CASE REPORT

A dual injury of the shoulder: acromioclavicular joint dislocation (type IV) coupled with ipsilateral mid-shaft clavicle fracture

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Accepted 4 November 2015

SUMMARY

A direct blow to the shoulder, as may be sustained in a road traffic accident (RTA), can result in various combinations of fracture dislocations in the shoulder joint complex. Among these, a rare variety is an acromioclavicular joint (ACJ) dislocation coupled with ipsilateral mid-shaft clavicle fracture. Diverse treatment options have been described in the literature, ranging from non-operative and operative, to hybrid management. Treatment for this complex injury is predominantly dictated by the type of dislocation and displacement of the clavicle fracture, as well as age and demand of the patient. Acute high grades of ACJ dislocation require restoration of the coracoclavicular relationship (in place of torn coracoclavicular (CC) ligament) by some form of internal fixation, thereby maintaining the ACJ reduction. An arthroscopic reinstatement of the coracoclavicular relationship using a dog bone button and fibre tape implant for this composite injury pattern has not been previously described. Furthermore, a comprehensive review of the literature associated with this injury pattern is briefly described.

BACKGROUND

A dual injury pattern of acromioclavicular joint (ACJ) dislocation with ipsilateral mid-shaft clavicle fracture is usually seen following a high-velocity direct impact injury to the shoulder. According to the authors' knowledge, there are only a handful of these atypical cases so far described in the English literature (table 1). Clavicle fractures have been managed non-operatively or operatively. On the contrary, treatment options for acute high-grade ACJ (Rockwood classification: types III, IV, V and VI) injuries are gradually evolving with better understanding of shoulder biomechanics and implant technology; from the era of non-operative management (closed reduction) to varieties of internal fixation such as Steinmann pins,¹⁻³ K-wires,⁴ cortical screws^{2 5 6} and clavicular hook plates.⁷⁻¹⁰ With the advent of arthroscopy, it is now possible to achieve a stable ACJ reduction (by restoring the coracoclavicular relationship) using two new techniques: tightrope,^{11 12} and recently, dog bone button (Arthrex, USA). This is the first case describing the utility of the latter.

CASE PRESENTATION

A 21-year-old, right hand-dominant engineering student was brought to the emergency room, with

multiple injuries following an RTA. The patient was a pillion rider on a two wheeler and, on a two-wheeler and, in a head-on collision with a four wheeler, was thrown off and hit a tree. At the time of presentation, the patient was drowsy and irritable. Preliminary examination revealed a right humerus shaft fracture and severe tenderness in the dorsal region of the spine, apart from a few soft tissue lacerations over the face. Neurovascular examination was normal. There were no prior medical comorbidities. After primary stabilisation, the following day, the patient reported pain in the left shoulder joint. Movement of the left shoulder was painful. Tenderness was noticed over the ACJ, and the lateral end of the clavicle appeared displaced posteriorly.

INVESTIGATIONS

A primary skeletal survey confirmed a bending wedge-type humerus mid-shaft fracture on the right. CT scan of the whole spine revealed undisplaced fractures of the transverse process of vertebrae D-5 and D-9. The next day, a left shoulder X-ray revealed a superior displacement of the lateral end of the left clavicle (figure 1). CT scan with three-dimensional (3D) reconstruction of the left shoulder revealed an undisplaced short oblique mid-shaft clavicle fracture in association with type IV ACJ dislocation (figure 2).

TREATMENT

The patient underwent two surgeries, first for the humerus shaft fracture on the right, and 4 days later, he was operated for the left shoulder.

Surgery was performed under general anaesthesia. The patient was positioned in a lateral decubitus (for shoulder arthroscopy), but reclined slightly backwards into a semisupine position, for ease of operating for the clavicle fracture. A lazy S-shaped incision was made over the left clavicle centred over the fracture site and extending up to the lateral end of the clavicle. Buttonholing of the lateral end of the clavicle into the trapezius (seen in type IV ACJ dislocation) was observed. Without much difficulty (as the fracture was undisplaced), a precountered six-hole 3.5 mm lateral clavicle locking plate was used to stabilise the fracture.

