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Absorbable polyglycolide pins in fixation of displaced fractures of the radial head

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Summary. In a prospective study 24 patients with a displaced fracture of the radial head were treated by open reduction and internal fixation using absorbable polyglycolide pins, 2 mm in diameter. All patients admitted with fractures involving a quarter or more of the radial head, whether comminuted or not, were included in the study whenever there was a displacement of 2 mm or more between the fragments. The mean follow-up time was 28 months (range 15–43 months). A postoperative redisplacement of 1–3 mm between the fragments was seen in four patients with severely comminuted fractures. A transient inflammatory reaction around the implants occurred in two cases 8–12 weeks postoperatively. The functional end-result was classified as excellent or good in 22 patients (91%). This study indicated that successful fixation of displaced fractures of the radial head can be accomplished by using absorbable pins.

Fixation of displaced fractures of the radial head with metallic screws and pins can be technically difficult [22, 23]. Results of prosthetic replacement of the radial head have not been encouraging either [13], and therefore excision of the radial head has long been recommended as a routine method of treatment when conservative treatment is not possible or fails [4, 7, 9, 14, 19, 24]. On the other hand, the importance of a congruent elbow joint has been pointed out as a prerequisite for a good functional result and stability of the joint [20, 26]. Consequently, open reduction and internal fixation has become an alternative method of treatment [16, 22, 23, 25].

Absorbable rods and pins have been tested in several experimental studies [6, 27–29], and polyglycolide and lactide-glycolide-copolymer rods have been clinically employed in ankle fractures [1, 2, 10, 12, 21] and in fractures of the distal radius [11], but their use in fractures of the radial head has not been reported previously. In the present study fresh, displaced fractures of the radial head were treated by open reduction and internal fixation with polyglycolide pins. This new method is described and the functional and radiographic results are reported and discussed.

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Patients and methods

This prospective study included 24 consecutive patients admitted to the authors' department from March 1986 to July 1988 with a fresh displaced fracture of the radial head. Children (age below 14 years) and old people (age above 70 years) were not included. The indications for open reduction and internal fixation were a fracture involving at least one quarter of the radial head and displacement of 2 mm or more between the fragments. The type of fracture was assessed using the Mason's classification [14]. There were 12 women and 12 men, the average age of the patients being 32 years (range 14–52 years). In eight patients the fracture was associated with a concomitant dislocation of the ulnohumeral joint (Mason type IV injury). Among the Mason type III and IV injuries there were four in which the fracture involved also the radial neck.

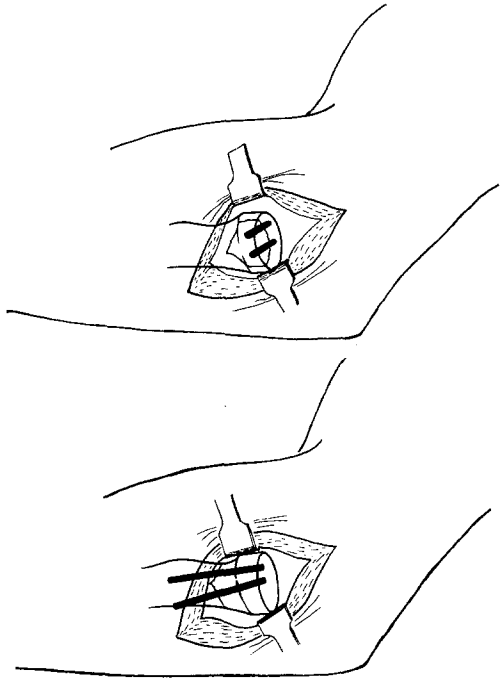

Fig. 1. Fixation of fractures of the radial head and neck: Positions of the polyglycolide pins in their channels after fixation of the fragments of the radial head *(top)* and neck *(bottom)*

The implants used, cylinder-shaped pins (Biofix C, Bioscience Ltd., Tampere, Finland), were made of polyglycolide, a chemical compound that has for nearly 20 years been in world-wide use as an absorbable suture material. The pins were coated with a thin layer of polydioxanone in order to lengthen the hydrolyzation time within bone tissue [28]. The devices used measured 2 mm in diameter and 20, 25 or 30 mm in length.

Fig. 2a, b. Case 9: displaced comminuted fracture of the radial head associated with an ulnohumeral dislocation. Anteroposterior and lateral views **a** on admission, **b** three years after operation. The anteroposterior view in **b** shows incongruity of the articular surface caused by comminution of the fragments

The fracture was exposed through a straight lateral approach, splitting the extensor muscles and the radiohumeral capsule over the radial head. The fragments were held in position by fingers while a 2-mm bit was drilled through the fracture surfaces in the radial head. One or two divergent pins were then inserted as far as to the opposite subchondral bone (fractures involving only the radial head) or through the opposite cortex (fractures also involving the radial neck; Fig. 1). A specific applicator was used when driving the pin in the channel.

