PRACTICAL ADVICE FOR PHYSICIANS

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# Acromioclavicular joint injuries treatment

## Lečenje povreda akromioklavikularnog zgloba

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**Ključne reči:**
**zglob, akromioklavikularni; povrede, atletske; zglob, iščašenja; ligamenti zgloba; ortopedske procedure; hirurgija, rekonstruktivna, procedure; rame, povrede.**

### Introduction

The acromioclavicular (AC) joint is one of the most frequently injured shoulder joints [1]. This injury is a typical result of falling directly onto the superolateral side of the shoulder. Acromioclavicular dislocation is a common injury especially in young people and athletes [2]. The AC joint injuries account for approximately 12% of shoulder dislocations and 10% of all shoulder injuries [3, 4]. Depending on the mechanism, acromioclavicular joint injuries represent a wide range of soft tissue lesions, ranging from mild, transient pain to significant dislocations, chronic pain, and changes in shoulder biomechanics. Multiple factors are involved in the treatment algorithm, including clinical and imaging findings, as well as patient-specific factors [5]. An incorrect treatment of an AC joint injury may predispose complications and that is why it is critical to understand the indications for operative and non-operative management [5]. Indications for the operating treatment of AC joint injuries are not clearly defined and differ depending on bibliographic sources. Accordingly, there is a need to understand complete anatomy, biomechanics and pathophysiology of AC joints [5]. In this paper we attempted to cover all operative and non-operative methods, as well as those possible complications of such treatments.

### Anatomy

The AC joint is a diarthrodial joint that alternates between the lateral end of the clavicle and the medial part of the acromion [6]. Joint stability is provided by both static and dynamic stabilizers. Static stabilizers are the AC ligaments, coracoclavicular (CC) igaments and coracoacromial ligament. Together, they account for about 90% of joint stability in the anteroposterior diameter [6]. The CC ligament complex, composed of two ligaments (*trapezium* and *conoideum*), connects the inferior surface of the clavicle with the coracoid and it is the major suspensory shoulder ligament [7]. These ligaments prevent superior-inferior clavicle dislocation, that is, they are responsible for vertical stability [8, 9]. The conoid ligament, which is of conical shape and average length of 11 mm, has its attachments on the calvicle and on the medial aspect of the coracoid extension [10]. These two ligaments close to each other at a 60-degree angle with a clearly limited bursa between them [11] as shown in Figure 1.

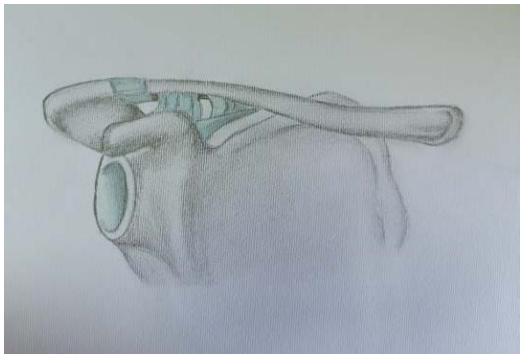

**Fig. 1 – Anatomy of acromioclavicular joint.**

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**Biomechanics**

The clavicle, AC and sternoclavicular joints all play a role in connecting the upper extremity to the axial skeleton. The biomechanics of the AC joint includes static and dynamic stabilizers and movements of the joint itself [12, 13]. AC ligaments act as primary stabilizers in the horizontal plane, in the anteroposterior direction, while CC ligaments act as the main stabilizers in the vertical plane [14, 15]. During adduction and flexion of the shoulder at up to 180 degrees, the AC joint is engaged in about 5–8 degrees of the movement while scapula and clavicle rotate through about 45 degrees [16]. Isolated movements of the AC joint are present in antero-posterior, superior-inferior and rotational planes [17]. A normal antero-posterior translation of an intact AC joint is approximately 6 mm, superior-inferior 3 mm and 3–5 degrees of axial rotation.

**Classification**

AC joint injuries are best classified based on the degree of damage caused by the acting force. There are 6 degrees of AC joint injuries [18–20] (Figure 2):

Type 1 – In this type of injury, the RTG finding is neat, there is only is a slight swelling of those soft tissue structures of the injured shoulder in relation to the uninjured.

Type 2 – In this type, we have a slight elevation of the lateral limb of the clavicle relative to the other shoulder. A rupture of AC ligaments occurs, while CC ligaments remain intact.

