Cast or external fixation for fracture of the distal radius

A prospective study of 126 cases

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In a prospective 4-year study, 126 consecutive patients with a fracture of the distal radius were followed. Functional, anatomic, and radiographic final results of fixation with above-the-elbow cast immobilization were compared with the results obtained with external fixation.

The results following external fixation of comminuted intraarticular fractures were better than those of similar fractures treated in a cast. Aged osteoporotic patients tolerated better residual deformities, and the clinical results had a relatively low correlation with the final anatomic alignment.

We suggest that extraarticular fractures of the distal radius should be treated with cast immobilization. Comminuted intraarticular fractures of the distal radius should be treated with external fixation, which maintains accurate anatomic position until solid fracture healing is achieved.

We present a prospective study of fractures of the distal radius treated with a cast or external fixation with an attempt to correlate criteria of functional final results with the fracture type

Patients and methods

Totally, 126 consecutive patients with a fracture of the distal radius were prospectively studied over 4 years. The fractures were classified according to Older (1965), which was preferred in a previous comparative study by Solgaard (1985). There were 64 extraarticular fractures of which 12 were undisplaced (Type I) and 52 showed dorsal displacement, minimal radial shortening, and minimal comminution (Type II); finally there were 62 displaced intraarticular fractures involving the radiocarpal or radioulnar joints or both joints. Of the latter, 14 showed comminution of the distal radius with shortening of the distal radius of 1 to 4 mm below the distal ulna (Type III). The remaining 48 had severe comminution and shortening of the distal radius of 5 mm or more (Type IV).

All the fractures were reduced under general or regional anesthesia. The 64 extraarticular fractures (Types I, II) were treated with above-the-elbow cast immobilization with the forearm in pronation. The 62 intraarticular fractures were treated either with external fixation or with above-the-elbow cast fixation (Table 1). Treatment groups were allocated by the day of admission. Thus, this study included 86 patients treated with closed reduction and above-the-elbow cast immobilization, and 40 patients were treated with closed reduction and external fixation using the "small" AO external tubular fixator.

The respective ages of patients with extraarticular fractures, intraarticular fractures treated with a cast, and intraarticular fractures treated with external fixation were 56 (20–89), 54 (22–79), and 48 (19–72) years.

Patients treated with a cast were not hospitalized, whereas those treated with external fixation were either hospitalized for 24 hours or were treated on a day-care basis.

A comparative analysis of fracture mechanism and the clinical and radiographic final results demonstrated that 16/86 patients treated with a cast and

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Table 1. Objective and subjective (*italics*) results according to fracture type

Fracture type	I	II	III	IV	Total
Cast	12	52	7	15	86
excellent and good	11 *10*	44 *45*	5 *5*	10 *11*	70 *71*
fair and poor	1 *2*	8 *7*	2 *2*	5 *4*	16 *15*
Ext. fixation	–	–	7	33	40
excellent and good	–	–	6 *6*	30 *30*	36 *36*
fair and poor	–	–	1 *1*	3 *3*	4 *4*
Total	12	52	14	48	126

Table 2. Radiographic evaluation of results. Secondary loss of position during fracture healing in italics

Fracture type	I		II		III		IV	
	C	E	C	E	C	E	C	E
Deformity								
none								
1st control	10	–	41	–	3	6	5	30
follow-up	8	–	27	–	1	5	2	28
loss of pos.	*2*	–	*14*	–	*2*	*1*	*3*	*2*
slight								
1st control	2	–	10	–	–	1	3	3
follow-up	4	–	18	–	4	2	6	5
loss of pos.	–	–	*2*	–	*2*	–	*3*	–
moderate								
1st control	–	–	–	–	2	–	5	–
follow-up	–	–	7	–	1	–	4	–
loss of pos.	–	–	–	–	*1*	–	*2*	–
severe								
1st control	–	–	1	–	2	–	2	–
follow-up	–	–	–	–	1	–	3	–
loss of pos.	–	–	–	–	*1*	–	*2*	–

C cast, E external fixation.

7/40 treated with external fixation had been injured by high-energy forces caused by road-traffic accidents or crush injuries of their wrists. In the remaining patients, fractures occurred after a fall or during sports activities.

All the patients were reexamined at 1, 2, 4, and 6 weeks after treatment and each time that radiographs were taken. In most of the patients, the cast or the external fixator was removed after 6 weeks of immobilization. In 15 patients, cast treatment was continued for an additional 2 weeks because of insufficient callus formation. Length of follow-up study in all the groups varied from 6 months to 4 years, with a mean of 3 years.

The assessment of functional final results was based on the criteria established by Gartland and Werley (1951), which were also adopted by others (Sarmiento et al. 1975, Vaughan et al. 1985, Altissimi et al. 1986, Knirk and Jupiter 1986). This is a demerit point system that includes subjective and objective evaluation of the final results.

