

Proximal humeral fractures

Late results in relation to classification and treatment

One hundred and eighty-eight proximal humeral fractures were reviewed retrospectively in relation to the Neer classification and the treatment given. The displacement criteria were found to have prognostic significance. Minimally displaced fractures had excellent outcome, whereas the results following any treatment of the displaced fractures were unsatisfactory in about one half of the cases. The indications for closed or open treatment can only be defined by prospective studies, and the methods of treatment should be improved.

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Since Neer (1970a) published his classic study on proximal humeral fractures, in which he described methods of classification as well as assessment of the results of treatment, the management of displaced fractures has been a matter of considerable dispute.

We have evaluated the late results of all types of proximal humeral fractures in adults in our department.

Materials and methods

The records and radiographs of all the patients above the age of 20 years with proximal humeral fractures admitted to our department during the period 1976 to 1982 were reviewed. In all, 188 fractures in 188 patients (132 females and 56 males) with a median age of 70 (20–101) years were thus included in the study.

Type of fracture. From the first post-injury radiograph, a classification of the fracture was done according to Neer (1970a). Minimally displaced fractures were thus all fractures regardless of the number and level of fracture lines in which no segments were displaced more than 10 mm or angulated/rotated more than 45 degrees. The classification of displaced fractures is outlined in Figure 1.

Clinical management. In 108 patients the position of the fracture was accepted, and immobilization in a sling for about 1 week was followed by functional exercises. In 37 cases closed reduction, either by manipulation or by using a hanging cast, was performed and considered successful in 28 cases. In the 9 cases of primarily failed closed reduction and in 43 further cases, open reduction was performed without fixation in 7 cases and with internal fixation in 39 cases, 32 of which had plate

osteosynthesis, 3 had resection of the humeral head, and 3 had a prosthesis.

Follow-up. One hundred and nineteen patients (64 per cent) attended a follow-up examination 4 (2–7) years after the injury. Fifty-one patients had died and 18 were lost for follow-up. The assessment was done according to a numerical scoring system, which included a subjective, objective, functional, and radiographic evaluation with a maximum score of 100 units, as well as an overall grading of excellent (≥ 90), good (89–80), fair (79–70), and poor (≤ 70) results (Neer 1970a).

Statistics. The chi-square test was applied for binomial observations and the Mann-Whitney rank-sum test for the comparisons of individual scores.

	Two-part	Three-part	Four-part
Anatomical neck			
Surgical neck			
Greater tuberosity			
Lesser tuberosity			
Fracture dislocation			

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

Table 1. Results in relation to fracture type in 119 proximal humeral fractures

Type	Total	Excellent	Good	Fair	Poor
Minimally displaced	48	22	23	1	2
Displaced					
2-part	30	5	19	3	3
3-part	29	4	11	7	7
4-part	12		3	4	5

Results

In the series as a whole, a median score of 85 (33–100) units was found. Seventy-three per cent of the cases were assessed as having an excellent or good result (score ≥ 80 units). There was no significant correlation of results to age and sex of the patients or time of follow-up. *Minimally displaced fractures* had better results than displaced fractures, and 2-part displaced fractures fared better than 3- and 4-part fractures ($P < 0.0005$, chi-square test; Table 1).

Displaced 2-part fractures. Twenty-six patients sustained a fracture through the surgical neck. In 14 patients the head remained in bony contact with the shaft, and reduction was not attempted. In 4 patients closed reduction was successful and in 8 patients open reduction and internal fixation was chosen. The healing was uneventful in all cases, and there was no difference between the results of the two groups (Table 2).

In the last 4 patients in this group, a displace-

ment of the greater tuberosity was found in combination with an anterior dislocation of the humeral head. After closed reduction the outcome was excellent or good in all the cases.

Displaced 3-part fractures. (Figures 2 and 3). There were 22 fractures of this type with a displacement of the greater tuberosity and the shaft. In 6 of these cases, reduction was not attempted. A satisfactory position was obtained after reduction in 8 cases, but in another 8 cases it was consistently unsuccessful, and open reduction without osteosynthesis in 1 patient and with osteosynthesis in 7 patients was necessary. The results of closed treatment were better ($P < 0.01$, Mann-Whitney). The fair or poor results following open reduction were due to necrosis of the humeral head in 2 patients and to postoperative deep infection in 1 patient. No nonunions occurred. Seven cases were classified as fracture dislocations. Closed reduction succeeded in 1 case only and open reduction and fixation was done in the remaining cases. Results were excellent or good in 3 cases.

