Treatment of acromioclavicular joint dislocation by hook plate and direct coracoclavicular ligament reattachment to the clavicle

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Received 13 December 2018
Accepted 1 January 2019

The Egyptian Orthopaedic Journal 2018, 53:316–321

Objective
The aim of this study is to evaluate the clinical outcome of treatment of acute acromioclavicular (AC) joint dislocation by clavicular hook plate and coracoclavicular ligament reattachment to the clavicle.
Patients and methods
A prospective study including 20 patients with AC joint dislocation either type III or V was conducted from October 2012 to June 2014 in Ain Shams University Hospitals. Patients were treated by open reduction of the dislocated AC joint and internal fixation by clavicular hook plate together with reattachment of the coracoclavicular ligament by transosseous sutures to the clavicle. The plate was removed after 3 months of the operation. The patients were evaluated by plain radiography for AC joint stability and functionally by Constant–Murley score.
Results
The mean follow-up period of the 20 patients was 18.05 months. The mean age was 33.35 years. The operative time of our procedure was of a mean of 43.65 min. All the patients had the plate removed at the third month postoperatively (mean, 97.3 days). Follow-up radiograph after plate removal showed maintained reduction of AC joint in 18 patients. Slight loss of reduction of 1–2 mm was noticed in the other two patients. The mean Constant–Murley score in the last follow-up was 92.9.
Conclusion
Based on this study, the treatment of acute AC joint dislocation using the clavicular hook plate combined with coracoclavicular ligament reattachment to the clavicle yields good short-term clinical results with a good functional outcome and low complication rate compared with other operative procedures.

Keywords:
acromioclavicular dislocation, conoid ligament, hook plate, trapezoid ligament

Egypt Orthop J 53:316–321

1110-1148

Introduction

Acromioclavicular (AC) joint separation represents one of the most common shoulder injuries seen in general orthopedic practice. Management of AC joint injuries has been controversial and continues to evolve [1]. Treatment modalities have changed with increasing understanding of the nature of the problem and the biomechanics of the joint [2].

Various surgical procedures have been described for the treatment of complete AC joint dislocation, but no consensus exists on the optimal therapy. The aim of each type of procedure is to stabilize the clavicle by substitution of the ruptured coracoclavicular ligaments [3]. The use of hook plates is an effective treatment option for AC joint dislocation to improve shoulder function and allow early mobilization of the shoulder [4].

The objective of this study is to evaluate the outcome of surgical treatment of acute AC dislocations (types III and V) using fixation with a hook plate and coracoclavicular ligament reattachment to the clavicle by transosseous sutures to maintain the AC joint stable even after removal of the plate.

Patients and methods

A prospective study was conducted including 20 patients in the period between October 2012 and June 2014 in Ain Shams University Hospitals. This study was approved by the Ethical Committee of Ain Shams University. All patients signed an informative consent form. Fifteen patients were males and five were females with age ranging from 21 to 48 years old. Eleven cases were Rockwood type III and the other nine were Rockwood type V dislocation. Twelve injuries were right sided and eight injuries were left sided. The

 DOI: 10.4103/eoj.eoj_67_18

mechanisms of injury included 11 road traffic accidents, five falls from heights, and four sports injuries.

