Case report

Surgical management of a midshaft clavicle fracture with ipsilateral acromioclavicular dislocation: A report on 2 cases and review of the literature

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1. Introduction

The clavicle articulates with the acromion at the acromioclavicular (AC) joint and is tethered to the scapula’s coracoid process by the coracoclavicular ligaments. Injuries to the clavicle are very common as they constitute 4% of all fractures in adults and comprise up to 44% of all shoulder girdle trauma [1–3]. Fractures of the clavicle have been reported to be 12 times more common than dislocations of the AC joint [4,5]. The location of the AC joint on the superolateral aspect of the shoulder and the bony anatomy of the shoulder girdle make it susceptible to dislocation injury. Nearly one-fifth of shoulder girdle injuries involve the AC joint. Even partial disruption of the AC joint may lead to subluxation [6,7]. While both clavicle and AC joint injuries are common, it is a rare event for both to occur concomitantly in the same shoulder [2,5,8–10].

Review of the literature produced one case series which described four fractures to the middle third of the clavicle (classified as an Allman Group) [11] associated with three Rockwood Type IV and one Type II AC disruptions [8]. A separate case report described a Group I clavicle fracture associated with a Type VI AC joint separation in an ice hockey player [9]. Another case report described a midshaft clavicle fracture associated with a Type III AC joint disruption in a cyclist [12]. In all cases, however, there was no report of operative technique since all patients were managed nonoperatively.

The purpose of this report is to describe two cases of this unique injury and the operative strategy utilized by the surgeon. In both cases, a dual plating technique with independent fixation was used to achieve fracture reduction and joint relocation.

1.1. Case 1

A 44-year-old right hand dominant male, who was involved in a motocross bike accident presented to a regional emergency department after unsuccessfully landing a jump. Chest radiographs were obtained upon presentation and revealed a completely displaced right-sided midshaft clavicle fracture, AC joint dislocation, multiple rib fractures, and a pneumothorax. A chest tube was placed prior to arrival to our Level I trauma facility. The patient’s right upper extremity exam detailed a normal C5-T1 motor and sensory exam. Clavicle radiographs, including anteroposterior (AP) view centred on injured clavicle with 15° cephalad tilt, and a bilateral, panoramic view, centred on the manubrium with 15° cephalad tilt (Panoramic), and a computed tomography (CT) scan revealed a right displaced, mid diaphyseal, oblique (Allman, Group I) clavicle fracture (OTA Type 15-B1.2) [13] with approximately 20° of any anterior angular deformity (Fig. 1). The AC joint was diagnosed as a Rockwood Grade III dislocation. The indication for surgery included complete fracture displacement in the context of a multiply fractured forequarter and ipsilateral, unstable AC joint, which was felt by the treating surgeon (initials blinded for review) to portend a poor prognosis if treated nonoperatively. On day 2 postinjury, the ipsilateral AC joint dislocation and clavicle fracture underwent open reduction and internal fixation.

While in the beach chair position, a straight incision was made from the medial side of the clavicle extending laterally over the AC joint. Two supravacuicular nerves were dissected and protected (Fig. 2A). The dissection was further taken through the platysma muscle down onto the clavicle shaft, and the midshaft fracture was reduced with reduction forceps. The dissection was taken laterally and superiorly over the AC joint. Complete disruption of the joint capsule and coracoclavicular ligaments was appreciated. The AC joint was debrided of devitalized tissue. At this juncture, a 2.7 mm and a 2.0 mm lag screw were placed to achieve anatomic reduction of the clavicle diaphysis, leaving the AC joint fully dislocated. Next, a precontoured, titanium, 8-hole superior clavicle plate (Acumed LLC, Hillsboro, OR) was applied on the cephalad surface. This