Displaced 4-part fractures. All 12 fractures in this group were through the surgical neck involving both tuberosities. Excluding 2 cases of prosthetic replacement and 1 of resection of the humeral head, open reduction and osteosynthesis gave better results than closed reduction only ($P < 0.05$, Mann-Whitney). Two cases of collapse of the humeral head segment occurred in each group.

Table 2. Results in relation to treatment in 71 displaced proximal humeral fractures

Parts	Type Fracture	Treatment ^a	Results/score				Median score
			Excellent ≥ 90	Good 89–80	Fair 79–70	Poor ≤ 70	
2	Surgical neck	C	2	13	3		83
		O	3	2		3	87
	Greater tuberosity	C		4			82
3	Greater tuberosity	C	3	6	3	2	82
		O		3	2	3	74
	Fracture-dislocation	C			1		79
		O	1	2	1	2	73
4	Lesser tuberosity	C			2	2	68
		O		3	2		83
		A			3		56

^a C closed, O open, A arthroplasty/resection.



Figure 2.



Figure 3.

Figure 2. Closed treatment of 3-part displaced fracture in a 76-year-old woman. Clinically, the fracture healed, and in spite of grave subluxation the functional outcome was good 4 years after injury. Score 82.

Figure 3. Open reduction and plate osteosynthesis of a 3-part displaced fracture in a 69-year-old woman. The plate was removed because of collision during abduction. Radiographic evidence of avascular necrosis was present 3.5 years after injury, and the functional outcome was fair. Score 74.

Discussion

Even if the Neer displacement criteria have not been truly established clinically (Jacob et al. 1984), our series confirms its prognostic value in agreement with Clifford (1981) and Mill & Horne (1985).

Minimally displaced fractures have an excellent prognosis. Clifford (1981) reported a significant relationship between the time spent in a sling, the duration of physiotherapy, and the final result, and recommended early active movements, whereas Lundberg et al. (1979) found no difference between independent exercises and conventional physiotherapy. We were unable to confirm any such relationship in this retrospective series.

Several methods of treating displaced fractures have been investigated (Table 3). The results reported by Neer (1970b) have not been convincingly confirmed by others. Using the Neer assessment key, closed, as well as open, reduction and internal fixation seems to yield 50–60 per cent satisfactory results.

Our study indicates that in 2- and 3-part fractures comparable late results can be achieved in the majority of cases following closed methods. Internal fixation seems indicated only if reduction is unsuccessful. In 4-part fractures open reduction and osteosynthesis gave satisfactory results in 3 of 5 cases, being in agreement with the results

reported by Paavolainen et al. (1983) and Stableforth (1984).

Necrosis of the humeral head invariably leads to unsatisfactory end results. Minimal osteosynthesis has been reported to lessen the risk of necrosis (Sturzenegger et al. 1982) in comparison with plate fixation. Considering the results reported lately following arthroplasty in these fractures (Kraulis & Hunter 1977, Anquin & Anquin 1982, Willems & Lim 1985), we find that this

Table 3. Results of treatment of displaced proximal humeral fractures according to the Neer classification and assessment system

Author, year	N	Treatment ^a	Results ^b
Neer 1970b	31	C	10
Neer 1970b	43	O	45
Neer 1970b	43	P	90
Svend Hansen 1974	61	C	65
Kraulis & Hunter 1977	11	P	20
Clifford 1981	37	C	55
Anquin & Anquin 1982	36	P	40
Sturzenegger et al. 1982	27	O	60
Paavolainen et al. 1983	31	O	70
Layshon 1984	42	C	60
Mills & Horne 1985	33	C	55
Willems & Lim 1985	10	P	40
Present study	41	C	75
Present study	27	O	60

^a C closed, O open, P prosthesis.

^b Per cent of cases with scores ≥ 80 .

procedure should be reserved for salvage cases that have developed necrosis.

However, no safe guidelines can be given for the treatment of displaced proximal humeral fractures. The indications for closed or open treatment can only be defined by a prospective

study, and the failure of reported methods to obtain satisfactory results in approximately half the patients indicates that greater efforts need to be made to develop more satisfactory methods of management of these fractures.

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