Radiographic final results were assessed according to the criteria of Lindström (1959) as modified by Sarmiento et al. (1975) and criteria of van der Linden and Ericson (1981). Measurements of the principal deformities of these fractures, such as radial displacement (shift), dorsal angulation, and shortening of the length of the radius beyond the distal ulna, were performed. The normal values as proposed by these authors were a volar tilt of the distal radius of 11° (0°–18°), a radial angle of deviation of the distal radius of 23° (10°–30°), and a radial length of 9 (8–14) mm beyond the distal end of the ulna. Radiographic results were divided by these authors into four grades:

Grade 1. No deformity, dorsal angulation not exceeding neutral, and shortening of less than 3 mm.

Grade 2. Slight deformity, dorsal angulation of 1°–10°.

Grade 3. Moderate deformity, dorsal angulation of 11°–14°, and shortening of 7–11 mm.

Grade 4. Severe deformity, dorsal angulation of 15° or more, and shortening of at least 12 mm.

The final radiographs taken at follow-up were measured by these criteria and were evaluated for the presence of degenerative changes.

Functional and anatomic final results were correlated. Statistical analysis was performed using the Student's *t*-test.

Results

Three patients with external fixation had temporary irritation of the cutaneous branch of the superficial radial nerve, which recovered completely following the removal of the fixators after fracture healing. One patient with an external fixator developed reflex sympathetic dystrophy and required physical therapy for a few months. Two patients had pin-tract infections that resolved after removal of the external

fixators. However, no pin breakage, loosening, or development of ring sequester osteomyelitis was observed.

The presence of pain, residual deformities, strength of grip, and the ability to return to previous activities were evaluated by the patients themselves (Table 1). Excellent and good results were found in 71 of 86 patients treated with cast immobilization. A higher incidence of satisfactory results was observed in Types I and II fractures as compared with Types III and IV. These final results were relatively better in aged patients than in the younger group. Excellent and good results were found in 36 of 40 patients with intraarticular fractures treated with external fixation. In Types III and IV fractures, the results after external fixation were superior to those after cast treatment ($P < 0.001$).

Of the high-energy fractures, 10 of the 16 treated in a cast were comminuted and unstable (Types III, IV), and their functional final results were poorer than those achieved in the seven high-energy fractures treated with external fixation. In Older's Types I and II groups, no difference could be demonstrated between the final results of high- and low-energy fractures treated with cast immobilization.

Initial postreduction radiographs showed that in 59/86 of the patients treated with cast immobilization accurate reduction had been achieved (Grade I) versus 36/40 in the external fixation group ($P < 0.001$; Table 2).

Radiographic evaluation at follow-up showed in the cast-treated group displacement in 21/59 patients with Grade I, in 7/15 with Grade II, and in 3/5 with Grade III. These changes from the postreduction position occurred mainly in intraarticular comminuted fractures (Older's Types III and IV; Table 2). In similar fractures treated with external fixation, only three had lost the postreduction alignment ($P < 0.001$).

Thirteen patients, all treated with a cast, needed remanipulations 1 or 2 weeks after their injury. The indications were radiographic evidence of redisplacement, malalignment of the distal fragment with a dorsal tilt of 11° or more, lateral displacement, and shortening. Improvement in the radiographic alignment of fractures following remanipulation was obtained in 8/13 patients. However, the clinical final results of these patients were not better than those of the other 5 patients in this group.

In all, 14/86 patients treated with a cast were above 65 years of age. At follow-up, 12 had excellent and good functional results, although 7 of them had radiographic shortening and lateral displacement with dorsal tilt of the distal fragments.

Discussion

Previous studies have shown a great variation in the percentage of satisfactory results in the treatment of fractures of the distal radius. By using the same method for the evaluation of final results as we did, Gartland and Werley (1951) had 68 percent satisfactory results, Frykman (1967) 75 percent, whereas Sarmiento et al. (1975) obtained 82 percent excellent and good results. Green (1975) and Altissimi et al. (1986) reported 13–14 percent unsatisfactory results. Cassebaum (1950) and Mason (1953) used another scoring system and reported 4–6 percent unsatisfactory results.

In our study, differences in functional final results between the two treatment group were demonstrated revealing the poorest functional final results in displaced comminuted intraarticular fractures (Types III, IV) treated with a cast. Patients with nondisplaced or minimally displaced fractures treated with a cast and patients with comminuted intraarticular fractures treated with external fixation had better wrist function.

Our study confirms that unstable comminuted intraarticular fractures of the distal radius are not suitable for cast immobilization.

In our patients, external fixation of the fractured fragments was both effective and successful in achieving stabilization of comminuted intraarticular fractures of the distal radius. These results confirm those of Cooney et al. (1979), Brooker et al. (1983), Vaughan et al. (1985), Bassett (1987), and Jenkins et al. (1987), who have described 85–90 percent satisfactory results, and markedly differ from those reported by Horne et al. (1990).

This treatment modality for unstable intraarticular fractures of the distal radius, which basically relies on ligamentotaxis, is safe and provides an efficient rigid immobilization until solid union is achieved.

In extraarticular fractures of the distal radius, a low degree of correlation was found between accurate anatomic alignment and functional final results. This may be related not only to the fracture type, but also to the trauma sustained by the soft tissues around the injured bone. Because both dorsal angulation and radial shortening appeared together in most patients who were remanipulated, none of these deformities could be separately defined as the detrimental factor for the final functional outcome, which is contrary to results recently reported by Solgaard (1989).

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