Triple fixation for acute acromioclavicular joint dislocation

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Introduction
Acromioclavicular joint (ACJ) dislocation is common in sports medicine. Surgical intervention is generally indicated for acute dislocation of Rockwood grade III and more severe injuries. Various methods of reconstruction and augmentation have been described.
Objective
The aim of this study was to evaluate the results of treatment of acute ACJ dislocation with coracoacromial ligament transfer combined with coracoclavicular suture loop and acromioclavicular suture fixation.
Patients and methods
Twenty-five patients with acute ACJ dislocation were treated with the previous technique. All patients underwent surgery within 2 weeks of injury. Through anterosuperior shoulder incision, two Ethibond sutures were wrapped under the coracoid and around the clavicle. Moreover, four drill holes were made in the acromion and clavicle (two in each bone) where another Ethibond suture was used to pass through these holes to fix the ACJ. Finally, the coracoacromial ligament was transferred to the under surface of the clavicle.
Results
The mean follow-up was 19 months; the mean Constant score improved to 96 points. All 25 patients returned to normal life at a mean of 2.5 months postoperatively. Radiologically, 22 patients achieved anatomical reduction of ACJ. In three patients, mild sublaxation was encountered.
Conclusion
Triple fixation technique is a simple, cheap, and reliable procedure for restoring stability in cases of acute ACJ dislocations. It does not only prevent the superior translation, but it also prevents the anterior–posterior translation of the clavicle.

Keywords:
acromioclavicular, coracoclavicular, dislocation, suture repair

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Introduction

Injuries to the acromioclavicular joint (ACJ) are common, representing about 9% of all shoulder injuries [1]. Despite the high frequency of acromioclavicular (AC) separations, there continues to be substantial controversy about their management [2].

The ACJ is a diarthrodial joint with the distal clavicle articulating with the medial aspect of the acromion. Stability to this joint is provided through two sets of ligaments: the AC and coracoclavicular (CC) ligaments [3,4]. Although motion at the AC articulation is minimal, it is important for maintaining normal shoulder function [5].

ACJ injuries usually occur as a result of a direct force applied to the top of the shoulder with the arm in adduction position or through an indirect trauma such as a fall on the outstretched hand. Rockwood *et al.* [6] classified these injuries into six types.

It is generally accepted that types I and II ACJ injuries are best managed conservatively, whereas types IV, V, VI, and most type III injuries generally require operative intervention [7,8]. The goal of operative intervention is to create a stiff and strong repair/reconstruction of the CC ligaments while providing stability in all planes. This will allow early and more aggressive rehabilitation [9].

Various techniques are described in the literature to surgically treat the acute dislocation of ACJ (types III–VI). Most of these techniques involve the use of metallic implants including threaded wires [10], hook-plate fixation [11], and CC screws [12]. The metallic implants used are usually difficult to place and may be associated with fixation failure, implant breakage, and need for removal of hardware [13]. To eliminate the problems of metal work, several authors have advocated the use of sutures or synthetic loops of absorbable or nonabsorbable material to stabilize the clavicle to the coracoid process with or without excision of the distal end of the clavicle, thus preventing the superior translation of the clavicle [14–17].

However, none of the published techniques reported the AC suturing to prevent the horizontal translation of the clavicle.

The purpose of our study was to evaluate the results of triple fixation of acute ACJ dislocation (type III or more) with AC suture, combined with CC suture loop and coracoacromial (CA) ligament transfer.

Patients and methods

The study was conducted in the Department of Orthopaedic Surgery, El-Hadara Orthopaedic and Traumatology University Hospital, Alexandria University, Egypt from 2008 to 2010. Twenty-five shoulders in 25 patients, 20 men and five women, with acute ACJ dislocation (Rockwood grade III or more) were included in the study. All patients had history of shoulder trauma and presented within 2 weeks after the injury. Patients with chronic ACJ dislocation or with associated ipsilateral shoulder fracture were excluded from the study. The mean age of the patients was 32.4 years (range, 25–42 years). The right shoulder was affected in 14 patients.