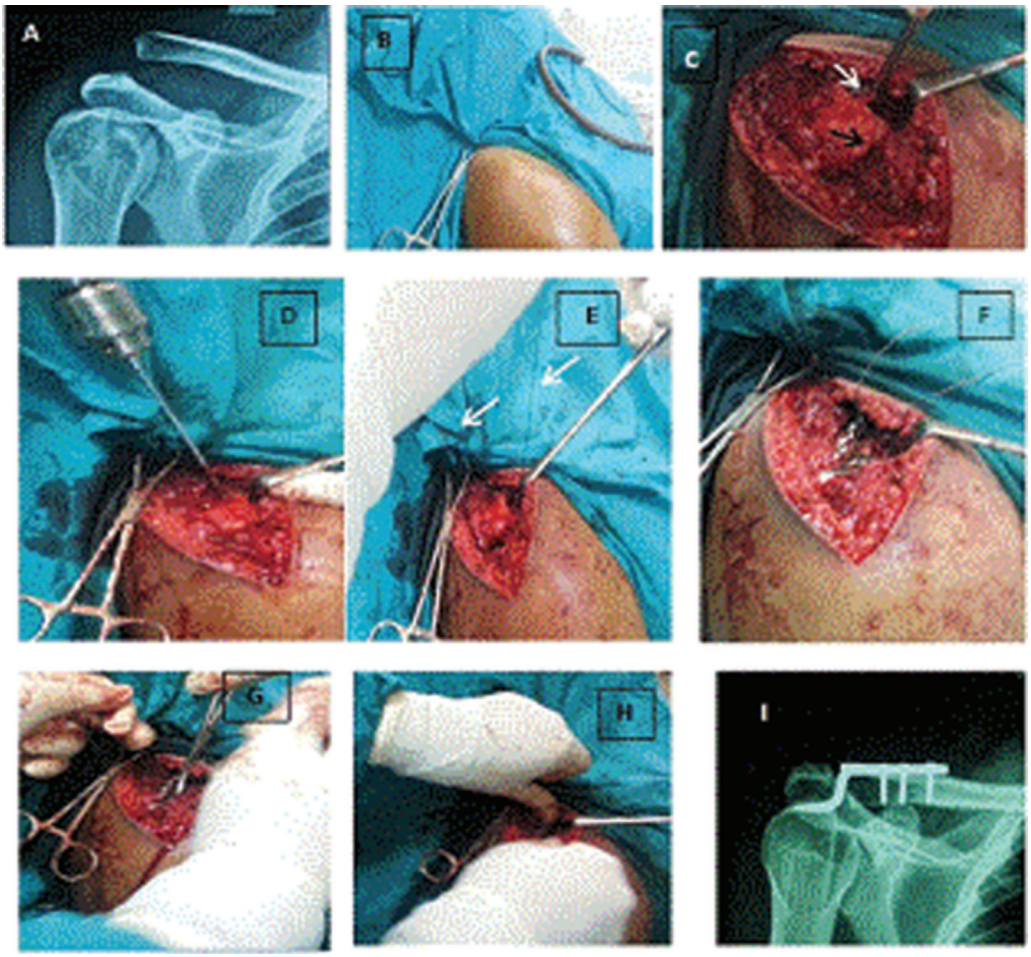
The preoperative evaluation of AC joint injury was done by plain radiography to classify the dislocation according to the degree of displacement. Other types of AC dislocation (Rockwood types I, II, IV, and VI), open injuries, and patients with associated shoulder fractures were excluded from the current study.

The patients were operated in beach chair position under general anesthesia with the arm on the affected side, freely moveable. A small roll was placed under the ipsilateral shoulder.

An incision 7–10 cm in length was made, 2 cm lateral to the AC joint. Full-thickness subcutaneous flaps were made for exposure of deltoid and trapezius aponeuroses, AC joint, and the lateral 4 cm of the clavicle. Then the fascia, periosteum, and capsules were incised to expose the dislocated joint and lateral third of the clavicle. Infraclavicular dissection was done to identify the coracoclavicular ligament. Stay sutures were applied to suspend the ligament using nonabsorbable polyester number 2. Two drill holes are done through the clavicle for reinsertion of the coracoclavicular ligaments to the clavicle. The stay sutures were passed through the drill holes without any locking or tightening of the sutures at that stage. The dislocated AC joint was reduced. After securing the hook below the acromion and adjusting the plate so as not to obscure the drill holes and sutures, the plate is fixed to the clavicle with three screws at least. We used locked stainless steel hook plates. The stay sutures are tightened to the clavicle with appropriate tension in the reduced position of the AC joint. Closure of the wound was done in layers, and the patient arm was suspended in pouch arm sling. Postoperative radiography was done, and the patient was discharged 1 day later in the pouch arm sling (Fig. 1).

