Double-attack technique in surgical treatment of acute complete acromioclavicular joint dislocation

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Introduction
Acromioclavicular joint (ACJ) dislocation often affects young athletes, and those involved in road traffic accidents and fall from height. Majority of these patients sustain high-grade injuries requiring surgical management to allow them to return to their sports.

Patients and methods
This was a prospective study of 16 patients with acute complete ACJ dislocations treated in Zagazig University Hospital in the period between February 2008 and January 2012. All patients were treated surgically using coracoclavicular screw fixation passed from the clavicle to the base of the coracoid process of the scapula supplemented with transfer of a half-thickness coracoacromial ligament with attached bone fragment to the distal clavicle.

Results
According to the Rockwood classification, five (31%) patients had type III lesion, four (25%) had type IV lesion, and seven (44%) had type V lesion. Ten (62.5%) patients showed excellent results, two (12.5%) showed good results, one (6.25%) showed a fair result, and one (6.25%) showed a poor result.

Conclusion
Open reduction and internal fixation of acute complete ACJ injury using the double-attack technique, coracoclavicular screw fixation supplemented with medial half coracoacromial ligament reconstruction, is technically simple, with high rates of satisfactory results, as it allows good functional outcome of the shoulder joint.

Keywords:
acromioclavicular, double attack, joint dislocation

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Introduction

Acromioclavicular joint (ACJ) dislocation is not uncommon and is normally caused by high-energy-impact injuries [1,2]. In some reports in the literature, treatment of incomplete ACJ dislocation is favored using nonsurgical methods. However, treatment of complete ACJ dislocation is still controversial [1–6]. ACJ dislocation has been subclassified by Rockwood into six types according to the extent of clavicle displacement and the severity of ligament compromise [1–4]. According to this classification, types I and II are incomplete dislocations and types III–VI are complete dislocations. Currently, surgical treatment for types IV–VI ACJ dislocation is supported by most orthopedists. As for type III ACJ dislocation, both early surgical treatment and nonsurgical treatment initially with late reconstruction if necessary have achieved support. Even so, a satisfactory surgical technique has not yet been developed [1–6].

Coracoclavicular (CC) screw fixation supplemented with different reinforcing techniques has been supported by some orthopedists [1,2,7,8]. Among these various reinforcing techniques is coracoacromial (CA) ligament reconstruction, which has achieved the most support [1,2,7–11]. In our study, CC screw fixation was augmented by transfer of medial half-thickness of the longitudinally split CA ligament with attached bone fragment to the distal clavicle.

Patients and methods

Sixteen patients with acute complete ACJ dislocations were treated in Zagazig University Hospital in the period between February 2008 and January 2012. Five patients were type III, four were type IV, and seven were type V. Twelve patients were men and four patients were women. Patients' ages ranged from 17 to 45 (mean 33.5) years. The cause of ACJ dislocations was motor vehicle accidents in six patients, fall from height in six, and fall on an outstretched hand in four. All patients were treated surgically using CC screw fixation supplemented with transfer of a half-thickness CA ligament with attached bone fragment to the distal clavicle (Table 1).

Surgical technique

All patients underwent general anesthesia with end tracheal intubation and were placed on the operating

table in the beach chair position. The involved shoulder was displaced outside the table to facilitate C arm positioning for fixation evaluation. A strap incision to expose the ACJ, the lateral end of the clavicle, and the coracoid process was performed [2]. It began 1 inch posterior to the clavicle, crossed the clavicle 1 inch medial to the ACJ, and then extended down to a point medial to the tip of the coracoid process. The incision was then undermined so that the ACJ, the distal 2 inches of the clavicle, and the anterior deltoid could be visualized. We divided the interval between the trapezieus and the deltoid in the distal 2 inches of the clavicle so that the clavicle could be grasped by a clamp and lifted upward. Then, the intra-articular disc, any loose frays, and tags of the ACJ ligament were debrided thoroughly. Nonabsorbable suture was taken at the remnants of the CC ligament but left nontightened till after fixation of the CC screw. The ACJ was then reduced and stabilized with a reduction clamp. With the superior surface of the clavicle exposed and the base of the coracoid visualized and palpated, a CC screw was placed vertically through the clavicle to the base of the coracoid. The screw was tightened until the ACJ was slightly over-reduced. The CA ligament was exposed and split longitudinally. The coracoid end of the medial half of the ligament was left attached to the coracoid, whereas the acromial end of the medial half was harvested with attached bone fragment and was fixed to the upper surface of the distal clavicle using a nonabsorbable suture through tow drill halls in 10 patients (Fig. 1) or a small compression lag screw in six patients (Fig. 2) after the upper surface of the clavicle was roughed. The CC screw was slightly loosened till the ACJ was exactly reduced. This allows the transferred CA ligament to be stretched. The suture that was taken at the remnants of the CC ligament was tightened. The proximal and distal end of the acromioclavicular ligament was repaired. The deltotrapezial muscle facial interval was repaired back to the clavicle and the wand was closed in layers.

