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ORIGINAL STUDY

Acute management of clavicle fractures
A long term functional outcome study

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The purpose of this study was to evaluate the long-term results after acute treatment of clavicle fractures. We reviewed 139 patients with an average age of 39.3 years (range : 18 to 74) who sustained a clavicle fracture either isolated or as part of a polytrauma. Besides demographic data, both clinical result and residual symptoms were also recorded. The average follow-up was 7.2 years (range : 4 to 13). The fracture showed a higher prevalence in young men and older women. The most frequent mechanism of injury was a fall (39.6%) and coexisting injuries were found in 12.9% of patients. Conservatively treated fractures united in 96.9% of cases and the time to union was no different with a sling or figure-of-eight bandage. Fracture location did not influence the functional outcome. One third of patients were still complaining of mild pain and discomfort during overhead activities and polytrauma patients had a lower Constant score.

Keywords : clavicle fracture ; conservative management ; long-term outcome.

INTRODUCTION

Clavicle fracture is a rather common injury representing approximately 5-10% of all fracture types and almost half of the entire shoulder girdle injuries (*3,10*). It typically follows a fall directly on the point of the shoulder or on the outstretched arm and it is mostly located in the midshaft of the bone (*7*). Routine physical examination is considered necessary not only for the estimation of skin integrity and neurovascular status, but also for the assessment of scapular position and posture of the upper extremity (*11*).

Conservative treatment (sling or figure-of-eight bandage) ensures a high union rate and a good clinical result in the majority of cases (*2,17*). However, the concept that bone healing can be achieved even if both ends of the clavicle are widely separated has been vividly disputed during the last decade (*9*). Many authors have reported superior results after surgical reconstruction in fractures with severe displacement and comminution (*9,15,16,19*).

In this long term retrospective study, we evaluated the incidence of clavicle fractures in relation to

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age and gender, the results of non-operative treatment and the influence of concomitant injuries and fracture location on the functional outcome.

MATERIALS AND METHODS

Between 1993 and 2002, 171 patients older than 18 years were admitted to the Accident and Emergency Department with a clavicle fracture, either isolated or as part of a polytrauma. At final follow-up, 2 patients had died and 30 patients were lost despite exhaustive search, or refused examination for different reasons (19%). The remaining 139 patients were identified and formed the study group.

The diagnosis was made within 24 hours after trauma and all the concomitant injuries or potential neurovascular disturbances were recorded. Standard or 45° cephalic tilt radiographs were performed for confirmation and assessment of the fracture type. Fractures were classified on the basis of their anatomic location according to the Allman classification system (*1*).

The decision making for fracture management was largely dependent upon surgeon's preference. In general terms, fractures with marked displacement and excessive skin tenting were treated by operative means. Surgical intervention included open reduction and internal fixation (ORIF) with plate and screws or closed reduction and internal fixation (CRIF) with intramedullary pins, K-wires and nails. A simple sling or figure-of–eight bandage was used for a variable period of time when conservative treatment was selected.

All patients were followed up at intervals of 2, 6 and 12 weeks and afterwards if residual symptoms or previous radiological findings necessitated further examination. Absence of radiographic evidence of union with persisting pain 24 weeks after the injury was defined as non-union (*14*). Functional outcome was assessed according to Constant- Murley Score (*5*). The range of follow-up was 4 to13 years (average 7.2 years).

Table I. — Associated injuries.

Associated Injuries	Number	Incidence
Rib fractures – Chest injuries	5	3.6%
Abdomen injuries	2	1.4%
Head injuries	3	2.2%
Long bone fractures	3	2.2%
Soft tissue damage	4	2.9%
Thoracolumbar spine fractures	3	2.2%
Pelvic fractures	2	1.4%
Cervical spine injuries	1	0.7%
Total	*23*	*16.5%*

Statistics

The Microsoft Excel Program and the SPSS Program were employed for the creation of tables and graphs. The SPSS program was used for the statistics of the study. The data was analysed using either the Chi-square test or the Mann-Whitney test in case of testing two independent samples. P values less than 0.05 were considered to be statistically significant.

