A rare injury of ipsilateral mid-third clavicle fracture with acromioclavicular joint dislocation

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Published online: 22 March 2011
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Introduction

Injuries around the clavicle are quite common. Furthermore, AC joint dislocation combined with fracture of the distal end of the clavicle are quite frequent and well recognized [13]. However, the specific combination of ipsilateral fracture of the mid-shaft clavicle with AC joint dislocation is a rare injury, and there have been only five reports (eight cases) in the literature [6, 8, 22–24].

To our knowledge, there have been no published study in the English literature for the treatment of this unusual ipsilateral shoulder injury with the use of a TightRope fixation system in reconstructing the AC joint dislocation combined with open reduction and internal fixation of the clavicle fracture with a locking plate.

Case Report

A 38-year-old man was involved in a road traffic accident and sustained an injury to his right shoulder and left elbow.

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He presented inability to use his shoulder with marked ecchymosis, swelling, and tenderness at the mid-clavicle and a prominent distal end of the clavicle. The neurovascular status of the right upper extremity was normal. Radiographic examination of the right shoulder (anteroposterior and axillary view) revealed a displaced mid-shaft fracture of the clavicle and a type-V dislocation of the AC joint according to Rockwood classification (Fig. 1). He also had a transverse fracture of the olecranon of his left elbow. The risks and benefits of operative treatment were discussed with the patient and he agreed to proceed.

Technique

The patient was placed in a semi-beach chair position. A transverse incision was made across the clavicle toward the AC joint. The distal clavicle was displaced, and there was major detachment of deltoid and trapezius muscles from the clavicle. The AC and coracoclavicular (CC) ligaments were found to be ruptured completely. The two fracture fragments of the clavicle were identified. After reduction of the clavicle fracture, fixation was performed with a special precontoured locking plate with eight holes (Acumed). Despite open reduction and internal fixation of the clavicle, the AC joint was still unstable, with superior and posterior displacement under stress, so it was decided to reconstruct the CC ligaments with a TightRope fixation system (Arthrex). The TightRope system is composed of two metal buttons, one circular and one oblong, joined by a No. 5 fiber-wire continuous loop. As sole fixation device, it is recommended for an acute injury (less than 1 month duration) (Fig. 2). The concept of this appliance is that if the joint is reduced acutely and held reduced during the healing phase, the native ligaments will heal restoring the stability of the AC joint.

Fig. 1 Anteroposterior view of the right shoulder revealed a displaced mid-shaft fracture of the clavicle and a type-V dislocation of the AC joint, according to Rockwood classification

The medial and lateral borders of the coracoid process were identified. A 2.4-mm drill bit guide was inserted to the superior clavicle (about 2.5 cm from AC joint) and to the base of the coracoid process as close to the scapula as possible. Using a 4-mm cannulated drill over the pin and through the clavicle and coracoid, we drilled bone tunnels, making sure not to plunge the drill bit or fracture the coracoid. A malleable retractor can also be placed inferior to the coracoid process to ensure that the drill bit does not plunge too deep below the coracoid process. It is important that the direction of the drill is in the center of the superior surface of the coracoid process to achieve an optimal fixation. We removed the guide pin and left the cannulated drill in situ. The TightRope was advanced through the bone

Fig. 2 Reconstruction of the CC ligaments with the TightRope system (Arthrex). The device is composed by two metal buttons, one circular and one oblong, joined by a No 5 fiber-wire continuous loop. As sole fixation device it is recommended only for an acute injury

tunnels with the aid of a suture-lasso wire loop. Finally, the AC joint was reduced and stabilized with the appropriate knots over the round button of the Tight Rope. Two TightRope devices can be used in order to achieve more stability, but in our case, we preferred to use just one because the stability of the AC joint was satisfactory with only one. Finally, we enhanced the stability of the repair by suturing the AC capsule with non-absorbable sutures (2-0 fiber wire) (Fig. 3).

Postoperatively, a sling was applied for 4 weeks with instructions of gentle range of motion up to the shoulder level, pendulum exercises, and flexion-extension of the right elbow. Light duties were allowed from 4 to 12 weeks, and full duties resumed from 3 months onwards. Contact sports were discouraged for 6 months.

