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Plate fixation of proximal humeral fractures

We performed open reduction and internal fixation with a T-buttress plate in 32 fractures of the proximal humerus with severe displacement and/or fracture dislocation. In 27 cases acceptable reduction was achieved. In four cases infection developed, and the implant was removed in five cases because of impingement of the plate under the acromion and in two cases because of loosening. There was no nonunion, but four humeral head necroses. At the re examination of 20 patients after 2–7 years, nine were excellent or satisfactory and eleven unsatisfactory or poor.
We conclude that the buttress plate offers satisfactory reduction and good stability at a high risk for complications. The indications for this method should be carefully considered, notably in the elderly, and the operation should only be performed by experienced orthopedic surgeons.

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In the majority of cases with proximal humeral fractures (PHF), satisfactory function can be expected following non operative management (Einarsson 1958, Neer 1970b, Clifford 1980, Young & Wallace 1985). About 20 per cent of PHF are classified as displaced (Horak & Nilsson 1975) according to Neer (1970a), and the treatment of these is still disputed. Closed methods are advocated by some (Mills 1974, Leyshon 1984, Young & Wallace 1985), while others prefer open reduction and internal fixation using Rush nails (Letz & Meuser 1980), wireloops (Neer 1970b, Sturzenegger et al. 1982), percutaneous pinning (Jacob et al. 1984), or plates (Weise et al. 1980, Paavolainen et al. 1983).

We present the radiographic and clinical results following T-buttress-plate osteosynthesis for displaced PHF.

Patients and methods

During the period 1976 to 1982, osteosynthesis with a T-plate was used in 32 cases of PHF. The indication was axillary and subcoracoidal fracture dislocation, comminuted fracture of the humeral head, or surgical neck fracture, displaced more than the width of the shaft or angulated more than 45 degrees, where closed reduction had been unsuccessful. The operative technique was according to Müller et al. (1979). Postoperatively, the arm rested in a sling for a few days, followed by functional exercises.

The median age of the patients was 63 (38–83) years and 19 were women. Twenty patients were re-examined 4 (2–7) years after surgery, as 11 patients had died and one could not be found. The fractures were classified according to Neer (1970a) in 2-, 3- or 4-part fractures and fracture dislocations. Six cases were surgical neck 2-part fractures, seventeen cases 3- or 4-part fractures, and nine patients had a fracture dislocation. From the postoperative radiographs the position of the implant and the quality of reduction were estimated according to Paavolainen et al. (1983). Complications were culled from the records. The results of treatment were evaluated according to Neer (1970a).

Results

The fracture position following surgery was classified as good in 10 cases, fair in 17 cases and poor in five cases. In these poorly reduced fractures, however, bony contact was present and rereduction was not tried. None of the re-examined cases had secondary displacement. In five cases the plate had been positioned too high, causing impingement under the acro-

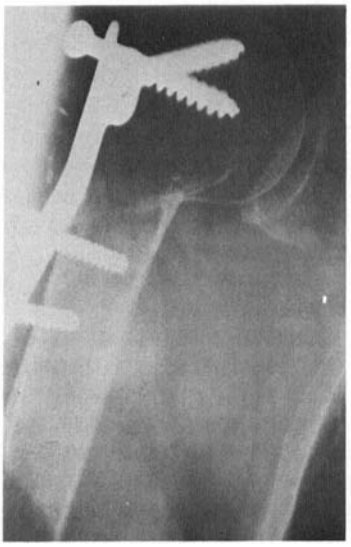

Figure 1

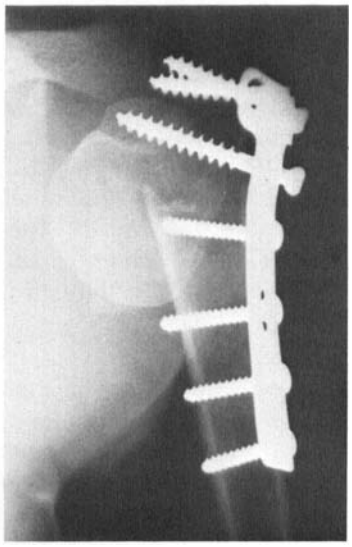

Figure 2

Figure 1. (Case 24). Loosening of the screws and plate 4 weeks postoperatively. The implant was removed, the fracture healed, and the result was satisfactory.

Figure 2. (Case 11). Secondary displacement immediately postoperatively in a 2-part fracture. The patient developed a deep infection, and a reoperation with removal of the implant and resection of the head was performed. The patient did not attend for reexamination.

