

A method for internal fixation of unstable distal clavicle fractures: Early observations using a new technique

Michael Kalamaras, BSc(Anat), BMBS, Ken Cutbush, MBBS, FRACS(Orth),
and Mark Robinson, MBBS, FRACS(Orth), Brisbane, Australia

Unstable distal clavicle fractures often require open reduction and internal fixation. A variety of fixation methods have been used and are currently in use. None of the current fixation methods seem to be without problems. We present a new technique and early observations using a distal radius locking T-plate normally used for fixation of distal radius fractures. (J Shoulder Elbow Surg 2008;17:60-62.)

Fractures of the distal end of the clavicle can be relatively unstable and are prone to malunion and nonunion compared with more proximal clavicle fractures. Allman¹ classified distal clavicle fractures into 3 subtypes, of which type IIA and IIB are inherently the most unstable because of the loss of the normal ligamentous tether. The pull of the trapezius on the long proximal fragment causes displacement when the clavicle is free of the conoid and trapezoid ligaments distally. Nonoperatively, nonunion rates are high, quoted at 22% to 33%,^{4,8} and union is slower than for other clavicular fractures, taking a mean of 3 months.³ Open reduction and internal fixation should be considered in patients with distal clavicle fractures that are clinically unstable.³⁻⁹ Current methods of fixation include tension-band wiring, trans-acromioclavicular joint screws, and specialized plates such as the clavicle hook plate manufactured by Synthes (Paoli, PA).

Despite a variety of techniques, current fixation methods can be problematic.⁵⁻⁷ This is due in part to the small size of the distal fragment, which does not

lend itself to holding strong fixation constructs. In addition, the counter-pull of the trapezius on the long moment arm of the proximal fragment provides strong displacing forces. Furthermore, the proximity of these fractures to the acromioclavicular joint can involve the joint from trans-acromioclavicular joint screws and the subacromial hook portion of the clavicular hook plate. Most current fixation devices require routine removal to prevent K-wire migration, to mobilize the acromioclavicular joint, and in the case of the hook plate, to remove the implant from the subacromial space. Other problems associated with the hook plate include discomfort from the bulky implant on the subcutaneous clavicle and damage to the rotator cuff from the hook.

Flinkkilä et al,⁵ in a series of 22 patients treated with tension-band wiring at a mean follow-up of 6.2 years, found K-wire migration in 12 patients, nonunion in 2, and loss of reduction in 7 and a mean Constant score² of 95. Henkel et al⁶ studied 19 patients with distal clavicle fractures treated with the clavicular hook plate at a mean follow-up of 3.9 years. In their series, 21% of patients had acromioclavicular joint arthritis, and the mean Constant score was 94. In addition, all patients required routine plate removal.

The nature of iatrogenic damage to the acromioclavicular joint, subacromial space, and rotator cuff and the high reoperation rate required with these techniques and implants led us to search for a better fixation device. Distal radial locking plates, first introduced by Synthes, were designed specifically for fractures of the wrist. These plates have inherently strong, angular stable, multiple 2.4-mm distal screws to facilitate fixation of the small distal fragments typical of distal radius fractures. By the very nature of their design, we have found these plates to lend themselves to the treatment of unstable distal clavicle fractures. In particular, the 5-hole, volar T-plate from the Synthes distal radial set allows the placement of 5 locking screws into a small distal clavicular fragment. Grooves on the T-portion of the plate allow for bending of the edges of the T-portion of the plate over the contour of the distal clavicle. The shaft of the plate allows multiple screw fixation along the long proximal fragment of the clavicle, including holes for up to 5 locking screws. The plate is low profile, making it ideal for the

From the Hand and Upper Limb Unit, Princess Alexandra Hospital, and Brisbane Hand and Upper Limb Clinic.

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Reprint requests: Michael Kalamaras, BSc(Anat), BMBS, Department of Orthopaedics, Royal Brisbane Hospital, Herston Road, Brisbane, Queensland 4001, Australia (E-mail: mkalamaras@mac.com).

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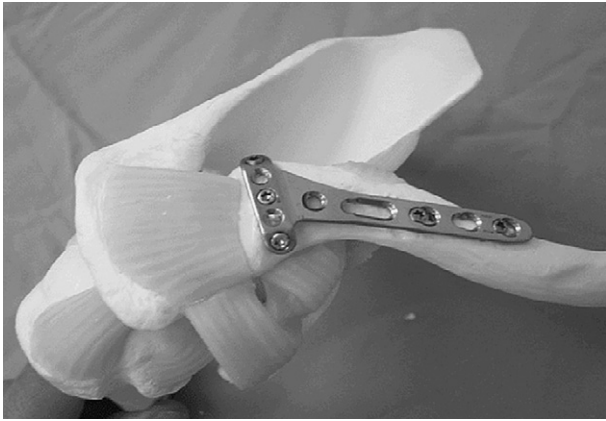


Figure 1 Distal radius locking plate on a clavicle bone model.

subcutaneous clavicle. These considerations led to the use of the distal radius plate in patients who presented with unstable distal clavicle fractures requiring internal fixation.

MATERIALS AND METHODS

We observed 5 patients from Princess Alexandra Hospital (Brisbane, Australia) and 4 from the Brisbane Hand and Upper Limb Clinic (Brisbane, Australia) (8 acute fractures and 1 nonunion; age range, 16-41 years). Between July 2004 and May 2005, 9 patients with distal clavicle fractures (Allman group II, type II) were treated with open reduction and internal fixation by use of a titanium distal radial locking plate (Synthes) for fixation (Figures 1 and 2). With the patient in the beach-chair position, a linear approach just anterior and parallel to the clavicle was normally used. The volar T-plate was used in 6 patients, and the locking L-plate was used in 3. The T-plate was flattened slightly at its T-junction to fit the clavicle, and the ends of the T were slightly bent downward (Figure 1) to angle screws into the clavicle. Of the 9 fractures, 6 were augmented by use of a looped FiberWire suture (Arthrex, Naples, FL) through the distal clavicle and around the coracoid. Patients were treated for 6 weeks by use of a sling allowing for range-of-motion exercises. A graduated physiotherapy regimen was then commenced after the sling was removed at 6 weeks.