Type 3 – We have a complete joint dislocation here. In addition to the rupture of AC ligaments in this type, there is also some rupture of CC ligaments.

Type 4 – In this type, in addition to the ruptures of AC and CC ligaments, we also have a rupture of *m. trapezius* with a posterior dislocation of the calvicle into muscle.

Type 5 – The type is characterized by a significantly greater dislocation of the clavicle than in previous two types, and along with ligament rupture, we also have a rupture of the deltoid and trapezius fascia.

Type 6 – It represents the rarest type of AC joint injuries. In this type, an inferior dislocation occurs below the acromion and behind the joint tendon of the biceps and step *brachialis* [21].

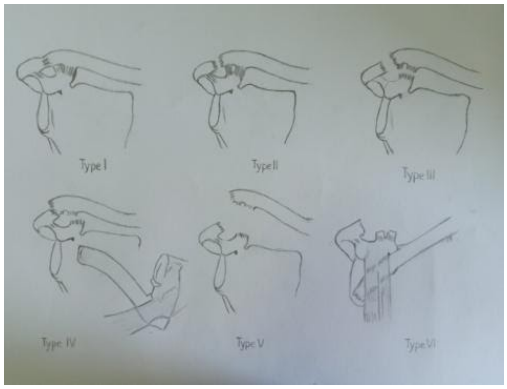


**Fig. 2 – Types of acromioclavicular joint injuries (see chapter Classification for further explanations).**

**Clinical signs and symptoms**

A detailed history that includes the mechanism of injury, duration, and localization of pain are key to the diagnosis of AC joint injuries. The information about the fall onto the lateral aspect of the shoulder, often during contact sports or a fall onto the outstretched arm, may indicate a possible injury to the AC joint [11]. Palpation of the distal clavicle end can provide valuable information on the severity of that injury and the degree of pain. Problems are most often exacerbated by active and passive shoulder movements [22]. A clinical examination followed by an intra-articular application of topical anesthetic can be quite useful in diagnosing such issues. When it comes to specific tests for the detection of acromioclavicular pathology, two tests have special clinical significance. These two are the Cross-arm adducton test and O'Brien's compression test [23]. In the O'Brien's test, the patient stands with their arm elevated at 90 degrees from the shoulder, the elbow being in its full extension with the adduction of the arm at about 10–15 degrees and the internal rotation so that the thumb is down. The doctor then applies a constant downward pressure to the arm [23]. A positive O'Brien's test can also speak in favor of labral pathology, that is, the presence of the superior labral anterior and posterior (SLAP) lesion [23]. Radiographic evaluation also plays a prominent role in the diagnosis of AC joint injuries.

**The mechanism of injuries**

The subcutaneous position of the joint itself and poor soft tissue coverage make it susceptible to a direct mechanism of injury [24].

One of the most common mechanisms involves a fall onto the shoulder with an arm in adduction. This force causes the displacement of the acromion medially and inferiorly leading to a standard pattern of injury – a rupture of the AC ligaments is followed by a rupture of the CC ligaments and finally a rupture of the deltoid trapezius fascia [25] (Figure 3).

**Fig. 3 – The most common cause of acromioclavicular joint injury is a fall onto the shoulder with an arm in adduction.**

**Treatments of AC joint injuries**

*Non-operative treatment*

In the case of type 1 and type 2 injuries, there is a general consensus that a non-operative treatment produces satisfactory results and can be treated with a specific period of immobilization in the form of arm sling and Sayer immobilization for 10–14 days. Certain studies have shown that these injuries can be symptomatic for up to 6 years [26-28]. When it comes to the type 3 injuries, there are still many controversies and disagreements today regarding what the best treatment may be. With the type 3 injuries, the AC and CC ligaments are completely ruptured and there is a dislocation with respect to the contralateral side, while in the type 5 with ruptured ligaments, we also have a rupture of the the deltoid trapezius fascia and a significant dislocation in regard to the contralateral side. In a prospective study of patients with acute 3 and 5 luxation, Smith et al. [28] compared non-operative immobilization treatment with operative reposition and fixation. Conservatively treated patients regained the full range of motion much earlier than those operated on. The authors' conclusion is that non-operative treatment is suitable for acute type 3 dislocations and that younger patients with a significant dislocation respond better to surgical treatments.

*Indications for surgical treatments*

The main goal of treating AC joint injuries is to achieve painless shoulder movements without any significant restriction of the range of motion [29].

