INTRODUCTION

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The acromioclavicular (AC) joint is a diarthrodial joint,only 1 of the 5 joints that make up the complex arrangement of the shoulder. Together with the sternoclavicular joint, the AC joint provides the upper extremity with a connection to the axial skeleton. Injuries to the AC joint are very common in athletes and a source of significant morbidity.AC pathology particularly affects athletes whose sport demands overhead upper limb activity. These problems are most frequently encountered in contact sports and are far more common in males; they may be responsible not only for aesthetically unpleasant deformities of the clavicle but also for pain, fatigue, and muscle weakness***. (Biem ,2000)***

The treatment of injuries to the AC joint has been controversial since the time of Hippocrates (460 to 377 BC***).(Adams , 1886)***

Rockwood's modern classification includes 6 types. Many treatment options have been proposed in the literature targeted toward the different types of injuries, but it is difficult to compare the different series***. (Rockwood et al, 1990)***

An understanding of the anatomy and an accurate clinical diagnosis are critical for the development of a successful treatment plan to address the injuries and degenerative changes that can affect the AC joint. AC joint pain may masquerade as other conditions in the shoulder; therefore, the pathology must be thoughtfully sought. Careful clinical examination and basic radiographic imaging help to direct a clinically effective approach to these problems . ***(Beim,2000)***

ANATOMY AND BIOMECHANICS

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1. ANATOMY

The acromioclavicular joint provides a ‘keystone’ link between the scapula and the clavicle. The coupling of scapulothoracic and glenohumeral movement dictates that the integrity of the sternoclavicular and acromioclavicular joints is important for the normal co-ordination of movement of the shoulder girdle. Until recently, movement at the acromioclavicular joint had not been accurately defined and was perhaps underestimated. ***(Rockwood 1998, Ludewig ,2004 , Sahara et al, 2007)***

The AC joint, which is approximately 9 mm by 19 mm, is a diarthrodial joint with various angles of inclination in both the sagittal and coronal planes. ***(Bosworth . 1949 , DePalma . 1957)***

The normal anatomic range of the distance between the coracoid process and the clavicle (CC interspace) is 1.1 to 1.3 cm. ***(Bearden et al 1973)***

The articular surface of the acromial end of the clavicle is hyaline cartilage until 17 years of age, at which time it acquires the structure of fibrocartilage. Similarly, the articular surface of the clavicular surface of the acromion becomes fibrocartilage at approximately 23 years of age.***(Tyurina . 1985)***

The acromioclavicular articulation is an arthrodial joint between the acromial end of the clavicle and the medial margin of the acromion of the scapula. Its ligaments are: the articular capsule,the articular disk, the superior acromioclavicular , the inferior acromioclavicular , the coracoclavicular (Trapezoid and conoid). **The Articular Capsule (*capsula articularis; capsular ligament*).**—The articular capsule completely surrounds the articular margins, and is strengthened above and below by the superior and inferior acromioclavicular ligaments. **The Superior Acromioclavicular Ligament (*ligamentum acromioclaviculare*).**This ligament is a quadrilateral band, covering the superior part of the articulation, and extending between the upper part of the acromial end of the clavicle and the adjoining part of the upper surface of the acromion. It is composed of parallel fibers, which interlace with the aponeuroses of the Trapezius and Deltoideus; *below,* it is in contact with the articular disk when this is present. **The Inferior Acromioclavicular Ligament.**—This ligament is somewhat thinner than the preceding; it covers the under part of the articulation, and is attached to the adjoining surfaces of the two bones. It is in relation, *above,* in rare cases with the articular disk; *below,* with the tendon of the Supraspinatus. **The Articular Disk (*discus articularis*).**—The articular disk is frequently absent in this articulation. When present, it generally only partially separates the articular surfaces, and occupies the upper part of the articulation. More rarely, it completely divides the joint into two cavities.

(DePalma ,1957)

The Synovial Membrane.—There is usually only one synovial membrane in this articulation., but when a complete articular disk is present, there are two .

The Coracoclavicular Ligament (*ligamentum coracoclaviculare*) (Fig 1)This ligament serves to connect the clavicle with the coracoid process of the scapula. It does not properly belong to this articulation, but is usually described with it, since it forms a most efficient means of retaining the clavicle in contact with the acromion. It consists of two fasciculi, called the **trapezoid** and **conoid ligaments.**

The Trapezoid Ligament (*ligamentum trapezoideum*), the anterior and lateral fasciculus, is broad, thin, and quadrilateral: it is placed obliquely between the coracoid process and the clavicle. It is attached, *below,* to the upper surface of the coracoid process; *above,* to the oblique ridge on the under surface of the clavicle. Its anterior border is free; its posterior border is joined with the conoid ligament, the two forming, by their junction, an angle projecting backward.

The Ligaments of the Scapula—The ligaments of the scapula (Fig 1) are:

The Coracoacromial Ligament (ligamentum coracoaromiale).—This ligament is a strong triangular band, extending between the coracoid process and the acromion. It is attached, by its apex, to the summit of the acromion just in front of the articular surface for the clavicle; and by its broad base to the whole length of the lateral border of the coracoid process. This ligament, together with the coracoid process and the acromion, forms a vault for the protection of the head of the humerus. It is in relation, above, with the clavicle and under surface of the Deltoideus; below, with the tendon of the Supraspinatus, a bursa being interposed. Its lateral border is continuous with a dense lamina that passes beneath the Deltoideus upon the tendons of the Supraspinatus and Infraspinatus. The ligament is sometimes described as consisting of two marginal bands and a thinner intervening portion, the two bands being attached respectively to the apex and the base of the coracoid process, and joining together at the acromion. When the Pectoralis minor is inserted, as occasionally is the case, into the capsule of the shoulder-joint instead of into the coracoid process, it passes between these two bands, and the intervening portion of the ligament is then deficient. **The Superior Transverse Ligament (ligamentum transversum scapulæ superius; transverse or suprascapular ligament**).—This ligament converts the scapular notch into a foramen. It is a thin and flat fasciculus, narrower at the middle than at the extremities, attached by one end to the base of the coracoid process, and by the other to the medial end of the scapular notch. The suprascapular nerve runs through the foramen; the transverse scapular vessels cross over the ligament. The ligament is sometimes ossified.

The Inferior Transverse Ligament (ligamentum transversum scapulæ inferius; spinoglenoid ligament).—This ligament is a weak membranous band, situated behind the neck of the scapula and stretching from the lateral border of the spine to the margin of the glenoid cavity. It forms an arch under which the transverse scapular vessels and suprascapular nerve enter the infraspinatous fossa.***(Lewis ,1959)***

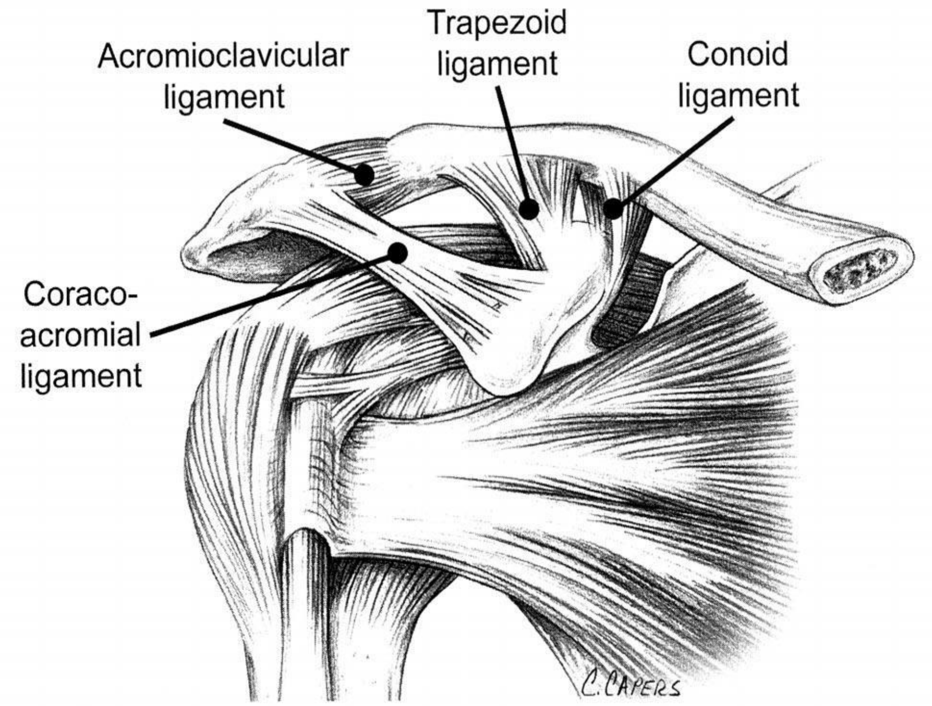


Fig (1) Ligamentous structures surrounding the acromioclavicular(AC) joint: acromioclavicular, trapezoid, conoid, and coracoacromial. The trapezoid and conoid ligaments make up the coracoclavicular ligament complex . (Beim 2000)

Innervations of the AC joint is from lateral pectoral, axillary,and suprascapular nerves***.(kennedy 1968) fig (2)***

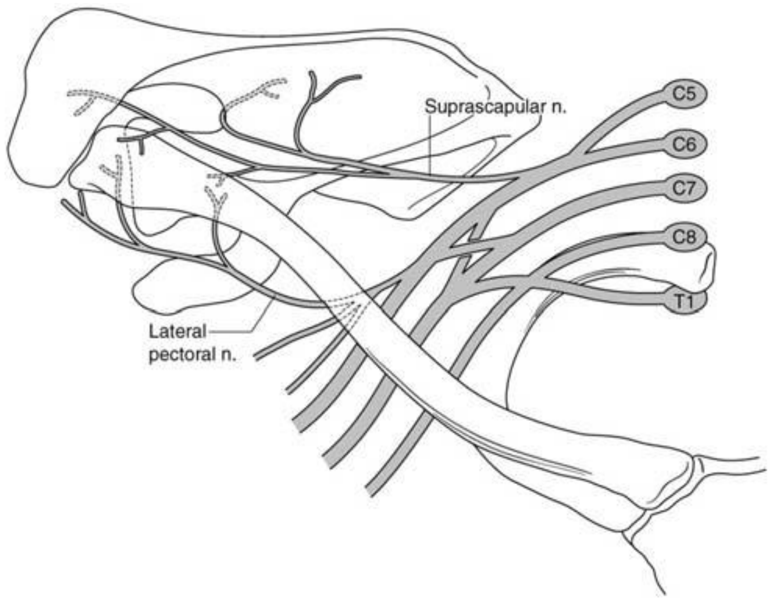


Fig (2) innervations of the AC joint (DeLee, Drez, 2003)

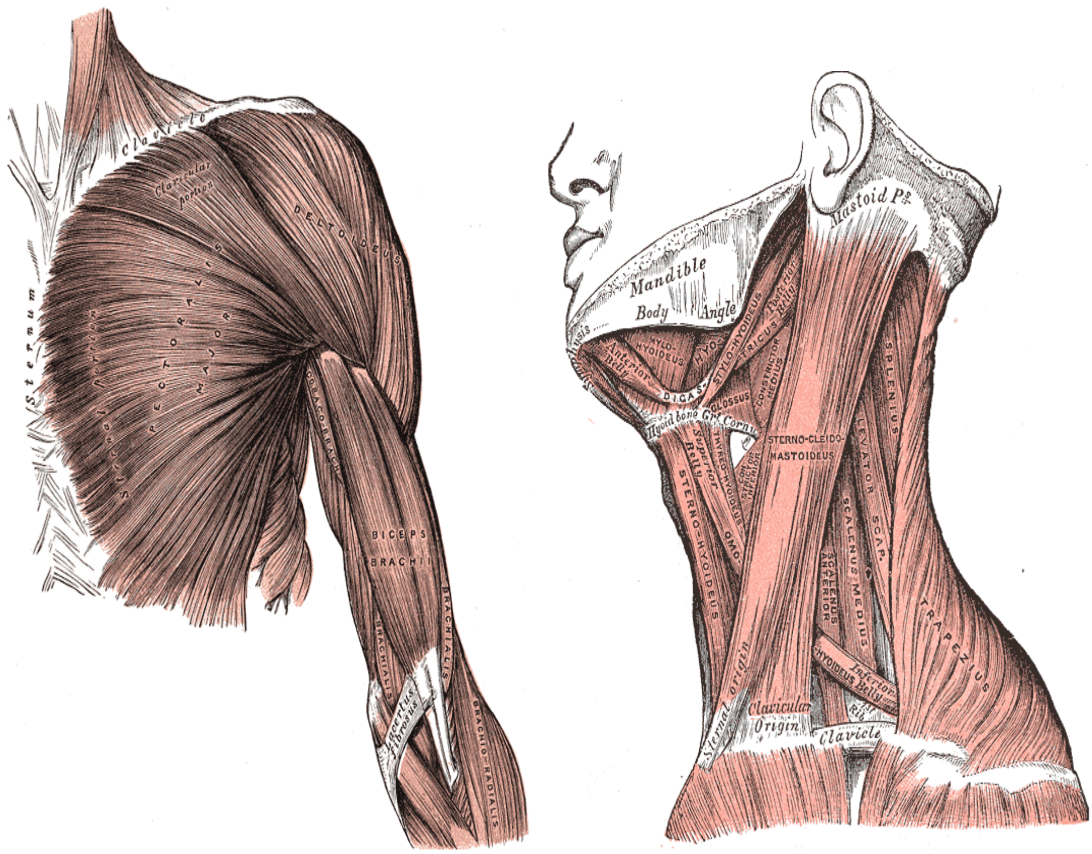
2. BIOMECHANICS

The AC joint is a diarthrodial joint that primarily rotates as well as translates in the anterior-posterior and the superiorinferior planes. The scapula (acromion) can protract and retract using the AC joint as a pivot point. It is surrounded by a joint capsule with synovium and an articular surface that is made up of hyaline cartilage containing an intraarticular meniscus-type structure.This intra-articular disk has tremendous variation in size and shape. ***(Mazzocca et al, 2007)***

It is now appreciated that during abduction of the shoulder, there is 15° of protraction, 21° of upward rotation and 22° of posterior tilting of the scapula relative to the clavicle at the joint.***(Sahara et al, 2007)***

Its actual function in the joint is negligible .The AC joint is stabilized both by static and dynamic stabilizers. The static stabilizers include the AC ligaments (superior, inferior, anterior, and posterior), the coracoclavicular ligaments (trapezoid and conoid), and the coracoacromial ligament. ***(Mazzocca et al ,2007) (fig1)***

The dynamic stabilizers include the deltoid and trapezius muscles. The trapezius and serratus anterior muscles form a force-couple that dynamically stabilizes the joint. Fibers from the superior AC ligament blend with the fascia of the trapezius and deltoid muscles,adding stability to the joint when they contract or stretch. ***(Mazzocca et al ,2007) fig(3)***



Fig(3) Deltoid and Trapezius muscles dynamic stabilizers of the acromioclavicular joint
(Henry Gray (1825–1861). Anatomy of the Human Body. 2000)

The AC joint capsule and the capsular ligaments are the primary restraints of the distal clavicle to anterior-to posterior translation.(***Fukuda et al, 1986)***

Posterior horizontal instability of the distal clavicle can cause abutment of the posterolateral portion of the clavicle into the spine of the scapula***. (Klimkiewicz et al, 1999)***

Serial sectioning of the AC joint ligaments reveals that the superior ligament contributes 56% and the posterior ligament contributes 25% of the resistance to posterior displacement of the clavicle***. (Mazzocca et al ,2007)***

