Postoperative complications of distal humeral fractures

27/96 adults followed up for 6 (2–10) years

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Of 96 adult patients with a distal intercondylar, intraarticular fracture of the humerus treated operatively during a 10-year period, 27 patients suffered a local complication, while the total number of individual complications were 34. There were six postoperative infections, 12 neural injuries, and 16 fixation failures. Because of the complication, a reoperation was performed in 12 of the 27 patients. The final outcome was assessed at a reexamination after a mean follow-up period of 6 (2–10) years. Three patients had a permanent dysfunction of the ulnar nerve. In another 3 patients, failure of the fixation had resulted in an established nonunion of the distal humerus. It appeared that the possibilities of internal fixation in several cases had been overestimated.

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Distal fractures comprise 10–15 percent of all the humeral fractures in adults, and occur mostly in elderly people (Rose et al. 1982). The majority of these fractures are displaced and intraarticular. Consequently, in the past two decades, open reduction and internal fixation seem to have become the prevailing method of management of these injuries (Cassebaum 1969, Johansson and Olerud 1971, Lansinger and Måre 1982, Jupiter et al. 1985, Waddell et al. 1988). However, a severely displaced, comminuted intraarticular fracture of the distal humerus in osteoporotic bone is undoubtedly one of the most challenging skeletal injuries to be treated operatively.

To our knowledge, no previous comprehensive studies on the complications associated with operative treatment of distal humeral fractures in adults have been published. The aim of the present study was to analyze the local complications seen in these patients at one large casualty department over a 10-year period and to assess the influence of a complicated course on the recovery and the final results of treatment.

Patients and methods

From 1977 to 1986 inclusive, a total of 96 adult patients with a displaced intercondylar, intraarticular humeral fracture were treated operatively in our department. The policy of management of these injuries consisted of open reduction and internal fixation unless absolute medical contraindications for anesthesia were present. Accordingly, the number of patients managed nonoperatively during the period under review was very small and could not constitute a group for a comparison of the results.

There were 62 women and 34 men. The mean age was 55 (18–82) years. The initial severity of the fracture was graded according to Riseborough and Radin (1969): Type I—simple, undisplaced; Type II—simple, displaced but without rotation of the fragments; Type III—displaced with rotation; or Type IV—displaced with intraarticular comminution. The distribution of the 96 fractures was as follows: Type I, 0 fractures; Type II, 9 fractures; Type III, 23 fractures; and Type IV, 64 fractures. There were 12 open and 84 closed fractures. Immediate posttraumatic neural injuries, recordable on admission, were not encountered.

As a rule, the operations were performed on the day of admission. A posterior approach was the routine; but depending on the personal preferences of the surgeon on duty, either an incision through the triceps tendon (82 patients) or an olecranon osteotomy (14 patients) was used. Ulnar nerve transpositions were not done at the initial operations. The fixation was performed with AO plates and screws (Müller et al. 1979).

The files of the 96 patients revealed that 27 had suffered one or several local complications. These 27 patients with complications were analyzed for

Table 1. Observations in 27 patients with a local complication/s after open reduction and internal fixation of a distal intra-articular humeral fracture

