Injury, Int. J. Care Injured 40 (2009) 236–239

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Stabilisation of vertical unstable distal clavicular fractures (Neer 2b) using locking T-plates and suture anchors

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ARTICLE INFO

Article history:
Accepted 11 July 2008

Keywords:
Clavicle
Suture anchor
Distal clavicular fracture
Locking plate

ABSTRACT

Distal clavicular fractures are associated with an increased risk of delayed union and non-union, and therefore operative treatment is favoured. Fragment dislocation and instability result from detachment of the coracoclavicular ligaments. Various methods for operative treatment can be found in the literature, but no gold standard has been established. In this retrospective study, we present a new surgical technique using a locking T-plate for osseous stabilisation in combination with vertical stabilisation by suture anchors.

Between October 2006 and December 2007, eight people underwent surgery for unstable distal clavicular fracture (Neer type 2b). Subsequently one patient could only be contacted by phone and was excluded from further analysis. Mean follow-up for the remaining seven individuals was 8.3 months. The Constant and DASH scores were evaluated and stress radiographs were performed to check for vertical instability. In all cases bony union was achieved within 6 weeks postoperatively. No intraoperative or early postoperative complications were observed. All but one patient regained excellent shoulder function, the mean Constant and DASH scores were 93.3 and 15.3, respectively. Coracoclavicular distance was successfully restored with a mean 1 mm (range 0–2 mm) side-to-side difference. Early clinical and radiographic results of this new method are promising, with good to excellent outcome in all cases.

Introduction

Approximately 15% of clavicular fractures are distal and more likely to be associated with delayed or non-union than midshaft fractures.[6] Neer subdivided these fractures into three types. Type 1 fractures are stable with the coracoclavicular (CC) ligaments intact. Type 2 fractures are medial to the ligaments, which often results in increased displacement of the medial fragment. This group is divided into type 2a, where the ligaments remain attached to the lateral fragment, and type 2b, with detachment of the ligaments from the lateral fragment resulting in instability with significant fracture dislocation (Fig. 1). Type 3 includes stable intra-articular fractures.[21]

Whereas for midshaft fractures good results can be achieved with non-operative therapy, unstable lateral fractures carry a higher risk of delayed or non-union and therefore surgical treatment is recommended by many authors.[1,7–9,11,15,17–19,22] Various procedures for these injuries have been described in the literature. Treatment options include stabilisation using a hook plate,[4,8,11,17–19] transacromial k-wires,[9,16] temporary coracoclavicular screw fixation,[7] tension-band suturing[1] and arthroscopic stabilisation.[22] Each of these techniques comes with specific benefits and disadvantages or complications such as non-union, implant failure,[11] pin migration,[9] bony defects and subacromial impingement.[17] Moreover, operative treatment is often complicated by small lateral fragments and multifragmentation, all of which are difficult to stabilise.

A new technique using locking T-plates and suture anchor stabilisation for treatment of this specific injury is presented. The plate configuration allows placement of at least three angular stable screws in the small lateral fragment. Clinical scores and radiographic assessments recorded the effectiveness and safety of this procedure.

Methods

Eight people who underwent surgery for isolated, unstable clavicular fracture Neer type 2b at our institution between October 2006 and December 2007 were included in the study. Of these, one could be contacted by phone but was not available for clinical and radiographic examination. Although subjective evaluation of the operated shoulder was excellent, he was excluded from further analysis. The remaining group consisted of six men and one

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0020–1383/$ – see front matter © 2008 Elsevier Ltd. All rights reserved.
doi:10.1016/j.injury.2008.07.021

Fig. 1. Typical preoperative radiograph, anteroposterior view showing lateral clavicular fracture with cranial displacement of the medial fragment.

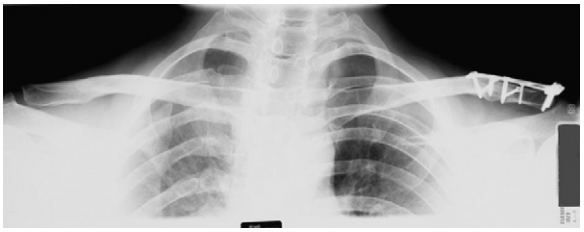

Fig. 2. Same case 5 months postoperatively. Stress radiograph with 5 kg axial load, showing bony union and sufficient restoration of vertical stability.

woman. The mean age at time of surgery was 39.1 ± 16.5 years (range 26–55 years). The mechanism of injury was a direct fall on the shoulder in all cases. The mean follow-up time was 8.3 months (range 4–16 months).