The coracoclavicular ligaments' main contribution is to vertical stability, preventing superior and inferior translation of the clavicle. This complex is made up of 2 structures—trapezoid ligament and conoid ligament. These 2 ligaments span the space (1.3 cm) between the coracoid and clavicle. ***(Bosworth et al 1949)***

The coracoclavicular ligaments perform 2 major functions: **(1)** They guide synchronous scapulohumeral motion by attaching the clavicle to the scapula,and **(2)** they strengthen the AC articulation. Fukuda et al, have reported that with small displacements the AC ligaments are the primary restraints to posterior (89%) and superior (68%) translation of the clavicle. He also determined that the AC ligament contributed about 50% of the total restraining torque for small amounts of posterioraxial rotation by superior displacement (65%).With larger displacements, the conoid ligament was found to be the primary restraint (62%) to superior translation, while the AC ligaments were still the primary restraint to posterior translation. The trapezoid ligament was found to be the primary restraint to compression of the AC joint at both small and large AC joint displacements**.**

(Fukuda et al 1986)

Urist determined that the AC ligament was the primary restraint to anterior and posterior displacement and the coracoclavicular ligament, specifically the conoid, resulted in an overall superior displacement or an inferior displacement of the entire scapulohumeral complex. The force contribution of the conoid ligament to resist superior displacement increased significantly, to 60% of the total, with further displacement**.** ***(Urist 1946)***

Lee et al reported that the trapezoid and conoid ligaments play a major role in limiting excessive AC joint displacements both in the superior and posterior directions, while the inferior AC capsule ligament is the major restraint to anterior translation. ***(Lee et al ,1997)***

They agreed with the recommendation of Fukuda et al that both the coracoclavicular and AC joint capsule ligaments should be considered for reconstruction**.** ***(Mazzocaa et al 2007)***

Klimkiewicz et al confirmed these findings and reported that the superior and posterior AC capsule ligaments are the most important in preventing posterior translation of the clavicle to the scapula. ***(Klimkiewicz, et al,1999)***

Finally, Debski et al, advancing earlier research, recommended that the conoid and trapezoid ligaments should not be considered as 1 structure when surgical treatment is considered, and that capsular damage resulted in a shift of load to the coracoclavicular ligaments.They also reported that the intact coracoclavicular ligaments cannot compensate for the loss of capsular function during anterior- posterior loading as occurs in type-II AC joint injuries **.** ***(Debski et al ,2001)***

MOTION OF THE ACROMIOCLAVICULAR JOINT

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Rockwood et al have reported that there is approximately 5° to 8° of rotation (in line with the scapula) detected at the AC joint with forward elevation and abduction to 180°. ***(Rockwood et al, 1998)***

Ludewig et al reported that during elevation of the arm, the clavicle, with respect to the thorax, undergoes elevation (11° to 15°) and retraction (15° to 29°). ***(Ludewig et al ,2004)***

Codman described that with an intact AC joint, scapular motion (3 planes, 2 translations) is synchronously coupled with arm motion by the clavicle. This motion is guided by the coracoclavicular ligaments. Because of the obligatory coupling of clavicle rotation with scapular motion and arm elevation, the AC joint should not be fixed, either by fusion, joint-spanning hardware (screws, plates, pins) or by coracoclavicular screws. Motion will be lost, limiting shoulder function, or the hardware may fail**.** ***(Codman et al, 1934)***

Normal scapular motion consists of substantial rotations around 3 axes and not simply upward rotation. Motion of the scapula (protraction-retraction) plays a major role in the motion at the AC joint. ***(McClure et al, 2001)***

EPIDEMIOLOGY

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Injuries to the acromioclavicular joint account for approximately 12% of those to the shoulder girdle seen in clinical practice. ***(Emery 1997)***

This is likely to be an underestimate of their true prevalence, since patients with minor sprains may not seek medical attention. They are between five and ten times more common in males. Incomplete separations of the joint are approximately twice as common as complete disruptions. In a review of 520 of these injuries, more than 300 occurred in the first three decades of life and most were minor sprains and subluxations. ***(Rockwood et al,1998)***

These injuries are typically sustained by younger patients participating in contact sports. They are the most common injury to the shoulder seen in American football players, ***(Kaplan et al, 2006)*** and in other developed countries are usually sustained in sports such as rugby, soccer and Australian rules football. ***(Webb , Bannister 1992)***

Among recreational skiers approximately one-fifth of injuries to the shoulder girdle involve the acromioclavicular joint. ***(Kocher , Feagin 1996)***

MECHANISM OF INJURY

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Injury to the AC joint most commonly occurs as a result of direct force produced by the patient falling on the point of the shoulder onto the ground or firm object with the arm at the side in the adducted position. (***Beim, 2000) Fig(4)***

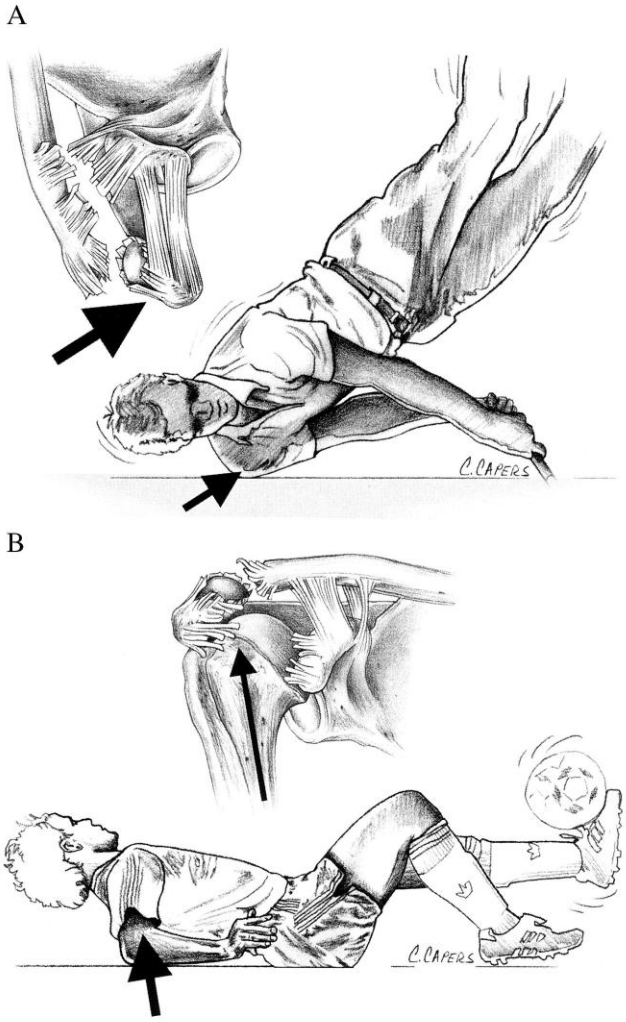

Figure 4. A, The most common mechanism of injury to the acromioclavicular (AC) joint is from a direct force onto the point of the shoulder. B, Indirect forces to the AC joint can also cause injury. For example, a fall onto the elbow can drive the humerus proximally, thus disrupting the AC joint. In this case, the strain is referred only to theAC ligaments and not to the coracoclavicular ligaments. (Beim 2000)

The most common events associated with AC injuries include contact sports such as hockey, rugby, and football. ***(Beim 2000)***

Webb and Bannister noted a 45% incidence of AC injuries in first-class rugby players, and most did well with conservative treatment. ***(Webb , Bannister 1992)***

The direct force of striking the point of the shoulder drives the acromion downward. Bearn has shown that the downward displacement of the clavicle is primarily resisted through an interlocking of the sternoclavicular ligaments. The clavicle remains in its normal anatomic position, and the scapula and shoulder girdle are driven inferiorly. The result, then, of a downward force being applied to the superior aspect of the acromion is either give-way of the AC and coracoclavicular ligaments or clavicle fracture. There may be an additional anteroposterior direction to the force. AC joint injuries consist of a continuum of ligament injuries, beginning with a mild sprain of the AC ligaments. Then the AC ligaments tear, followed by stresses to the coracoclavicular ligament. Finally, if the downward force continues, tears of the deltoid and trapezius muscle attachments occur from the clavicle, as well as ruptures of the coracoclavicular ligament ***(Fig5).*** When these structures tear, the upper extremity has lost its ligamentous support from the distal end of the clavicle, and it droops downward. With severe force, the skin overlying the AC joint can also be disrupted. In the rare type VI injury to the AC joint ,a different mechanism of injury is responsible***(fig5G).*** A severe direct force onto the superior surface of the distal clavicle along with abduction of the arm and retraction of the scapula has been described.
(McPhee 1980)

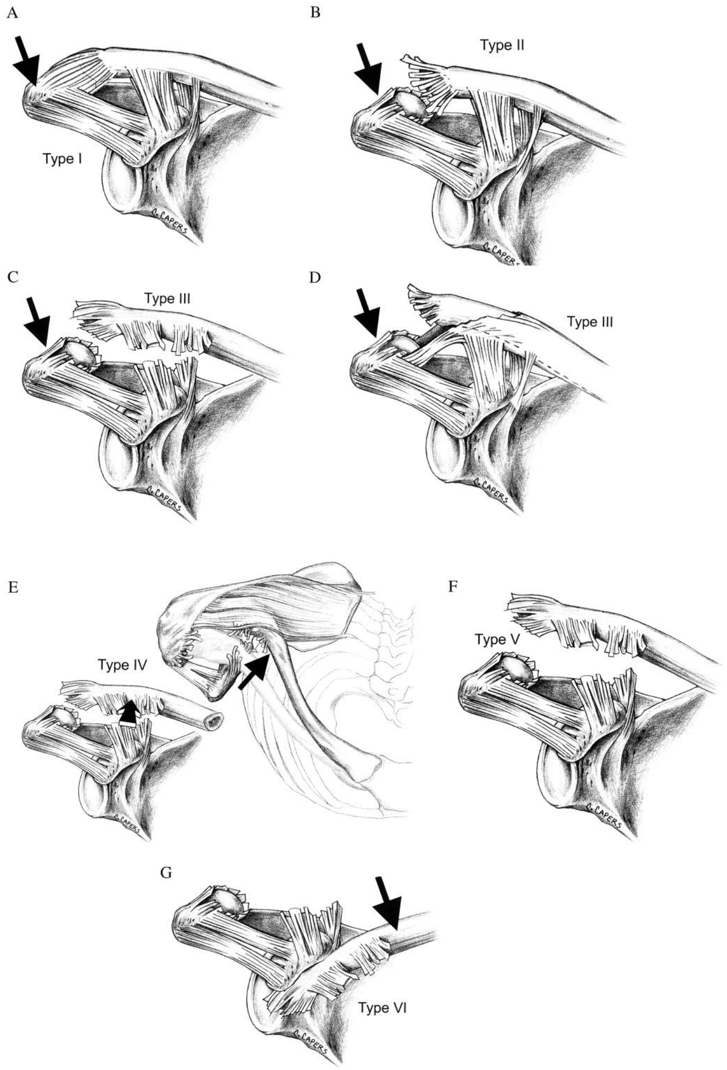

Fig 5. Acromioclavicular (AC) ligament injuries: types I–VI. A, Type I: minor AC ligament sprain. The ligaments are intact and the joint is stable. B, Type II: rupture of the AC ligament and sprain of the coracoclavicular ligaments. The distal clavicle is unstable. C, Type III: rupture of both the AC and the coracoclavicular ligaments. The joint is unstable. D, Type III: displacement of the distal clavicle through a tear in the periosteal tube. This can occur in children who sustain a severe force to the shoulder. The AC and coracoclavicular ligaments remain intact to the periosteal tube. E, Type IV: tears of both the AC and the coracoclavicular ligaments with posterior displacement of the distal clavicle. The distal clavicle may become interposed within the fibers of the trapezius muscle. F, Type V: tears of both the AC and the coracoclavicular ligaments with superior displacement of the distal clavicle. G, Type VI: tears of both the ACand the coracoclavicular ligaments with subcoracoid or subacromial displacement of the distal clavicle. (Beim 2000)

The clavicle is driven inferiorly, where it lodges beneath either the acromion or the coracoid.***(McPhee 1980)***

The subcutaneous position of the joint, without a large amount of muscle protection, theoretically increases the incidence of injury. The stability of the sternoclavicular joint transfers the energy of the injury to the AC and coracoclavicular ligaments. Indirect injury to the AC joint by falling on an adducted outstretched hand or elbow, causing the humerus to translocate superiorly, driving the humeral head into the acromion. ***(Mazzocca et al, 2007)***

Indirect forces to the AC joint may also be responsible for injury. An upward force to the AC joint can occur from a fall on an outstretched hand transmitting up the arm through the humeral head into the acromion process. The strain is referred only to the AC ligaments and not to the coracoclavicular ligaments, thus producing isolated AC joint injury ***(Fig 5b).***A downward force by a pull through the upper extremity while carrying a heavy load may also cause AC joint injury; however, this is a very uncommon mechanism. ***(Beim 2000)***

CLINICAL ASSEMENT

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The history and the mechanism of injury are important in making an accurate diagnosis. A direct blow to the AC joint or a fall on the elbow forcing the head of the humerus into the AC joint is the mechanism associated with an AC separation**.** ***(Mazzoca et al , 2007)***

The clinical diagnosis of an acute acromioclavicular injureis usually relatively simple since the pain is commonly localised accurately to the area of the joint.
Marked swelling , abrasions and ecchymoses may be seen over the affected joint, although compromise of the skin is unusual. In some patients who present late with chronic discomfort in the shoulder girdle after injury, the diagnosis of pain in the acromioclavicular joint may be less clear. Chronic symptoms may occur after both minor and severe injuries to the joint, but are more common in association with higher levels of disruption**.** ***(Fraser-Moodie , 2008)***

Injury to the AC joint is identified by a triad of point tenderness, pain at the AC joint with cross-arm adduction, and relief of symptoms by injection of a local anesthetic. ***The cross-arm adduction test*** is performed with the arm elevated to 90° and then adducted across the chest with the elbow bent at approximately 90°. This cross-arm adduction will produce pain specifically at the AC joint. It may sometimes produce pain in the posterior aspect of the shoulder associated with a tight posterior capsule or produce pain at the lateral aspect of the shoulder, which is also associated with rotator cuff injury. The reason that the cross-arm adduction test causes pain at the AC joint specifically is due to the compression across the AC joint with that motion**.*****(Mazzoca et al 2007)fig(6)***

Fig (6) cross arm adduction test .(www.nismat.org/orthocor/exam/sexam08.)