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titanium plate was applied and fixed with minimal contouring while leaving enough area for the anticipated placement of a second plate distally (Fig. 2B). Next, a 3.5 mm clavicle hook plate (Synthes/AO, Paoli, PA) was placed so that its distal extension (hook) was placed underneath the acromion in order to lever down the clavicle, effectively reducing the AC joint. The stem of the hook plate was then fixed to the shaft of the clavicle. Suture repair of the AC joint capsule and the coracoclavicular ligaments was performed. Due to the concern for the stress riser between the adjacent plates on the cephalad clavicular surface, a 10-hole, 2.7 mm locking reconstruction plate (Synthes/AO, Paoli, PA) was placed with 4, 2.7 mm screws to span this zone (Fig. 2C). Postoperative AP radiographs were obtained to confirm adequate reduction and fixation (Fig. 3). Postoperatively, the patient was managed in a sling and swath to support the weight of the upper extremity for two weeks; however, the patient was instructed on passive range of motion exercises starting with Codman’s activities.

At three months follow-up the patient was progressing well but had limitation of motion with regard to forward flexion of his shoulder. He had resumed normal daily and other physical activities, and was back to motocross, lifting heavy weights, and using a chain saw. He denied pain. The hook plate was removed 4 months postoperatively and the patient noted an improvement in motion specifically in forward flexion. The hook plate removal was performed to prevent the well described entity of acromial osteolysis [14]. No other hardware was removed at that time.

At 13 months follow-up, the patient returned and was given an Upper Limb Disabilities of the Arm, Shoulder and Hand (DASH) [15] follow-up questionnaire, and AP clavicle radiographs were taken (Fig. 4). Radiographs revealed the reduction of the AC joint to be satisfactory though showing a mild degree of subluxation. Physical examination revealed a well healed scar, no tenderness, and no skin tenting. Range of motion demonstrated symmetry with respect to the unaffected shoulder in regards to forward flexion and abduction and the patient had returned to work with no limitation in function. His DASH score was 3.33 (on a one hundred point scale for which lower values are better), which was lower than the reported normative U.S. general population value of 10.10 [16]. The work module demonstrated a score of 6.25, which was also below the U.S. normative value of 8.81 [16].

1.2. Case 2

A 36-year-old male who sustained a severe constellation of injuries from an ATV rollover, presented to our department. The patient had a right-sided acetabular fracture and scapulothoracic dissociation also on the right side which eventuated in a right forequarter amputation. These operations had already taken place prior to attention to his left shoulder injury. Shoulder and clavicle radiographs, including anteroposterior (AP) view centred on injured clavicle with 15° cephalad tilt, and a bi-lateral, panoramic view, centred on the manubrium with 15° cephalad tilt (Panoramic), revealed a left displaced, mid diaphyseal, oblique (Allman, Group 1) clavicle fracture (OTA Type 15-B1.2) [13]. The distal clavicle had been displaced through the trapezius posteriorly, representing a Rockwood Type IV dislocation. A 3D-computed

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Fig. 1. Preoperative anteroposterior view of bilateral clavicles. Note the fractured clavicle and displaced acromioclavicular joint (Case 1).

Fig. 2. (A) Intraoperative view of the medial clavicular diaphyseal fracture. Note the protected supraclavicular nerves, and the torn acromioclavicular joint and coracoclavicular ligaments. The pointed bone reduction clamp is approximating the displaced previously displaced clavicle shaft. (B) The clavicle is reduced. (C) This is a view demonstrating the fixation montage (Case 1).

Fig. 3. Postoperative anteroposterior view of the right clavicle (Case 1).

Fig. 4. Anteroposterior view of the right clavicle 13-months post-operative. The acromioclavicular joint shows mild subluxation in the asymptomatic patient (Case 1).
tomography (CT) scan from his initial spiral CT trauma scan was reformatted to elucidate the injury further (Fig. 5). The indication for surgery included complete fracture displacement and ipsilateral, unstable AC joint. At one month post-injury, the ipsilateral AC joint dislocation and clavicle fracture underwent open reduction and internal fixation. In the operating room, a straight incision was made extending from 2 cm lateral to the left side of midline of the sternum and extending anteriorly over the clavicle and then superiorly over the AC joint. After reduction, an anterior lateral plate (Synthes/AO, Paoli, PA) was applied for fixation. The hook plate (Synthes/AO, Paoli, PA) was placed as in Case 1. Postoperatively the patient was placed in a sling for comfort and was allowed passive range of motion of the entire left upper extremity for a month, followed by active range of motion for the second month.

