

# Characteristics And Comparison of Tossy and Rockwood Classifications for Acromioclavicular Joint Separations

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**Abstract.** Acromioclavicular joint (AC joint) is one of the four articulations that make up the shoulder joint. Injuries related to the shoulder joint often damage the AC joint. Since AC joint separation is usually caused by external force applied to the shoulder, it is one of the most familiar shoulder injuries in sports, especially sports with body contact such as ice hockey, football, and basketball. As the force that causes injury varies, there are different grades of severity of the AC joint separation. This study focuses on two main classifications (Tossy classification and Rockwood classification) of the severity of the AC joint separation and discusses the corresponding treatments as well as the criticisms of each classification. Tossy three-degree classification is straightforward that could be categorized quickly after diagnosis. Grade 1 requires the use of a well-designed sling, Grade 2 needs a specific treatment plan, and Grade 3 requires open surgeries. Rockwood's six-type classification is more detailed than the three-degree classification and represents the complicated pathophysiology. Types I and II are recommended for non-operative treatments, Type III should adopt non-operative treatment firstly, and then the operative management. Types IV, V, and VI need surgical treatments.

**Keywords:** Treatment, Tossy Classification, Rockwood Classification, Acromioclavicular Joint

## 1. Introduction

Nowadays, people tend to have a longer period of sitting down with more office work. This trend causes a lot of health problems such as backache, cervical spondylosis, and shoulder pain. A study showed that shoulder and neck problems are more prone to happen in sedentary lifestyles among adolescents (15–25 years), especially shoulder problems [1]. A previous study showed that the students who sit for the entire day are also more likely to suffer shoulder pain [2].

Furthermore, since the shoulder joint is the least stable joint in the human body, not only sitting down can cause shoulder pain, but exercises and sports can also result in shoulder injuries. For example, tennis and baseball players usually get impingement syndrome; handball and American football players usually get rotator cuff tears; ice hockey players usually get AC joint separations. AC joint separation, which is the third most customary injury in the college hockey leagues, is almost always the result of a sudden, traumatic event [3]. As ice hockey is becoming more popular among teenagers all over the world, people need to focus on protecting their shoulders, and try to, especially, avoid the separation of the AC joint.

Separation of the AC joint occurs very frequently in physically active people. This study focuses on two main kinds of classifications of AC joint separation to help patients and doctors to have a better idea of what treatment should be used. Backgrounds and detailed comparisons are introduced as well as the advantages and disadvantages of each classification.

## 2. Background

### 2.1. Anatomical Structure Of Shoulder Joint

The shoulder joint is one of the important joints in our body, which are comprised by three main bones: the humerus (upper arm bone), the clavicle (collarbone), and the scapula (shoulder blade). The clavicle solely connects the main part of the body to the shoulder girdle through the sternoclavicular joint medially and the AC joint laterally. The clavicle fills in as a plat for muscle attachments, an

obstruction to safeguard fundamental neurovascular structures, and a swagger to balance out the shoulder joint and keep it from dislodging medially with the enactment of the pectorals and other axiohumeral muscles. The scapula is a huge, slim, three-sided bone lying on the posterolateral part of the chest (ribs 2 to 7), that serves predominantly as a facet for muscle attachments. The humerus is the longest and biggest upper arm bone, with its proximal piece consisting of the half-spheroid articulating surface or head [4]. Muscles, ligaments, and tendons surrounding these bones could provide support and connection.

There are four independent articulations including the sternoclavicular (SC) joint, the scapulothoracic joint, the glenohumeral joint, and the acromioclavicular joints, making up the shoulder joint [5]. The SC joint is located at the base of the neck where the clavicle meets the sternum (breastbone). The scapulothoracic articulation consists of the posterior thoracic cage and the anterior scapula. The glenohumeral articulation is a ball-and-socket joint consisting of a complex, dynamic joint. The AC joint is formed where the clavicle meets acromion, a bony projection off the scapula. It is a gliding or plane-style synovial joint that allows movement, such as shoulder abduction and flexion. The AC ligaments, as the static stabilizers, play a key role in stabilizing the AC joint [3].

## 2.2. Common Shoulder Injuries

Because the humerus is relatively loosely fitted into the scapula, the shoulder joint has a wide range of motion, which makes it at risk to injuries. Some common injuries are dislocation of the shoulder joint, rotator cuff tear, impingement syndrome, and fracture of the clavicle. Shoulder dislocation happens when the glenohumeral head is separated partially or completely from the socket. Rotator cuff tear is a partial or total tear of the rotator tendons. Impingement syndrome is the entrapment of soft tissue between the acromion and subacromial space as the result of tissue enlargement. Fracture of the clavicle is a broken clavicle and it most commonly occurs in lateral 2/3 of the bone.