Walton et al, recently documented the accuracy of clinical tests for determining whether pain is caused by AC joint injury. They describe using ***The Paxinos test*** (thumb pressure at the posterior AC joint) and a bone scan to accurately assess pain secondary to the AC joint pathology***. (Walton et al ,2004)***

O'Brien et al recommended the active compression test for diagnosis of AC joint abnormalities. ***The active compression test of O'Brien et al, :*** The arm is elevated forward by 90°, adducted by 10° to 15°, initially with the forearm fully pronated and then supinated, while the examiner applies resisted downward pressure on to the hand. The test is positive if pain is produced by resisted pronation and relieved by resisted supination. It is specific for injury to the acromioclavicular joint only if pain is localised to the joint. If the test produces a deep-seated pain 'inside'the shoulder, this is suggestive of symptoms related to the superior labrum or biceps tendon. ***(O'Brien et al,1998) fig(7)***

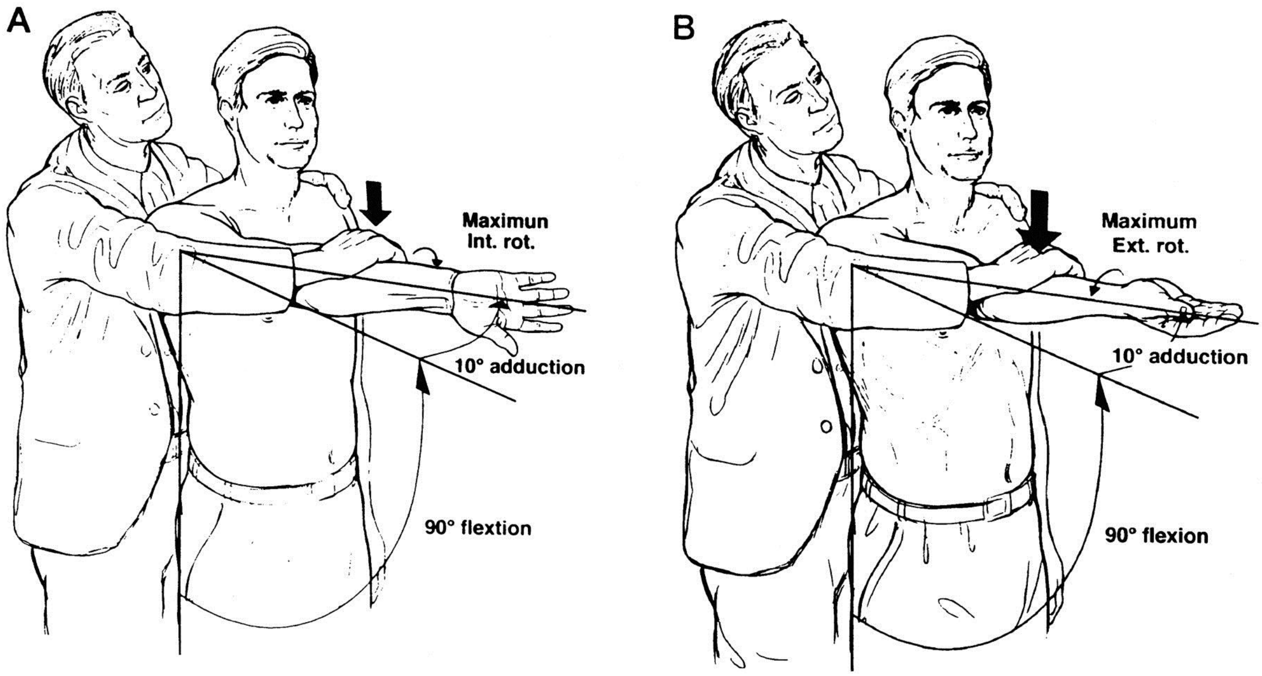

Fig (7) the active compression test (ajs.sagepub.com/content/28/4/587/F4.large.jpg)

One study reported the sensitivity of this test for AC lesions was only 41% but the specificity was 94%. ***(Chronopoulos et al 2004)***

This test is often used to assist in the diagnosis of superior labral tears; lesions of the superior labrum and AC joint can be difficult to distinguish. The sensitivity (63%) and specificity (73%) has been determined for superior labral pathology. ***(Gerber et al , 1998)***

The joint is tender to palpation and the clavicle often feels mobile, the ***'piano-key'*** sign. ***(Fraser-Moodie, et al 2008)***

Forced adduction of the symptomatic arm across the chest, the ***<u>Scarf test</u>***, is also likely to reproduce pain at the injured joint. ***(Park et al , 2005)***.

DIFFRENTIAL DIAGNOSIS

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There may be more than one contributory cause for symptoms in these patients and all potential sources must be addressed at the time of any secondary reconstructive procedure ***(Fraser-Moodie et al , 2008) (Table 1).***

Cause	**Symptoms**	**Clinical findings**	**Investigation-s**	**Treatment options**
Pain in the AC joint from osteoarthritis or disc disease	Pain localised over the AC joint	Localised tenderness in the AC joint. Positive Scarf/O'Brien30 tests	Plain radiography Steroid injection into the AC joint MRI/bone scan	Physiotherapy, modification of activity, oral analgesia Excision of the AC joint
Osteolysis of the distal Clavicle	Pain over the lateral clavicle	Localised tenderness and swelling of the lateral clavicle	Characteristic plain radiological and MRI appearances	Physiotherapy, modification of activity, oral analgesia Excision of the AC joint
Instability of the AC joint	Pain localised over the AC joint	Localised AC joint pain. Positive Scarf/O'Brien tests 'Piano-key' sign	Plain and stress radiography	Physiotherapy Ligament reconstruction
Rotator-cuff impingement or tear	Painful arc or shoulder weakness Cuff tear, usually in older patients	Positive impingement signs. Rotator-cuff weakness	Subacromial injection of steroid USS*/MRI for cuff tear	Subacromial injection of steroid for impingement Subacromial decompression Repair of cuff tear
Adhesive capsulitis	Diffuse shoulder pain Night pain	Global restriction of passive movement,	Clinical diagnosis	Physiotherapy Distension arthrography Manipulative/arthrolysis

	Shoulder stiffness	especially in external rotation		
Thoracic outlet syndrome	Dysaesthesia Motor weakness	Arm position can reproduce symptoms Specific tests insensitive	Chest radiography Nerve-conduction studies MRI of the neck and thoracic Outlet	Physiotherapy Surgical decompression
Superior labral tears (SLAP lesions)	Shoulder pain on overhead activities	Positive O’Brien/Speed test	MRI arthrography Arthrograph	Physiotherapy SLAP repair or debridement
Complex regional pain Syndrome	Diffuse shoulder pain Stiffness Neurological dysfunction	Reduced movements, skin changes, altered feeling, swelling distally	Clinical diagnosis Radiography may demonstrate osteopenia	Multidisciplinary approach: Physiotherapy Pain control (pain clinic) Oral medication Second-line oral therapies Regional nerve blocks

Table 1. Differential diagnoses in patients with chronic shoulder pain after injury to the acromioclavicular (AC) joint (Fraser-Moodie et al, 2008)

CLASSIFICATION

CLASSIFICATION

The pathologic characteristics of AC joint dislocation were originally described by Cadenat ***(Cadenat 1917).*** as a sequential injury beginning with the AC ligaments, progressing to the coracoclavicular ligaments, and finally involving the deltoid and trapezial muscles and fascia.***(Mazzoca et al , 2007)***

Tossy et al and Allman originally classified AC joint injuries into three grades ***.(Tossy et al ,1963 ,Allman ,1967)*** .This classification was subsequently modified by Rockwood into six types ***.(Williams et al, 1989) (Table2)***

Type	**AC ligaments**	**CC ligaments**	**Deltopectoral Fascia**	**Radiographic CC distance increase**	**Radiographic AC appearance**	**AC joint reducible**
I	Sprained	Intact	Intact	Normal (1.1to 1.3 cm)	Normal	N/A
II	Disrupted	Sprained	Intact	< 25%	Widened	Yes
III	Disrupted	Disrupted	Disrupted	25%-100%	Widened	Yes
IV	Disrupted	Disrupted	Disrupted	Increased	Posterior clavicle displacement	No
V	Disrupted	Disrupted	Disrupted	100%-300%	N/A	No
VI	Disrupted	Intact	Disrupted	Decreased	N/A	No

AC= acromio clavicular , CC=coracoclavicular , N/A= not applicable

Table (1) characterization of acromioclavicular injuries by Rockwood classification .. (Williams et al, 1989)

The classification scheme for AC separation described by Rockwood and Young is well accepted. Six types of injury are classified according to the degree of displacement of the distal clavicle, the involvement of the AC and coracoclavicular ligaments, and the integrity of the fascia overlying the deltoid and trapezius musculature ***(Rockwood and Young ,1990)***

Type I. Type I AC separations occur secondary to a mild force to the point of the shoulder, which produces a minor strain to the fibers of the AC ligaments. The AC joint remains stable, and the ligaments are intact. On physical examination, AC joint tenderness is minimal to moderate without palpable deformity**.**

(Beim, 2000)fig(8)

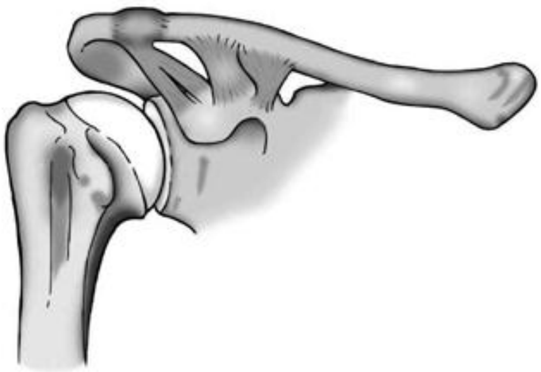


Fig 8 . Acromioclavicular joint Type I injuries. (Fraser-Moodie, et al , 2008)

Type II. Type II AC separations result from a moderate force to the point of the shoulder, yet severe enough to rupture the AC ligaments. The distal end of the clavicle is unstable, but the coracoclavicular ligaments are intact. The scapula may rotate medially, widening the AC joint. If the coracoclavicular ligament is mildly stretched, slight downward displacement of the scapula from the distal end of the clavicle may be apparent. On physical examination, pain at the AC joint can be moderate to severe. The outer end of the clavicle may be slightly superior to the acromion. Shoulder motion produces pain in the joint, and the coracoclavicular space is tender to palpation. Manipulation of the clavicle in the horizontal plane may result in subtle motion detectable with palpation of the AC joint.***(Beim , 2000) Fig (9)***

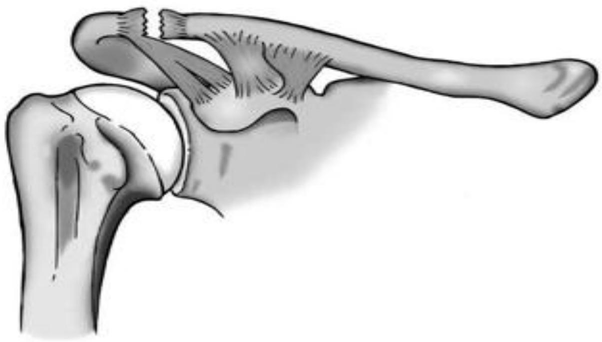


Fig 9. Acromioclavicular joint Type II injuries. (Fraser-Moodie, et al , 2008)

Type III. Disruption of the AC and coracoclavicular ligaments occurs after a severe force is applied to the point of the shoulder. In children, the AC and coracoclavicular ligaments may remain intact to the periosteal tube of the clavicle, and the clavicle is displaced out of the periosteal tube, secondary to a longitudinal split in the periosteal sleeve . The mechanism for this injury is similar to that described above. The deltoid and trapezius muscles are disrupted from the distal end of the clavicle, or the periosteal sleeve with muscle attachments may be separated from the outer end of the clavicle. On physical examination, a type III injury may be less painful than a type II injury, in which the distal clavicle is unstable, yet is still contained in the region of the acromion by the intact coracoclavicular ligaments, allowing abnormal movement between the 2 bones and resulting in irritation and pain. The patient often presents with a depressed upper extremity compared with the normal shoulder, and the distal end of the clavicle may be prominent enough to tent the skin. Abduction generally causes the most severe pain in this injury. In type III AC separations, the distal clavicle can be manually reduced into its anatomical location; however, it will remain unstable when the pressure is removed. ***(Beim, 2000) fig (10)***

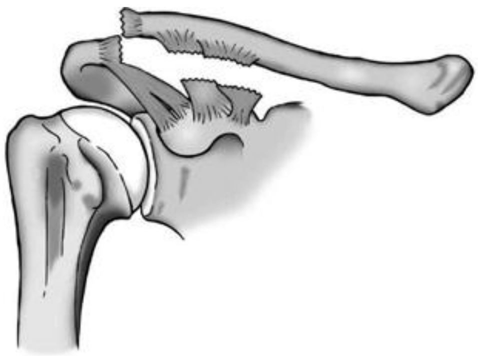


Fig 10. Acromioclavicular joint injuries type III (Fraser-Moodie, et al , 2008

Type IV. This injury is similar to a type III AC separation except that the distal clavicle is displaced posteriorly and may even be locked within the fibers of the trapezius muscle. The physical examination is similar to that in type III injuries, although the patient will present with significantly more pain with shoulder motion. Observation of the shoulder superiorly may reveal that the outline of the involved clavicle is posteriorly inclined when compared with the uninvolved shoulder. Significant posterior displacement of the clavicle may tent the skin on the posterior aspect of the shoulder. A manual reduction maneuver is not possible in this type of injury, and thus, helps to distinguish it from a type III injury .(***Beim, 2000) fig(11)***

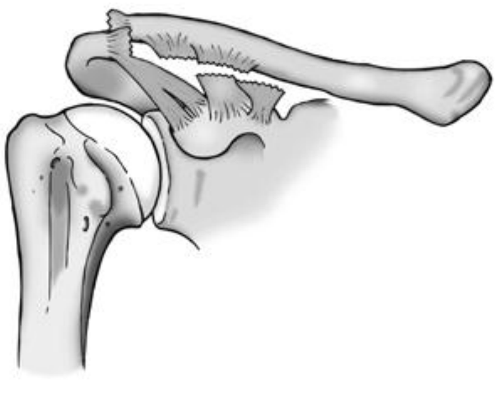


Fig 11. Acromioclavicular joint injuries type IV (Fraser-Moodie, et al , 2008)

Type V. This is a very severe type III injury with disruption of the AC and coracoclavicular ligaments, as well as detachment of the deltoid and trapezius muscles from the distal third of the clavicle. As a result, the entire upper extremity droops inferiorly, making the clavicle appear very prominent. In addition to the tenderness noted in a type III injury, the patient also has pain over the distal half of the clavicle secondary to the extensive muscle and soft tissue disruption from the clavicle.***(Beim ,2000) Fig (12)***

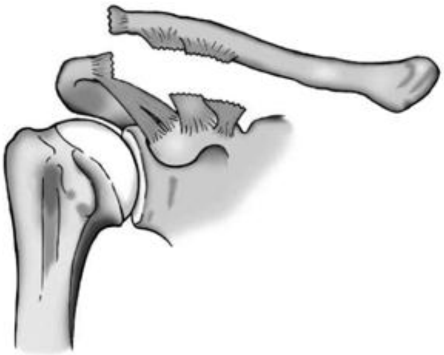


Fig 12 . Acromioclavicular joint injuries type V (Fraser-Moodie, et al , 2008)

Type VI. This is a very rare injury resulting from a significant traumatic abduction force to the upper extremity. The distal end of the clavicle is dislocated under the coracoids process and is posterior to the conjoined tendons (coracobrachialis and short head of the biceps). On physical examination, the shoulder has a flattened appearance, as opposed to the rounded contour of the normal shoulder. The acromion is prominent, and the superior surface of the coracoid process can be palpated easily. Associated fractures of the clavicle and upper ribs and injury to the brachial plexus must be carefully sought due to the significant amount of trauma required to cause a type VI injury.***(Beim ,2000) Fig (13)***

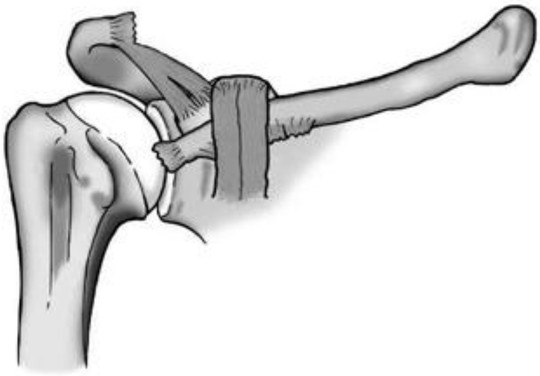


Fig 13.Acromioclavicular injuries type VI (Fraser-Moodie, et al , 2008)