Operation required the beach-chair position with the injured limb freely mobile. A standard sabre-cut approach medial to the acromioclavicular (AC) joint was performed to visualise the fracture site and allow exposure of the coracoid process. The deltoid fascia was incised in line with the clavicle, if not already torn at injury. One or two suture anchors with no. 2 non-absorbable threads were inserted in the coracoid. The fracture was reduced under direct visualisation and intraoperative fluoroscopy control. A 3.5-mm locking T-plate was applied for internal fixation and, if necessary, 2.0-mm cortical screws for fixation of large fragments. The sutures were then transferred around the clavicle and over the plate. Standard friction knots were used and, to ensure anatomical reduction of the AC joint, the sutures were fastened while substantial downwards pressure on the clavicle was exerted. The deltotrapezoid fascia was reconstructed with absorbable sutures and the wound was closed in the standard manner. The limb was immobilised in a sling postoperatively. Early controlled passive mobilisation of the shoulder was started within 24 h postoperatively. After discharge, the patients completed a physical therapy programme involving passive and active mobilisation of the joint, with limitation of flexion and abduction of the shoulder joint to 90° for 2–6 weeks. Heavy labour and sports were limited for 12 weeks postoperatively.

Clinical follow-up consisted of assessment with the Constant score[5] and the German version of the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire.[10,13]. Radiological fracture healing was evaluated by anteriorposterior and axial shoulder views. Stress radiographs of the shoulder girdle with 5-kg weights suspended on each arm by wrist straps were used to measure maintenance of vertical reduction. Radiographs were analysed according to previously published data[12] by measuring the distance between the highest point of the coracoid and the inferior border of the clavicle on both sides. Horizontal displacement was assessed in axial views.

Results

In all cases bony union was achieved within 6 weeks postoperatively. No intraoperative or early postoperative complications were seen. Implant removal was performed in two cases at 6 months and in one case at 10 months postoperatively.

Excellent function was regained with a Constant score of 93.3 ± 6.1 (range 82–99) in all but one case. At 3-month final follow-up, one person complained of mild pain during strenuous activity. All patients had full range of motion except one, who revealed mild restriction of internal rotation. Patient No. 7, with a good Constant score at 10 months postoperatively, still showed the limited shoulder function he had before this study, caused by a motorbike accident in 1989.

Constant score results were subdivided into the following categories: excellent (100–90); good (89–80); satisfactory (79–70); and fair (<70).[23] According to the absolute Constant score, there were five excellent and two good results. DASH score analysis revealed a mean of 15.3 ± 4.1 points (range 0.8–20), with 0 as the best possible and 100 as the worst possible result. Although this score is normally not further subdivided, the scores could be referred to subjectively as excellent and good, with no major impairment of shoulder function.

There were no clinical or radiographic signs of vertical or horizontal clavicular instability. To further assess possible lack of vertical reduction, CC distance was measured in the stress radiographs (Fig. 2). The distance was 11 ± 2.7 mm on the operated side and 10 ± 3.1 mm on the opposite side, showing a mean 1 mm side-to-side difference. Results are summarised in Table 1.

Table 1
Results of seven cases treated for lateral clavicular fractures (Neer type 2b) with locking T-plates and suture anchor augmentation.

Patient number	Age (years)	Gender	Side injured	Follow-up (months)	Constant score	DASH score	CC difference (mm)
1	55	m	Left	16	99	1.7	2
2	28	m	Right	4	89	7.5	2
3	27	m	Right	6	93	0.8	1
4	26	m	Right	8	99	8.3	0
5	31	w	Left	9	95	12.5	0
6	31	m	Left	5	96	13.3	0
7	40	m	Left	10	82	20	2
Mean	34.0			8.3	93.3	15.3	1.0
S.D.	10.4			4.0	6.1	4.1	

DASH, Disabilities of the Arm, Shoulder and Hand; CC, coracoclavicular; m, man; w, woman.