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ORIGINAL PAPER

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Fractures of the distal third of the clavicle treated by hook plating

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Abstract We retrospectively assessed the union and shoulder function following hook plate fixation in 18 patients with Neer type 2 fractures of the lateral end of the clavicle. The average age was 40 (range 22–62) years, and the mean follow-up was 25 (range 6–48) months. Fifteen patients had acute fractures and the rest were non-unions. Complications included two non-unions, one following a deep infection. There were no iatrogenic fractures. Acromial osteolysis was seen in five patients who had their plates in situ. The average pain score at rest was 1 (range 0–4), and the average pain score on abduction was 2.2 (range 0–5). The average Constant score was 88.5 (range 63–100). Patients were asked to rate their shoulder function; three rated it as normal, 11 as nearly normal and one as not normal. Hook plate fixation appears to be a valuable method of stabilising Neer type 2 fractures of the clavicle, resulting in high union rates and good shoulder function. These plates need to be removed after union to prevent acromial osteolysis.

Résumé Nous avons étudié rétrospectivement, chez 18 malades, la consolidation des fractures du quart externe de la clavicule type 2 de Neer et la fonction de l'épaule, après fixation par plaque crochet. L'âge moyen était de 40 (20–62) ans et la moyenne de suivi de 25 (6–48) mois. Quinze avaient une fracture fraîche les autres une pseudarthrose. Les complications ont inclus deux non consolidations, dont l'une après une infection profonde. Il n'y avait pas de fracture iatrogénique. Une ostéolyse acromiale a été noté chez cinq malades qui avaient la plaque en place. Le score moyen de la douleur au repos était de 1 (0–4) et celui en abduction était de 2,2 (0–5). Le score moyen de Constant était de 88,5 (63–100). On a demandé aux patients d'estimer la fonction de leur épaule; trois ont dit que leur épaule était normale, onze ont dit qu'elle était presque normale et un a estimé quelle n'était pas normale. La fixation par plaque crochet paraît être une bonne méthode pour stabiliser les fractures de type Neer 2 de la clavicule, permettant un taux élevé de consolidation et une bonne fonction de l'épaule. Ces plaques ont besoin d'être enlevé après la consolidation pour prévenir l'ostéolyse de l'acromion.

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Introduction

Unstable fractures of the lateral end of the clavicle (Neer type 2) are a treatment dilemma. There is a very high risk of delayed union, malunion and non-union (22–35%) [9–12] and the risk of acromio-clavicular joint (ACJ) arthritis with conservative management. Most authors recommend open reduction and internal fixation as the treatment of choice [1–4, 7], but there is still no consensus about the ideal method to produce the best functional outcome. We report our experience with the use of hook plate fixation in unstable fractures of the lateral third of the clavicle.

Patients and methods

We retrospectively studied unstable fractures of the lateral end of the clavicle (Neer type 2) stabilised in our institute between 1999 and 2003 by the use of a hook plate. Patients with Neer type 2 injuries with more than a 6-month follow-up after surgery were included. We excluded patients with ACJ dislocations, those who were lost to follow-up and those with incomplete data. Local ethics committee approval was obtained. Patients were evaluated in a research clinic after obtaining consent, with X-rays to assess union; shoulder function was assessed using the Constant score

and patient satisfaction rating with the shoulder and VAS pain score.

A standard sabre approach to the lateral end clavicle was used in all patients. The fracture was exposed and reduced, in some cases held by using a temporary K- wire and then stabilised with the hook plate, the important technical issue being to ensure proper subacromial placement of the hook. The arms were held in a sling for six weeks during which only passive movements were allowed; no overhead abduction was permitted. After six weeks the sling was removed, and patients were encouraged to actively mobilise. In all patients, the plate was not removed until at least three months in order to ensure adequate union.

Results

There were 18 patients with Neer type 2 fractures from a cohort of 26 patients when the inclusion and exclusion criteria were applied; 14 were men, and the average follow-up was 26 (range 6–48) months. Average age was 41 (range 22–62) years. Fifteen patients had acute fractures and the rest had non-unions. Five were involved in heavy manual labour, three were unemployed and ten were clerical workers.