Types 1 and 2 lesions are generally treated inoperatively with quite satisfactory functional results [30]. A surgical treatment is generally advised in young and active people with lesions of types 4, 5 and 6 because of the significant morbidity associated with the mechanism and the degree of injury that can lead to persistent joint dislocations, instability with changes in scapula kinetics and shoulder function [30].

*Surgical treatment of AC joint injuries*

When it comes to the surgical treatment of the AC joint, it is important to note that there is no method representing the gold standard. Since the beginning to our present day, there have been several treatment methods and methods of fixation in use, each of which have had more or fewer complications.

Hook plate

This method was initially made for fractures of the acromial end of the clavicle, but over time it has found its use in the treatment of AC joint injuries. The disadvantage of this technique is that it is compounded of a number of complications such as acromion fractures, plate bending, and AC joint arthritis that is, according to some studies [31] , present in every other patient. Due to all the complications mentioned above, this method is rarely used (Figure 4).

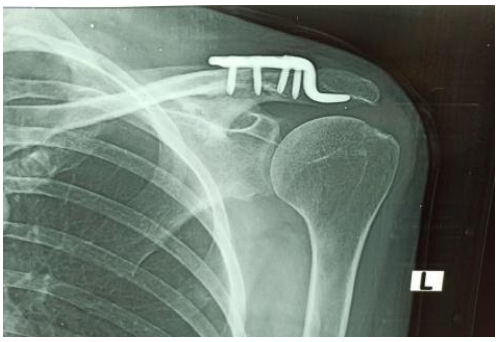

**Fig. 4 – Surgical treatment of acromioclavicular joint injury by the Hook plate method.**

Bosworth method

This method represents the AC joint stabilization by a single screw between the base of the coracoid and the clavicle, thus providing a rigid fixation. In this method it is crucial to achieve bicortical fixation on the coracoid (Figure 5).

**Fig. 5 – Surgical treatment of acromioclavicular injury by the Bosworth method.**

Endobutton method

Various techniques have been devised to achieve the anatomical reconstruction of the CC ligaments [32–34] (Figure 6).

**Fig. 6 – Anatomical reconstruction of coracoclavicular ligaments by the Endobutton method.**

Repair is performed using a suture between the endobuttons on lateral clavicle and coracoid [33].

Weaver-Dunn procedure

The idea behind this procedure is to replace the step-clavicular ligament with a CC ligament.This method involves removing the ligament from its insertion to the acromion, resection of the distal clavicular end and transfer of the ligament to the lateral end of the calvicle as closely as possible to the junction of the CC ligament [35]. The disadvantage of this method is that the CA ligament is not nearly as strong as the native ligament.

Tension band

It involves the placement of two K wires through the acromion and the lateral end of the clavicle and thus the anatomical reposition of the joint is established. The disadvantage of this technique is that frequent needle migration occurs as well as the appearance of the AC joint arthrosis.

CC ligament reconstruction

The method includes an anatomical reconstruction of the ligament and its insertion at the coracoid base and the lateral end of the clavicle. A modification of this method is the reconstruction of the ligaments using biological grafts that run through one or two previously made holes on the clavicle [36].

**Complications**

Each method has shown its disadvantages and none is without complications. The most common and significant complication is reluxation, which, judging by some works, occurs in as many as 40% of cases. Another, less common complication is the onset of infection [37]. Brachialis plexus injuries are also a potential complication, especially due to the proximity of the coracoid. Any method involving coracoid drilling has this injury as a possible complication [38]. Also, with the type 3 injury, plexus injury can appear owing to scapular dyskinesis and plexus involvement.

**Conclusion**

Despite the development and better understanding of this type of pathology, there is still no method that can be said to be standard and the best choice for the AC joint injuries. Each method, to a greater or lesser extent, carries with it a number of complications. When it comes to treating these injuries, it should be adjusted to every patient individually, taking into account the patient's age, physical activity and quality of life. Keeping all this in mind, the surgeon should choose the method with which the surgeon is most familiar with and which gives the best opportunity for the patient to fully recover and return to normal life activities.