The patient was repositioned to standard lateral decubitus for shoulder arthroscopy with traction device attached. A standard posterior arthroscopic portal was made and diagnostic glenohumeral arthroscopy performed. Further, a standard

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To cite: Madi S, Pandey V, Khanna V, et al. *BMJ Case Rep* Published online: [please include Day Month Year] doi:10.1136/bcr-2015-213254

Table 1 Cases of ACJ dislocation combined with ipsilateral mid-shaft clavicle fracture described in the literature

Author (year)	Age/ sex	Mechanism of injury	Clavicle fracture (mid-shaft)	Acromioclavicular dislocation	Follow-up
Lancourt (1990) ¹	19/F	Fall from a horse	Non-operative	Posterosuperior: OR+two crossed Steinmann pins	3 years; full painless ROM with no ACJ separation on weight-bearing films
Wurtz (1992) ² — reported four cases	36/M	Fall from a bicycle	No fixation	Type IV: fixation with CC cancellous screw	3 years; asymptomatic; full ROM
	23/M	RTA	Osteoclasia of malunited clavicle was performed	Type IV: fixation with CC cancellous screw	2 years; painless full ROM
	19/F	Fall from a horse	No fixation	Type IV: two acromioclavicular transfixation Stienmann pins	3 years; asymptomatic full ROM
	33/F	Fall from a horse	Non-operative	Type II: non-operative	1 year; painless full ROM
Heinz (1995) ¹³	34/M	Cycle race	Conservatively with a figure-of-eight clavicle bandage	Grade III: conservatively with a figure-of-eight clavicle bandage	24 months; the patient returned to cycling, weight lifting and competitive rowing. However, he continued to have deformity of the mid left clavicle and distal clavicle
Juhn, Mark (2002) ¹⁴	21/M	Ice Hockey injury	Greenstick mid-shaft: non-operative	Type VI (subacromial): non-operative	10 months; the patient's clavicle fracture healed with minimal distal-end osteolysis. He continued to play ice hockey comfortably
Wisniewski (2004) ⁴	32/M	RTA	Non-operative	Posterosuperior: OR+two K-wires	10 years; full ROM shoulder
Peter C Yeh (2009) ¹⁶	46/F	Fall from a horse	Precountered plate	Posterosuperior: acromioclavicular and CC ligaments were reconstructed with a semitendinosus allograft	1 year; the patient resumed her normal preinjury activities, including horse riding
Kakwani RG (2011) ¹¹	45/M	RTA	Precountered locking plate	Type IV: tightrope technique (Arthrex)	4 months; the patient returned to preinjury recreational level of sports and work as a forklift driver. DASH:11.7
Psarakis (2011) ¹²	38/M	RTA	ORIF with precountered locking plate	Type V: tightrope fixation system for CC ligaments	18 months; the patient had no pain, and resumed full duties with full range of motion of the shoulder
Woolf (2013) ⁹	34/F	RTA	ORIF with a 3.5 mm lag screw and a 3.5 mm anterior neutralisation plate	Type IV: CC ligaments repaired with No. 2 Fibrewire and ACJ reduced with hook plate	3 years; the patient has no functional limitations and is pleased with the outcome
Grossi (2013) ³	19/M	Fall from bicycle	Greenstick type mid-shaft: no fixation	Type VI: fixed using two Steinmann wires	12 months; the patient had an excellent clinical and radiographic result
Wijdicks (2013) ⁷ — reported two cases	44/M	RTA	Mid-shaft (OTA type 15-B1.2): Precontoured, 8-hole superior clavicle plate and interfragmentary screws	Type III: 3.5 mm clavicle hook plate—additional 2.7 mm locking anterior reconstruction plate to counter stress riser due to dual plating	13 months; the patient's DASH score: 3.33. The work module demonstrated a score of 6.25
	36/M	RTA	Mid-shaft (OTA type 15-B1.2): anterolateral plate	Type IV: hook plate fixation	6 months; the patient's 30-item DASH outcome measure score was 30
Ibrahim Paryavi (2013) ¹⁰	23/M	RTA	Anteroinferior limited contact dynamic compression plate	ACJ: clavicle hook plate CC ligaments with No. 5 Ethibond sutures	7 months; the patient's DASH score: 22, with no loss of reduction abduction: 130°, flexion: 130°, internal rotation: up to L4
Beytemür (2013) ⁸	50/M	RTA	Low profile anatomic plate	Type III: clavicular hook plate fixation; 4 hole	23 months; the patient had full and painless ROM with widening of ACJ space, and degenerative findings were seen
Solooki (2014) ⁵	40/M	RTA	A 3.5 mm reconstruction plate by contouring	Type III: CC ligaments with two full threaded cancellous screws	1 year; the patient had complete union of clavicle fracture and anatomical reduction of ACJ with pain free full joint ROM
Davies EJ (2014) ¹⁵	40/F	Fall from stairs	Reconstruction plate+lag screw and bone grafting	Type VI (b): ACJ reduced and stable. No fixation performed	9 months; the fracture united with normal alignment of ACJ
Tidwell (2014) ⁶	19/M	RTA	A low-profile precontoured superior clavicle plate	Type IV: –5 mm of the distal clavicle was resected; –3.5 mm fully threaded cortical screw from clavicle, to coracoid	1 year; the patient reported intermittent soreness over the lateral shoulder but was not limited in his activities and was back to performing manual labour without difficulty