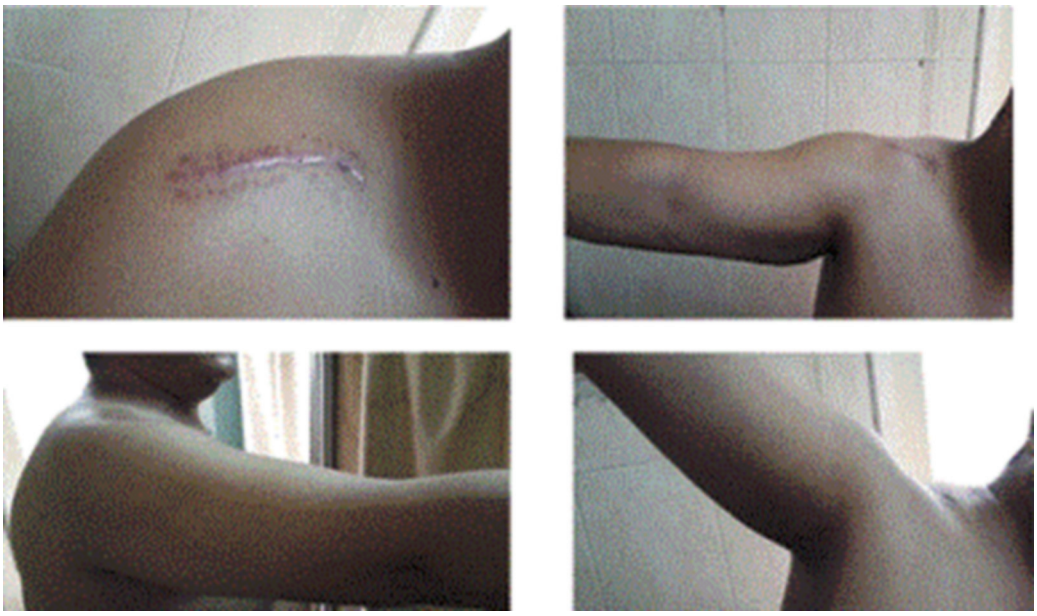
The follow-up schedule was 2 weeks postoperative for removal of sutures and starting range of motion under physiotherapist supervision (Fig. 2). The patient was

Figure 1



(a) Preoperative radiograph. (b) Patient in beach chair position. (c) The black arrow points the AC joint and white arrows point to the coracoclavicular ligament. (d) Drill holes. (e) The white arrows point to the stay sutures. (f) The plate in place. (g, h) Tightening of the sutures. (i) Immediate postoperative radiograph. AC, acromioclavicular.

Figure 2



The wound and range of motion of the shoulder after 1 month postoperatively.

instructed not to carry heavy objects for the first 3 months by the affected limb. Monthly radiography was done till the third month postoperatively. All patients were scheduled for plate removal 3 months postoperatively.

After removal of the plate, radiography was done monthly for the first 3 months and then every 3 months for the first year. Final functional evaluation was done according to Constant–Murley score.

Results

The mean age of the patients enrolled in this study was 33.35 years old. Five patients had associated injuries either surgical or orthopedic injuries owing to high-energy trauma. Patients who had fractures in the same limb were excluded from the study. The time passed since the date of injury till operation was of mean 3.3 days. This delay was because of either late presentation or time needed till stabilization of the general condition of the high-energy trauma patient. The operative time of our procedure ranged from 65 to 30 min, with a mean of 43.65 min. This time was calculated from the incision time till the last stitch taken. One patient had superficial wound infection with prolonged discharge for more than 5 days. This infection was controlled with antibiotics and frequent dressing. The hospitalization period was of a mean 4.95 days. The patients with solitary AC injury had the shorter stay at hospital. Polytraumatized patients and high-energy trauma patients had longer hospitalization period.

The patients started range of motion of the affected shoulder after 2 weeks of the operation. Four patients complained of mild impingement symptoms or shoulder discomfort during motion in the first 3 months. These symptoms disappeared after plate removal. Radiological assessment before plate removal showed no acromion osteolysis or loss of reduction. All the patients had the plate removed 3 months postoperatively (mean, 97.3 days).

Follow-up radiograph after plate removal showed maintained reduction of AC joint in 18 patients (Fig. 3). Slight loss of reduction of 1–2 mm was noticed in the other two patients that did not affect the final functional outcome.

The functional outcome of the patients was assessed using the Constant–Murley score. The highest score was 99 and the lowest score was 78 with a mean of 92.9.