There were two non-unions: one due to a deep infection requiring removal of the plate progressed to a painful non-union; one patient had a fracture of the clavicle four months post-operatively following a second injury at the proximal end of the plate, which was treated conservatively. Five patients demonstrated asymptomatic acromial osteolysis on X-rays (Fig. 1). The plates were removed in 17 patients at an average of five months. Figures 2, 3, and 4 show the results of hook plate fixation in a 54-year-old male patient until removal of plate (Fig. 5).

Fifteen patients (84%) were evaluated in a research clinic. The average Constant shoulder score achieved in the fractured side was 88.5 as compared with an average of 100 in the uninjured side. The average pain in the shoulder at rest was 1 (range 0–4), and the average pain on abduction was 2.2 (range 0–5). Patients were asked to grade their shoulder; three said it was back to normal, 11 said it was nearly normal and one said it was abnormal. One patient with a non-union could not be evaluated in the clinic.

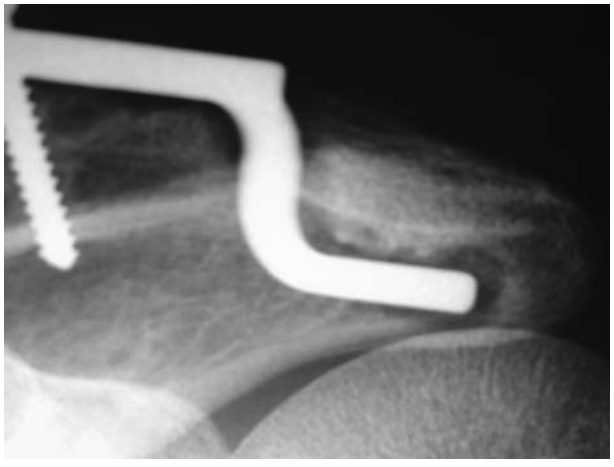

Fig. 1 Patient 1: a 33-year-old man with hook plate with acromial osteolysis before plate removal