RESULTS

Follow-up was performed in 8 of 9 patients after the procedure (Table I). One patient preferred to continue physiotherapy and follow-up at a center closer to home and was not followed up by us. In all 9 patients, immediate postoperative recovery was uneventful. In all 8 patients seen in our clinics, union was achieved, with excellent results for pain and function (mean Constant score, 96; range 96-100). All 8 patients observed had returned to full activities by 7 weeks after surgery. One patient had an infected wound after

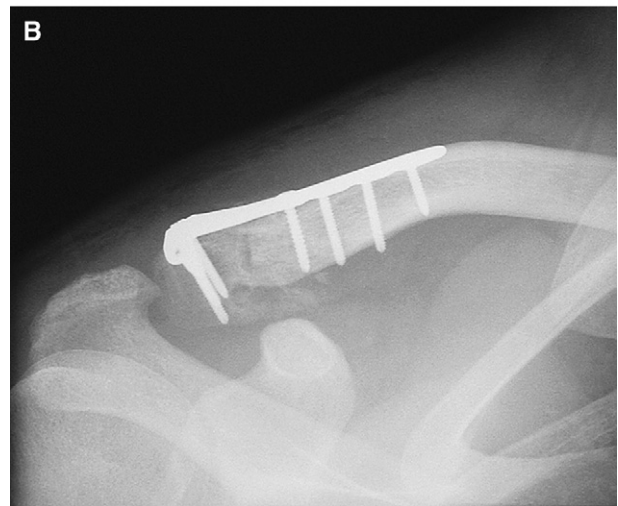
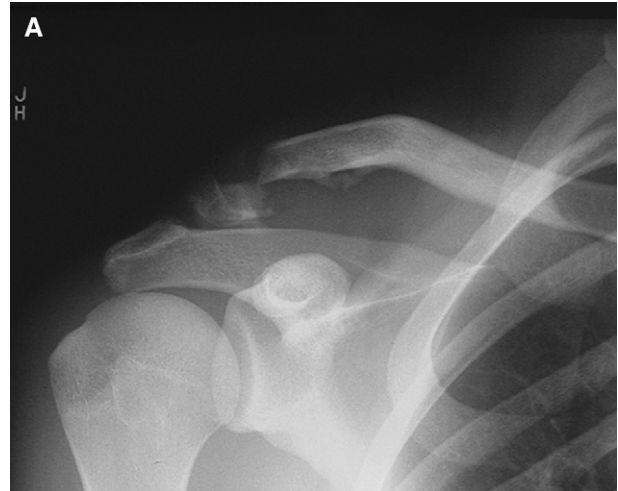


Figure 2 Distal clavicle fracture in a 21-year-old man: 15 months after fracture with symptomatic and mobile nonunion (A) and after open reduction and internal fixation with distal radius locking plate (B).

a fall 3 weeks postoperatively. However, this patient maintained a good range of motion and function and was pain-free (Constant score of 98 at 3 weeks) while progressing to union. The infection was treated successfully with antibiotics, and union was achieved within 8 weeks.

DISCUSSION

Although in studies of the hook plate and the tension-band mechanism, the functional results have been reasonable, those in our study compare favorably at a much shorter follow-up period. There has been no interference with the acromioclavicular joint and no iatrogenic damage to the rotator cuff or impingement. In addition, we believe that there may be no need to remove the plates. The plates have

Table I Observations of 9 patients treated with distal radial locking plate for type II fracture of distal clavicle from 2004 to 2005

Patient No.	Age (y)/sex	Total follow-up (mo)	Evidence of union on radiography	Functional range of motion	Constant score	Complication	Comment
1	31/F	16	8 wk	8 wk	96 at 24 wk	None	NA
2	32/M	16	8 wk	8 wk	98 at 24 wk	None	NA
3	41/M	11	8 wk	8 wk	83 at 8 wk	None	NA
4	21/M	13	16 wk	8 wk	100 at 16 wk	None	Malreduction
5	27/F	16	NA	NA	NA	None	Lost to follow-up
6	20/M	19	18 wk	18 wk	98 at 18 wk	None	No follow-up for 16 wk
7	16/M	11	6 wk	6 wk	98 at 6 wk	Wound infection	NA
8	38/M	10	3 mo	12 wk	NA	None	NA
9	34/M	10	6 wk	6 wk	98 at 12 wk	None	NA

held reduction while allowing early range of motion in all patients with minimal or no pain. The union rates have been high (all observed). This has been achieved despite an infection and early motion. These are small numbers, as have been those in previous series of other fixation techniques for distal clavicle fractures. This is due to the fact that this type of fracture is uncommon. However, a longer follow-up and larger series are necessary.

In conclusion, the use of distal radial locking plates in this manner has not been described previously, as far as we are aware. It has provided stable fixation, with minimal early complications. The configuration of the locking screws seems to provide a stable construct in a small distal clavicular fragment. This has been achieved without disturbance to the acromioclavicular joint, subacromial space, or rotator cuff. In addition, it is believed that routine removal will not be required. Although our observations are short term, they are promising. This technique provides an alternative method for internal fixation of distal clavicle fractures that, we anticipate, will provide satisfactory results in these difficult-to-treat fractures.

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