MRI of a limited number of injuries has shown some inconsistencies in this classification and questioned the current understanding of the disruption of the soft tissue. ***(Barnes et al,2004)***

At operation the findings typically support the current classification ,although more studies on the imaging of these injuries may yet challenge this.
(Bannister et al, 1992)

'Pseudodislocation' is an unusual injury seen in children and adolescents, in which the joint is dislocated, but with the coracoclavicular ligaments intact and remaining attached to a periosteal sleeve stripped off the distal clavicle.
(Falstie-Jensen et al 1982)

A second uncommon variant is a separation of the joint in which the coracoclavicular ligaments are intact but there is a bony avulsion fracture of the coracoid process. ***(Eyres et al ,1995)***

RADIOGRAPHIC EVALUATION

RADIOGRAPHIC EVALUATION

The grading of the injury is made on radiological examinationas determined by the extent of displacement of the articular surfaces .***(Fraser-Moodie et al , 2008)*** ***fig (14)***

Fig 14. Anteroposterior radiograph of the acromioclavicular joint showing a type-IV injury
(Fraser-Moodie et al, 2008)

Routine radiographic projections of the AC joint have traditionally been taken using a horizontal-beam technique .This may lead to superimposition of the AC joint on the spine of the scapula, which can result in missed pathology. In addition, if the AC joint radiographs are taken by the technician with the same x-ray exposure setting used to penetrate the heavier and thicker glenohumeral joint, the resulting dark and overpenetrated x-ray of the AC joint will be difficult to interpret for AC pathology. The exposure must be reduced approximately 50% from an ordinary glenohumeral joint radiograph to maximally visualize the AC joint. ***(Beim , 2000)***

The Zanca view of the AC joint was developed to address the superimposition of the AC joint on the scapular spine .The patient is positioned standing, with both AC joints projected onto a single large cassette, and a true anteroposterior view (45° angulation from the thoracic plane) with a 10° to 15° cephalic tilt is performed. The cephalic tilt view centred on the acromioclavicular joint maximizes visualization of the joint and helps to identify small fractures that may be present. ***(Zanca 1971) fig (15)***

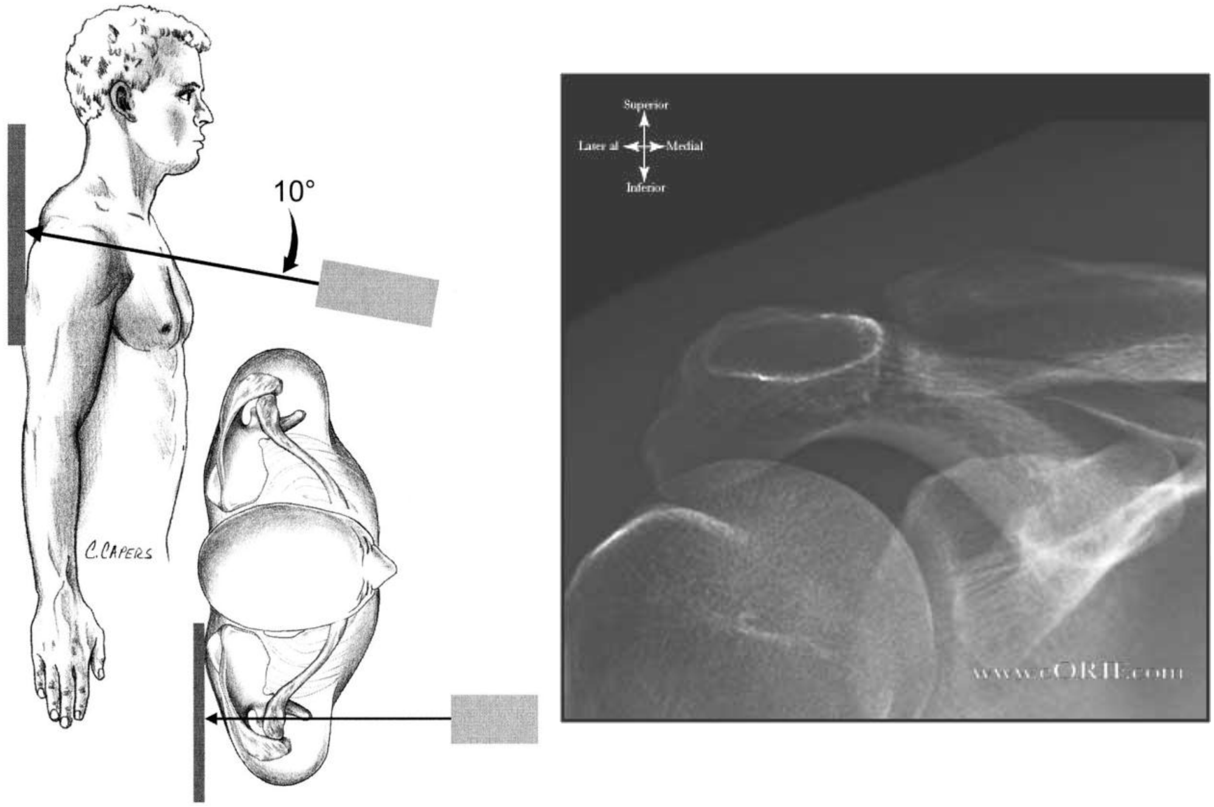


Fig 15. The Zanca view of the acromioclavicular (AC) joint. A standing, true anteroposterior view of both AC joints is performed with or without weights suspended on the forearms. A 10° to 15° cephalic tilt maximizes visualization of the joint and helps to identify small fractures that may be present. (Beim,2000)

The axillary lateral view of the shoulder is important to identify any posterior displacement of the clavicle, and it may also reveal small fractures not visible on the anteroposterior x-ray. The axillary lateral view is taken with the arm abducted 70° to 90° and the radiographic beam directed cranially. Although this view can be obtained in almost any patient, an occasional patient may be unable to abduct the arm enough for this view. Several techniques are useful in this situation**.** ***(Warner 1995)***

The arm can usually be carefully passively abducted to allow this film to be taken. In other patients, a curved cassette can be placed in the axilla and the beam directed inferiorly onto the cassette. Alternately, the arm can be forward flexed rather than abducted. Finally, the Velpeau axillary lateral view can be obtained without even removing the injured extremity from its immobilized position. The patient is simply asked to lean backward over the edge of the radiography table where the x-ray cassette is placed, and the beam is directed from superior to inferior . ***(Beim, 2000)***

The technique for a stress radiograph of the AC joint issimilar to that in the anteroposterior view with the addition of a 10- to 15-lb (4.54- to 6.80-kg) weight suspended from the forearm.Care must be taken not to allow the patient to hold the weights because proximal muscular contraction may reduce the degree of the AC joint dislocation. The average distance between the superior aspect of the coracoid process and the inferior aspect of the clavicle varies from 1.1 cm to 1.3cm.***)*** **.**However, the coracoclavicular distance varies in normal subjects, depending on how far the patient is from the x-ray tube and cassette. Therefore, the most important measurement is the side-to-side comparison with the uninvolved side. Bearden et al, recommended comparing the 2 sides: an increase in the coracoclavicular distance of the injured shoulder over the normal shoulder by 40% to 50% can be considered a complete coracoclavicular ligament disruption. ***(Bearden et al, 1973)***

Rockwood and Young have documented that a side-to-side difference of 25% of the coracoclavicular distance is diagnostic of a complete disruption of the coracoclavicular ligaments***. (Rockwood and Young 1990)***

Vanarthos et al, performed a cadaver study to establish whether an anterior/posterior (AP) x-ray with the arm in internal rotation could replace the weightbearing view to diagnose type III AC dislocations. ***(Vanarthos et al, 1994)***

Bossart and colleagues reviewed the stress x-rays of 82 patients who did not have an obvious type III injury of the AC joint. They only diagnosed 5 patients with type III injuries, and therefore, did not recommend routine use of stress x-rays of the AC joint. ***(Bossart et al, 1988)***

An orthogonal view is required to assess the degree of anteroposterior translation of the Surfaces of the joint. CT or MR arthrography is useful in assessing the size and extent of displacement of the fragment***..(Fraser-Moodie et al, 2008)FIG (16)***

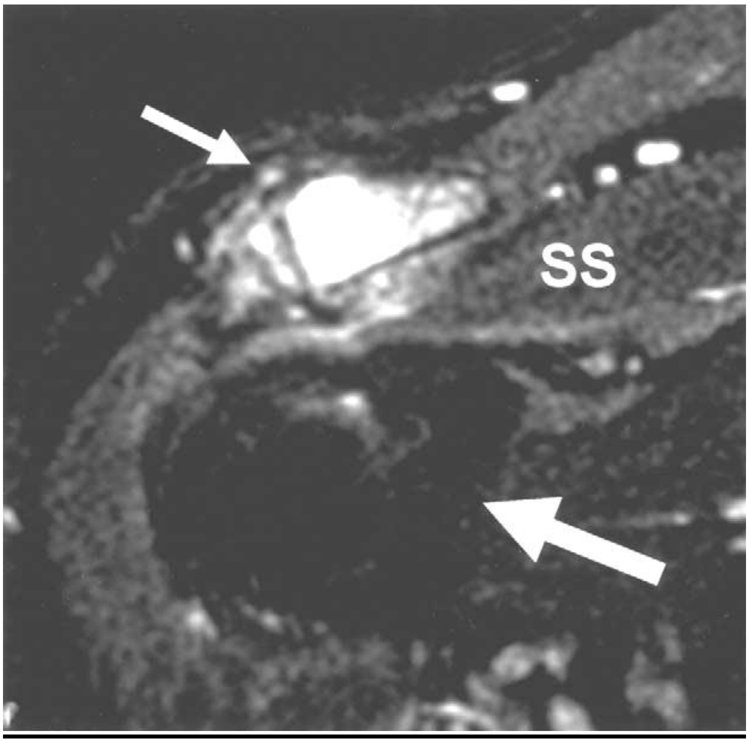


Fig 16. MRI scan of right AC joint in a symptomatic patient demonstrating joint space narrowing, osteophytes, and bone edema in the lateral clavicle and medial acromion. SS, supraspinatus. (Shubin Stein et al 2006)

ASSOCIATED INJURIES

ASSOCIATED INJURIES

Any of the three bones and joints of the shoulder girdle may be affected, and separation of the acromioclavicular joint is often encountered as part of the disruption of the sternoclavicularacromial linkage. Injuries to the vasculature and the brachial plexus are common, and a widened scapular index, as measured from the midline of the spine to the medial border of the scapula, when seen on an anteroposterior radiograph of the chest, is pathognomonic***.(Fraser-Moodie et al, 2008)***

1. Fractures

Fractures of the acromial process, clavicle, and ribs can be associated with AC dislocations. Type VI injuries are generally caused by severe trauma and are more likely to be associated with other injuries. Distal clavicle fractures can occur in association with AC joint injuries. ***(Beim 2000)***

Neer classified these fractures according to their location in relation to the coracoacromial ligaments. ***(Fig 17).*** Type I injuries occur lateral to the coracoclavicular ligament complex and are quite stable ***(Fig 17A).*** Type II injuries are complex, unstable fracture dislocations that leave the distal clavicle and the AC joint intact but separate the clavicle from the underlying coracoclavicular ligament complex through an oblique or vertical fracture ***(Fig 17B, 17C).*** Type III injuries are intra-articular fractures of the distal clavicle at the AC joint and may be an occult source of posttraumatic arthritis and pain ***(Fig 17D).*** Some more unusual associated fractures have been reported in the literature***. (Neer 1984)***

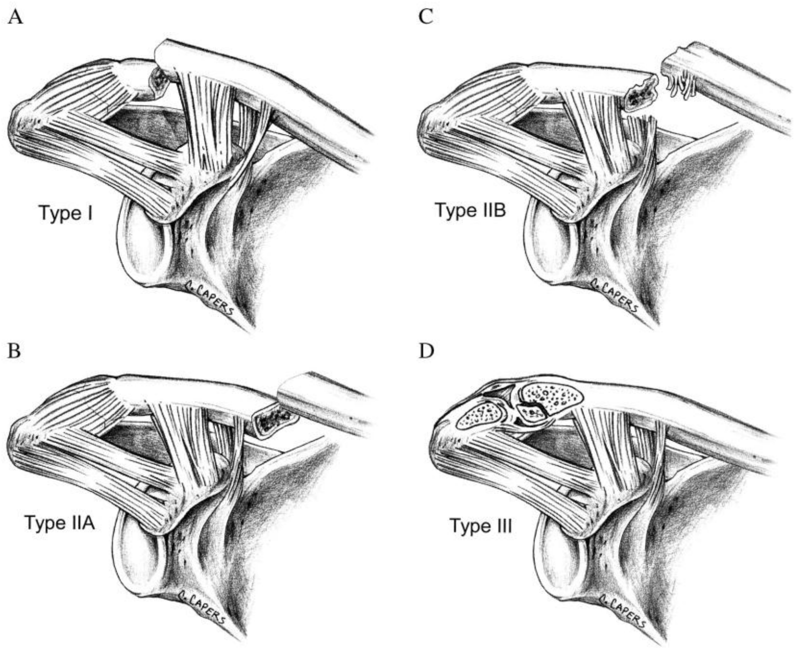
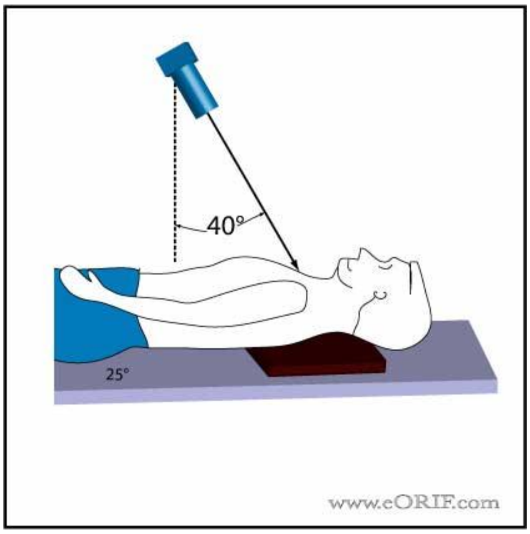


Fig 17. Distal clavicle fractures. A, Type I: stable fracture lateral to the coracoclavicular ligament complex. B, Type IIA: unstable, complex fracture-dislocation leaving the distal clavicle and the acromioclavicular (AC) joint intact but separating the clavicle from the underlying coracoclavicular ligament complex through an oblique fracture. C, Type IIB: unstable, complex fracturedislocation through a vertical fracture. D, Type III: intra-articular fracture of the distal clavicle at the AC joint.(Beim , 2000)

A coracoid process fracture associated with AC joint dislocation and with rupturing of the coracoclavicular ligaments in an adult has been reported . Two separate mechanisms, direct trauma to the shoulder girdle and a sudden pull on the coracoid process by the conjoined tendons of the short head of the biceps and the coracobrachialis muscles, appear to be responsible for this unusual triple lesion. ***(Wang et al, 1994)***

2. Sternoclavicular Dislocation

The sternoclavicular joint should be palpated for tenderness in every routine shoulder examination.If tenderness is elicited, a serendipity view of the sternoclavicular joints (AP x-ray with a 40° cephalic tilt) should be performed or a computed tomographic scan should be obtained. ***(Rockwood 1984)***