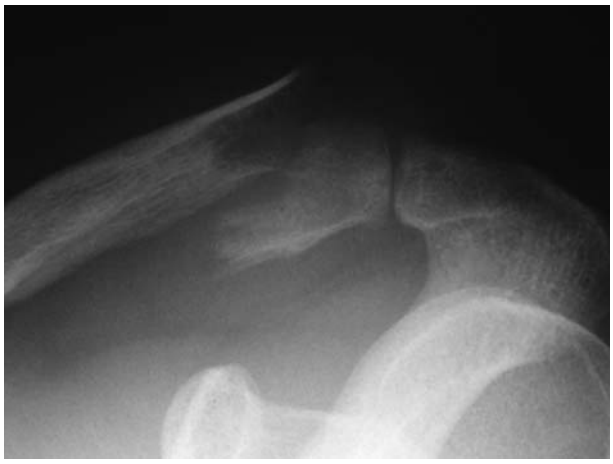

Fig. 2 Patient 2: Neer type 2 fracture of clavicle in a 54-year-old man

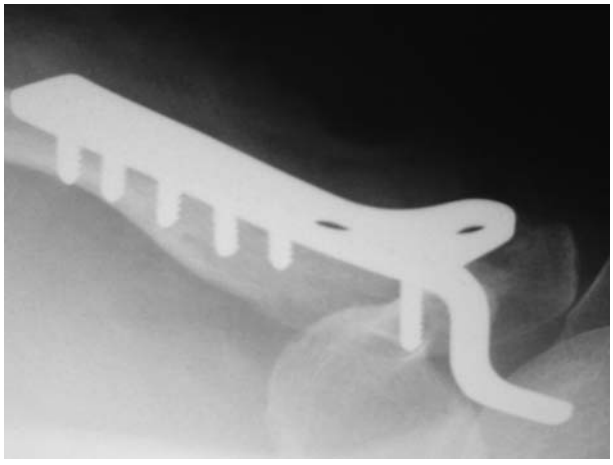

Fig. 3 Patient 2: post-operatively after hook plate fixation

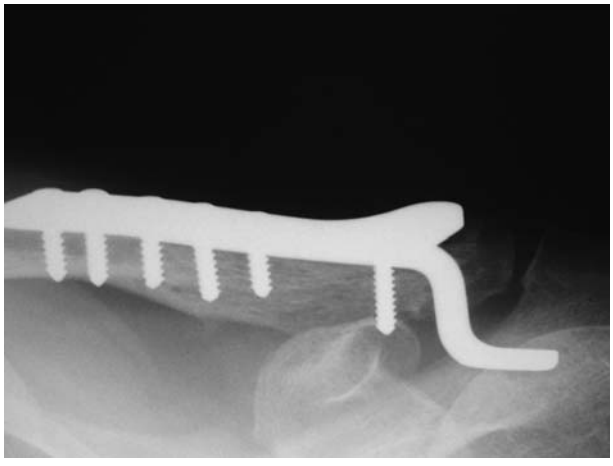

Fig. 4 Patient 2: post-operatively at 6 months prior to plate removal

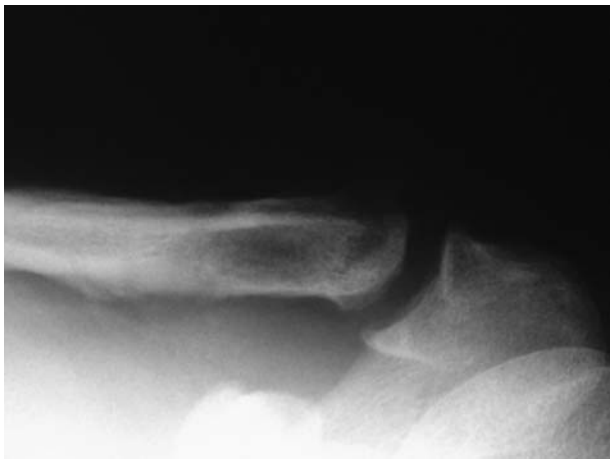

Fig. 5 Patient 2: X-ray after plate removal shows early osteophyte formation

Discussion

Fractures of the lateral end of the clavicle represent 10% of clavicular fractures [12]. They are associated with a high rate of non-union and delayed union after conservative management [9–12]. Various methods of treatment have been described, including conservative management [11], transacromial K-wiring [4, 7], coraco-clavicular fixation [1, 13] and direct plate fixation [3].

Conservative management has been advocated by some authors. Nordquist et al. [11] reported ten non-unions in 23 patients with type 2 fractures in their series of 110 patients; however, only eight were asymptomatic, and none had severe residual shoulder dysfunction. The authors recommended that short-term sling immobilisation can be used to treat Neer type 2 fractures of the clavicle. They did not objectively assess shoulder function. Neer et al. found a non-union rate of 50% [8, 9] using conservative methods. Similarly, Edwards et al. [2], in a series of 43 patients with type 2 fractures, found a much higher incidence of local complications, residual shoulder dysfunction and non-union using conservative methods and recommended open reduction and internal fixation as the treatment of choice.