## 2.3. AC Joint Separation

One of the most frequent injuries related to the shoulder is AC joint separation. Studies show that around 9% of shoulder joint injuries involve impairment to the AC joint, and adults in their 20s suffer the most from the AC joint injuries. Men are more prone to experience acromioclavicular dislocations than women, with 70% of incomplete dislocations [3]. Injuries to the AC joint account for roughly 50% of all shoulder injuries in athletes who participate in sports that involve a lot of collisions with the human body. Furthermore, because many people with mild injuries do not seek medical help, this statistic likely underestimates the real occurrence [6].

The AC joint separation happens when the ligaments that keep bones together tear and the collarbone no longer lines up with the acromion. It is usually caused by an external force like falling onto the shoulder. The depression force on the shoulder, such as a fall from a bicycle or a crash during sports, is the most common trauma mechanism. The AC and CC ligaments are torn because the stress lowers the scapulohumeral complex. In 18% of patients with moderate to severe dislocations, there are associated shoulder injuries [7]. The patient would experience immediate pain and suffer from raising the arm on the same side as the injured shoulder.

## 3. Classifications of Ac Joint Separation (Dislocation)

There are two major classifications for the degrees of severity of the separation of the AC joint. In 1963, Tossy, Mead, and Sigmond first identified three-degree classification. Later in 1984 Rockwood extended 3 subdivisions, forming the most widely used six-degree classification system. [6].

### 3.1. The Three-Degree Classification

The separation of the AC joint is categorized into three grades ranging from a mild separation to a complete dislocation (Figure 1). Grade 1 involves strains and contusions of the AC joint, with pain, swelling, and tenderness in the articulation itself. It is difficult to observe through naked eyes or radiographs.

Grade 2 is characterized by localized discomfort, swelling, and soreness, as well as a reluctance or difficulty to lift vigorously. The clavicle's outside end may be extremely visible. The AC joint is separated roughly one-half on roentgenograms taken by the approved technique. The space between the inferior cortex of the clavicle and the superior tip of the coracoid process is also lengthened.

Grade 3 injuries have a prominent malformation of the clavicle's outer end, which appears beneath the skin posterior and upward. There is generally a lot of discomfort and incapacity. Roentgenograms reveal a distinct acromioclavicular joint separation larger than half its typical depth, as well as a broad separation of the CC connection. It indicates that both the conoid and trapezoid ligaments have been ripped entirely [8]

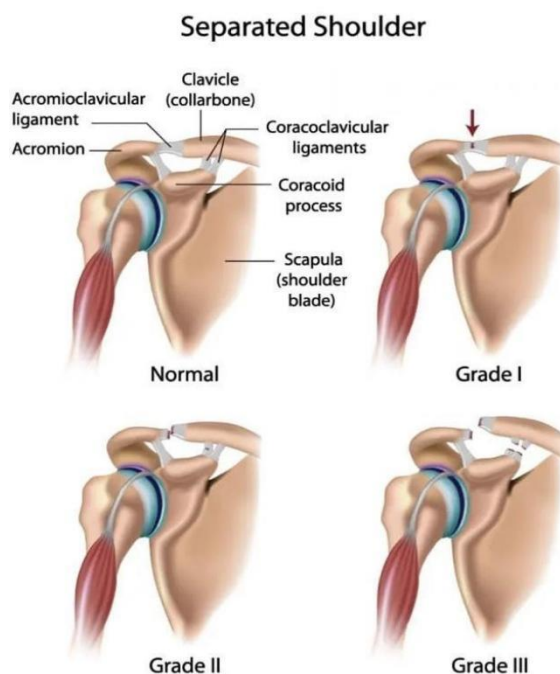


Figure 1. The three-degree classification

### 3.2. The Six-Degree Classification

The six-degree classification is expanded by Rockwood and Green to provide more detailed information to categorize different levels of injury. They think that the third grade of Tossy classification is too broad. The anteroposterior, axillary, and Zanca radiographs are used to assess the direction and level of displacement, and the Rockwood categorization helps the doctor understand it.

Type I injury is characterized by a sprain or partial rupture of the joint capsule without medical characterization (Figure 2). The AC ligaments are completely torn in Type II injuries, while the CC ligaments are not disrupted. Because the CC ligaments are intact, the acromion shows very little radiographic depression. This kind can sometimes be seen in stress views, although it usually has little effect on therapy. As for Type III injuries, the AC and CC ligament complexes are ripped. This frequently results in clavicle displacement, with CC displacement that are up to 100 percent larger than the healthy contralateral side. Type IV injury is featured by complete posterior displacement of the distal clavicle, sometimes with a hole in the trapezial fascia. Type V injuries also cause full disturbance of the AC and CC ligaments, with a CC distance of larger on the afflicted side than on the uninjured side. When the distal clavicle buttonholes through the deltotrapipezial fascia as a result

of these injuries, they become irreducible. Type VI injuries appear the inferior displacement of the distal clavicle causes [7].