RESULTS

Of a total of 139 patients included in this study, 105 (75.5%) were men and 34 (24.5%) women. The mean age was 39.3 ± 15.2 years (range : 18 to 74). The fracture showed a higher prevalence in younger ages among men and in older ages among women .

The clavicle fracture was caused by a fall in 55 patients (39.6%), a car accident in 37 patients (26.6%), a motorcycle collision in 27 patients (19.4%), a bicycle accident in 10 patients (7.2%) and a sports injury in 10 patients (7.2%). A road traffic accident (car, bicycle or bicycle) was the main mechanism of injury in men (66/105 = 62.9% of the males) while in women a fall was responsible for the majority of fractures (23/34 females = 67.6%).

Coexisting injuries were found in 18 (12.9%) patients. Rib fractures were the most common associated injuries (5 patients) complicated by pneumothorax in 2 cases and haemothorax in 1 case (table I).

According to Allman's classification, the fractures were located at the medial third of the clavicle in 9 (6.5%) patients, at the middle third in 91 (65.4%) patients and at the lateral third in 39 (28.1%) patients. No major vascular injury was recorded. Transient brachial plexus or neural injury was noted in 7 (5%) patients, all of which had complete resolution of neurological symptoms at the latest follow-up visit.

The fracture was treated conservatively in 128 cases. The mean time to union was 19.6 weeks. Eventually, 124 (96.9%) fractures went on to union and 4 (3.1%) to non-union. The latter group includ-

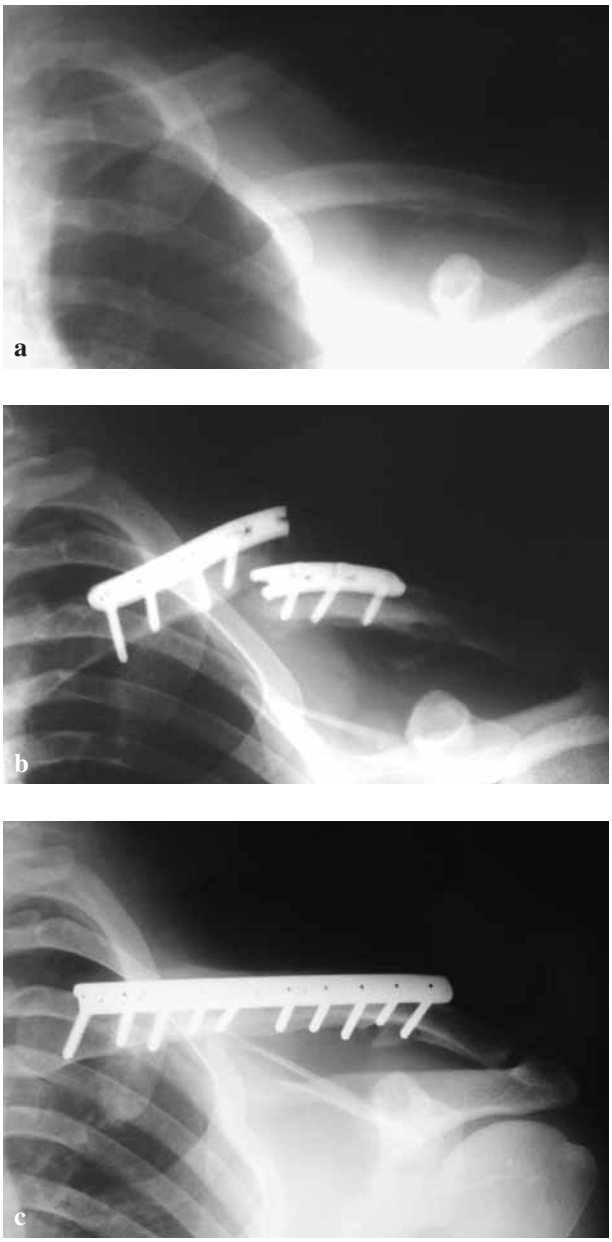

Fig. 1. — **(a)** Mid-diaphysis fracture of the left clavicle. **(b)** Fracture non-union and plate breakage 8 months after internal fixation. **(c)** Revision of plate osteosynthesis and iliac crest graft led to fracture union.

ed 3 patients with a lateral-third clavicle fracture and one patient with a diaphyseal fracture. No significant difference was evident between sling and figure-of-eight bandage immobilisation regarding the time to union and overall union rate ($p > 0.05$).

