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OPERATIVE TREATMENT OF SEVERE PROXIMAL HUMERAL FRACTURES

PEKKA PAAVOLAINEN[1], JAN-MAGNUS BJÖRKENHEIM[1], PÄR SLÄTIS[1] & PERTTI PAUKKU[2]

[1]Division of Orthopaedic Surgery and Traumatology, [2]Division of Radiology, Surgical Hospital, University Central Hospital, Helsinki, Finland

Results after the operative treatment of 41 severe proximal fractures of the humerus are reported. The fractures were classified according to Neer (1970a). The aim of treatment was accurate reduction and stable fixation of the fracture with screws or with screws and a plate.

When scored according to Neer's (1970a) functional assessment, results in the 31 patients re-examined more than 1 year postoperatively were excellent or satisfactory in 23 patients. Results were excellent or satisfactory in 14/15 patients with type III fractures, in 7/11 with IV, and 2/4 with type VI. In the only re-examined patient with a type V fracture the result was unsatisfactory.

The most common technical error was a too high positioning of the AO plate and persistent varus deformation of the head of the humerus. High positioning of the plate caused post-operative restriction in the movements of the glenohumeral joint because the implant impinged under the acromion during abduction. No aseptic necrosis of the humeral head was observed.

Of the patients of working age all but one returned to their preoperative occupations within a mean of 3.5 months after surgery.

Key words: bone plates; fracture fixation; humerus

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Reported results after treatment of proximal humeral fractures are inconsistent. Such fractures have been treated by conservative methods (Einarsson 1958, Clifford 1980), by operative methods (Bandi 1976) or by a combination of these two (Neer 1970b, Svend-Hansen 1974). Comparison of the end results is hampered both by lack of uniform classification of the fractures and by differences in the evaluation of results. Einarsson (1958) grouped his patients according to the number of fracture fragments. Later, the classification of fractures proposed by Neer (1970a) was used by Neer (1970b), Svend-Hansen (1974) and Clifford (1980) (Figure 1).

Two-part fractures seem to heal with good results after conservative treatment (Svend-Hansen 1974, Clifford 1980). In the more difficult fractures with three and four fragments, good results after conservative treatment have been reported in 80 per cent of patients by Einarsson (1958), in 56 per cent by Clifford (1980) and only in 39 per cent by Svend-Hansen (1974). In his series, Neer (1970b) observed that closed reduction of both three- and four-part fractures was inadequate; the preferred method for three-fragment fractures was open reduction (41.9 per cent with excellent or satisfactory results), and that for four-part fractures, prosthetic replacement. In the series of Bandi (1976), which was not subgrouped according to the number of fracture fragments, results were good in 68 per cent of the patients treated with open reduction. Cumulative

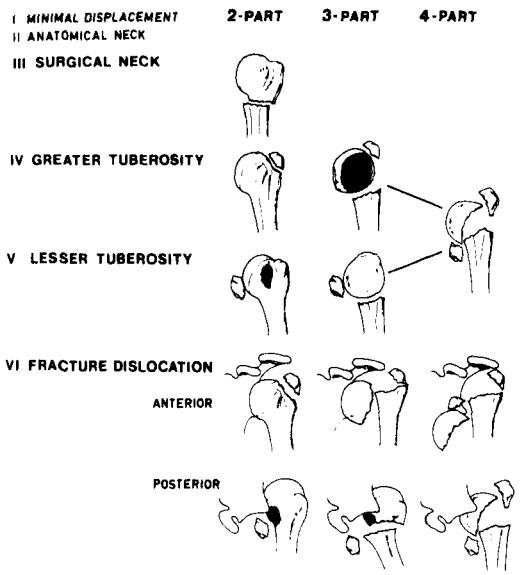

Figure 1. Classification of displaced proximal humeral fractures according to Neer (1970a).

experience related in recent reports suggest that good results with conservative methods can only be achieved in two-part fractures. The trend in the treatment of three- and four-part fractures is towards open reduction and internal fixation. We report the results of 41 consecutive severe proximal humeral fractures treated only operatively and classified pre- and post-operatively according to Neer (1970a).