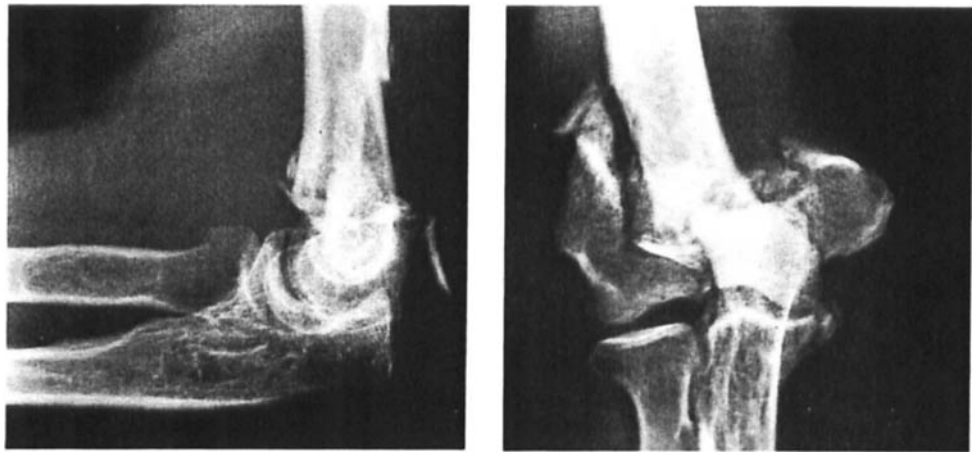
A	B	C	D	E	F	G	H	I	K
1	78	F	IV	1	f	5	2	P	2
2	40	M	IV	3	n	3	7	G	
3	78	F	II	1	n	1	3	E	
4	73	F	IV	1	f	4	2	G	
5	71	F	III	2	n	1	10	G	1
6	31	F	IV	1	i, f	4	2	G	
7	60	F	IV	2	i, f	4	9	G	
8	75	F	IV	3	n	1	3	G	1
9	50	M	IV	3	i, n, f	4	8	G	
10	60	F	IV	3	f	1	3	P	
11	66	F	IV	3	f	1	7	P	2
12	57	F	IV	3	n	1	7	G	
13	70	F	II	1	f	1	7	G	
14	59	M	IV	2	n	3	10	P	1
15	37	M	IV	3	f	1	2	G	
16	67	F	III	1	f	1	8	G	
17	35	F	IV	3	n	3	6	G	
18	68	F	IV	2	f	5	6	P	2
19	74	M	IV	3	n	1	2	G	
20	24	M	IV	2	f	4	3	G	
21	73	F	III	1	i	2	4	P	
22	61	F	IV	1	n, f	1	7	G	
23	65	M	IV	3	i, f	2	10	G	
24	57	F	II	1	n	3	10	G	
25	67	F	IV	1	i, f	2	10	P	
26	43	M	IV	3	n	1	2	G	
27	73	F	III	1	f	1	3	P	

A Case
B Age
C Sex
D Fracture type according to Riseborough and Radin (1969)
E Fixation
  1 screws only
  2 single lateral plate
  3 dual plates
F Complication
  i deep infection
  n neural injury
  f failure of fixation
G Specific treatment of complication
  1 none
  2 debridement
  3 nerve deliberation
  4 reosteosynthesis
  5 orthosis
H Follow-up time (years)
I Outcome according to Horne (1980)
  P poor
  G good
  E excellent
K Remarks
  1 permanent neural deficit
  2 established nonunion

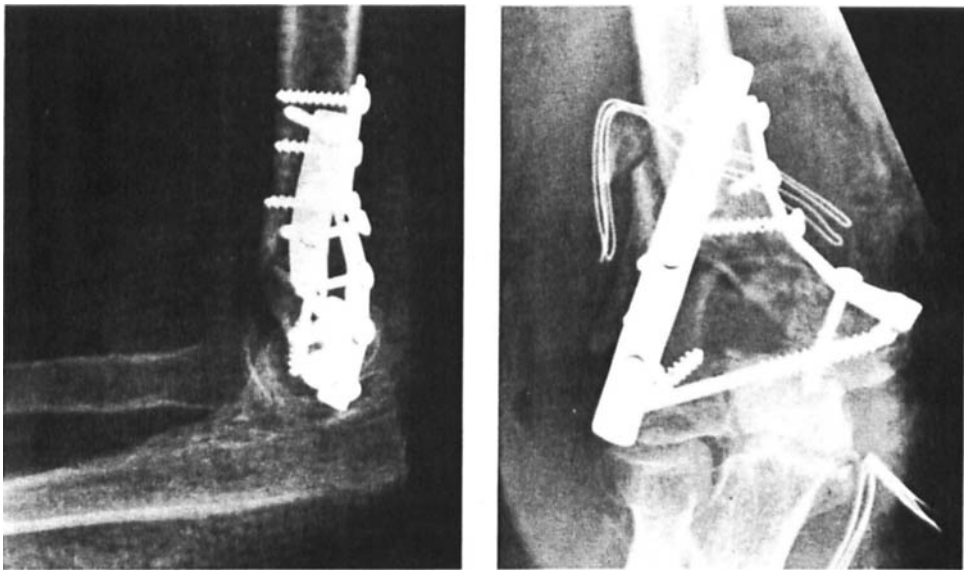
demographic data, fracture type, clinical course, and ultimate functional and radiographic results at a follow-up examination. A fixation was considered to have failed if loosening or breakage of an implant resulted in a redisplacement between the fragments of 5 mm or more. Standard anteroposterior and lateral radiographs were obtained, and the final functional and radiographic outcome was assessed according to Horne (1980) as excellent, good (fair), or poor. An excellent result included a flexion-extension range of the elbow joint of at least 10°–120°, unrestricted pronation-supination, and a normal carrying angle on the radiographs. The result was good (fair) if the flexion-extension range was at least 30°–95°, if there was a minor restriction of pronation-supination, or if the carrying angle deviated from the normal intact side but did not exceed 10°. The result was poor if the extension deficit was more than 30°, if the maximum flexion was not more than 95°, or if the carrying angle deviated more than 10° from the normal intact side. Because this grading (Horne 1980) did not pay attention to pain or neural function, these were recorded separately. The mean follow-up period was 6 (2–10) years. The Student's *t*-test was used for statistical evaluation.