Operative treatment was applied primarily in the remaining 11 patients and in the 4 cases with nonunion after conservative treatment. The postoperative course and bone healing were uneventful in 12 of these 15 fractures. In 2 cases, CRIF of the lateral third of clavicle fracture led to K-wire migration and re-operation. The last case – a mid-diaphysis clavicle fracture – ended with nonunion and plate breakage after ORIF (fig 1).

Despite fracture union, approximately one third of patients (44 patients = 31.7%) reported mild pain or discomfort with overhead activities. The mean Constant and Murley score was 88 (range, 72-100). Polytrauma patients showed inferior results in comparison with patients with an isolated fracture ($p = 0.044$). No association was found between fracture location and clinical result ($p > 0.05$).

DISCUSSION

Clavicle fracture seems to have a specific allocation among men and women at certain age groups. Previous studies showed a higher prevalence in men, especially in younger ages (*13*). According to our findings, 71.5% of men were younger than 50 years and 76.4% of women were over 60 years old at the time of injury. The fracture was mostly caused by a fall on the arm in women, and by a road traffic accident in men.

In high-energy trauma, concomitant injuries often jeopardise the patients' survival and may worsen the final outcome (*4,18*). Robinson (*14*) in his series of 1000 clavicle fractures recorded 96 patients suffering from other injuries : 75 had additional orthopaedic injuries, 29 had head or facial injuries, 27 had serious chest injuries and 4 had abdominal injuries. In our study, rib fracture was the most frequent associated injury (5 of 18 patients suffering other injuries = 27.3% or 3.6% of the total series of 139) leading in almost all cases to life threatening complications such as pneumothorax and haemothorax. Moreover, polytrauma patients scored inferiorly, particularly in terms of pain and discomfort during shoulder movements.

The majority of clavicle fractures can be effectively treated non-operatively (*7,10,17*). A randomised clinical trial by Andersen *et al* (*2*) illustrat-

ed no functional or radiographic difference between the sling and figure-of-eight bandage. Furthermore, Zlowodzki *et al* (*19*) in a systematic review of 2144 midshaft clavicle fractures found a higher patient satisfaction rate when a sling was selected for limb immobilisation. In our study, no statistical difference was detected between the above methods regarding the time to union and overall healing rate. The current vogue of conservative treatment is in favour of a sling followed by the gradual institution of motion when the pain subsides and fracture site stability has improved.

However, later studies have revealed that the union rate for displaced midshaft and lateral third fractures of the clavicle may not be as favourable as once thought (*9,14,15,16,19*). The non-union rate of fractures of the lateral end of the clavicle can rise to 37% when a non-operative treatment protocol is initially adopted (*15*). Similarly, Hill *et al* (*6*) reported 15% non-unions and 31% unsatisfactory results after conservative treatment of midshaft clavicle fractures. In a recent multicenter, prospective clinical trial, 132 patients with a displaced midshaft fracture of the clavicle were randomised to either operative treatment with plate fixation or non-operative treatment with a sling. Besides a lower non-union rate, the patients in the operative group were more likely to be satisfied with their shoulder in general than were those in the non-operative group. It is becoming apparent that the presence of scapular winging (dynamic or static), in association with anterior rotation of the distal clavicle fragment, is a prognostic indicator for poor outcome following nonoperative care (*8*).

As with most conditions for which various options are advocated, established methods for the operative treatment of acute midshaft clavicle fractures and clavicular non-unions have had complications and varying results (*7,9*). Pin fixation could offer a good cosmetic result with minimal soft tissue damage but hardware problems is an issue of major concern (*12*). Even though the number of surgically treated patients in the present study is small, migration of K-wires was encountered in 2 cases. The authors recommend plate fixation for all displaced clavicle fractures requiring internal fixation.

CONCLUSION

The satisfaction rate of patients after clavicle fracture is relatively high despite the risk of fracture non-union and the possibility of complications emerging from the selected treatment. Major concomitant injuries seem to adversely affect the functional outcome while fracture location and type of immobilisation have no impact on final result.

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