PATIENTS AND METHODS

During the 5-year period from 1974 to 1980, 162 patients with fractures of the proximal humerus were admitted to the division of Orthopaedic Surgery and Traumatology, Surgical Hospital, University Central Hospital in Helsinki. Of this number, those 41 who had a displaced humeral fracture were treated with open reduction and internal fixation.

There were 22 men, ranging in age from 15 to 71 years (mean 46.5 years) and 19 women, ranging in age from 23 to 89 years (mean 61 years). The fractures were subgrouped according to Neer (1970a) (Table 1). Our series contained no type I or II fractures. Twenty patients had type III, 14 had type IV, two had type V, and five had type VI.

Indications for open reduction were unacceptable fracture reduction in two-part fractures, any three- or four-part fractures and a greater than 5-mm dislocation

Table 1. Age distribution of 41 patients according to fracture type (Neer classification)

Fracture type	No. of patients	Age (years)				
		1–19	20–39	40–59	60–79	80+
III	20	4	5	2	8	1
IV	14	–	4	5	5	–
V	2	–	–	–	2	–
VI	5	–	1	3	1	–
Total	41	4	10	10	16	1

in type IV avulsion of the greater tuberosity. Deltopectoral exposure was used in all cases. The fracture was operatively reduced and was secured in 24 patients with a plate and screws, in six patients with single screw fixation of the greater tuberosity, and in 10 patients with screw fixation of the collum. In one patient a four-part fracture was realigned with cerclage alone and led to failure. All patients started physiotherapy 3 weeks after immobilization in a Velpeau dressing.

Thirty-one patients (75.6 per cent) attended a re-examination. Six patients had died of causes unrelated to the humeral fracture before the re-examination and four could not be traced. Each patient was personally examined by one of the authors and routine radiographs were taken of the shoulder joint.

Radiographically, the fracture position was rated as *good* if exact fracture alignment and correct inclination of the humeral neck (130° ± 10°) were combined with good positioning of the implants; as *fair* if the inclination of the humeral neck was 100–120°; and as *poor* if the inclination was less than 100° (Figure 3).

The plates and screws used for osteosynthesis were left in place in all but eight patients.

The end results were evaluated according to the functional criteria of Neer (1970a). The total maximum score is 100 units, with maximum scores in the four functional assessment categories being:

Pain	35 units
Function	30 units
Range of motion	25 units
Anatomy	10 units
Total maximum score	100 units

Unit scores correspond to results as follow:

Excellent: >89 units
Satisfactory: 80–89 units
Unsatisfactory: 70–79 units
Failed: <70 units

RESULTS

Radiographically the fracture position was graded good in 21 patients, fair in 15 and poor in 5 (Figures 2 and 3). Analysis of the radiographs revealed a number of noteworthy technical errors. In six patients the T-plate had been positioned up too high with the result that the plate protruded above the greater tuberosity causing impingement of the plate under the acromion during abduction (Figure 4). In two patients unstable osteosynthesis caused a late fracture dislocation. Fixation of a type III fracture with screws alone was successful in young patients, but was not sufficiently firm in the more porotic bone of elderly persons (Figure 5).

In one patient the screw tip had penetrated into the joint cavity, and in two patients loose fragments were detected after osteosynthesis. No avascular necrosis of the humeral head was seen.

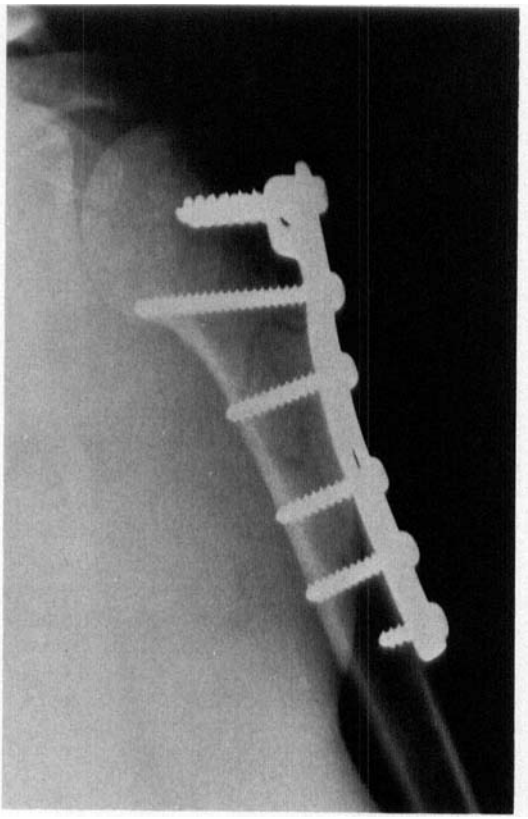

Figure 2. Radiography showing exact fracture alignment and correct inclination of the humeral neck combined with good positioning of the implant.