Clinical and radiological follow-up was at 2 and 6 weeks and 6, 12, and 18 months. Postoperative radiographs demonstrated union of the fracture and excellent reduction of the coracoclavicular interval and the AC joint (Fig. 4). At the final follow-up, 18 months postoperatively, the patient had an uneventful recovery with no pain and resumption of full duties with full range of motion of the shoulder. Anatomical reduction of the AC joint was maintained.

Discussion

The AC joint is a diarthrodial joint which together with the sternoclavicular (SC) joint provides the upper extremity a connection to the axial skeleton. The AC joint is surrounded by a thin capsule that is reinforced above and below by the superior and inferior AC ligaments (which

Fig. 3 Open reduction and internal fixation of the clavicle fracture with a special precontoured locking plate with eight holes (Acumed) was done. Despite internal fixation of the clavicle the AC joint was still unstable, with superior and posterior displacement under stress. So it was decided to reconstruct the CC ligaments with a TightRope fixation system (Arthrex)

Fig. 4 Postoperative anteroposterior view of the right shoulder demonstrated union of the fracture and excellent reduction of the CC interval and the AC joint

provide the joint with horizontal stability) and the anterior and posterior AC ligaments. The fibers of the superior AC ligament blend with the fibers of the deltoid and trapezius muscles, which are attached to the superior aspect of the clavicle and the acromion process. These muscle attachments are important in strengthening the AC ligaments and adding stability to the AC joint [16]. The meniscus of the AC joint is poorly understood, and little is known of its biomechanical role. AC stability is maintained by the CC ligaments (conoid and trapezoid) in addition to the AC capsule and ligaments (Fig. 5). The conoid ligament appeared to be more important than has been previously described, in that it plays a primary role in constraining anterior and superior rotation as well as anterior and superior displacement of the clavicle [2].

Fig. 5 The AC joint is surrounded by a thin capsule that is reinforced by superior, inferior, anterior, and posterior AC ligaments. AC stability is also reinforced by the CC ligaments (conoid and trapezoid)

AC joint dislocations (six types according to Rockwood classification) (Table 1) as isolated injuries are common. Regarding their treatment, most literature has supported conservative management for Rockwood's grade I and II injuries, whereas there is a general consensus that grade IV, V, and VI injuries are best treated with surgery [17, 18, 21]. The management of grade III injuries, however, remains controversial with proponents for and against surgical treatment. Currently, there are four main surgical treatment options for the dislocated AC joint: (a) primary AC joint fixation (with pins, screws, suture wires, plates, hook plates) with or without ligament repair or reconstruction [15], (b) primary CC interval fixation (with Bosworth screw, wire, fascia, conjoint tendon, or synthetic sutures) with or without incorporation of acromioclavicular ligament repair/reconstruction [4, 9], (c) excision of the distal clavicle with or without CC ligament repair with fascia or suture, or coracoacromial ligament transfer [12, 19, 20], and (d) dynamic muscle transfers with or without excision of the distal clavicle [3]. The multitude of techniques described illustrates the fact that the ideal technique to treat a symptomatic AC joint dislocation remains to be found.

Table 1 Rockwood classification of acromioclavicular joint injuries

Type	Major Injuries	Radiographic appearance
I	Sprain of acromioclavicular ligaments	Normal
II	Disruption of acromioclavicular ligaments; incomplete sprain of coracoclavicular ligaments	May be slightly widened, with clavicle subluxated slightly superiorly
III	Disruption of acromioclavicular and coracoclavicular ligaments	Scapula and acromion displaced inferiorly from clavicle
IV	Similar to type III with clavicle displaced posteriorly	May be normal or slightly widened on anteroposterior radiograph; axillary lateral radiograph shows posterior displacement
V	Disruption of acromioclavicular and coracoclavicular ligaments: major detachment of deltoid and trapezius muscles from distal end of clavicle	Inferior displacement of arm away from clavicle: coracoclavicular interspace is 100% to 300% wider than in normal shoulder
VI	Disruption of acromioclavicular and coracoclavicular ligaments: major detachment of trapezius and deltoid from clavicle: clavicle displaced under coracoid process and posterior to conjoint tendons	Clavicle displaced inferiorly to coracoid process