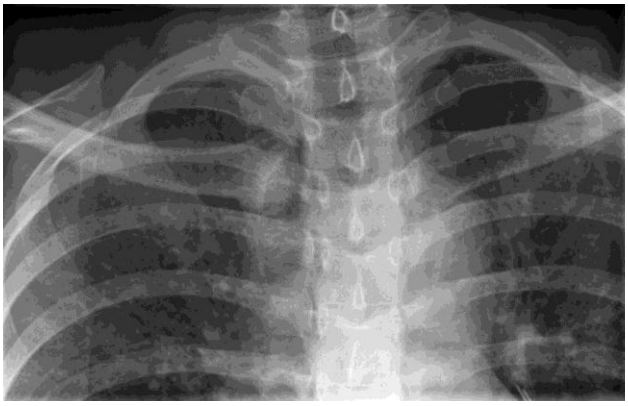


Fig 18 Serendipity view showing the sternoclavicular joints (http://eorif.com/Shoulderarm/XrayShoulder.html)

3.Pulmonary Injury

Barber described a patient with a type IV AC dislocation, an ipsilateral pulmonary contusion, and a contralateral pneumothorax.The mechanism of injury was a direct blow to the posterior aspect of the scapula. Diagnosis of this rare but serious injury, which may be associated with an AC dislocation requires an attentive physical examination not limited to the shoulder, as well as a high index of suspicion**.** ***(Barber 1987)***

TREATMENT

TREATMENT

The best primary treatment for acute acromioclavicular dislocation is still controversial***.(Rockwood 1984 ,Clarke , McCann 2000)***

In analyzing various management schemes, it is important to keep the overall goals of treatment in mind. Is the treatment directed at correcting the anatomic deformity, functional impairment ,or pain?,.The demands on the shoulder will differ from patient to patient, and these demands should be taken into account during the initial evaluation. Most types I and II AC joint separations are treated non surgically , and type III injuries are usually evaluated on a case-by-case basis, taking into account hand dominance, occupation, heavy labor, position/sport requirements (quarterbacks, pitchers), scapulothoracic dysfunction, and the risk for re injury. Treatment of type III injuries remains controversial, with a trend toward initial non operative treatment in most cases .This controversy results from the low level of evidence of the early literature and the evaluation of all AC joint injuries with a type I through III classification system. ***(Mazzocca et al, 2007)***

Despite a lack of compelling evidence, it is often suggested that patients with a type-III injury who have a high level of functional demand on the shoulder may benefit from early intervention. ***(Dias et al, 1987, Bannister et al, 1989)***

However, the current view remains in favour of conservative management of acute type-III injuries***. (McFarland et al, 1997).***Athletes involved in throwing or contact sports are sometimes considered as special cases. Some argue that throwing requires an anatomic reduction of the AC joint. Recent reports of successful non operative treatment of Major League Baseball pitchers suggest this is not the case. Therefore, the preferred treatment of type III injuries remains non operative, with surgical treatment reserved for those patients who present with persistent symptoms after 3 to 6 months, even in high-level athletes. ***(Mazzoca et al ,2007)***

Rockwood reported that type III injuries are usually treated non operatively, particularly in patients who participate in contact sports (football ,hockey, soccer, and lacrosse), where the risk of re injury is high. ***(Rockwood et al, 1998)***

A subset of patients, of course, will have persistent pain and an inability to return to their sport or job with non operative treatment. In these cases, successful surgical stabilization has allowed return to sport or work. Evidence supporting non operative treatment of type III AC dislocations has been provided by a meta-analysis. In a review of 1172 patients, 88% who were operatively treated and 87% who were non operatively treated had satisfactory outcomes .Complications included the need for further surgery (59% operative versus 6% non operative), infection (6% vs 1%), and deformity (3% vs 37%). Pain and range of motion were not significantly affected. ***(Phillips et al, 1998)***

Complete AC joint injuries (types IV, V, and VI) are usually treated surgically because of the significant morbidity associated with persistently dislocated joints and severe soft tissue disruption. There is some literature to support reduction of the clavicle in types IV, V, and VI injuries, turning them into a type III injury and then treating them conservatively.***(Nuber and Bowen 1997)***

The aim should be to return the patient to the level of function before injury, with a pain-free, strong and mobile shoulder.***(Fraser-Moodie, et al 2008)***

CONSERVATIVE TREATMENT

This is almost universally applicable to type-I and type-II injuries. The most common form of non-operative treatment involves simple analgesia, topical ice therapy and rest in a sling to give relief from symptoms. A broad arm sling is preferable to a collar and cuff because it supports the elbow and tends to minimize sagging of the shoulder. The sling should be discarded once the acute symptoms have settled, typically after the first week after injury. It is unusual for the patient to require formal physiotherapy, since weakness and stiffness of the shoulder are seldom a problem. ***(Emery 1997)***

Generally , type I injuries can be treated by use of a simple sling for 7 to 10 days or until pain subsides . Type II injuries may require immobilization for as long as 2 weeks for resolution of symptoms .Once the shoulder pain has subsided , an early and gradual rehabilitation program is instituted , with the focus on passive – and –active assisted range of motion (ROM) after symptomatic and painless shoulder ROM is achieved , an isometric strengthening program is begun . This is followed by isotonic strengthening with a garadual escalation of strengtheinig and endurance. ***(Ryan Simovitch et al ,2009)***

A variety of techniques of external strapping and commercially- manufactured braces is available. There is no evidence that any of these can reduce subluxation of the joint, ***(Bergfeld et al ,1978)***

Gladstone et al described a 4-phase rehabilitation program for athletes. These phases are **(1)** pain control, immediate protective range of motion, and isometric exercises**;** **(2)** strengthening exercises using isotonic contractions; **(3)**

unrestricted functional participation with the goal of increasing strength, power, endurance, and neuromuscular control; and **(4)** return to activity with sport specific functional drills**.** ***(Gladstone et al, 1997)***

Contact sports and heavy lifting should be avoided for 8 to 12 weeks after injury. Aching discomfort may be felt in the area of the injured joint for up to 6 months. ***(Mouhsine et al, 2003)***

After rehabilitation, the strength and endurance are similar to those of the uninjured shoulder , and most patients return to their previous level of employment, sport and recreational activities. ***(Tibone et al, 1992,Schlegel et al, 2001)***

A substantial number of patients have reproducible joint pain after conservative treatment, and up to one-third of those with type-I and type-II injuries has pain on activity at longer term follow-up. ***(Mouhsine et al, 2003)***

The subluxation persists, but typically produces minimal cosmetic problems and is well tolerated, and the satisfactory functional results appear to be maintained in the longer term. ***(Rawes and Dias et al , 1996)***

OPERATIVE TREATMENT

Operation is used to treat medically-fit patients with type- IV and type-V injuries. ***(Malcapi et al ,1978, Rockwood 1991, Verhaven et al, 1992)***

Type-VI injuries are very rare, and almost all reported cases have been treated surgically ***(Gerber and Rockwood 1987, McPhee 1990)***

A wide variety of operative procedures has been described, but none has been shown to be notably superior to the others. The latest more minimally-invasive techniques appear to be promising, but well-designed prospective follow-up studies should be performed before their use becomes widespread.

(Fraser-Moodie et al, 2008)

The main goals of treatment, whether surgical or nonsurgical, are to achieve a pain-free shoulder with full range of motion, normal strength, and no limitations in activities . ***(Fraser-Moodie et al, 2008)***

PRINCIPLES OF SURGICAL TREATMENT:

1) accurate reduction of the acromioclavicular joint must be achieved, by correction of the inferior sag of the scapula, together with any anteroposterior translation of the joint surfaces.**2)** an acutely reduced joint is inherently unstable, and will re-displace unless the disrupted ligaments are either repaired or substituted. Substitution may be performed using either an autograft from a local or distant source, or an allograft, and must closely mimic the normal joint restraints. **3)** the reduction and ligament reconstruction must have sufficient immediate stability to prevent acute redisplacement or else be protected temporarily until the repair heals;**4)** rigid implants used for temporary stabilisation of a ligament reconstruction must be removed once the repair has consolidated, or they will eventually break, loosen or produce stiffness in the shoulder. Most techniques of reconstruction in the acute injury involve reduction of the joint ligamentous repair and stabilisation of the joint, whereas in most delayed reconstructions an excision of the lateral end of the clavicle is performed before reduction, with stability restored by ligamentous substitution. ***(Fraser-Moodie et al , 2008)***

BIOMECHANICAL STUDIES OF ACROMIOCLAVICULAR JOINT RECONSTRUCTION

BIOMECHANICAL STUDIES OF ACROMIOCLAVICULAR JOINT RECONSTRUCTION

- *Coracoacromial Ligament Transfer and Transfer With Augmentation*

  From a biomechanical perspective, the importance of the coracoclavicular ligaments and AC ligaments in controlling superior and horizontal translations has been elucidated. ***(Kwon , Iannotti 2003 ,Jari , Costic, et al, 2004).***

Despite the common occurrence of AC joint separation and the extensive experience with surgery in the treatment of these injuries, only recently have investigators evaluated the biomechanical properties and performance of various augmentation and reconstructive procedures., ***(Larsen , Hede 1987,Harris et al, 2000, Motamedi et al, 2000, Costic et al, 2004, Deshmukh et al, 2004, Grutter , Petersen 2005***)

First, the coracoacromial ligament as a graft source transferred to the distal clavicle represents only 20% of the ultimate load of the intact coracoclavicular ligament complex**.** ***(Motamedi et al, 2000,Lee et al, 2003)***

Motamedi et al evaluated the biomechanics of the coracoclavicular ligament complex and augmentations used in repair and reconstruction. Augmentations around or through the clavicle improved load to failure and stiffness of the reconstructions. ***(Motamedi et al, 2000)***

- *Coracoclavicular Suture, Cerclage, Slings, and Screw Fixation*.

A single 6.5-mm cancellous screw placed from the clavicle to the coracoid had a significantly lower failure load and was a stiffer construct than polydioxanone augmentations triple-stranded and braided and placed via a coracoclavicular cerclage method through drill holes. Harris et al reported that bicortical screw augmentation through the coracoid ligament provided superior strength and comparable stiffness to that of the coracoclavicular ligaments. ***(Harris et al, 2000)***

Jari et al evaluated the biomechanical function of a suture-type coracoclavicular sling procedure with a coracoacromial ligament transfer construct and a Rockwood screw (DePuy Orthopaedics, Warsaw, Ind). This study was unique in the assessment of not only superior translation, but also anterior and posterior translation after these surgical procedures. Furthermore, in situ graft forces were measured. Importantly, the in situ forces for all 3 surgical constructs were significantly increased compared with the intact coracoclavicular ligaments. The authors concluded that current surgical procedures do not have the appropriate stiffness to restore the stability of the intact joint before healing. This may be a biomechanical explanation for the recurrence of subluxation and dislocation after coracoclavicular ligament reconstruction using the well-accepted Weaver-Dunn procedure. ***(Jari et al, 2004)***

Other types of fixation have been biomechanically evaluated, including suture cerclage and suture anchors. ***(Deshmukh et al, 2004)***

Although none of these techniques fully restored native AC joint stability, they were still found to be superior to the Weaver-Dunn procedure. ***(Mazzoca et al, 2007)***

- *Free Graft Augmentation/Reconstruction of the Coracoclavicular Ligament Complex* . Several authors have advocated using a separate and potentially more robust graft source to improve surgical results. ***(Jones et al, 2001, LaPrade , Hilger 2005)***

As cited previously, Lee et al performed a biomechanical study comparing reconstruction of the coracoclavicular ligaments with free tendon grafts to the intact coracoclavicular ligament complex and a coracoacromial ligament transfer. The coracoacromial ligament transfer was the weakest construct. Importantly, in this study, a free gracilis, toe extensor, or semitendinosus graft had an ultimate failure load that was equivalent to the native coracoclavicular ligaments. ***(Lee et al, 2003)***

- *Anatomic Reconstruction With Free Graft*. The use of a free tendon graft placed in a more anatomic position attempting to reproduce the trapezoid and conoid ligaments has been shown to perform as the intact coracoclavicular ligament complex in our laboratory (***Mazzocca et al, 2006) (Fig19)***

Costic et al found that the anatomic coracoclavicular reconstruction more closely approximates the stiffness of the native coracoclavicular ligaments than a standard
Weaver-Dunn repair. ***(Costic et al, 2004)***

Grutter and Petersen have also shown a successful variation in reconstructing the AC and coracoclavicular ligaments. All these techniques have been validated biomechanically as being superior to the existing procedures.
(Grutter , Petersen et al ,2005)

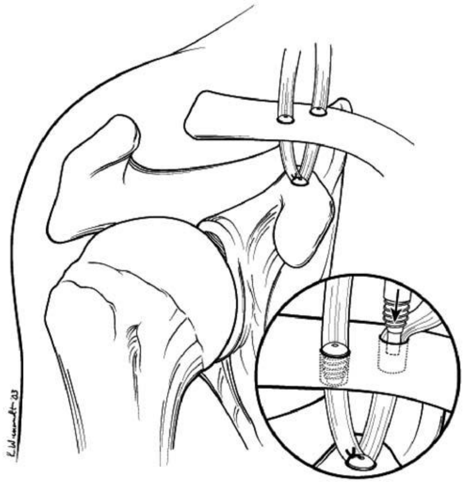


Fig 19. Final view of the anatomic coracoclavicular ligament reconstruction. Note the position of the clavicular bone tunnels in relation to the center line of the clavicle and the interference screw fixation backed up with a nonbiologic No. 5 FiberWire suture (Arthrex, Naples, Fla) through the cannulated holes of the interference screws.(Mazzoca et al, 2007)

Conclusions.

Several conclusions can be drawn from are view of these more recent biomechanical studies: **(1)** The well-accepted coracoacromial ligament transfer is only ¼ as strong as the intact coracoclavicular ligaments; **(2)** this can be improved by augmenting the coracoacromial ligament transfer with a suture or tape material in a sling fashion around the base of the coracoid process; **(3)** the coracoacromial ligament transfer with augmentation has been shown to have no effect on anterior-posterior translation of the distal clavicle; **(4)** surgical reconstructions have much higher in situ graft forces when the AC joint capsule is either injured or incompetent; and **(5)** a free tendon graft appears to provide a substantial improvement in initial stability or load-to-failure equivalent to the intact coracoclavicular ligaments and represents a biomechanical improvement compared with coracoacromial ligament transfer. As mentioned previously, these findings may explain the observed residual instability and pain that can occur after reconstruction of the chronic complete AC joint dislocation***.(Weinstein et al, 1995, Tienen et al, 2003)***

SURGICAL RECONSTRUCTION OF ACROMIOCLAVICULAR JOINT DISLOCATIONS

<u>SURGICAL RECONSTRUCTION OF ACROMIOCLAVICULAR JOINT DISLOCATIONS</u>

Six basic operative techniques used to treat AC dislocations are reviewed: **(1)** AC ligament repair, **(2)** dynamic muscle transfer, (**3)** coracoacromial ligament transfer, **(4)** coracoclavicular ligament repair, (**5)** distal clavicle resection with coracoclavicular reconstruction, and **(6)** anatomic reconstruction of the coracoclavicular ligaments. In addition, some authors have advocated combinations of these procedures**.** ***(Mazzoca et al, 2007)***

Surgical techniques can be categorized into three main groups ***(Table(2)*** **,**although all have the same goal of obtaining and retaining AC joint reduction. ***(Ryan Simovitch et al, 2009)***

Technique	***Method***	***Features***
Primary acromioclavicular Joint fixation	Kirschner wires, Hook plate	Limited dissection Risk of pin migration Reserved for acute injury
Fixation between the coracoid process and clavicle	CC screw, Suture loop	Screw requires staged removal Suture loop can be inserted arthroscopically Reserved for acute injuries Suture loop can cut through the clavicle or coracoid bone
Dynamic muscle transfer	Coracoid transfer	Abandoned due to inferior long term results
Ligament reconstruction	Autogenous hamstring , anterior tibialis, CA ligament transfer	Attempts to anatomically reestablish CC ligament anatomy Provides biologic scaffold for reconstruction.

