CLOSED TREATMENT OF DISPLACED MIDDLE-THIRD FRACTURES OF THE CLAVICLE GIVES POOR RESULTS

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We evaluated 242 consecutive fractures of the clavicle in adults which had been treated conservatively. Of these, 66 (27%) were originally in the middle third of the clavicle and had been completely displaced. We reviewed 52 of these patients at a mean of 38 months after injury.

Eight of the 52 fractures (15%) had developed nonunion, and 16 patients (31%) reported unsatisfactory results. Thirteen patients had mild to moderate residual pain and 15 had some evidence of brachial plexus irritation. Of the 28 who had cosmetic complaints, only 11 considered accepting corrective surgery. No patient had significant impairment of range of movement or shoulder strength as a result of the injury.

We found that initial shortening at the fracture of ≥20 mm had a highly significant association with nonunion (p < 0.0001) and the chance of an unsatisfactory result. Final shortening of 20 mm or more was associated with an unsatisfactory result, but not with nonunion. No other patient variable, treatment factor, or fracture characteristic had a significant effect on outcome.

We now recommend open reduction and internal fixation of severely displaced fractures of the middle third of the clavicle in adult patients.

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Fracture of the clavicle is common, accounting for 5% to 12% of all fractures and up to 44% of injuries to the shoulder girdle.1–3 About 70% to 80% of these fractures are in the middle third of the bone.1,4

We suspected that our results for severely displaced fractures of this type in adults were poor, and therefore reviewed our experience.

PATIENTS AND METHODS

From 1988 to 1992 inclusive we treated 242 consecutive fractures of the clavicle in adult patients. Of these, 66 (27%) were in the middle third and completely displaced. We attempted to review all these patients, but four had died and we were unable to locate ten.

We therefore contacted 52 patients of whom 47 were examined clinically and had radiographs at a mean follow-up of 38 months (15 to 68). There were 37 men and 15 women; their mean age was 34 years (18 to 59), and there were 33 left- and 19 right-sided injuries.

Nineteen of the fractures (36%) were on the dominant side, and 20 patients (38%) were smokers at the time of injury. Twenty-eight patients had manual work; 24 had sedentary occupations.

The fracture was caused by a fall or a direct blow in 30 patients (58%), only two describing a fall on an outstretched hand. Twenty patients (38%) were uncertain of the mechanism and 21 (40%) had other injuries such as rib fractures, a head injury, or a long-bone fracture. There were two grade-I open injuries.

Ten of the 52 patients had had an attempted reduction; 42 (81%) were managed by a figure-of-eight brace, four in a sling, and six had no treatment. The average period of brace treatment for patients with a healed fracture was 6.1 weeks (1 to 12). Thirty patients used a brace or sling all the time; 16 used one only when out of bed.

The apparent fracture shortening on the initial radiograph averaged 11.4 mm (1 to 25) in 43 cases (Fig. 1) and nine fractures were distracted by an average of 8 mm (3 to 15).

There was comminution in 27 patients, marked obliquity in 14 and a transverse break in 11. No patient had radiological evidence of disruption of the coracoclavicular ligaments.
RESULTS

Fifty-two patients completed the questionnaire but five were unable to return for clinical and radiological examination. These five patients were all completely satisfied with the result, reporting a full range of movement, good strength, no pain, and no crepitus at the fracture site. We therefore assumed that they had united fractures in addition to the 39 with definite radiological union. We found non-union in eight patients (15% of the reviewed series) on follow-up radiographs.

Only 36 of the 52 patients surveyed (69%) were satisfied with the final result. Thirty-nine (75%) had no pain and 13 had mild to moderate pain which required analgesic medication (Table I). Fifteen patients had residual paraesthesia, eight of these being in the united group. Twenty-eight patients (54%) found the end-result cosmetically displeasing, but only 11 would consider corrective surgery. Nineteen patients reported difficulty in lifting objects of more than 20 lb (9 kg) above shoulder level, 20 said that shoulder straps caused pain and 23 had some discomfort when lying on the affected side. Forty-eight of the 52 patients had returned to their previous work and the clavicle fracture was not the main reason for failing to do so in the other four.

Of the eight patients with nonunion, seven had pain or paraesthesia or found the result cosmetically displeasing. All seven rated the end-result as unsatisfactory. One patient with nonunion had only mild pain and insignificant paraesthesia and was generally pleased. All eight patients had difficulty in lifting heavy objects. Six of them had returned to their previous employment after an average of 23.8 weeks (1 to 52).