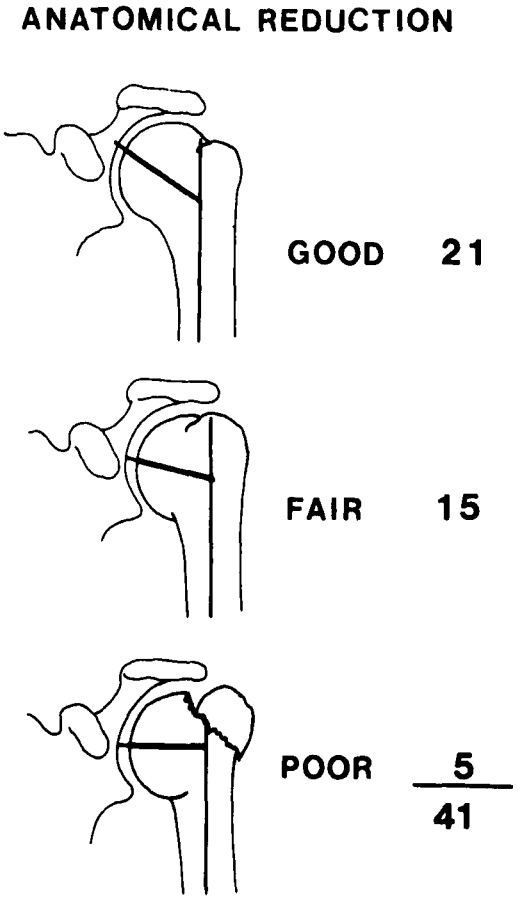

Figure 3. Results of the radiographic analysis.

Among the 31 patients re-examined, results were excellent or satisfactory in 23 patients, and unsatisfactory or poor in the remaining 8 (Table 2). Results were excellent or satisfactory in 14/15 patients with type III fractures, in 7/11 with type IV fractures, and in 2/4 with type VI. In the only re-examined patient with a type V fracture, the result was unsatisfactory.

No pain or only occasional pain in the shoulder was reported by 26 patients, mild or moderate pain by four and severe pain by one.

Strength of the upper extremity was reported and assessed to be normal in 10 patients, good in 14, fair in 4 and poor in 3. Extension of more than 170° was achieved by 22 patients and less

Figure 4. A too high positioning of the plate can lead to varus deformation of the caput humeri and to limitation of movement as the plate impinges under the acromion during abduction (arrow).

than 80° by only two. Abduction of more than 170° was achieved by 18 patients and of less than 80° by three.

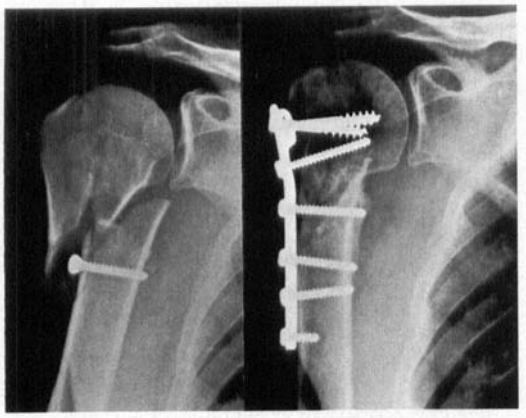

Figure 5. The holding capacity of a single screw, even in oblique shaft fractures, is insufficient. In this case the first fixation failed and led to reoperation and proper fixation with plate and screws.

Table 2. Neer functional assessment scores – distributed according to fracture type – of 31 patients at re-examination

Fracture type	No. of patients	Score		
		Mean	Lowest	Highest
III	15	89	62	100
IV	11	79	22	100
V	1	79	–	–
VI	4	76	67	96

Six patients had postoperative complications: two had wound infections, one had a deep infection, two had postoperative psychosis and in one the shoulder was stiff and painful.