All patients had a plaster cast for 3 weeks with the elbow flexed to 85–90°, after which free mobilization was allowed. Radiographic and clinical check-ups were arranged at 3 weeks, 6 weeks, 3 months, 6 months, 12 months and at the end of the study. The functional outcome was evaluated using a scoring system by Broberg and Morrey [4], the qualitative groups being excellent (95–100 points), good (80–94 points), fair (60–79 points) and poor (0–59 points). The range of motion (flexion/extension with the forearm in neutral position and supination/pronation with the elbow in 90° flexion) was assessed by comparison with the unaffected side. The stability in valgus/varus directions was tested manually, as was the strength of extension – flexion of the elbow, both compared to the uninjured side. The grip force of both hands was measured using a dynamometer. Up to 10% stronger values were considered normal in the dominant extremity. The mean follow-up time was 28 months.

Results

The reduction obtained was maintained until union in 20 patients. In four patients with severely comminuted fractures of the radial head, all complicated initially with dislocation of the ulnohumeral joint, anatomical reduction could not be achieved and there was an additional postoperative redisplacement of 1–3 mm between the fragments. Three of these patients showed non-union or fragmentation of one or several of the fragments at the final radiographic check-up. Minor incongruity due to comminution of the fracture was observed in another four cases (Fig. 2). In 16 cases the final radiographic result was anatomical (Fig. 3; Table 1).

No complications ensued during the operations. Iatrogenic or additional fragmentation of the often very small fragments did not occur when drilling the holes or inserting the pins. There was one bacterial wound infec-

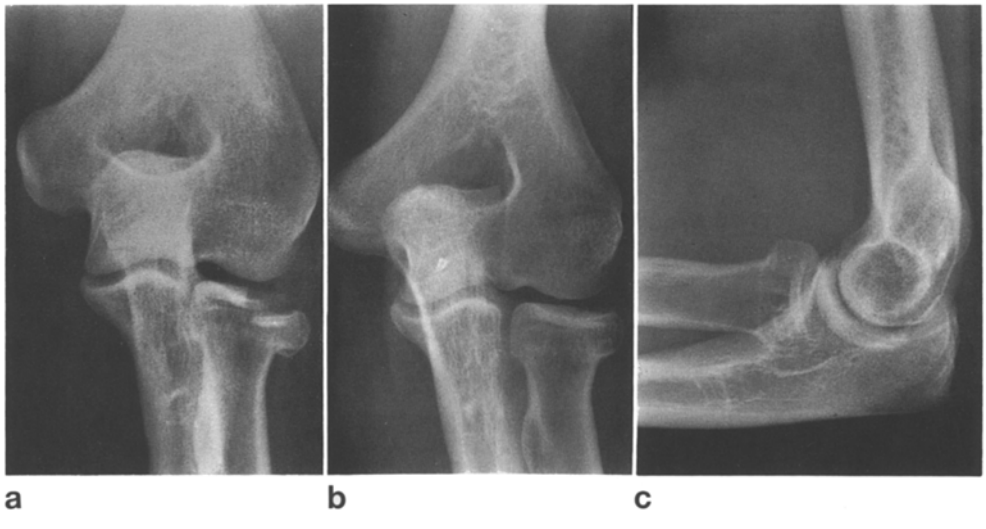

Fig. 3a, b. Case 6: simple displaced marginal fracture of the radial head. **a** Anteroposterior view on admission. **b** Anteroposterior and **c** lateral views three years after operation, showing a good radiographic end-result. The lateral view reveals that the channel of the 2-mm polyglycolide pin is still visible

Table 1. Results in 24 patients with a fracture of the radial head treated with polyglycolide pins

Case	Sex, age (yrs.)	Fracture type[a]	Complication	Radiographic result	Functional score (points)[b]	Follow-up time (months)
1	M, 36	II	None	Good	100	43
2	M, 14	III	None	Good	100	38
3	M, 26	III	Wound infection	Good	100	18
4	F, 29	II	None	Good	100	38
5	F, 33	IV	None	Redisplacement	92	38
6	M, 34	II	None	Good	100	36
7	F, 23	III	None	Good	100	34
8	F, 21	III	None	Good	100	33
9	F, 27	IV	None	Minor incongruity	100	33
10	F, 26	IV	None	Good	98	33
11	M, 52	II	None	Good	100	18
12	F, 40	II	None	Good	100	43
13	M, 44	IV	Fluid accumulation	Redisplacement	72	28
14	F, 18	III	None	Good	100	29
15	F, 26	II	None	Good	93	28
16	F, 20	III	None	Minor incongruity	92	27
17	F, 42	IV	None	Minor incongruity	100	24
18	M, 44	II	None	Good	100	23
19	F, 40	III	None	Good	100	22
20	M, 22	III	None	Minor incongruity	100	21
21	M, 41	IV	None	Redisplacement	74	18
22	M, 52	IV	Fluid accumulation	Redisplacement	93	18
23	M, 28	IV	None	Good	90	18
24	F, 24	III	None	Good	98	15