Table 1 Patient data

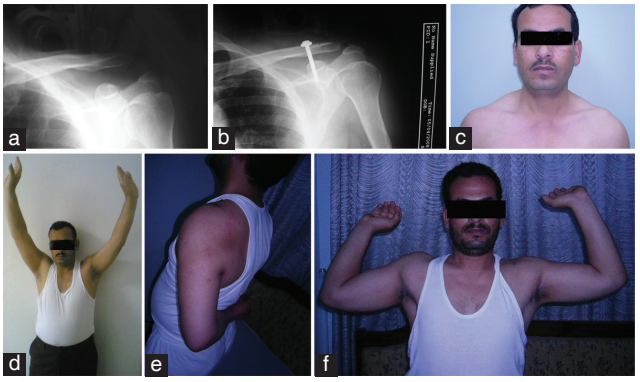
Type of injury	
Type III	5
Type IV	4
Type V	7
Cause of injury	
Motor vehicle accidents	6
Fall from height	6
Fall on outstretched hand	4
Type of injury	
Type III	10
Type IV	4
Type V	2
Cause of injury	
Motor vehicle accidents	6
Fall from height	6
Fall on outstretched hand	4

After the operation, each patient used a sling for 3 weeks. Then, patients were permitted to perform their daily activities gradually. Abducting the upper extremity above the shoulder was prohibited for 6 weeks. After 3 months, patients were permitted to perform normal activities. The CC screw was not removed routinely, but it was removed under local anesthesia in two patients as its head was prominent under the skin and in one patient as it became loose and painful. Each patient's clinical recovery course was followed up annually and whenever necessary. The wound condition and complications were recorded and managed. To evaluate the functional outcomes of the shoulders, Imatani's scoring system was used [12]. It included assessment of pain, function, and movement of the shoulder. Four grades were categorized and a satisfactory outcome included an excellent or a good result (Table 2). This scoring system was used because of its relative simplicity and practicality.

Results

Sixteen patients were followed up for 12–35 (mean 21.5) months. The operating time ranged from 58 to 120 (mean 95.6) min. During the latest follow-up examination, satisfactory outcomes were noted

Figure 1



Male patient, 41 years old, was involved in a road traffic accident. Shoulder radiograph shows type III acromioclavicular joint (ACJ) dislocation. Coracoclavicular screw fixation was performed and medial half-thickness transfer of the coracoacromial ligament with attached bone fragment was performed and fixed to the distal clavicle using nonabsorbable suture. The patient used a sling for 3 weeks, and then resumed daily activities gradually for another 3 weeks and arm abduction after 6 weeks. Normal activities were resumed after three months and the patient had a satisfactory outcome. (a) Preoperative radiograph shows type III ACJ dislocation. (b) Postoperative radiograph. (c) Preoperative photo shows a prominent left clavicle. (d) Postoperative photo shows full abduction. (e) Postoperative photo shows full internal rotation. (f) Postoperative photo shows full external rotation.

in 14 (87.5%) of the patients. The unsatisfactory complaints in two patients were because of intermittent shoulder pain that required irregular oral analgesics. During the latest follow-up examination, partial loss of reduction of the ACJ occurred in one patient who still showed satisfactory results and no further operations were performed (Fig. 2).

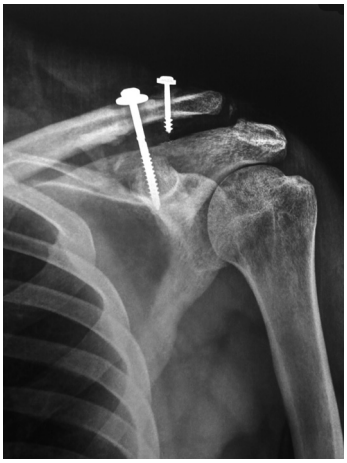
Complications

Two superficial wound infections were treated successfully with oral antibiotics and local wound care. No other complications were observed (Table 3).