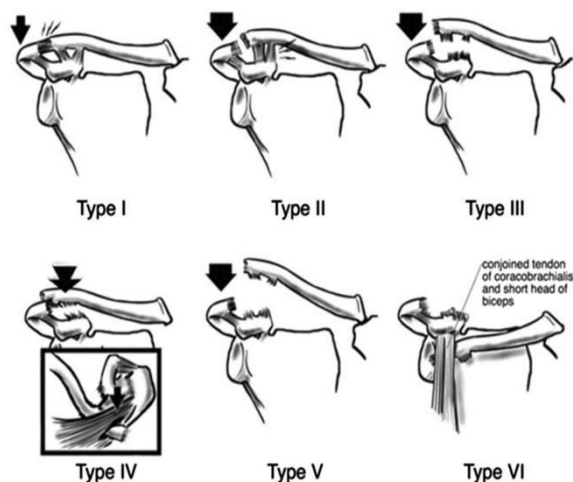


Figure 2. Rockwood six-degree classification [8]

## 4. Discussion

### 4.1. Treatments Of Both Classifications

#### 4.1.1. The Three-Degree Classification

Tossy three-degree classification is straightforward that could be categorized quickly after diagnosis. For this classification, different levels of severity should be treated with different treatments. For Grade 1, all that is required is the use of a well-designed sling, such as one from Zimmer, for three weeks. For Grade 2, a specific treatment plan is required. If a correct closed reduction can be established, an abduction plaster spica with a cushioned shoulder strap is an effective technique for retaining it. The cast should be put with the shoulder abducted at 60 degrees and the elbow forward at 45 degrees. The spica that covers the shoulders should be sliced open, revealing the clavicle curving prominence and end neck area. The plaster front and back have a broad webbing strap with a buckle in the center that falls just anterior to the clavicular prominence. To protect the skin around the clavicle, a felt pad is connected to the strap. The strap is then tightened to the point when roentgenograms show the CC distance has returned to normal. The AC separation has to be maintained if this is done. For 6 weeks, the spica is utilized. For Grade 3, open surgery is required [9].

Based on clear corresponding treatments, the three-degree classification is considered the first classification for AC joint separation in history.

#### 4.1.2. The Six-Degree Classification

Rockwood classification is more detailed than the three-degree classification. The first two types of Rockwood classification are similar to the first two grades of the three-degree classification. It is recommended for non-operative treatments, such as sling and straps. Types III-VI are the expansion of the surgical part of the three-degree classification. For Type III, the patient should adopt non-operative treatment firstly, and then the operative management. For Types IV, V, and VI, surgical treatments are required for patients to recover [10].

### 4.2. Advantages And Disadvantages Of Both Classifications

Both classifications have different reflections on shoulder damage. For example, a study showed the degree of soft tissue damage did not correspond with Tossy's three-degree classification of AC joint injuries. As for Rockwood's six-degree classification, the patients categorized as Types IV and

V had disconnected muscle insertions, while virtually Type II injuries had intact muscle insertions. Type III injuries have different degrees of muscle insertions, with around a third of the patients having badly severed muscle insertions.

Compared with the three-degree classification, the Rockwood classification could represent the complicated pathophysiology. The research shows that the three-degree classification is of little utility. For example, more than 20% of patients requiring procedures due to a severe horizontal clavicular dislocation were overlooked for level 2. Twenty-five cases with Rockwood IV and V types were overlooked in grade III injuries and are suggested for surgery [11].

Another research points out the lack of reliability of Rockwood's six-type system of classification. The management of AC joint separation, particularly those of Rockwood type III vs type IV and type III against type V, is still a challenge. The difference between these kinds is critical in the clinical context since there is a tendency toward nonoperative management of type III separation but surgical management of type IV and type V separation. Although axial radiography of the shoulder joint is essential for this differentiation, type IV injuries can be arduous to diagnose and require a good axial picture to determine posterior translation. Plain radiographs have been shown in several other studies to be insufficient for identifying type IV injuries. For a more precise evaluation of the degree and direction of AC joint disease, additional radiographic methods such as X-ray, CT, ultrasound, and MRI are required [12-14].

## 5. Conclusion

There are a lot of injuries that people suffer in their daily life, and most of the time, the injury is associated with the shoulder joint. The shoulder joint is the most vulnerable joint in the human body because of its structure. Among all the different shoulder injuries like the dislocation of the shoulder joint, rotator cuff tear, impingement syndrome, and fracture of the clavicle, the separation of the AC joint is the most common in sport involving body contact. A direct force against the shoulder joint is usually the mechanism of this injury.