[a] Mason's classification [14] for fractures of the radial head: type I, undisplaced marginal fracture; type II, marginal fracture involving more than 30% of the radial head, displaced more than 2–3 mm; type III, comminuted fracture of the radial head or fracture of the radial neck; type IV, ulnohumeral dislocation associated with any of the above types of fracture of the radial head or neck

[b] Functional scoring scale by Broberg and Morrey [4]

tion. In two cases the later postoperative course was compromised by an accumulation of soluble polyglycolide mass beneath the scar. This occurred 8 weeks (case 22) and 12 weeks (case 13) postoperatively. The bacterial cultures in both cases were negative. No radiographic signs of osteitis were seen. A 5-mm incision was performed and after drainage these sinuses healed completely within a few weeks.

The functional results showed an average score of 96 points (range 72–100 points). Among the eight patients whose fractures were complicated with ulnohumeral dislocation, five had some restriction of extension/flexion of the joint (mean 8°, range 5–15°) and restriction of pronation/supination (mean 26°, range 20–45°); 4 had slight instability and 4 had pain during heavy activity. One of them could not return to heavy work (case 21). Two of these eight patients were symptomless with an unlimited range of motion and a stabile elbow joint.

Of the 16 patients with Mason type II–III fractures of the radial head, two spoke of mild pain in the elbow during physical activity (cases 15 and 16). Two had a restriction of extension of 5° and restriction of pronation/supination of 10° and 25° (cases 16 and 24, respectively). All others (13 cases) had unlimited ranges of motion, normal strength and no pain (Table 1).

Discussion

This study, in our opinion, showed that successful fixation of fractures of the radial head is possible using polyglycolide pins. Even in severely comminuted fractures acceptable end-results could be attained. In 22 cases (91%) in this study the good or excellent functional outcome was well comparable to those presented using metallic osteosynthesis devices [16, 22, 25], and better than those presented after excision of the radial head [4, 7, 9, 14, 17, 18, 24].

In previous studies results using mini screws and metallic pins for fixation of the radial head have been considered good in about half of the cases with Mason II-III type fractures [16, 25], and encouraging even in more comminuted fractures [22]. The more sophisticated Herbert screw has been used for fractures of the radial head, the number of cases reported on being still limited [5, 15]. However, when screws are used for transarticular

fixation of fragments, they should be recessed below the articular surface, which causes additional damage to the articular cartilage. Nevertheless, in some cases these metallic implants have to be removed.

Resection of the radial head may cause proximal migration of the radius, increased valgus of the elbow joint, loss of strength, degenerative changes within the joint and pain [7, 9, 17, 19]. Thus we agree with Menger et al. [16], Sanders and French [22] and Schatzker [23] that excision of the radial head should be avoided whenever possible. An intact radiohumeral joint is even more important if the fracture is associated with a rupture of the ulnar collateral ligament in simultaneous ulnohumeral dislocation. A repair of the ulnar collateral ligament is not sufficient to restore stability if the radiohumeral articular support is missing [23]. Indeed, in the present study, in those five patients with concomitant ulnohumeral dislocation in whom the bony architecture could be restored, no residual valgus instability developed.

In this study no failures of fixation necessitating excision of the radial head were encountered. Even in those four patients with redisplacement of the fracture the functional results were not poor. The friction force between the bone channel and the pin surface seemed to be strong enough to counteract the displacing forces, provided that the bone structure in both fragments was not severely comminuted. However, in comminuted cases some redisplacement may occur.

The technique used in this study caused no difficulties. No temporary fixation was needed while preparing drill-holes or inserting the pins. No torsional forces seem to affect the intra-articular fragments during the operation. The transient inflammatory reaction with accumulation of fluid and polyglycolide particles seen in this study was similar to those reactions reported in 6–7% [2, 3, 8, 10] or 22% [11] of cases in previous studies using polyglycolide rods in other fractures, or using sutures manufactured of the same material in abdominal surgery. This was the only actual complication of clinical importance in this study. Although inconvenient to the patient, the phenomenon was transient and did not have any adverse effect on the final radiographic or functional result.

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