Discussion

Conservative treatments for acute type III ACJ dislocations have been reported with high satisfactory rates [1–6]. The satisfactory rate of surgical treatment type III ACJ dislocations is around 88% [5,6]. Therefore, a large number of orthopedists consider surgical treatment for acute type III ACJ dislocation simply for cosmetic reasons [1–4,13]. Irrespective of the nonsurgical or surgical treatment performed, the most common complaint of failure of treatment is shoulder pain [5,6]. In some reports in the literature, symptomatic pain occurs more commonly in patients with surgical treatment. The pathomechanism of shoulder pain associated with complete ACJ dislocation is varied, which can be induced by many bony or soft tissue factors solely or concomitantly [1,2]. Theoretically, anatomic reduction of the dislocated ACJ may avoid tenting the soft tissues and the skin. Thus, shoulder pain may be ameliorated. However, surgical reduction of the dislocated joint may extensively destroy the compromised soft tissues. Treatment of acute complete ACJ dislocation is always controversial from various viewpoints [1,2]. Once surgical treatment is chosen, the principle of reducing destruction of soft tissues and proving sufficient stability should always be followed [1,2,8,9]. By itself, CC screw fixation may not provide sufficient stability; thus, various supplementary techniques normally are needed [1,2,7,8,11]. In patients with complete ACJ dislocation, the torn CC ligament normally is so damaged that the effectiveness of repair is questionable. Reconstruction using the CA ligament can reinforce the stability of the ACJ (14). Clinically, it had several advantages. It supplemented the CC screw fixation during the recovery process and reduced the stress on it. It preserved the articular cartilage of the ACJ compared with other techniques in which the ACJ was fixed by metals [14–17]. Therefore, it had a comparative satisfactory result with the Copeland and Kessel technique (18), which required no stabilization of the ACJ. In some reports in the literature, fixation of the CC segment can be performed using various nonabsorbable sutures, tape, wire, or various screws [1,2,7–11]. In our study, CC screw fixation supplemented with transfer of the medial half of the split CA ligament was used. It provided sufficient stability during the recovery period. In their study, Wellmann *et al.* [19] used a

Figure 2



Follow-up radiograph shows partial loss of reduction. The transferred coracoclavicular ligament was fixed to the clavicle using a small compression screw.

Table 2 The scoring system by Imatani's for acromioclavicular separation

Distributions	Score
Pain (40 points)	
None	40
Slight, occasional	25
Moderate, tolerable	10
Limited activities, severe, constant, disabling	5
Function (30 points)	
Weakness (proportion of preinjury)	20
Use of shoulder	5
Change of occupation	5
Movement (30 points)	
Abduction	10
Flexion	10
Adduction	10
Result	
Excellent	91–100
Good	81–90
Fair	61–80
Poor	<60

Table 3 Results

Excellent	10
Good	4
Fair	1
Poor	1

similar supplementary technique for the treatment of acute ACJ dislocation in which the medial half of the CA ligament was transferred and fixed in a medialized position at the clavicle, but the CC augmentation was performed using a strong 1-mm polyester loop that was intertwined between two flip buttons for coracoid and clavicle fixation, and they concluded that the augmented CA ligament transfer using the medial half of the CA ligament and supplementing it with a strong 1-mm polyester loop intertwined between two flip buttons for coracoid and clavicle fixation has been shown to restore anterior and superior translation of the native ACJ [19]. In another study, 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 [20]. The CA ligament plays a role in static restraint of the glenohumeral joint. It provides a suspension function and may restrain anterior and inferior translations through an interaction with the coracohumeral ligament; this indicates that the CA ligament contributes toward glenohumeral stability. Release of the CA ligament resulted in a significant increase in glenohumeral joint translations in both the anterior and the inferior directions. Caution should be exercised in the release of the CA ligament [21]. In our study, we transferred the medial half of CA ligament and left the lateral half, thus preserving the stability and the biomechanics of the shoulder joint. This technique requires a longer operating time and more extensive dissection of soft tissues because of the need for CA ligament dissection. Shoulder pain may be induced by soft tissue factors or ACJ arthritis. Once it occurs, resection of distal clavicle may be attempted [22,23].

The main advantage of this technique was its technical simplicity as compared with other techniques and the outcomes were largely similar.

Conclusion

Open reduction and internal fixation of acute complete ACJ injury using the double-attack technique, CC screw fixation supplemented with medial half CA ligament reconstruction, is technically simple, with high rates of satisfactory results, as it allows good functional outcome of the shoulder joint.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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