Transacromial wire fixation is a commonly used method of fixation [4, 6–8, 10]. Fann et al. [4], using transacromial Knowles pins, reported union in all 32 patients they treated. They reported no complications associated with the use of pins. Kona et al. [7], in a smaller series of 19 patients—13 of whom were treated using K-wires—reported ten unsatisfactory and nine satisfactory results. All six non-unions and five infections occurred in patients where K-wires were used. They concluded that K-wire fixation should not be recommended in such fractures. Neer [8], in a smaller series of seven unstable fractures, reported union in six patients. Flinkilla et al. [6] in a study comparing transacromial fixation versus hook plating found no difference in union rate or post-operative function achieved. However, they recommended the use of hook plates because of the very high complication rate using the K-wires. Three of 22 united in the K-wire group where they had an average follow-up of 6.2 years as against two of 17 in the hook plate group, who had an average follow-up of 2 years. Patients achieved a mean constant score of 84 and 90 in the K-wire and hook plate groups, respectively. In the K-wire group, the wires migrated in 12 patients, resulting in loss of reduction in seven and infection in three as compared with one clavicular fracture in the hook plate group. Eskola et al. [3], in a series of 23 patients with type 2 fractures, used two K-wires not crossing the ACJ in 20 patients. Bone graft was used if there was associated comminution. They noted satisfactory outcomes in 19 patients, one non-union and a 25% complication rate, including three superficial infections. Ballmer et al. [1] and Yamaguchi et al. [13] reported their results using indirect coraco-clavicular fixation with a Bosworth type screw in a small series of patients (five and 13, respectively).They achieved union in all patients and concluded that this is a safe and easy technique to treat such fractures. They also recommended routine screw removal at second surgery. Similarly, Weber et al. using a coracoclavicular sling reported union in all the 15 patients treated by them. Faraj and Ketzer [5] used hook plates in conjunction with a Weaver Dunn procedure in a small group of seven patients who had acromio-clavicular injuries (three fractures). All fractures united and had pain-free function. Objective assessment of function was not done. They did not, however, remove the hook plate in any patients. There are few papers in the literature reporting on the use of hook plates in the treatment of unstable lateral-end clavicular fractures. Most reports are about its use in ACJ dislocations.

In our study, we had two non-unions, and satisfactory shoulder function was achieved in 14 of the 15 shoulders assessed. Good shoulder function was achieved although asymptomatic acromial osteolysis was seen in five cases. This led us to routinely remove the plate. Our study is retrospective, and the numbers are small; however, we can conclude that hook plate fixation is a useful method of treating unstable fractures of the lateral end of the clavicle. High union rates and good shoulder function are achieved while avoiding the potential complications associated with transacromial wire fixation. The plates need to be removed in a second operation once union is achieved in order to avoid progressive acromial osteolysis, which could potentially cause problems in the future.

References

1. Ballmer FT, Gerber C (1991) Coracoclavicular screw fixation for unstable fractures of the distal clavicle. A report of five cases. J Bone Joint Surg Br 73:291–294
2. Edwards DJ, Kavanagh TG, Flannery MC (1992) Fractures of the distal clavicle: a case for fixation. Injury 23:44–46
3. Eskola A, Vainionpaa S, Patiala H et al (1987) Outcome of operative treatment in the in fresh lateral clavicular fractures. Ann Chir Gynaecol Fenn 76:167–169
4. Fann CY, Chiu FY, Chuang TY, Chen CM, Chen TH (2004) Transacromial Knowles pins in the treatment of Neer type 2 displaced clavicle fractures. A prospective evaluation of 32 cases. J Trauma 56:1102–1106

5. Faraj AA, Ketzer B (2001) The use of hook plate in the management of acromioclavicular injuries. Report of ten cases. Acta Orthop Belg 67:448–451
6. Flinkkila T, Ristiniemi J, Hyvonen P, Hamalainen M (2002) Surgical treatment of unstable fractures of the distal clavicle: a comparative study of Kirschner wire and clavicular Hook plate fixation. Acta Orthop Scand 73:50–53
7. Kona J, Bosse MJ, Staheli JW et al (1990) Type 2 distal clavicle fractures: a retrospective review of surgical treatment. J Orthop Trauma 4:115–120
8. Neer CS II (1984) Fracture dislocation of the shoulder. In: Rockwood CA Jr, Green DP (eds) Fractures in adults, 2nd edn. Lippincott, Philadelphia, pp 711–712
9. Neer CS (1963) Fractures of the distal third of the clavicle with detachment of the coracoclavicular ligament in adults. J Trauma 3:99–100
10. Neviaser RJ (1987) Injuries of the clavicle and the acromioclavicular joint. Orthop Clin North Am 18:433–438
11. Nordqvist A, Petersson C, Redulund-Johnell I (1993) The natural course of lateral clavicular fractures. 15 (11–21) year follow up of 110 cases. Acta Orthop Scand 64:87–91
12. Prost M (1978) The shoulder, surgical and non-surgical management. Lea & Febiger, Philadelphia
13. Yamaguchi H, Arakawa H, Kobayashi M (1998) Results of the Bosworth method for unstable fractures of the distal clavicle. Int Orthop 22:366–368