Results

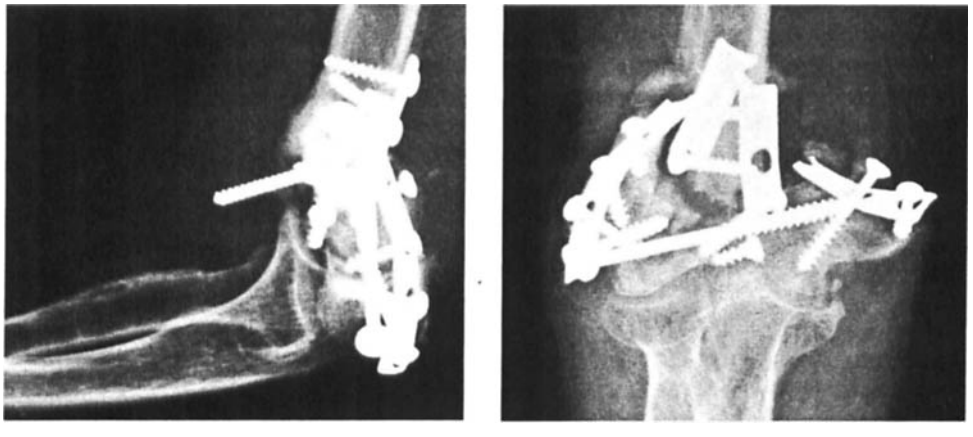
The mean age of the 27 patients with a clinical course with a complication/s was 60 (24–78) years—the difference from those with an uneventful course, mean age 54 years, being nearly significant (P = 0.05). There were 19 women and 8 men. In all, 34 complications occurred among the 27 patients. There were six infections, 12 neural injuries, and 16 fixation failures (Table 1). Thirteen of the patients with a complicated



At admission.



Immediately after open reduction and internal fixation with dual plates.



Five months after fixation. The plates were broken and the fixation failed at 4 weeks, and nonunion subsequently developed. The patient refused a reoperation.

Figure 1. Case 11. A comminuted intercondylar, intraarticular fracture of the distal humerus in a 66-year-old woman with general osteoporosis.

course were under 65 years of age. There were 21 patients with a solitary complication, 5 with two complications, and 1 patient who suffered all three types of local complication. The management of the complication included readmission to the hospital in 12 of the 27 patients (Table 1).

Infections

The mean age of the 6 patients with postoperative deep infection was 58 years. The predominant cultured pathogen from the infections was *Staphylococcus aureus*. Two patients had an open fracture. The duration of the initial operation had exceeded 120 minutes in 4 of the patients. In 3 patients, surgical drainage and antimicrobial agents were able to control the infection. Two patients required a debridement procedure under anesthesia. In 1 patient an intense, deep infection necessitated prompt removal of the "hardware"; and in 4 cases, the infection obviously contributed to subsequent failure of the fixation by loosening of the screws. The position of fixation could thus be maintained in only 1 of the patients with an infection. A successful refixation was later undertaken, and an acceptable final outcome was achieved in 3 patients (Table 1).

Neural complications

A probable iatrogenic intraoperative neural injury was diagnosed immediately postoperatively in 12 patients. The median nerve was affected in 1 patient, the radial nerve in 2, and the ulnar nerve in 9 patients. In 2 cases the tourniquet time had exceeded 140 minutes and both patients sustained a transient radial palsy. The median and radial nerve lesions recovered spontaneously. For an ulnar nerve injury, a deliberation procedure was later done in 4 patients. A direct interference with the metallic fixation devices could not be observed. At the follow-up examination, 3 patients still had a dysfunction of the ulnar nerve (Table 1).