CA= coracoacromial , CC=coracoclavicular

Table (2) showing surgical techniques for the management of AC joint dislocations

(Ryan simovitch et al, 2009)

OPERATIVE METHODS:

Surgical approach: open or arthroscopic? Open exposure of the dislocation using a 'bra-strap' incision remains the most common surgical approach. Although this causes more prominent scarring, it is technically easier, allows direct visualization of the reduction of the joint and removal of any degenerative disc material. Injury to the important deltotrapezius aponeurosis can only be assessed and repaired by an open surgical approach***. (Lizaur et al, 1994)***

SURGICAL APPROACH TO THE ACROMIOCLAVICULAR JOINT :

A vertical skin incision is made from just posterior to the acromioclavicular joint to the tip of the coracoid process along the Langer lines ***(Fig. 20).*** After development of subcutaneous flaps, a longitudinal incision is made in the condensation of the deltotrapezial fascia, which overlies the reduced position of the clavicle. After the acromioclavicular joint has been identified .The anterior portion of the deltoid is then split distally for a distance of up to 4 cm in the direction of its fibers (***Fig. 21).*** A stay suture is placed at the end of the split to prevent propagation and protect the axillary nerve. The coracoacromial ligament is identified and carefully protected. With the deltoid flaps retracted, the base of the coracoids process is exposed and the anterior subdeltoid space is developed. The conjoined tendon attached to the tip of the coracoids process is also identified and exposed ***(Fig. 22).*** (***Chunyan Jiang et a,l 2007)***

Fig20 The skin incision is made from just posterior to the acromioclavicular joint to the tip of the coracoid process in the Langer lines. (Chunyan Jiang et a,l 2007)

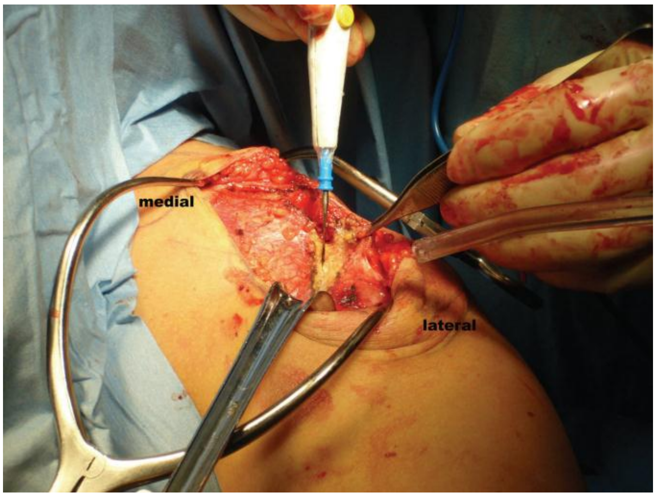


Fig21 The anterior aspect of the deltoid is split for up to 4 cm distally in the direction of its fibers. (Chunyan Jiang et a,l 2007)

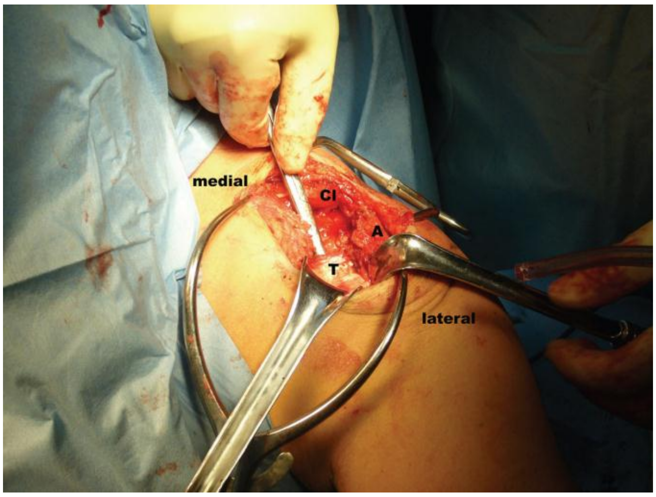


Fig22 Exposure of the conjoined tendon attached to the tip of the coracoid process. Cl = distal end of clavicle, A = acromion, and T = conjoined tendon. (Chunyan Jiang et a,l 2007)

Advances in instrumentation and implants have produced a recent trend towards the use of arthroscopic approaches. Many of these techniques are similar to those used for ligamentous reconstruction in the knee. The accuracy of reduction of the joint is more difficult to assess arthroscopically , although the use of intra-operative fluoroscopy may help. Arthroscopic surgery causes less injury to the soft-tissue envelope, but there is a steeper learning curve for its use when compared with open reconstructive procedures. ***(Fraser-Moodie et al, 2008)***

The literature is replete with surgical techniques used to treat complete AC dislocations, including primary repair of the coracoclavicular ligaments, augmentation with autogenous tissue (coracoacromial ligament), augmentation with absorbable and nonabsorbable suture as well as prosthetic material, and has included coracoclavicular stabilization with metallic screws**. *(Motamedi et al, 2000,Lee et al, 2003 ,Sloan et al, 2004)***

Which ligament reconstruction? There are several types of repair.*1)Techniques using native ligament* .Repair of the ruptured coracoclavicular and acromioclavicular ligaments is only possible when it is performed within the first two weeks after injury, and as an open procedure. The joint is first reduced under direct vision and similar techniques to those described for tendon repair are then used to suture the torn ligaments directly. The repair must be protected by temporary rigid fixation or transfixation of the joint until ligamentous healing occurs. The problems associated with these techniques include the technical difficulty of surgical access and of suturing mid-substance ligamentous injuries, typically of a ‘shaving-brush’ quality, and the uncertainty regarding the structural integrity of the repair.***(Fraser-Moodie et al, 2008)***

2)Ligament substitution with local ligaments or tendons. Transfer of the coracoacromial ligament was introduced by Weaver and Dunn and remains the mainstay of delayed Stabilization. ***(Weaver , Dunn 1972)(Fig.23).***

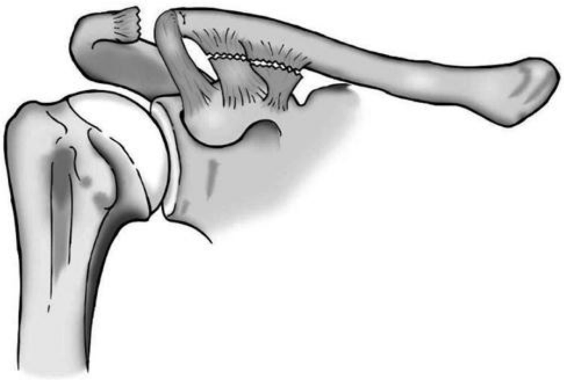


Fig (23) Diagram showing the 'classic' procedure of Weaver and Dunn. This consists of transfer of the coracoacromial ligament into the lateral end of the clavicle after excision of it lateral 5 mm to 10 mm.((Weaver , Dunn 1972)

The procedure as originally described carries a recognized risk of ongoing pain, which may be related to instability and recurrent subluxation because of failure of the fixation. A number of modifications have been introduced, ***(Weinstein et al, 1995 Tienen et al, 2003, Mazzocca et al, 2006)*** and these have been used successfully in the management of acute type-III dislocations, as well as in patients with more chronic symptoms***.(Weinstein et al ,1995)***

The procedure as originally described has only approximately 30% of the strength and 10% of the stiffness of the intact ligaments, with failure occurring mainly at the suture attaching the transferred ligament. ***(Harris et al, 2000)***

The mean laxity after reconstruction, of approximately 42 mm in an anteroposterior plane and 14 mm vertically, compares with the 8 mm and 3 mm, respectively, in intact ligaments***. (Deshmukh et al, 2004)***

These parameters can be improved significantly by augmentation of the coracoclavicular suture.***(Lee et al, 2003, Deshmukh et al, 2004, Mazzocca et al, 2006)***Newer suture materials (Fiberwire; Arthrex Inc., Naples, Florida) and more anatomical techniques may perform better, and approach the load to failure of the intact ligaments.***(Mazzocca et al, 2006)***

Both arthroscopically-assisted and all-arthroscopic techniques have now been described to transfer the coracoacromial ligament, augmented by either autograft or synthetic suture material. ***(Lafosse et al, 2005, Baumgarten et al , 2006)***

It remains to be seen whether these techniques produce results comparable with those of the open techniques. The conjoined tendon has also been used as a local graft to create a 'dynamic muscle transfer' stabilisation of the lateral clavicle. There are several variations of this procedure, including direct transfer of the tendon superiorly, either alone, ***(Vargas ,1942)*** or together with a portion of osteotomised coracoid origin.***(Brunelli , Brunelli 1968. Berson et al, 1978)***

The operation carries the risk of over tightening of the coracoclavicular space. A proximally based transfer has therefore been developed. This retains the origin of the tendon and divides its lateral half distally, then reverses the tendon and implants it into the lateral end of the clavicle ***(Sloan et al, 2004 ,Jiang et al, 2007) (Fig.24)***

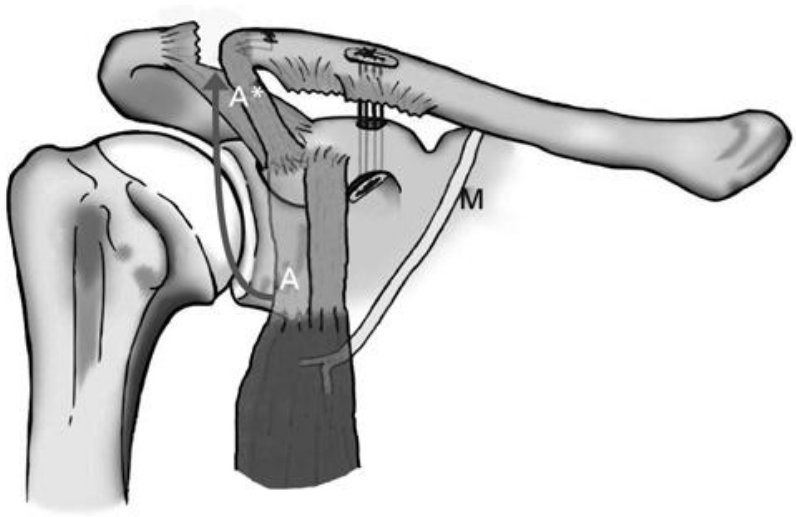


Fig (24) Diagram showing transfer of the lateral half of the conjoined tendon to the distal clavicle augmented by Endobutton fixation of the acromioclavicular joint. The arrow shows the pivoting at the origin of the conjoined tendon and the movement of the distal end of the tendon from A to A* where it is sutured into the end of the clavicle. The close proximity of the musculocutaneous nerve (M) is highlighted .(Fraser-Moodie, et al 2008)

Biomechanical studies and clinical experience suggest that the conjoined tendon has better properties and greater consistency of quality of the graft compared with those of the coracoacromial ligament.***(Berson et al, 1978, Sloan et al, 2004, Jiang et al, 2007)***

It also offers an alternative source of a graft in revision procedures when the coracoacromial ligament has already been harvested. However, when a partial osteotomy of the coracoid is performed there is a risk of subsequent fracture, ***(Skjeldal et al ,1988) a***nd transfer of the conjoined tendon to the clavicle has been associated with injury to the musculocutaneous nerve***.(Caspi et al, 1987, Lemos , Tolo 2004)***

<u>3)Other techniques of ligament substitution</u>. Coracoclavicular cerclage is a well-established technique and has been carried out using numerous materials including tendons, wire loops and synthetic ligament substitutes such as Dacron, Mersilene tape or polydioxanone ***.(Stam , Dawson , 1991, Krueger-Franke et al, 1993, Morrison , Lemos 1995, Nicholas et al, 2007)***

This form of reconstruction does not rely on biological healing, and temporary rigid stabilisation of the joint after operation is not usually required.
(Mazzocca et al, 2006)

Tendons such as semitendinosus, gracilis and the toe extensors have shown strength and stiffness similar to those of the native ligaments,***(Lee SJ et al, 2003, Tauber et al, 2007)*** and the use of peroneus brevis has also been described.
(Gonzalez et al, 2007)

The weak point of the reconstruction is the method of securing it, but tying a knot in the graft, or using interference screws, may help to overcome this problem.***(Lee et al, 2003 , Mazzocca et al ,2006),***A cerclage graft using semitendinosus with suture augmentation has been described using a minimally-invasive approach. ***(Pennington et al, 2007)***

One end of the graft is sutured to a plate and the other fixed to the clavicle,using a biotenodesis screw. Earlier cerclage techniques were typically less stable than those using intact ligaments ***(Deshmukh et al, 2004)*** ,but the latest generation of more robust, non-absorbable sutures perform better.***(Mazzocca et al, 2006)***

To prevent excessive anterior subluxation, which may occur using complete clavicular cerclage, the graft may be passed through a drill hole in the anterior third of the clavicle rather than over its posterior aspect***. (Morrison , Lemos 1995)***

Alternatively, two holes may be drilled in the clavicle at the site of insertion of the previous ligament to produce a more anatomical reconstruction. The typical attachment of the conoid ligament is 45 mm medial to the end of the clavicle in its posterior half and of the trapezoid 15 mm lateral to this in the midline.***(Mazzocca et al, 2006).***A double-suture technique may also be adopted when utilising twin drill holes. ***(Jiang et al, 2007)***

Various modifications have been made to the original techniques of coracoclavicular cerclage. The coracoid cerclage may be retained, or direct fixation to the bone achieved using either drill holes, endobuttons or sutureanchors. ***(Wolf ,Pennington 2001, Breslow et al, 2002, Wellmann et al, 2007) (Figs 25 and 26,27)***

These may help to minimise the risk of injury to underlying neurovascular structures and avoid dislocation of the lower portion of the cerclage loop off the front of the coracoid.Repair has also been performed using a continuous loop of suture running between two Endobuttons, which are passed through the lateral clavicle and coracoids . ***(Wellmann et al, 2007)***

Fig. 25 Operative situs during placement of the Imhoff delivery device on the base of coracoid. The arthroscope is in the posterior portal and the electrothermic ablation device in the antero-lateral portal (Chernchujit et al ,2006)

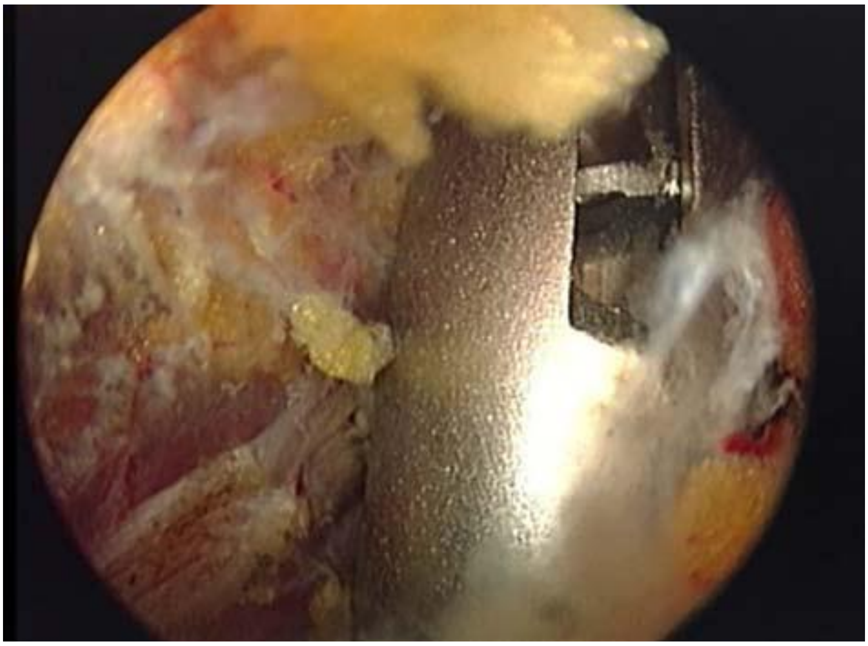


Fig.26 The correct placement of the delivery device and position of the ancors is controlled arthroscopically (Chernchujit et al ,2006)