## R E F E R E N C E S


1. *Kurtoglu A, Sukur E, Ciceklin O, Daldal I, Kochai A, Sen Z,* at al. Does the ZipTighTM effective to maintain reduction after the treatment of acute acromioclavicular joint dislocation? Medicine (Baltimore) 202; 99(9): e19387.
2. *Hibberd EE, Kerr ZY, Roos KG, Djoko A, Dompier TP.* Epidemiology of Acromioclavicular Joint Sprains in 25 National Collegiate Athletic Association Sports: 2009-2010 to 2014-2015 Academic Years. Am J Sports Med 2016; 44(10): 2667–74.
3. *Martetschläger F, Kraus N, Scheibel M, Streich J, Venjakob A, Maier D.* The Diagnosis and Treatment of Acute Dislocation of the Acromioclavicular Joint. Dtsch Arztebl Int 2019; 116(6): 89–95.
4. *Kelly BT, Barnes RP, Powell JW, Warren RF.* Shoulder injuries to quarterbacks in the national football league. Am J Sports Med 2004; 32(2): 328–31.
5. *Iannotti JP, Williams GR Jr, Miniaci A, Zuckerman JD.* Disorders of the Shoulder: Diagnosis and Management Package. 3rd ed. Baltimore, MD: Wolters Kluwer/Lippincott Williams & Wilkins; 2014.
6. *De Palma. AF.* Surgical anatomy of acromioclavicular and coracoclavicular joint. Surg Clin North Am 1963; 43: 1541–50.
7. *Rockwood CA Jr, Wirth MA, Fehringer EV, Sperling JW, Matsen FA, Lippitt SB.* Rockwood and Matsen's The Shoulder. 5th ed. St. Louis, MO: Elsevier Health Sciences; 2016.
8. *Ramsingh V, Yewlett AD, Pullen HC.* Three intrasubstance failures of a LARS™ ligament used for ligament reconstruction. Ann R Coll Surg Engl 2019; 101(3): e79–e83.
9. *Mazzocca AD, Arciero RA, Bicos J.* Evaluation and treatment of acromioclavicular joint injuries. Am J Sports Med 2007; 35(2): 316–29.
10. *Rios CG, Arciero RA, Mazzocca AD.* Anatomy of the clavicle and coracoid process for reconstruction of the coracoclavicular ligaments. Am J Sports Med 2007; 35(5): 811–7.
11. *Tornetta P 3rd, Ricci W, Court-Brown CM, McQueen MM, McKee M.* Rockwood and Green Rockwood and Green's Fractures in Adults. 9th ed. Philadelphia, PA: LWW Lippincott Williams and Wilkins; 2019.
12. *Dawson PA, Adamson GJ, Pink MM, Kornswiet M, Lin S, Shankwiler JA,* et al. Relative contribution of acromioclaviculare joint capsule and coracoclavicular ligaments to acromioclavicular stability. J Shoulder Elbow Surg 2009; 18(2): 237–44.
13. *Abat F, Sarasquete J, Natera LG, Calvo Á, Pérez-España M, Zurita N,* at al. Biomechanical of acromioclaviclular joint dislocation repair using coracoclavicular suspension devices in two different configurations. J Orthop Traumatol 2015; 16(3): 215–9.
14. *Lee SJ, Nicholas SJ, Akizuki KH, McHugh MP, Kremenic IJ, Ben-Avi S.* Reconstruction of the coracoclavicular ligaments with tendon grafts: a comparative biomechanical study. Am J Sports Med 2003; 31(5): 648–55.
15. *Rios CG, Mazzocca AD.* Acromioclavicular joint problems in athletes and new methods of management. Clin Sports Med 2008; 27(4): 763–88.
16. *Rozin AP.* Ultrasound measurement of the acromioclavicular joint. Ann Rheum Dis 2009; 68(3): 445–6.
17. *Yoo YS, Tsai AG, Ranawat AS, Bansal M, Fu FH, Rodosky MW,* et al. A biomechanial analysis of the native coracoclavicular ligaments and their influence on a new reconstruction using a coracoid tunnel and free tendon graft. Arthroscopy 2010; 26(9): 1153–61.
18. *Barnes CJ, Higgins LD, Major NM, Basamania CJ.* Magnetic resonance imaging of the coracoclavicular ligaments: its role in de-