Table 1. Patients and results in 32 cases of proximal humeral fractures treated by plate osteosynthesis

Case	Sex	Age	Fracture type	Fracture position	Complications	Reoperation	Follow-up time (yr)	Result score
1	F	63	FD	G			–	
2	F	72	3	G			–	
3	M	59	FD	G	M	R	–	
4	M	54	4	F			–	
5	F	44	FD	F	I		–	
6	F	83	FD	F			–	
7	M	61	4	P	L	R	–	
8	M	75	3	P			–	
9	M	57	4	F			–	
10	M	68	FD	G			–	
11	M	38	2	P	I	RD	–	
12	F	77	4	G			–	
13	F	63	3	G	MN	R	6	49
14	M	81	3	P	N		2	33
15	M	59	4	F	MN	R	3	72
16	F	60	FD	F			2	66
17	M	63	2	F			3	64
18	M	44	2	F	IM	R	2	62
19	F	75	2	F			4	70
20	F	82	FD	F			3	50
21	F	65	4	F			6	90
22	F	65	3	F			6	64
23	F	69	3	G			6	71
24	F	80	3	F	L	R	2	84
25	M	63	3	F			6	80
26	F	67	3	G			5	84
27	F	64	FD	F	M	R	7	84
28	M	44	2	G	I	D	7	90
29	F	46	4	P	L		6	83
30	F	40	2	G	L		2	94
31	F	70	3	F			2	83
32	F	72	FD	F	N		3	72

Fracture type: FD fracture-dislocation, 2 2-part, 3 3-part, 4 4-part fracture.
Fracture position after surgery: G good, F fair, P poor.
Complications: I infection, L loosening, M malposition of implant, N necrosis of the humeral head.
Reoperation: R removal of implant, D drainage for infection.
Score: 100–90 excellent, 89–80 satisfactory, 79–70 unsatisfactory, < 70 poor (Neer 1970a).

mion during abduction. In all of these cases the implant was removed after the fracture had healed. In four cases the plate and/or the screws loosened during the healing period (Figure 1); in two cases the plate was removed. In one case the humeral head displaced immediately postoperatively (Figure 2). This patient in addition developed a deep infection; thus the implant was removed, the head resected, and drainage was performed. Another case of deep infection was drained surgically without removal of the implant, and two cases of superficial wound infection were managed with antibiotics. A total of nine reoperations were performed.

There was no nonunion, but four humeral heads collapsed because of necrosis. Two of these were 3-part and two were 4-part fractures; all four cases had an unsatisfactory result. Of all the cases, nine were assessed as excellent or satisfactory and 11 as unsatisfactory or poor. No correlation was found between the final result and the age or sex of patient, type of fracture, quality of reduction, removal of implant or time of follow-up.

Discussion

In our series, infections were encountered in four patients, and in two of them the infection was deep. This is in the same range as reported by Neer (1970b) and Paavolainen et al. (1983).

Open reduction and internal fixation of PHF have been claimed to have the advantage of exact reduction and allow early exercises. A good or fair fracture position was achieved in 27 of 32 of our cases, in agreement with Paavolainen et al. (1983). The importance of accuracy has, however, been questioned by many (DePalma & Cautilli 1961, Moriber & Patterson 1967, Mills 1974, Young & Wallace 1985); and in our relatively small series, no correlation between an anatomic fracture position and a satisfactory final result was found. It appears that if bony contact can be obtained, healing will take place.

Stableforth (1984) reported that only 23 of 32 cases of displaced 4-part PHF healed following closed treatment. Also internal vertical fixation using nails or wires (Neer 1970b, Sturzenegger et al. 1982) may lead to nonunion. In our series no case of nonunion was observed, which accords with other reports (Paavolainen et al. 1983, Weise et al. 1983) indicating that plate fixation offers considerable stability minimizing the risk of pseudoarthrosis.

The number of technical failures, most frequently consisting in positioning the plate too high leading to compromised abduction and eventually to a reoperation, were in agreement with earlier reports on this method (Paavolainen et al. 1983, Weise et al. 1983). Loosening of the implanted material led to redisplacement in one case and reoperation in two. The insufficient holding power of screws in the osteoporotic bone of the elderly may prolong the time of immobilization with a risk of further loss of motion (Sturzenegger et al. 1982) and must be taken into consideration when chosing the proper treatment.

That necrosis with collapse of the humeral head results in a poor functional outcome has been well known (Neer 1970b, Sturzenegger et al. 1982, Stableforth 1984, Leyshon 1984) and has been confirmed in our series. The incidence is dependent on the fracture type, and in addition the generous surgical exposure needed for plate fixation may be a risk (Sturzenegger et al. 1982).

The outcome in our severely displaced PHF was assessed as unsatisfactory in more than half of the cases, comparable to closed treatment, as well as to other methods of internal fixation, or to prosthetic replacement (Kraulis & Hunter 1977, Tanner & Cofield 1983). Willems & Lim (1985) reported 10 cases of Neer arthroplasty following four-part PHF, only four of which were satisfactory or excellent.

The results following plate fixation reported by Paavolainen et al. (1983) were more gratifying than ours, but their series contained younger patients, and half of their cases were two-part fractures only.

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