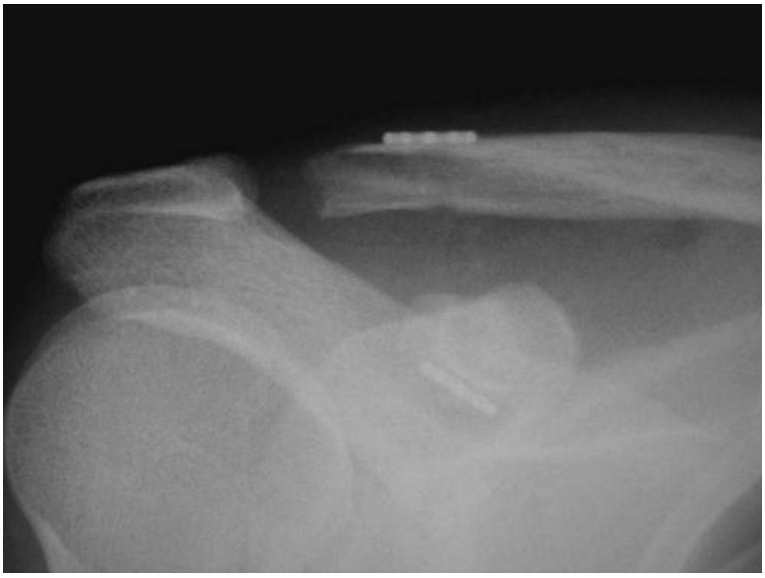


Fig 27 Radiograph of the acromioclavicular joint showing twin endobuttons in situ. The endobutton suture technique was used to augment a conjoined tendon transfer (as shown in Fig. 19) in a 23-year-old man six months after a type-III injury which remained significantly symptomatic despite conservative treatment. (Fraser-Moodie, et al 2008)

These techniques lend themselves particularly well to arthroscopic insertion in which a custom-made drill guide is used to assist in the placement of the drill hole in the coracoid. Few data are available on the clinical outcomes of these techniques, although early reports are promising.***(Chernchujit et al, 2006)***

Although techniques of cerclage provide more secure reconstruction of the reduction, failure may still occur, from a stress fracture of either the clavicle or the coracoids as a result of a ‘cheese-wire’ effect, or by failure of the graft itself. ***(Moneim , Balduini 1982, Fullerton 1990,Harris et al, 2000)***

The use of an absorbable suture may reduce the risk of fracture and may achieve satisfactory results, although, more commonly, non-absorbable implants are used and retained.***(Clayer et al, 1997)***

Aseptic foreign-body reactions have also been reported using synthetic grafts,but this is probably less common with the newer suture materials.*(Colosimo et al, 1996)*

Protection of the soft-tissue repair. The arm is placed in a sling for three to six weeks after the surgery in order to avoid early failure. Temporary methods of rigid stabilization of the joint have also often been used to protect soft tissue repairs which rely on biological healing of the graft. These must be removed once the soft-tissue repair has consolidated sufficiently to withstand normal joint forces, usually at six to 12 weeks after the initial operation. If removal is carried out too soon there is a risk of rupture of the graft and re-displacement of the joint, whereas if it is performed too late there may be stiffness in the shoulder or failure of the implant. ***(Fraser-Moodie et al, 2008)***

Fixation using a coracoclavicular screw, first described by Bosworth,***(Bosworth 1941)*** has been the most widely-used technique to provide temporary stabilisation of the joint ***(Tsou 1989, Sundaram et al, 1992) (Fig.28)***

Fig (28) Anteroposterior radiograph of a coracoclavicular screw used to treat a 45-year-old man who fell down several steps, sustaining a type-V injury of the acromioclavicular joint. (Fraser-Moodie et al, 2008)

However, it is technically difficult to achieve good placement of the screw in the narrow corridor of bone in the horizontal portion of the coracoid, irrespective of whether this is performed as an open or fluoroscopically assisted technique. Percutaneous insertion of the screw has an unacceptably high rate of technical failure, ***(Tsou 1989)*** but the use of arthroscopy to visualise the coracoid directly may improve its placement. ***(Rolla et al, 2004)***
Even a technically-satisfactory fixation is subject to cyclical loading by movements transmitted from the adjacent joints and is therefore prone to failure by cut-out or loosening. A prospective, randomised study has compared fixation by a coracoclavicular screw with non-operative treatment. Better results were seen overall in those managed conservatively, although a subset of markedly-displaced injuries benefited more from surgery. ***(Bannister et al, 1989)***

In the past Kirschner wires have been used extensively to transfix the acromioclavicular joint temporarily after reduction. These give relatively poor fixation ***(Lizaur et al 1994),*** may precipitate osteoarthritis within the joint, and severe complications and even fatalities may occur from distant migration of the wire to the lung, spinal cord or neck. Given the wider range of better implants which is now available. ***(Sethi , Scott 1979, Roper , Levack 1982, Lindsey , Gutowski 1986 , Lancaster 1987)***

A modified dynamic compression plate (Synthes, Welwyn Garden City, United Kingdom) with a lateral hook designed to engage under the posterior part of the acromion, has been used successfully to maintain reduction of acute dislocations ***(Habernek et al, 1993, Sim et al, 1995,Gonzalez et al , 2007) fig(29)***

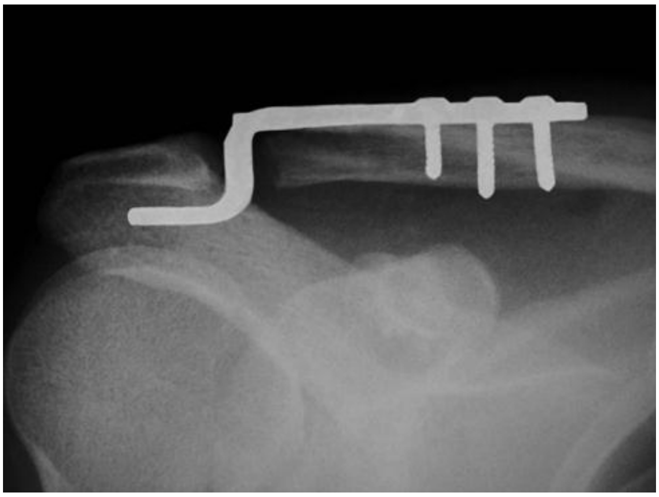


Fig (29) Anteroposterior radiograph of an acromioclavicular joint hook plate used in the treatment of a 35-year-old man who fell playing football. (Fraser-Moodie et al, 2008)

This osteosynthesis closely reproduces the stability of the intact joint,***(McConnell et al, 2007)*** but its prolonged retention can produce stifnesss of the shoulder, clavicular osteolysis and peri-prosthetic fracture, whereas its removal at an early stage may lead to re-subluxation of the joint. ***(Nadarajah et al, 2005)***

Removal of the implant is therefore recommended between eight and 12 weeks after the procedure. The use of a novel alloy coracoclavicular hook has been described with satisfactory results, but this still requires early removal.
(Ryhanen et al, 2006)

In the newer minimally-invasive and arthroscopic techniques, insertion of hardware to stabilise the soft-tissue repair is not possible, and they rely on the immediate stability of the graft construct to maintain the clavicle in the reduced position. ***(Fraser-Moodie et al , 2008)***

EARLY VS DELAYED REPAIR

<u>EARLY VS DELAYED REPAIR</u>

A retrospective study the results of early acromio-clavicular joint reconstructions immediately after trauma (group early repair, ER) were compared with the results of delayed reconstructions in patients who first got conservative treatment and failed after some time (group delayed repair, DR).The early operated group (Group ER) consisted of 29 patients (2 women and 27 men) with a mean age of 37 years. In group ER twenty-nine patients were treated with a modified Phemister technique according to Mayr including a PDS coracoclavicular sling and temporary K- wire fixation. In group ER surgery was done at an average of 10.2 days after trauma. Group DR consisted of 20 patients (2 women and 18 men) with a mean age of 46 years. In group DR twenty patients were treated with a modified Weaver–Dunn- procedure with additionally transposition of the coracoacromial ligament and AC-joint resection .All patients in group DR were initially thought to have type III injuries according to Rockwood. In this group surgery was done at an average of 215.3 days after trauma. Both groups had comparable levels of activities and suffered their trauma in nearly all cases during sporting activities. After informed consent an anteroposterior stress radiograph of both shoulders with a 10-kg weight suspended from each arm with wrist straps was obtained from each patient. The degree of displacement of the ACJ was evaluated and compared with the contra lateral side. The coracoclavicular distance was measured in each side and the increase of height on the operated side was compared to the unaffected side and calculated in percent. Additionally the height of the lateral clavicle in comparison to the acromion according to Tossy´s classiffication was determined. ***.(Olaf Rolf et al , 2008) Fig (30)***

Fig.30 Measuring the coracoclavicular distance on AP stress-radiograph. The patient carries a 10 kg weight in both hands fixed on each side with wrist straps.(Olaf Rolf et al, 2008)

From a clinical point of view there was a slight prominence over the reconstructed ACJ in 45% of the patients in group ER and in 70% in group DR at time of follow-up***.(Olaf Rolf et al, 2008)***

On stress radiographs the ACJ was completely reduced to its anatomic position in only 12 patients (9/31% in group ER, 3/15% in group DR), corresponding with the clinical findings.At follow-up, the displacement of the ACJ was analyzed on the anteroposterior stress radiograph in comparison to the contralateral. ***.(Olaf Rolf et al, 2008)***

In group ER the mean coracoclavicular distance on the affected side was 1.27 cm (±0.43) ,on the nonaffected side 0.97 cm (±0.21), resulting in an increase of clavicles height of 34% on the operated side on stress radiographs . In group DR the mean coracoclavicular distance on the affected side was 1.45 cm (± 0.54) , on the non affected side 0.93 cm (± 0.20) , resulting in an increase of clavicles height of 58% on the operated side. Furthermore the number of complications was higher in the group with delayed reconstruction.***.(Olaf Rolf et al, 2008)***

Results

A comparison of the overall results revealed a statistically significant better outcome in the early repair group, regarding the degree of acromioclavicular joint- reduction, numbers of complications and patient`s satisfaction. ***.(Olaf Rolf et al, 2008)***

Accurate reduction of the joint is easier when surgery is performed within the first two weeks after injury, when the ruptured ligamentous restraints can often be repaired directly. Complete reduction of the joint is more difficult when several months have elapsed after the injury, and the native ligaments may then be difficult to identify and repair. ***(Fraser-Moodie et al, 2008)***

POSTOPERTIVE REHABILITATION

POSTOPERTIVE REHABILITATION

After CC fixation with a metallic screw or suture construct for acute AC injuries , the shoulder is immobilized in a simple sling and cold therapy device . At 2 weeks , active and passive ROM is initiated and restricted to beneath the shoulder level . Doing so allows the patient to begin activities of daily living while avoiding lifting heavier than 5 pounds . Once the screw is removed at 2 or 3 months , full active and passive ROM is encouraged , with strengthening limited to light resistance for 6 to 8 weeks . Once full Rom and strength are obtained , return to atheletic competition is permitted. ***(Ryan Simovitch et al, 2009)***

After AC joint reconstruction with an autogenous or allograft ligament reconstruction (eg semitedinosus graft , modified Weaver –Dunn) , the arm is maintained in a simple sling , at 2 weeks pendulum exercises are initiated , followed by light activities of daily living at 4 weeks . With further graft maturation at approximately 8 weeks , active and passive ROM is encouraged with a therapist , and light resistance can be initiated after 3 months . Once full ROM and strength are obtained , return to atheletic competition or manual labor is permitted . ***(Ryan Simovitch et al, 2009)***

TYPE III ACROMIOCLAVICULAR DISLOCATION CONSERVATIVE OR SURGICAL TREATMENT

TYPE III ACROMIOCLAVICULAR DISLOCATION CONSERVATIVE OR SURGICAL TREATMENT

In general, there seems to be no disagreement on the management of types I and II injuries (as defined by Allman and Rockwood et al***) (Allman , 1967, Rockwood et al, 1996)*** usually treated conservatively, and types IV, V, and VI, almost always treated surgically***. (Bradley ,, Elkousy .et al, 2003)***

However, controversy still exists over the treatment of type III injuries, the type of injuries studied in the review by Phillips et al. According to the meta-analysis, in terms of overall satisfaction, range of motion, strength, and complication rates, conservative treatment of AC dislocations is indicated over surgical management. The only potential advantage for surgical treatment is the reduction in residual deformity; however, the degree of deformity does not correlate well with long-term improvements in pain, motion, or strength. ***(Bradley , Elkousy . et al, 2003)***

The occupation, activity level, and physical demands of daily functioning play an enormous role in global patient satisfaction. On the surface, these data might suggest that surgical intervention may be the best treatment for people in high demand occupations and sports. Yet given the high incidence of postsurgical complications and the availability of reconstruction surgeries for chronic AC dysfunction***.(Guttmann et al, 2000, Bradley et al, 2003),*** attempting conservative treatment at first may be warranted for most type III AC injuries.***(Bradley , Elkousy .et al, 2003)***

Surgery has been advocated to restore the anatomy of acromioclavicular joint but carries a significant risk of complications ***. (Larsen et al, 1986)***

Instead, conservative treatment, even if does not restore the anatomy, allows patients to rehabilitate more rapidly ***.(Galpin et al, 1985 , Larsen et al, 1986 , Bannister et al, 1989)***

Even if, in the last years, the number of publications about the surgical procedure are increasing, it is still not evident which is the gold standard and the conservative treatment is considered a valid procedure also for grade III acromioclavicular separation. ***(Ceccarelli et al, 2008)***

Another factor to consider when deciding on a treatment course is the time elapsed since the injury at the patient's first clinical presentation. A window of optimum opportunity for surgical intervention may correlate with the best treatment outcomes. ***(Bradley ,, Elkousy .et al, 2003)***

Further research should focus on factors that may be important predictors of both successful clinical outcomes and long-term patient satisfaction. ***(Ceccarelli et al , 2008)***

Conclusion:

The randomized prospective studies concluded that non operative treatment was superior because the surgical results were no better and were associated with more complications. In addition, surgical procedures were associated with increased convalescence time, away from work and sport. The only adverse result of the conservative treatment seems to be the persistence of the dislocation of the acromioclavicular joint even if it is not correlated to worst clinical outcomes and it could be present also in the surgery group after device removal even if in a lower percentage. Despite the limitations of this systematic review the author concludes that non operative treatment seems to be superior, till now, to surgical approach in the treatment of acute acromioclavicular severe dislocation. ***(Ceccarelli et al, 2008)***

CHRONIC ACROMIOCLAVICULAR DISRUPTION

CHRONIC ACROMIOCLAVICULAR DISRUPTION

There are some contradictory opinions about the definition of chronic complete acromioclavicular dislocation. Previously it was thought to be associated with a complete disruption of the acromioclavicular joint and of the coracoacromial ligament. Recently it has been reported that chronic complete acromioclavicular dislocation is characterized by anteroposterior and supero-inferior acromioclavicular instability in addition to articular degeneration. ***(Galatz et al, 2001)***

Most complete acromioclavicular dislocations treated conservatively do not become symptomatic. ***(Weaver , Dunn ,1972 ,Goldberg , et al, 1987, Rockwood , Young, 1990 , Guy et al, 1998)***