By three months follow-up the patient was progressing well (Fig. 6). He claimed to have a painless shoulder and on physical examination the patient demonstrated 90° of forward flexion, 80° of abduction and was nontender over his incision. At six months follow-up, after Hook Plate removal, the patient’s range of motion returned to near normal. Radiographs revealed the reduction of the AC joint to be excellent (Fig. 7). His 30-item DASH outcome measure score was 30. This patient lived out of state and did not return for further follow up.

2. Discussion

There have been few published cases that report a concomitant clavicle with either AC or CC ligament disruption, and none evaluated surgical results with fixation of both injuries [2,3,5,8,12,17]. Though a different scenario than what we were presented, surgical treatment of a distal clavicle fracture with disruption of the ipsilateral coracoclavicular ligament with concomitant AC disruption has been described in various reports [2,3,17]. Surgical management of these injuries was performed with different techniques, ranging from suture anchors, intramedullary Kirshner-wires, Mersilene tape, and cannulated screw fixation. With regard to midshaft clavicle fractures associated with complete AC disruptions, we were only able to identify three previous reports. Wurtz et al. reported four cases of combined middle third clavicle fractures with dislocation of the AC joint [8]. There were three Type IV and one Type II AC joint dislocations. The AC joint injuries dictated the decision to operate, whereas the entire clavicle in this series was treated expectantly without internal fixation. The three Type IV AC joint dislocations were treated with AC transfixation pins (2) or with a coracoclavicular bone screw (1). The fourth case had a Type II AC joint injury and was treated conservatively along with the clavicle fracture. Another report described a single case of a combined middle third clavicle fracture with a Type VI AC joint separation in a hockey player [9]. Both of these injuries were treated nonoperatively. Lastly, a case report described a conservatively managed midshaft clavicle fracture with a Type III AC joint disruption in a cyclist, which was the only report that we found with a similar clavicle and AC classification to our Case 1, but again, these authors did not report an open reduction and internal fixation [12]. Due to the nonoperative care of this cyclist, the patient continued to have

Fig. 5. Preoperative 3D-CT of shoulder (Case 2).

Fig. 6. Anteroposterior view of left clavicle 3-months post-operative (Case 2).

Fig. 7. Anteroposterior view of left clavicle 6-months post-operative showing a well reduced acromioclavicular joint (Case 2).
deformity of the middle distal clavicle and continued AC separation after 2-years, although reported no subjective problems or limitations in his activity.

Historically, Type I, II, and III AC joint injuries have been successfully treated conservatively [18–22]. Surgical management for the Type IV, V, and VI has been advocated [22–24]. While treatment of AC joint injuries followed more of an algorithm, the treatment options for displaced fractures of the clavicle include various methods of open reduction with internal fixation as well as nonoperative treatment and no definite agreement on the optimal management strategy [25]. Conservative treatment of displaced clavicle fractures will necessarily eventuate in malunion, though this outcome is generally well tolerated and associated with reasonably good function. However, there have been studies that suggest that there are subpopulations of patients with functional deficits following nonoperative treatment [26–30]. Moreover, there is evidence that suggests that there is an increased risk of nonunion following displaced clavicle fractures with no contact of the bone ends, especially in distal fractures and those which occur in elderly patients [25,31]. Malunion and nonunion can impair the function of the clavicle, in terms of its linkage of the axial to the appendicular skeleton and the consequent affect on stability and motion of the upper extremity, as well as possibly the protective role to the underlying subclavian vessels and brachial plexus [32].

3. Conclusion

A surgically managed diaphyseal fracture of the clavicle, in conjunction with an ipsilateral dislocated AC joint, has not been previously reported. We provide an account of two such injuries, their respective treatment, and documented good clinical outcomes for the patient that had sufficient follow up.

Conflict of interest statement

P.A.C. has received honoraria from AOIF, AONA. P.A.C. is a consultant for Synthes, Inc. Authors and their immediate family, have no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

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