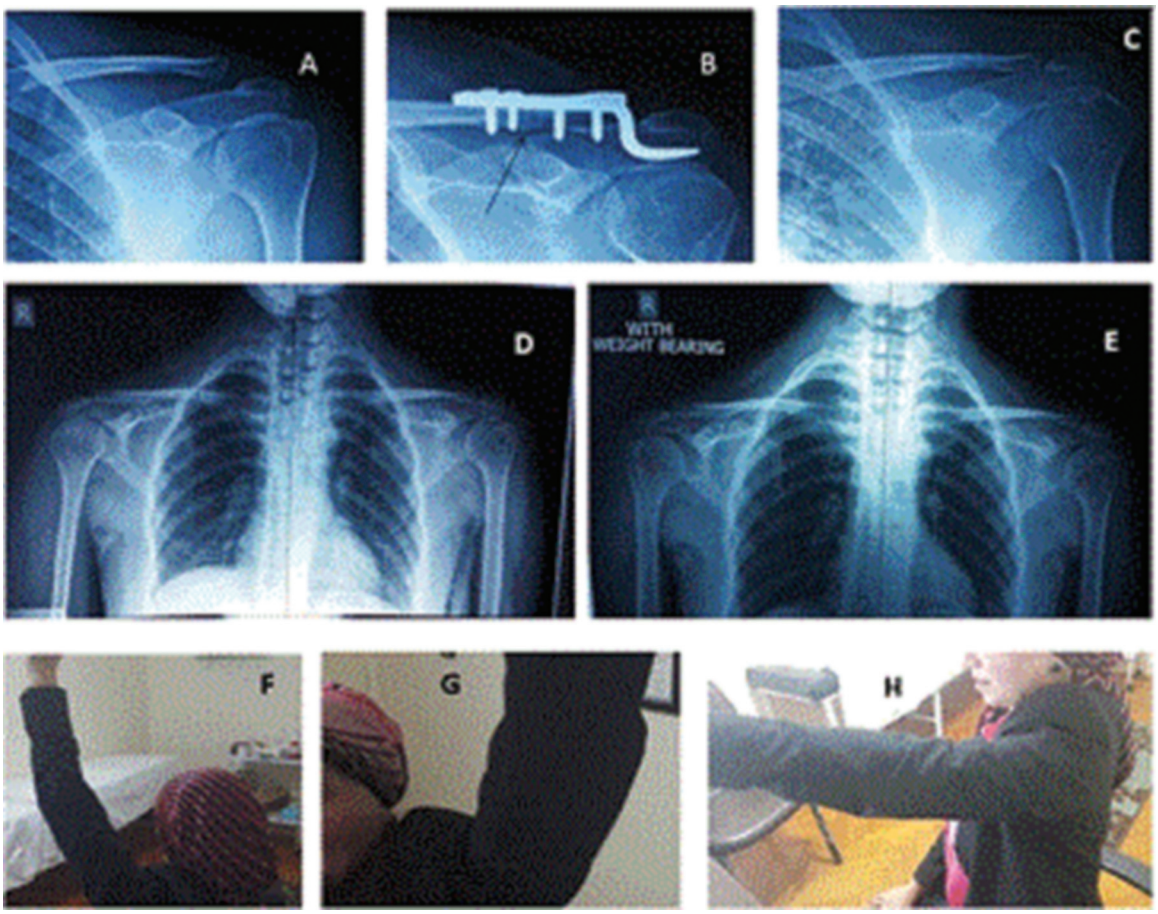
The follow-up period ranged from 12 to 24 months. The mean of follow-up period was 18.05 months (Table 1).

Discussion

Depending on the magnitude of injury to the AC joint capsule and ligaments as well as to the coracoclavicular ligaments, AC joint dislocation can be classified with increasing severity as type I through type VI [5].

From a biomechanical perspective, the importance of the coracoclavicular ligaments and AC ligaments in

Figure 3



(a) Preoperative radiograph of AC dislocation type III. (b) Immediate postoperative radiograph. The black arrow shows drill hole for attachment of the coracoclavicular ligament. (c) Plain radiograph after plate removal. One-year follow-up radiographs show reduced AC joint with maintained coracoclavicular distance in comparison with the other shoulder in static films (d) and stress view of the AC joint while carrying 10 kg in both hands (e). (f–h) Full range of motion of the shoulder after 1 year. AC, acromioclavicular.

controlling superior and horizontal translations has been elucidated [6–8]. In fact, failure to surgically reproduce the conoid, trapezoid, and AC ligament function in treatment of AC dislocation may explain the observed incidence of recurrent instability and pain [9].

When treating AC joint injuries, simple repair of the coracoclavicular and AC ligaments without the additional support of internal fixation is likely to fail [3]. A wide variety of internal fixation techniques have been used, each of which has limitations and complications [10]. These include bandages, fixation of the AC joint with pins, tension band wiring, modified Weaver–Dunn procedure, fixation with washer and screw, and clavicular hook plate [11].