All patients underwent thorough clinical examination followed by radiological evaluation with plain radiograph (anteroposterior and with weight). The Constant score was used in the study to monitor the state of the shoulder before and after at least 6 months from the operative intervention. This is a 100-point score with parameters of pain (15 points), activities of daily living (20 points), range of motion (40 points), and power (25 points) [18].

At the time of surgery, open suture reconstruction and CC ligament transfer were applied to all patients. The patients were operated upon under general anesthesia and in semisitting position. A 4 cm anterosuperior longitudinal skin incision was applied from the ACJ to the coracoids process. Following splitting of the anterior deltoid fibers, the CA ligament was exposed. A stay suture was applied to the medial half of the ligament, which was then released from its acromial attachment and prepared to be sutured later to the lateral end of the clavicle. Two Ethibond sutures (no. 5) were then wrapped under the coracoid process and around the clavicle (two threads anterior and two posterior to the clavicle). Moreover, four drill holes were made in the acromion and clavicle, two in the lateral clavicular and two in the medial acromial ends, where another Ethibond suture was used to pass through these holes (from the clavicle to the acromion and back to the clavicle). The ACJ dislocation was then reduced, followed by tying the two CC loops then the AC suture. Finally, the CA ligament was transferred and sutured to the under surface of the clavicle. The stability of the reconstruction was intraoperatively assessed by moving the shoulder in different planes. Approximating stitches were applied to the deltoid muscle followed by subcutaneous and skin closure. Figure 1 shows a schematic diagram for the triple fixation technique used in the study.

Postoperatively, all patients were immobilized in a broad arm sling for 4 weeks. A three-phase rehabilitation program was then initiated: 3-week passive exercises, 3-week active assisted exercises, and 4-week strengthening exercises.

Results

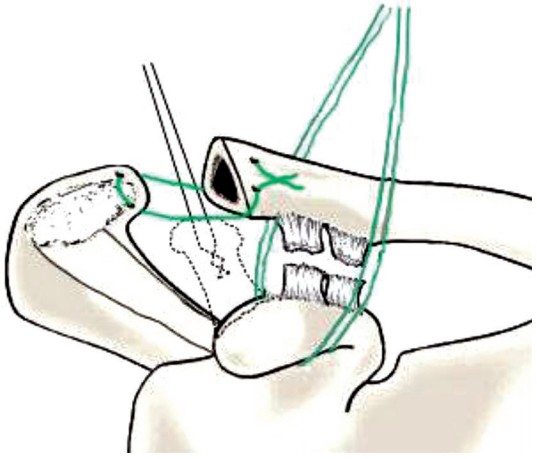
The follow-up period ranged from 15 to 22 months, with a mean of 19 months. The mean Constant score improved significantly from 20.4 points (range, 13–25 points) preoperatively to 96.01 points postoperatively (range, 85–99 points) ($P < 0.01$).

The mean score of pain improved from 0.80 point (range, 0–5 points) preoperatively to 13.10 points (range, 10–15 points) postoperatively. The mean range of motion improved from 14.44 points (range, 8–18 points) preoperatively to 34.79 points (range, 28–38 points) postoperatively. The differences between the preoperative and postoperative pain and range of motion were statistically significant ($P < 0.001$).

All 25 patients were satisfied and returned to normal life at a mean of 2.5 months postoperatively (range, 2–3.5 months).

Radiologically, 22 patients achieved anatomical reduction of ACJ. In three patients, mild sublaxation was encountered; however, this did not affect the

Figure 1



Triple fixation of acromioclavicular joint dislocation, coracoclavicular cerclage, coracoacromial ligament transfer, and acromioclavicular suture.

overall results. No intraoperative or postoperative complications were encountered.

Figure 2 shows the preoperative and postoperative radiographs of one of the cases with acute ACJ dislocation.

Discussion

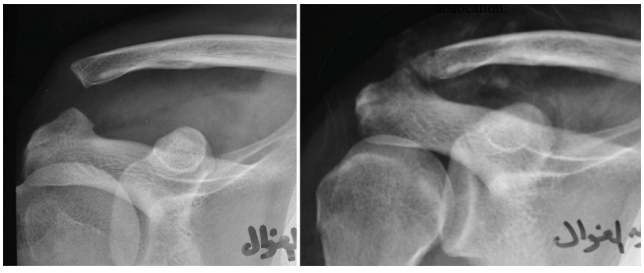
ACJ injuries and, more specifically, dislocations are common both in everyday activities and during athletic participation [1].