On clinical examination, 13 of the 52 had either a large clavicular lump or marked shoulder droop and 20 had local tenderness to palpation, but 44 had a full active range of shoulder movement at follow-up. Two with healed fractures had losses of 10° and 15° of total elevation, and one patient with nonunion had lost 20°. Of the six patients with

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<tr>
<td>Pain*</td>
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* requiring the regular use of non-steroidal anti-inflammatory drugs

Fig. 1
Anteroposterior radiograph showing a severely displaced midshaft fracture of the clavicle with shortening of >20 mm. The arrows represent shaft displacement.
reduced strength, two had established nonunion. Loss of strength appeared to be related to pain rather than to muscle dysfunction.

Fifteen patients, seven of them with nonunion, had some evidence of thoracic outlet syndrome on hyperabduction of the arm but there were no permanent nerve injuries. One patient showed clinical signs of vascular compression on the side of the fracture.

Of 47 patients having radiographs at follow-up, 42 showed an average of 11.8 mm (0 to 22) of apparent shortening as compared with the contralateral normal clavicle on the same film. The other five had a mean lengthening of 7 mm (2 to 13). There had been no change from the initial film in eight, but 22 had apparently shortened during healing and 17 had apparently increased in length. Thickening at the fracture site, estimated as a percentage of that of the normal side, averaged 211% (140 to 423). There were five hypertrophic and three atrophic nonunions.

We found no statistical association of nonunion or an unsatisfactory result with age, gender, occupation, smoking status, mechanism of injury, or the presence of associated injuries (Fisher’s exact test). Neither attempts at reduction nor the method of immobilisation appeared to affect the result. None of our radiological measurements other than shortening had any apparent influence on healing or the result (Student’s t-test to compare means) and Fisher’s exact test showed no significant association of comminution with nonunion. The latter was associated (p < 0.05) with evidence of nerve-compression symptoms, but the amount of callus thickening was not.

We found that initial shortening at the fracture site ≥20 mm was significantly associated with the development of nonunion (Fisher’s exact test, p < 0.0001). All six patients with initial shortening ≥20 mm developed nonunion, and no patient who united had initial shortening of over 18 mm. Final shortening of ≥20 mm was very significantly associated with an unsatisfactory result (p < 0.001).

DISCUSSION

Reported results for the non-operative treatment of fractures of the clavicle have been uniformly good: a combined series of over 3000 fractures showed a rate of nonunion of 0.4%.1,2,4-7 These series, however, were all very mixed with regard to age, clavicular site and severity and degree of the fracture. They also included variable proportions of children who have greater healing and potential for remodelling.

We evaluated 52 of a consecutive series of 66 adult patients with completely displaced fractures of the middle third of the clavicle, regarding them as a group at special risk of complications.

Most of the fractures in our series healed, but 15% developed nonunion. Neer1 reported nonunion in only three of 2235 patients with middle-third fractures treated by closed methods, although Rowe3 had an incidence of nonunion of 0.8% in 566 fractures. Neither report identifies the proportion of paediatric patients. Eskola et al2 found a nonunion rate of 3% in a predominantly adult population with 65% of the fractures in the middle third of the bone. White et al4 reviewed clavicular fractures medial to the coracoid in adults, and found an incidence of nonunion of 13% with an association with high-energy trauma.

Late neurovascular impairment has been rarely reported. Rowe4 found late neurovascular compromise in 0.3% and attributed this to excessive callus formation. Wilkins and Johnston9 reported a 6% incidence of thoracic outlet syndrome in patients with nonunion of the clavicle, but we found that a significantly higher proportion of patients had paraesthesia of the upper extremity related to specific activities. Our diagnosis of thoracic outlet syndrome was based on unilateral symptoms which could be reproduced during physical examination. Definite symptoms were present in 29% of our series, affecting 18% of patients with healed fractures and 88% of those with nonunion. A trend towards association between excess callus formation and the thoracic outlet syndrome was not statistically significant.

The statistical association which we found between final shortening and an unsatisfactory result, and between initial shortening and nonunion is probably related to the degree of soft-tissue stripping or interposition, as suggested by Neer.1

We reviewed patients with completely displaced middle-third clavicular fractures, which formed only 27% of our consecutive adult series, and the overall results could be regarded as satisfactory, but the 15% incidence of nonunion was strongly associated with an unsatisfactory result as was initial shortening of ≥20 mm. There was also a relatively high incidence of other problems including pain and nerve-compression syndromes.

Our findings have led us to recommend the open reduction and internal fixation of severely displaced fractures of the middle third of the clavicle in adult patients.

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REFERENCES