The clavicle hook plate is an easy to handle solid plate that aligns the clavicle and does not interfere with its rotational movement [12]. It allows as well early mobilization of the shoulder joint [4]. Eschler *et al.* [13] in a comparative study between the hook plate and polydioxansulfate sling in the treatment of AC joint separation concluded that hook plate fixation finally restores the coracoclavicular distance more accurately. Although there have been favorable results in many studies using the hook plate, several documented complications such as infection, subacromial impingement, and acromial osteolysis have been reported [14,15]. So, it is important to inform the patients about the necessity of timely removal of the plates as recommended to limit the morbidity associated with the plate being left *in situ* [11].

Moreover, it has been reported that when the plate has been applied alone in primary cases, even 1 year after plate removal, there is the possibility of recurrence in 12% of cases [16]. For that, we think the primary stabilizers of the AC joint, especially the coracoclavicular ligaments, should be addressed when dealing even with acute AC dislocation.

Use of synthetic materials or grafts for coracoclavicular fixation has been associated with many complications. Several authors reported infection and erosion of the

Table 1 Patients' data

	Age (years)	Mode of trauma	Injury classification	Time to operation (days)	Operative time (min)	Hospitalization. (days)	Removal of plate (days)	Follow-up (months)	Constant–Murley score
1	25	Sport	III	1	65	2	93	24	98
2	36	RTA	III	3	46	5	98	24	94
3	21	Fall	V	2	58	3	105	24	92
4	34	RTA	III	5	49	8	97	22	95
5	26	Fall	V	3	47	3	106	21	88
6	34	RTA	V	4	53	3	95	20	93
7	42	RTA	III	2	36	3	89	20	96
8	21	Sport	III	1	32	2	98	19	99
9	48	RTA	V	4	42	7	97	18	78
10	28	Fall	III	7	39	3	95	18	96
11	37	RTA	III	8	48	12	98	17	89
12	22	Sport	V	2	46	3	98	17	98
13	45	RTA	V	6	52	9	106	16	90
14	33	Fall	III	3	38	6	96	16	97
15	30	RTA	V	2	35	5	92	16	90
16	42	RTA	V	3	46	6	96	15	92
17	33	Fall	III	2	36	7	102	15	96
18	40	Sport	III	1	35	2	94	14	89
19	39	RTA	V	5	40	4	97	13	95
20	31	RTA	III	2	30	6	94	12	93
Mean	33.35			3.3	43.65	4.95	97.3	18.05	92.9

RTA, road traffic accident.

distal clavicle caused by the synthetic loop [17]. Neurovascular injury can occur as sutures are passed around the base of the coracoid process [18]. Costic *et al*. [19] compared anatomic restoration using semitendinosus tendon with intact CC ligament. Although the reconstruction resulted in a significant development in biomechanical terms, properties of strength of up to 40% of the normal CC ligament and maximum resistance of up to 75% were shown. In a cadaver study of anatomic reconstruction with semitendinosus graft, reasons for graft failure were clavicular fracture, impairment of the graft integrity, and fractures forming in the coracoid process. Lee *et al*. [20] also showed impairment of the graft internal integrity and coracoid layer fractures to be the reason for failure in studies of anatomic reconstruction.

In our technique, we used the hook plate for treatment of types III and V of AC joint separation. It is an easy and rapid procedure that allows reduction and maintains the joint reduced. The hook plate allows early range of motion of the shoulder joint and early physiotherapy. Coracoclavicular ligament is dissected and reattached again to the clavicle through drill holes to restore the normal anatomical restraint against AC joint subluxation. The hook plate is removed after 3 months. This period allowed solid attachment of the coracoclavicular ligament to the clavicle and avoided the aforementioned complications.

The mean follow-up was 18.05 months. Patients in the current study had neither persistent impingement symptoms nor acromial osteolysis. The Constant–Murley shoulder outcome score was of a mean of 92.9 at the last follow-up. It is a better functional outcome than a group of patients who underwent hook plate and ligament reconstruction by palmaris longus (88.5) and another group used suture anchors (92.7) in a comparative study done by An *et al*. [21] This score also is better than the score of patients who underwent modified Weaver–Dunn procedure and hook plate in treatment of AC joint dislocation (88.2) by Liu *et al*. [3].Our data provide short-term results for this technique. Further investigation and long-term results are needed to confirm these preliminary findings.

Conclusion

Based on this study, the treatment of acute AC joint dislocation using the clavicular hook plate combined with coracoclavicular ligament reattachment to the clavicle yields good short-term clinical results with a good functional outcome and low complication rate compared with other operative procedures.

Financial support and sponsorship
Nil.

Conflicts of interest

There are no conflicts of interest.

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