Nineteen patients were pensioners at the time of the injury. Twenty-one patients returned to their preoperative occupation after a mean sick leave of 3.5 months. One patient had to give up her work because of a stiff and painful shoulder that was subsequently treated with an arthrodesis of the glenohumeral joint.

DISCUSSION

Overall results in which the outcome was excellent or satisfactory in 74.2 per cent of patients is gratifying. However, this favourable percentage might be misleading because our series contained four patients younger than 20 years of age. In Clifford's (1980) series of 80 patients whose proximal humeral fractures were treated conservatively, results were excellent or satisfactory in 81 per cent. This material also included type I fractures, which are not present in our material. Bandi (1976) reported excellent results in 68 per cent of those 106 patients treated operatively. Of Svend-Hansen's (1974) 49 patients treated both conservatively and operatively, results were excellent or satisfactory in only 39 per cent.

Indications for open reduction and internal fixation should be based on severe angulation, rotation deformity, displacement and loss of contact between the fragments, neurovascular compromise or irreducible fracture dislocation. When any of these indications exist, especially in

three- or four-part fragmentation, open reduction is worth trying (Neviaser 1962, Neer 1970b, Bandi 1976). Of the 31 patients with three-part fractures that Neer (1970b) treated operatively, results were excellent or satisfactory in 19. Of the 13 four-part fractures that he treated with open reduction and internal fixation, all were failures. Reported results thus seemed to be poor in type IV fractures and in type VI fracture dislocations with extensive fragmentation and lesions of the rotator cuff. The treatment of choice in four-part fractures might therefore be prosthetic replacement combined with reconstruction of the rotator cuff (Neer 1970b, Post 1980).

Complications, though rare, did occur. There was only one deep infection. No patient had necrosis of the caput humeri. Most complications were associated with technical errors: a faulty or too high positioning of the plate or loosening of the osteosynthesis material. There is an obvious risk that plates and screws may become loosened, especially in patients older than 50 years in whom the underlying bone tissue is porotic and therefore has a reduced capacity for holding screws (cf. Horak & Nilsson 1975) (Figure 5). A too high positioning of the plate can lead to limitation in the range of movements when the plate impinges under the acromion during abduction. Such faulty positioning can also lead to angulation and varus deformation of the caput humeri with corresponding limitation of movements (Figure 4). On a normal humerus the angle formed by the axis of the anatomical neck and the shaft of the humerus has been reported to be 140° (Einarsson 1958).

Our patient series is too small for a closer analysis of differences among the various osteocynthesis methods. But from the consideration of individual cases it seems clear that in type III fractures screw fixation alone can lead to good results only in young patients with hard and healthy bone tissue; in older persons use of the T-plate is recommended. However, in two-part type IV fractures, fixation of the tuberculum majus with screws led to good results.

Of the five patients with poor results in the re-examination (total score less than 70 points) four were older than 65 years. One patient had a severe fracture dislocation with four-part fragmentation. A deep infection developed in one patient, and the osteosynthesis failed in two. The fifth had chronic alcoholism and suffered a postoperative psychosis. All patients of working age, except one, returned to their occupations after a mean sick leave of 3.5 months. When compared with earlier reports on length of disability, this can be concluded to be a good result (Svend-Hansen 1974, Clifford 1980).

At re-examination use of the Neer functional assessment key seemed to be satisfactory because it takes into account not only the range of movements but also functional ability. From interviews with patients it became clear that, to them, a painless glenohumeral joint, even if movement was limited, is more important than full range of motion. In almost all patients in this series, the glenohumeral joint was painless on re-examination.

In conclusion it can be said that especially with two- and three-part fractures operative treatment with adequate fracture reduction and reconstruction of the rotator cuff is worth trying. In these cases the results can be even improved when compared with the earlier series with conservative treatment. In the cases of four-part fractures the results were poor even with internal fixation of the fracture fragments and this might speak in favour of primary prosthetic replacement of the glenohumeral joint.

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Correspondence to: Pekka Paavolainen, Division of Orthopaedics and Traumatology, Surgical Hospital, University Central Hospital, Kasarmikatu 11–13, 00130 Helsinki 13, Finland.