There are also many reports in the literature regarding injuries around the clavicle [1, 5, 7]. Moreover, the combined shoulder injury of AC joint dislocation with fracture of the distal end of the clavicle is quite common and well recognized [13]. However, the specific combination of ipsilateral fracture of the mid-shaft clavicle with AC joint dislocation is a rare injury, and there are only eight cases in five reports in the literature. Lancourt [8] in 1990 reported a case of a 19-year-old horseback rider who was thrown from the animal, sustaining the combination injury to her mid-shaft clavicle and AC joint dislocation. Surgical intervention performed with reduction, and fixation of the AC joint with two Steinmann pins, the clavicle fracture was not opened, and the CC ligaments were not explored. A 3-year follow-up reported a final good result. Wurtz et al [23] in 1992 reported this combined injury in four cases. One was involved in a motor vehicle accident, two had fallen off a horse, and another had fallen from a bicycle. Three of the patients (type IV AC dislocation) sustained an open reduction and internal fixation and went on to have asymptomatic range of motion. Two of the three were treated by an internal fixation with a CC cancellous bone screw. In the third, AC transfixation Steinmann pins were used. In each of these patients, the fixation device was removed approximately 6 to 8 weeks later. One patient was diagnosed with a type II injury and was treated conservatively with early physiotherapy, with a good final result. Heinz and Misamore [6] in 1995 reported a case of a cyclist who sustained the injury during a race. This patient was treated conservatively with a figure of eight clavicle brace for 5 weeks. The patient returned to his activities without problems, follow-up radiographs showed a wide AC separation with superior displacement of the healed clavicle that was greater than the width of the clavicle. It is unclear what significance this will have on future function for the cyclist. Wisniewski [22] reported a case of a 32-year-old man with AC dislocation entrapment in trapezius muscle of the lateral end of the clavicle, undisplaced clavicle fracture, and CC ligaments were stretched but intact. Kirschner wires were used to stabilize the AC joint. Recently, Yeh et al [24] in 2009 reported a case of a woman, 46-year-old horseback rider who felt down and sustained an injury to her mid-shaft clavicle and an AC joint dislocation. The patient was treated with a plate to the clavicle and a semitendinosus allograft placed through the clavicle, looped around the coracoid, and sewn to itself. In our case, we fixed the clavicle with a locking plate, and for the reconstruction of the CC ligaments, we used the TightRope fixation device.

A complete clinical and radiological work-up is important after a severe trauma to the shoulder. The anteroposterior radiograph of the shoulder may underestimate the displacement of the distal clavicle in an AC dislocation, so

an axillary view is important in determining the type of the dislocation. Furthermore, a computer tomography (CT) of the shoulder may clear the posterior dislocation of the AC joint in type IV dislocation of the AC joint. In our case, the displacement of the distal fracture of the clavicle was major and the coracoclavicular interspace was 100% to 300% wider than in normal shoulder, so it was classified as type V, and it was decided not to undergo a CT scan of the shoulder.

This rare injury is not only a bony injury but also a soft-tissue one. Regarding the clavicle fracture, there is increasing evidence that sequelae from non-operative treatment are more common than once thought [14] and that shortening from a clavicle fracture yields decreased abduction endurance strength and overall patient satisfaction [11]. Regarding the soft-tissue injury, it is important to examine the status of both the AC and CC ligaments. It's vital to stress the clavicle after reduction and fixation of the fracture to see if the clavicle tends to subluxate posteriorly and superiorly at the AC joint. In our case, to achieve stability of the clavicle to the acromion, a TightRope system was used. There are many techniques to repair the CC ligaments and to achieve stability to the AC joint. Choosing the right technique for a specific patient population is important for the successful management of the injury [10].

To the best of the author's knowledge, there are no published studies in the English literature on the use of a TightRope system in reconstructing the AC joint dislocation combined with open reduction and internal fixation of the clavicle fracture with a locking plate for the treatment of this unusual ipsilateral shoulder injury.

Conflict of interest The authors declare that they have no conflict of interest.

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