ACJ, acromioclavicular joint; CC ligaments, coracoclavicular ligaments; DASH, disabilities of shoulder arm and hand; F, female; M, male; ORIF, open reduction and internal fixation; OR, open reduction; OTA, Orthopaedics Trauma Association; ROM, range of motion; RTA, road traffic accident.

anteroinferior portal was established. Probing via the anteroinferior portal did not reveal any intra-articular pathology. Further, the base of the coracoid was identified after clearing the rotator interval using a radiofrequency device (Arthrocare). Through the anteroinferior portal, a special drill guide for the dog bone button was introduced and placed under the base of the coracoid. The arthroscope was shifted to the anterosuperior lateral portal and the position of the drill guide at the base of

the coracoid was confirmed. Keeping the sleeve of the drill guide over one of the lateral holes of the clavicular plate, clavicle and coracoid tunnels were drilled with the help of a 3.0 mm cannulated drill. A looped polydioxone suture was passed through the tunnels and was brought out through the anteroinferior portal. Then, the dog bone button and fibre tape (Arthrex) were assembled by passing the fibre tape through the titanium dog bone button. The free end of the fibre tape was

Figure 1 X-ray of the left shoulder joint (preoperative).

loaded over the loop end of the PDS and the suture was pulled out from the clavicle end. This manoeuvre brought the dog bone button under the coracoid ([figure 3](#)). Now the ACJ was reduced into position by pushing the arm upwards and clavicle downwards. Then, a second dog bone button was attached to the free ends of the fibre tape over the clavicle and the fibre tapes were knotted together one after the other keeping the ACJ in reduced position, completing the repair. The wound was closed layer by layer over a drain. The patient was shifted out of the theatre, with an arm sling support. Postoperative X-rays confirmed that the dog bone buttons were in their appropriate positions and showed a well-reduced ACJ ([figure 4](#)).

OUTCOME AND FOLLOW-UP

The patient was given arm sling support for 6 weeks postsurgery. During that period, active elbow and finger mobilisation was encouraged. After 6 weeks, the sling was discarded and active gentle shoulder mobilisation with 30° abduction and flexion and 0° neutral rotation was initiated. Gradually, the 10–20° range was increased. By the end of 3 months, the patient had 150° of flexion and abduction with some terminal restriction of external rotation. With aggressive Theraband stretching exercises, he eventually regained full range of motion and normal shoulder strength. At final follow-up at 13 months postinjury, there was no widening in the ACJ and the fracture was united ([figure 5](#)). The patient's Constant-Murley score is 88. He has also returned to preinjury levels of sporting activities (cricket).