However, there are some patients who have persistent symptoms after conservative treatment. Some surgeons advocate early operation for ACJ dislocation particularly in manual workers and sportsmen and it has been suggested that the results of early repair are superior to late repair.(***Guy et al, 1998)***

The optimal treatment for symptomatic chronic AC joint dislocations is still a matter of debate. The functional imbalance of the shoulder girdle due to anterolateral rotation of the scapula caused by the loss of ligamentous suspension may be responsible for the unsatisfactory results achieved by conservative or failed operative treatment after complete AC joint dislocation **.** ***(Hedtmann et al, 1998 , Tauber et al, 2007)***

More than 60 different surgical procedures as well as a variety of conservative measures have been suggested for treatment of this injury. ***(Rockwood , Young 1990)***

It has been reported surgical procedures for chronic, complete acromioclavicular dislocations are numerous; many only of historical interest. Currently most surgical procedures involve some combination of coracoclavicular and acromioclavicular fixation with or without distal clavicle excision. Methods of coracoclavicular fixation include coracoclavicular screws, absorbable and nonabsorbable coracoclavicular sutures, and suture anchors. Acromioclavicular fixation options include acromioclavicular wires and screws. Imbrication of the deltotrapezius aponeurosis is an important part of the reconstruction. ***(Faisal F. Adam , Osama Farouk, 2003)***

Some authors describe resection arthroplasty of the distal clavicle. However, this procedure fails to address the concomitant problem of instability associated with disruption of the coracoclavicular ligament and injuries of the deltoid and trapezius muscles.***(Lazcano et al, 1961 , Sage , Salvatore , 1983)***

Delbet carried out the first coracoclavicular reconstruction using a single strand of silver wire looped under the coracoid and through a drill hole in the clavicle and most of the coracoclavicular fixations described in the literature have been modifications of Delbet's original procedure. ***(Kappakas et al, 1978)***

However, simple coracoclavicular circlage causes anterior subluxation of the distal clavicle with malreduction of the ACJ and synthetic material such as wire may wear through the bone and result in failure of reduction.***(Fujikawa et al, 1989)***

The use of a Bosworth screw requires a second procedure to remove the screw to avoid breakage or migration. ***(Guy et al, 1998)***

Although good results have been reported with Weaver-Dunn coracoacromial ligament transfer, this coracoacromial ligament is not always available, and this procedure by necessity disrupts the coracoacromial arch. ***(Weaver , Dunn 1972)***

Woven polyester ligaments have been used previously to reconstruct ligaments in the knee joint because of the material's ability to provide a scaffold for tissue ingrowth and its adequate mechanical properties. ***(Fujikawa et al, 1989 Macnicol et al, 1991, Keen , Amis 1999 , Field et al, 2003)***

Recently this braided polyester material has been modified into a purpose made ligament with loops on both ends to reconstruct the disrupted coracoclavicular ligament. ***(In-Ho. Jeon et al,2007) (fig 31 , 32)***

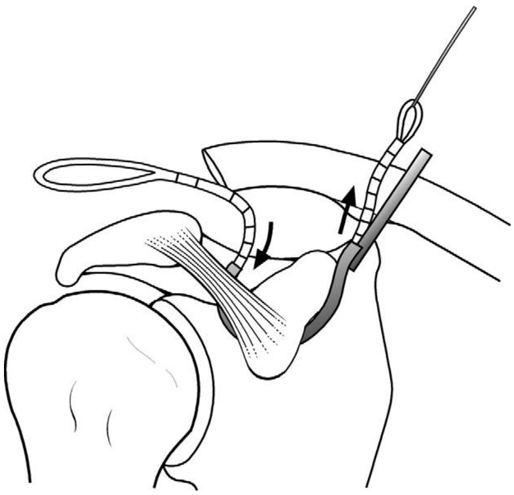


Fig 31 Curved guide passed around the coracoid process from medial to lateral in order to avoid the brachial plexus. The ligament was passed around the coracoids process and then the ligament was threaded through one of its loops to afford secure attachment at the base of the coracoid process.(In-Ho Jeon et al , 2007)

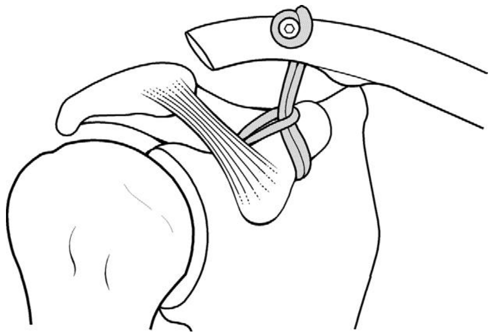


Fig 32 The free end was then passed inferiorly round the posterior aspect of the clavicle and tensioned prior to fixation through the second loop onto the clavicle. The AP (anterior—posterior) view after fixation onto the clavicle. .(In-Ho Jeon et al , 2007)

Mazzocca et al. have shown that a free tendon graft placed in a more anatomic position to recreate the trapezoid and conoid ligament performs biomechanically equal compared to the native coracoclavicular ligament complex.

(Mazzocca et al, 2004)

Different free tendon grafts have been investigated. Lee et al. in a biomechanical study found that a free gracilis graft had an ultimate failure load that was equivalent to the native coracoclavicular ligaments.***(Lee et al, 2003)***

The free tendon graft needs to be protected during the healing and remodelling process by reducing the ultimate failure load. The Tight-Rope stabilization technique has recently been described for acute AC joint dislocation via an open approach and represents an excellent tool to augment and protect the anatomical coracoclavicular ligament repair. ***(Hernegger , Kadletz 2006) figs (33 , 34, 35, 36, 37, 38 ,39)***

Figs.33 , 34 The gracilis tendon graft is inserted into the coracoclavicular space by attaching its suture tag to the Wrst guide wire at its clavicular end and pulling from the other end so that it comes out through the anteroinferior portal. (Markus Scheibel et al, 2007)

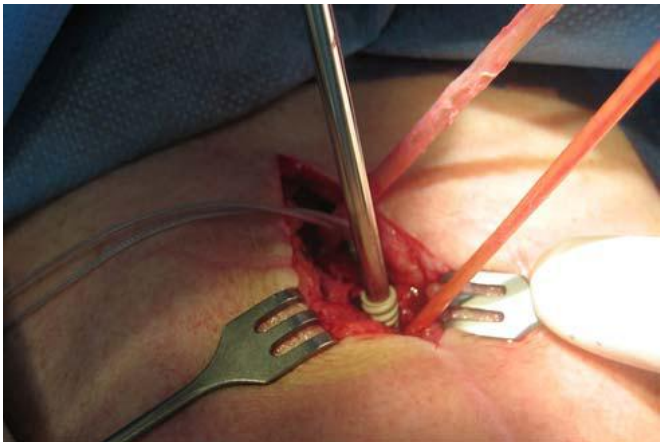
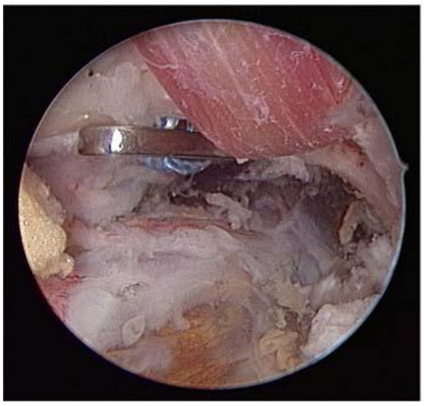
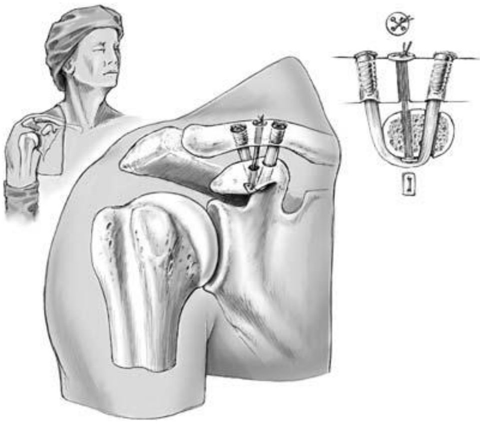
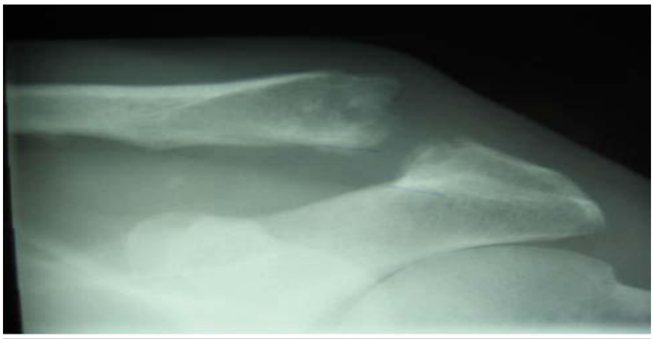


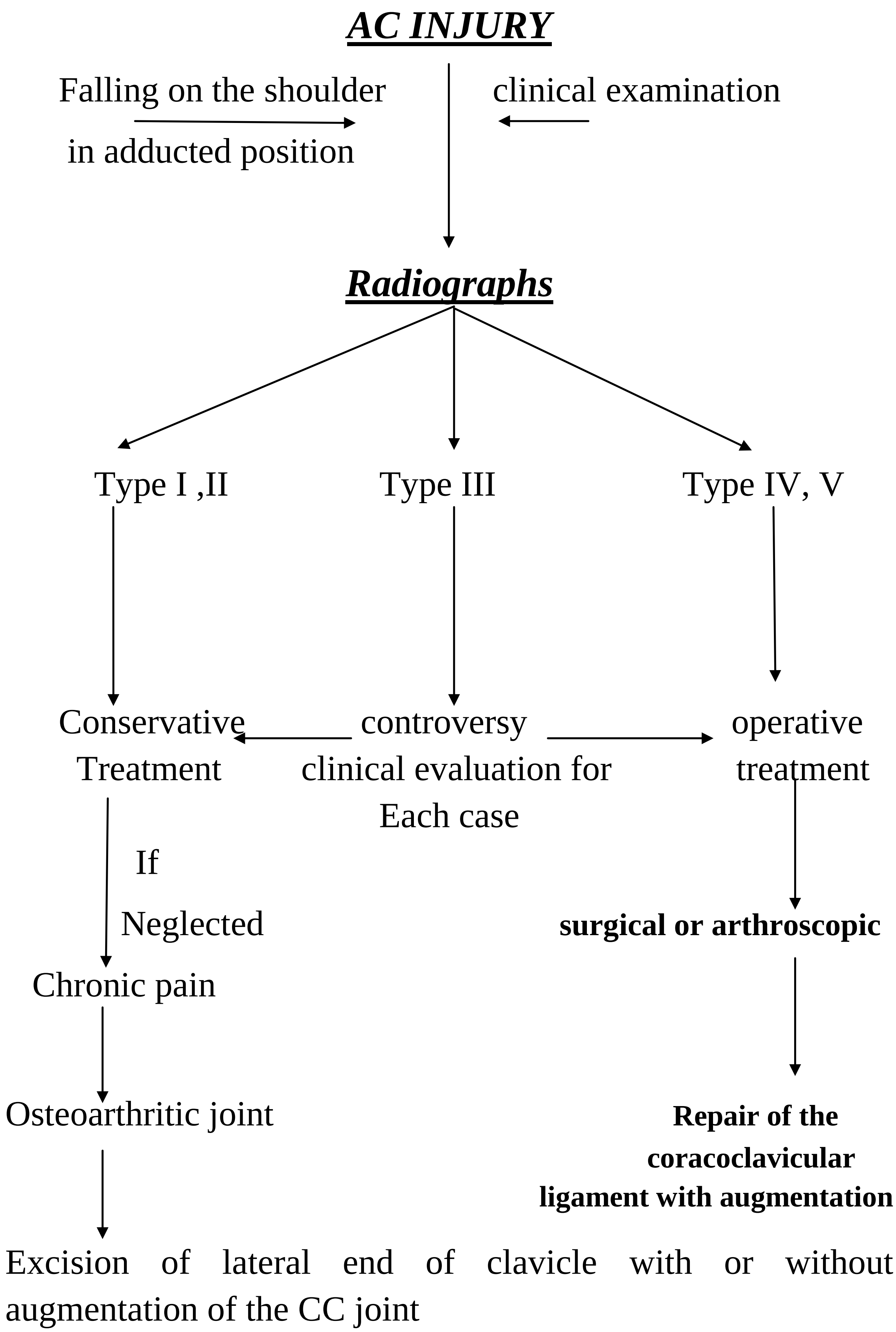
Fig. 35 The free gracilis tendon is Wxed with two Tenodesis Screws (Arthrex, Naples, FL, USA) (Markus Scheibel et al, 2007)

Figs. 36 , 37 The final construct consists of a Tight-Rope through the middle drill hole and the tendon graft straddling the former . (Markus Scheibel et al, 2007)




Figs. 38 , 39 Pre- and postoperative radiograph of a right AC-joint before and after the described reconstruction technique. (Markus Scheibel et al, 2007)


AC INJURY
Falling on the shoulder in adducted position
clinical examination
Radiographs
Type I ,II
Type III
Type IV, V
Conservative Treatment
controversy clinical evaluation for Each case
operative treatment
If Neglected
surgical or arthroscopic
Chronic pain
Osteoarthritic joint
Repair of the coracoclavicular ligament with augmentation
Excision of lateral end of clavicle with or without augmentation of the CC joint

ENGLISH SUMMARY

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Acromioclavicular (AC) joint injuries represent 40 % to 50% of athletic shoulder injuries . (***Thorndike , 1942 , Kaplan et al , 2005).***

The treatment of AC instability has been ongoing source of controversy . Long before a three-grade classification of the injury was developed Tossy et al and Allman in the 1960s (***Tossy et al, 1963, Allman , 1976)*** and then expanded by Rockwood in 1989 ***(Willimas et al, 1989)***, surgeons debated the method and timing of treatment .The greatest source if dispute has been the issue of non surgical management versus surgical reconstruction for complete dislocations .
(***Ryan simovitch, et al, 2009)***

In the mid 1970s , most residency program directors in the United States recommended surgical treatment for type III dislocations .(***Powers , Bach 1974)***

However , by the early 1990s , 135 of 187 surgeons preferred non surgical treatment (72.2 %) ***.(Cox , 1992)*** .A series of comparative studies has supported this trend ***.(Gaplin et al, 1985, Larsen et al, 1986 , Taft et al, 1987 , Bannister , Phillips et al, 1998)***

Today , the tendency in management is towards minimal intervention . ***(Bradley , Elkousy 2003)***

However , surgical management , most commonly in the form of coracoclavicular (CC) fixation (***Lemos 1998***) and / or ligament reconstruction is often undertaken after consideration of individual patient demands and injury chronicity. (***Weaver , Dunn , 1972)***

Significant recent advances have been made in the approach to AC joint injury . there is a consensus that type I and II AC joint injury should be treated non surgically , while acute type IV , V and VI injuries should be treated surgically , the correct algorithm for treating type III injuries is not known ; most studies do not show a significant difference in the clinical outcome between non surgically and surgically treated patients . Although it has not been sufficiently demonstrated , it may be that a subset of overhead athletes and heavy laborers would benefit from surgical reconstruction of type III injuries . The idea that adequate rehabilitation is critical to a successful outcome of non surgical treatment of a type III injury is worthy of attention and further study . It is often the case that non surgical care translates into benign neglect , and perhaps inadequate rehabilitation has been responsible for some failures related to non surgical treatment . (***Ryan simovitch et al, 2009)***