion and distention of superior joint capsule. Acr = acromion, Cla = clavicle.
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**Fig. 14—Acromioclavicular ganglia.**

A, Ultrasound long-axis image in 62-year-old woman shows multiloculated anechoic cyst arising from acromioclavicular joint (arrow) and extending superiorly, consistent with ganglion.

B, Axial MR proton density fat-saturated image in 91-year-old woman shows high-signal-intensity septate ganglion (arrow) arising laterally from acromioclavicular joint.

**Fig. 15—Imaging guided acromioclavicular joint procedures.**

A, Anteroposterior fluoroscopic image in 45-year-old man shows needle within acromioclavicular joint, with contrast enhancement confirming intraarticular location.

B and C, In- (B) and out-of-plane (C) needle approaches shown with positioning of needle with respect to transducer.

D, Long-axis ultrasound image of acromioclavicular joint in 61-year-old man with moderate joint effusion and superior capsular distention. In-plane needle approach for joint aspiration is shown with arrow pointing to needle.

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