DISCUSSION

Isolated injuries of the shoulder, such as clavicle fractures or ACJ dislocations, are very common following any direct

Figure 2 Preoperative three-dimensional reconstruction CT scan of the left shoulder joint defining the complex injury pattern.

Figure 3 Arthroscopic image of the dog bone button under the coracoid process seen through opened left rotator interval.

impaction. However, when this force of trauma further drives through, either the lateral half of the fractured clavicle will dislodge from the acromion or an ACJ dislocation (either postero-superior or inferior) will displace the clavicle at its mid-shaft level, mutually affecting one another. However, the exact mechanism by which a middle-third clavicle fracture with simultaneous ACJ separation occurs remains undefined.⁹

The type of ACJ dislocation or clavicle fracture from conventional radiographs can sometimes be difficult to appreciate (or even missed). CT scans of the shoulder joint (although not always necessary) with 3D reconstruction have been employed to better understand the nature of this complex injury.^{6–8 10 16} In our patient, the undisplaced clavicle fracture was revealed in the CT scan and facilitated better preoperative planning.

Of the two injuries, the clavicle fracture is the benign component. In the early 1990s and 2000s, clavicle fractures were predominantly managed conservatively.^{1–4 13 14} Only recently has the trend drastically shifted towards open reduction and internal fixation with reconstruction plates^{5 9 15} or precontoured locking plates.^{6–8 11 12 16} In our patient, as the stabilisation of the coracoclavicular assembly using a dog bone button by passing fibre tape between the coracoid and the lateral half of the clavicle was contemplated, the mid-shaft fracture (despite being undisplaced) required stabilisation to prevent further displacement.

Figure 4 Postoperative X-ray of the left shoulder, anteroposterior view.

Figure 5 Follow-up X-ray at 13 months: left shoulder anteroposterior view.

Likewise, the treatment options for acute high grades of ACJ dislocation have been gradually shifting towards operative intervention. Previous surgical options such as those employing Steinmann pins,^{1–3} K-wires,⁴ cortical screws^{2 5 6} and clavicular hook plates,^{7–10} all required implant removal once the coracoclavicular ligament healed. Recently, in two cases, tightrope technology for ACJ stabilisation was employed (emulating the same success seen in cruciate ligament reconstruction in the knee) and was found to produce satisfactory outcomes.^{11 12}

Dog bone button and fibre tape technology involves drilling small tunnels in the coracoid and clavicle with the help of a jig. This helps in precise placement of the button on the undersurface of the coracoid, which can be confirmed by arthroscopy.

Learning points

- ▶ Acromioclavicular joint (ACJ) dislocation coupled with ipsilateral mid-shaft clavicle fracture is a rare dual injury of the shoulder joint.
- ▶ There is a high chance of this complex injury being overlooked, especially in poly-trauma cases, and sometimes it is difficult to appreciate the nature of injury by conventional radiographs alone.
- ▶ Several modalities of treatment exist, predominantly based on type of dislocation, displacement of the clavicle fracture, as well as on the age and demand of the patient.
- ▶ Treatment for acute high-grade ACJ injuries is evolving; use of a dog bone button and fibre tape implant for coracoclavicular ligament reconstruction is a promising option.

Unlike in cases where a cortical screw or clavicular hook plate is used to maintain the reduction of ACJ, here, only the fibre tape passes through these tunnels and thus obviates the necessity for an implant removal at a later date. Moreover, these fibre tapes are thicker than those used in the tightrope system, thereby reducing probabilities of implant failure.

The trend in recent times for this fracture–dislocation combination is towards surgical management of both the components, in order to initiate an accelerated rehabilitation protocol in the immediate postoperative period. However, the prognosis for this complex injury is reported to be seemingly good regardless of the type of treatment undertaken. Most patients have recovered over time and many have returned to preinjury levels of activity including hard manual labour and sports.

Competing interests None declared.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

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