Failures of fixation

In 16 patients the fixation failed 7 to 45 days after the initial operation (Figure 1). The mean age of the patients was 60 years. As many as 13 of the fractures were of Riseborough-Radin Type IV. In 2 patients in addition to failure of the humeral fixation, also the screw fixing the olecranon osteotomy failed. Considering the causes of the failures, the structure of the bone was noticeably porotic already on the radiographs obtained on admission in 9 patients. At fixation, a diastasis had been left between the condylar portion of the humerus and the metaphyseal area in 2 cases. In 5 failed fixations a Type IV fracture had been operated on using screws only (Table 1).

A successful reosteosynthesis was performed in 5 patients of the 16. In 11 cases, no refixation was done because of the patient's high age, a reluctance to have additional procedures, or medical contraindications for repeated surgery. Of these 11 patients, 7 subsequently showed delayed union, the consolidation time being 4 months or more. At the follow-up examination, 3 patients had a confirmed nonunion.

Functional outcome

The outcome was classified as poor in 8 of these 27 patients (Table 1). Six of the patients with a poor result were found among the 16 patients with a fixation failure; these 6 patients each had an incongruent elbow joint and a grossly restricted range of motion. Of the remaining 2 patients with poor functional outcome, 1 had a permanent ulnar nerve lesion and the other had an arthrotic narrowing of the joint space after a deep infection. None of the patients complained of constant pain during daily activities, and most of them declared that they were well-accustomed to their functional limitations.

Discussion

The frequency of complications in this study was high, with more than one fourth of the patients suffering a substantial complication that delayed their recovery, that increased the consumption of hospital resources, and that often impaired the ultimate outcome. A comparison between the complication rates recorded in different studies on distal humeral fractures is rendered difficult by the fact that in most of the reports either the number of patients treated is too small to permit conclusions or the data given of the complications are meager and inconsistent.

Among the few series with a total number of patients higher than 40 operated on using modern internal fixation devices, Uuspää (1978) recorded in 78 patients 4 cases of nonunion after failure of fixation. In a multicenter study on 412 patients, Burri et al. (1984) reported a mechanical instability of the fixation in 5 percent and deep infection in 6 percent. Waddell et al. (1988) had "complications of importance" in 7 out of 48 patients operated on mainly by a limited number of experienced surgeons. Letsch et al. (1989)

recorded loosening of implants in 5 and ulnar nerve palsy in 6 out of 104 patients, but this study had a heterogeneous patient material and included also many unicondylar fractures in children. Compared with our study, the impression is that the complication rate found here was on no account lower than that reported in the previous studies.

Much of the suffering and waste of resources due to the postoperative complications would have been avoided if a conservative approach had been chosen; but it is, of course, impossible to say or to predict whether or not the final functional outcome in some of the patients with a clinical course with complication/s would have been better off with an initially nonoperative treatment. This applies especially to the patients with failures of fixation in severely comminuted fractures. With nonoperative treatment, a comminuted displaced fracture cannot be maintained in an anatomic position, and the resultant incongruity in combination with an immobilization period of 6–8 weeks of the elbow joint often causes a significantly decreased range of motion (Miller 1964, Horne 1980). A complication that both conservative and operative treatment of distal humeral fractures have in common is nonunion. The frequencies reported with nonoperative treatment vary greatly, i.e., from two nonunions out of 80 fractures (Uuspää 1978) to two out of eight (Lansinger and Måre 1982).

It seems very likely that some of the failures were due to an inadequate fixation technique. Screws alone are definitively insufficient to fix a comminuted intercondylar fracture. In several recent studies the technical aspects of the management of these fractures have been emphasized, and the current recommendation seems to be a dual-plate fixation, with the ulnar plate being placed medially and the radial plate posteriorly (Gabel et al. 1987, Henley 1987, Helfet and Hotchkiss 1990). Yet, comminuted, osteoporotic distal humeral fractures probably occur that cannot be securely stabilized by any method of internal fixation. A desperate attempt to obtain internal fixation of an unrewarding fracture prolongs the operation and exposes the patient to infection and neural injuries, as was shown in this study. Further, the ulnar nerve appears to be very sensitive to handling and stretching under these operations.

In the case of the average surgeon treating the average patient, an overestimation of the possibilities of operative management of comminuted distal humeral fractures in adults is prone to result in a high complication rate. Even if open reduction and internal fixation must be the principal approach, one should hesitate to operate on a comminuted fracture in radiographically clearly osteoporotic bone in an elderly patient. Good judgement is required in making the decision. When an operation of a distal displaced, intercondylar, intraarticular humeral fracture is chosen, strict observance of the proper technique is mandatory.

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