fining pathoanatomy at the acromioclavicular joint. J Surg Orthop Adv 2004; 13(2): 69–75.
19. *Granville-Chapman J, Torrance E, Rashid A, Funk L.* The Rockwood classification in acute acromioclavicular joint injury does not correlate with symptoms. J Orthop Surg (Hong Kong) 2018; 26(2): 2309499018777886.
20. *Kraeutler MJ, Williams GR Jr, Cohen SB, Ciccotti MG, Tucker BS, Dines JS,* et al. Inter- and intraobserver reliability of the radiographic diagnosis and treatment of acromioclavicular joint separations. Orthopedics 2012; 35(10): 1483–7.
21. *Crönlein M, Postl L, Beirer M, Pförringer D, Lang J, Greve F,* et al. Analysis of the bony geometry of the acromio-clavicular joint. Eur J Med Res 2018; 23(1): 50.
22. *Walton J, Mahajan S, Paxinos A, Marshall J, Bryant C, Shnier R,* et al. Diagnostic values of tests for acromioclavicular joint pain. J Bone Joint Surg Am 2004; 86(4): 807–12.
23. *O'Brien SJ, Pagnani MJ, Fealy S, McGlynn SR, Wilson JB.* The active compression test: a new and effective test for diagnosing labral tears and acromioclavicular joint abnormality. Am J Sports Med 1998; 26(5): 610–3.
24. *Kaplan ID, Flanigan DC, Norwig J, Jost P, Bradley J.* Prevalence and varience of shoulder injuries in elite collegiate football players. Am J Sports Med 2005; 33(8): 1142–6.
25. *Takase K.* The coracoclavicular ligaments: an anatomic study. Surg Radiol Anat 2010; 32(7): 683–8.
26. *Simovitch R, Sanders B, Ozbaydar M, Lavery K, Warner JJ.* Acromioclavicular joint injuries: diagnosis and management. J Am Acad Orthop Surg 2009; 17(4): 207–19.
27. *Rios CG, Arciero RA, Mazzocca AD.* Anatomy of the clavicle and coracoid process for reconstruction of the coracoclavicular ligaments. Am J Sports Med 2007; 35(5): 811–7.
28. *Smith TO, Chester R, Pearse EO, Hing CB.* Operative versus nonopera tive management following Rockwood grade III acromioclavicular separation: a meta-analysis of the current evidence base. J Orthop Traumatol 2011; 12(1): 19–27.
29. *Jari R, Costic RS, Rodosky MW, Debski RE.* Biomechanical function of surgical procedures for acromioclavicular joint dislocations. Arthroscopy 2004; 20(3): 237–45.
30. *El Shewy MT, El Azizi H.* Suture repair using loop technique in cases of acute complete acromioclavicular joint dislocation. J Orthop Traumatol 2011; 12(1): 29–35.
31. *Chang HM, Hong CK, Su WR, Wang TH, Chang CW, Tai TW.* Comparison of clavicular hook plate with and without coracoclavicular suture fixation for acute acromioclavicular joint dislocation. Acta Orthop Traumatol Turc 2019; 53(6): 408–13.
32. *Breslow MJ, Jazrawi LM, Bernstein AD, Kummer FJ, Rokito AS.* Treatment of acromioclavicular joint separation: suture or suture anchors? J Shoulder Elbow Surg 2002; 11(3): 225–9.
33. *Wellmann M, Zantop T, Weimann A, Raschke MJ, Petersen W.* Biomechanical evaluation of minimally invasive repairs for complete acromioclavicular joint dislocation. Am J Sports Med 2007; 35(6): 955–61.
34. *Inoue D, Furuhata R, Kaneda K, Ritsuno Y, Kono A, Kiyota Y,* at al. Clavicule fracture at the suture hole aafter acromioclavicular joint reconstruction using a suture-button. BMC Musculoskelet Disord 2019; 20: 333.
35. *Tauber M, Gordon K, Koller H, et al.* Semitendinosus tendon graft versus a modified Weaver-Dunn procedure for acromioclavicular joint reconstruction in chronic cases: a prospective comparative study. Am J Sports Med 2009; 37(1): 181–90.
36. *Abat F, Sarasquete J, Natera LG, Calvo Á, Pérez-España M, Zurita N,* at al. Biomechanical analysis of acromioclavicular joint dislocation repair using coracoclavicular suspension devices in two different configurations. J Orthop Traumatol 2015; 16(3): 215–9.
37. *Yeak RD, Daud H, Nizlan NM.* Osteomyelitis post acromioclavicular joint reconstruction. Chin J Traumatol 2019; 22(3): 182–5.
38. *Gallagher CA, Blakeney W, Zellweger R.* Acromioclavicular joint dislocation with associated brachial plexus injury. BMJ Case Rep 2014; 2014: bcr2013203299.

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