Surgical treatment for acute ACJ injuries remains controversial; it is indicated in types IV, V, VI, and in most cases of type III injuries. More than 75 surgical procedures have been described for the treatment of AC injuries, but none have established a gold standard [19,20].

Many of the described surgical procedures involve the use of metallic hardware such as Kirschner (K) wires [21], pins [22], screws [23], and hook plates [24]. These metallic implants are usually difficult to place and are associated with high incidence of failure and complications, such as loss of reduction, pin migration [25,26], plate bending, plate dislocation, and surgical-site infection [27]. Moreover, such implants have to be removed before returning back to normal activities, with the increased risk for another surgical intervention.

Other surgical procedures involve CA ligament transfer, and, despite various modifications, they are generally referred to as the Weaver–Dunn procedure [28]. A cadaveric study has shown that the CA ligament transfer alone was found to be the weakest, and it was recommended that this type of repair should be augmented with another form of CC fixation [29]. Some other techniques reconstructed the CC and AC ligaments for both acute and chronic cases using tendon grafts; however, these techniques required temporary hardware fixation such as K- wires with its hazards and need for removal [25,30].

Figure 2



Preoperative and postoperative radiographs of one of the cases with acute acromioclavicular joint dislocation.

Semitendinosus allograft was also used to reinforce reduction and healing, either open or arthroscopically, sometimes with temporary fixation with K-wires with good results [31]. Jiang *et al*. [32] transferred the lateral half of the conjoined tendon to be fixed to the lateral third of the clavicle with 11% failure.

The use of sutures, synthetic loops, or suture anchors of absorbable or nonabsorbable material to stabilize the clavicle to the coracoid process was reported by several authors [14,15,33]. Tienen *et al*. [16] used absorbable braided sutures to transfer the CA ligament to the under surface of the clavicle; this technique failed to reduce the ACJ in three (14.4%) of 21 patients.

A cadaveric study has shown that similar stability can be achieved for CC fixation with suture anchors or with sutures of similar material, placed around the base of the coracoid for the treatment of ACJ dislocation [34].

Another cadaveric study has shown that suture anchors can provide strength similar to that of intact CC ligament [29]. Shin *et al.* [35] used CC ligament reconstruction for AC dislocation using two suture anchors and CA ligament transfer. With a follow-up of 28 months, the mean Constant score was 97, but there were three patients with complete loss of reduction. Although the use of anchors is easier and quicker, it is obviously more expensive and has the risk for loss of reduction due to the pulling out of the anchors.

In our study, acute AC dislocations (type III or more) were treated with CA ligament transfer combined with CC suture loop to prevent the superior translation of the clavicle. Moreover, additional AC suture fixation was performed to add stability and to prevent the horizontal clavicular translation. No complete failures or redislocation of the ACJ were encountered. Three patients had mild subluxation with no effect on the daily activities, and the overall Constant score improved to a mean of 96. We did not encounter any neurovascular injuries from the sutures passed around the coracoid.

The technique is easy with a small incision (4 cm) and is cheap, without anchors (using only sutures) and metal implants, which need later removal. The CC cerclage and AC transosseous sutures make ACJ stable in both vertical and horizontal planes. The association of CA ligament transfer improves the fixation and further reinforces the repair.

This triple fixation is rigid, and it also allows the remnant fibers of the torn CC ligament to be more closely aligned, and thus heal together in a more

anatomical position without the need for the difficult handling of the torn, unreliable tissues of the CC ligaments.

Conclusion

Triple fixation technique is a simple, cheap, and reliable procedure for restoring stability in cases of acute ACJ dislocations. It does not only prevent the superior translation, but also prevents the horizontal translation of the clavicle with neither redislocations nor postoperative stiffness. It also encourages early postoperative mobilization.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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