This study examined the two main kinds of classification (Tossy classification and Rockwood classification). Tossy and his team came up with a three-degree classification in 1963. Grade 1 injury causes the least amount of damage and just affects the joint itself. For this level of injury, only a well-designed sling is needed for at least three weeks to recover. Grade 2 injury damages the ligaments at the AC joint, as well as the other ligaments that support the joint. The CC ligaments are strained but not completely ripped in Grade 2 injury. For this level of injury, abduction plaster spica with a cushioned shoulder strap is an ideal treatment. The cast should be placed with the shoulder abducted at 60 degrees and the elbow forward at 45 degrees. The portion of the spica that covers the shoulders should be cut open, exposing the clavicle curving prominence and end neck area. In a grade 3 injury, the coracoclavicular ligaments are entirely ripped and the collarbone is no longer attached to the shoulder blade. As a result, the collarbone no longer aligns with the acromion, resulting in a joint deformity. For this level of injury, surgical treatment is required.

Rockwood, in 1996, extended Tossy's third-level injury into three more detailed categories that need to be managed surgically. Rockwood's classification is based on radiographs solely. According to Rockwood's classification, Types I and II could be treated conservatively (no surgery). For type III, patients should start with a non-surgical operation and then, if needed, surgery would be suggested. For Types IV, V, and VI, open surgery is required for patients to recover. On the other hand, neither classification is perfect. For example, Tossy's three-degree classification of AC joint injuries did not correctly reflect the degree of soft tissue damage. More studies need to be done to come up with a more accurate reflection of the distinguishing levels of the AC joint separation injury.

## References

- [1] S. Thakur, M. Gupta. Relationship of sedentary lifestyle with neck and shoulder. *Indian Journal of Health Sciences and Care*, 2021, vol. 8, pp.56-56.

- [2] Z. Shan, G.Y. Deng, J.P. Li, Y.Y. Li, Y.X. Zhang, Q.H. Zhao. How Schooling and Lifestyle Factors Effect Neck and Shoulder Pain? A Cross-sectional Survey of Adolescents in China. 2014, vol. 39, pp. E276-E283, DOI: 10.1097/BRS.0000000000000124
- [3] A.D. Mazzocca, R.A. Arciero, J. Bicos. Evaluation and treatment of acromioclavicular joint injuries. *The American journal of sports medicine*, 2007, vol. 35, pp.316-329.
- [4] G.C. Terry, T.M. Chopp. Functional anatomy of the shoulder. *Journal of athletic training*, 2000, vol. 35, pp.248.
- [5] V.T. Inman, L.C. Abbott. Observations of the function of the shoulder joint. *Clinical Orthopaedics and Related Research*, 1996, vol. 330, pp.3-12.
- [6] R.J. Warth, F. Martetschläger, T.R. Gaskill, P.J. Millett. Acromioclavicular joint separations. *Current reviews in musculoskeletal medicine*, 2013, vol. 6, pp.71-78.
- [7] C.J. van Bergen, A.F. van Bommel, T.D. Alta, A. van Noort. New insights in the treatment of acromioclavicular separation. *World journal of orthopedics*, 2017, vol. 8, pp.861.
- [8] J.D. Gorbaty, J.E. Hsu, A.O. Gee. Classifications in brief: Rockwood classification of acromioclavicular joint separations, 2017.
- [9] J.D. Tossy, N.C. Mead, H.M. Sigmond. Acromioclavicular separations: useful and practical classification for treatment. *Clinical Orthopaedics and Related Research*, 1963, vol. 28, pp.111-119.
- [10] K. Beitzel, A.D. Mazzocca, K. Bak, E. Itoi, W.B. Kibler, R. Mirzayan, A.B. Imhoff, E. Calvo, G. Arce, K. Shea. ISAKOS upper extremity committee consensus statement on the need for diversification of the Rockwood classification for acromioclavicular joint injuries. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*, 2014, vol. 30, pp.271-278.
- [11] G. Heers, A. Hedtmann. Correlation of ultrasonographic findings to Tossy's and Rockwood's classification of acromioclavicular joint injuries. *Ultrasound in medicine & biology*, 2005, vol. 31, pp.725-732.
- [12] C.H. Cho, I. Hwang, J.S. Seo, C.H. Choi, S.H. Ko, H.B. Park, J. Dan, Reliability of the classification and treatment of dislocations of the acromioclavicular joint. *Journal of shoulder and elbow surgery*, 2014, vol. 23, pp.665-670.
- [13] M.A. Verdano, A. Pellegrini, M. Zanelli, M. Paterlini, F. Ceccarelli. Modified Phemister procedure for the surgical treatment of Rockwood types III, IV, V acute acromioclavicular joint dislocation. *Musculoskeletal surgery*, 2012, vol. 96, pp.213-222.
- [14] K. Ogawa, N. Matsumura, A. Yoshida. Nonunion of the coracoid process: a systematic review. *Archives of Orthopaedic and Trauma Surgery*, 2021, vol. 141, pp.1877-1888.