Acta Orthop Scand 1988;59(1):39–42

Function after distal radius fracture

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Follow-up of 154 patients 3.5 years after a distal radius fracture treated by reduction and immobilization in plaster demonstrated that the initial displacement influenced their function. The classification of Older et al. (1965) was prognostic for the outcome. Residual deformity had the greatest influence on the function. The most frequent late problem was instability and tenderness in the distal radioulnar joint.

In previous studies on distal radius fractures, the final radiographic result was shown to correlate with the degree of initial displacement (Lidström 1959, Frykman 1967, Sarmiento et al. 1975, Bünger et al. 1984, Solgaard 1985).

I have studied the correlation between the fracture type and the late function and analyzed which parameters were most important for the final function.

Patients and methods

One hundred and fifty-four patients, 35 men and 119 women, with a distal radius fracture were included in the study, which required that they had sufficient radiographic follow-up and no previous or later lesions of the upper extremities. All the patients had been treated with a low cast for 5 to 6 weeks following a closed reduction if considered necessary (84 patients). No patient underwent more than one reduction. Their age was 58 ±4 years (mean ± SD).

The fractures were classified according to Older et al. (1965) (Figure 1). The dorsal angulation and the length of the radial styloid distal to the ulna were measured on the radiographs initially, after reduction, and at fracture union. The follow-up examination after 42 ± 4 months (mean ± SD) included radiographs and a clinical examination with the unfractured wrist as a control.

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Arthrosis was defined according to Lidström (1959); minor arthrotic changes consisted of minute osteophytes, whereas sclerosis and narrowing of the joint space were called moderate changes.

Function was evaluated using a modification of a scoring system, described by Gartland and Werley (1951) (Table 1). The residual deformity and the subjective evaluation were recorded in the same way as in their original scoring system. The range of motion was measured using a goniometer measuring dorsal and volar flexion, radial and

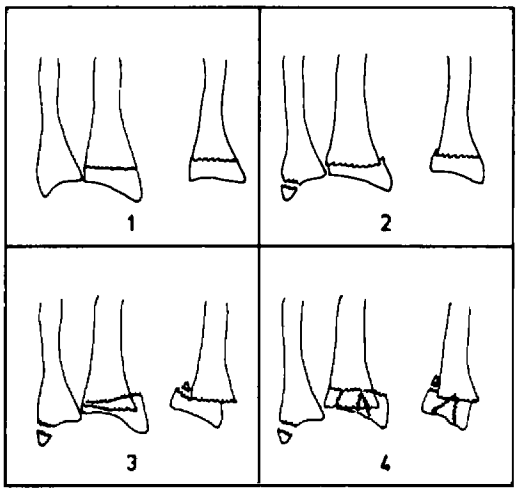

Figure 1. Classification system by Older et al. (1965). Type 1: dorsal angulation up to 5 degrees, radial length distal to ulna at least 7 mm; Type 2: dorsal angulation, radial length 1 to 7 mm, no comminution; Type 3: dorsal radius comminuted, radial length less than 4 mm, distal fragment slightly comminuted; Type 4: marked comminution, radial length usually negative.

Table 1. Functional scoring system modified after Gartland and Werley (1951)

		Points
Deformity	Prominent ulnar styloid	1
	Radial deviation	1–2
	Dinner-fok deformity	1–3
	Maximum	6
Subjective evaluation	No pain, no limitation of motion	0
	Slight pain, slight limitation of motion	2
	Occasional pain, some limitation of motion, weakness	4
	Pain, limitation of motion, activities restricted	6
	Maximum	6
Range of motion	Limitation of motion < 20 per cent	0
	Limitation of motion 20–50 per cent	2
	Limitation of motion > 50 per cent	6
	Stiffness of wrist	6
	Maximum	6
Grip strength	Normal (within 2 SD)	0
	2–4 SD	2
	4–6 SD	4
	< 6 SD	6
	Maximum	6
Complications	None or minimal	0
	Slight crepitation	1–2
	Severe crepitation	3–4
	Median nerve compression	1–3
	Pulp-palm distance 1 cm	3
	Pulp-palm distance > 2 cm	5
	Pain in distal radioulnar joint	1–3
	Maximum	15
Total score	Excellent	0– 2
	Good	3– 7
	Fair	8–18
	Poor	19–39

ulnar deviation, pronation and supination, and the sum calculated as the percentage of the unaffected wrist (Solgaard et al. 1986). The grip strength was included in the score and measured with a My-Gripper, and the result was classified using a nomogram (Solgaard et al. 1984).

The statistical analysis was performed using multidimensional contingency tables (Bishop et al. 1975). The Mann-Whitney test, chi-square test, and Goodman-Kruskall's gamma-test (marginal and partial) were used to evaluate associations between variables.

Results

In the functional evaluation, most of the patients had very few residual symptoms, and no patient had a poor end result (Table 2). The number of fair results increased with an increasing residual dorsal angulation and a decreasing length of the radial styloid (Tables 3 and 4).

Table 2. Classified functional score in 154 patients with a distal radius fracture. Scoring system modified after Gartland and Werley (1951) (Table 1); fracture types according to Older et al. (1965) (Figure 1)

Type	Excellent	Good	Fair	Reduction	Total
1	43	18	2	5	63
2	26	17	7	39	50
3	8	10	4	22	22
4	3	11	5	18	19

All the parameters recorded in the modified Gartland and Werley scoring system were important for the final evaluation and were interrelated (Table 5). The subjective evaluation was closely correlated with the presence of deformity ($P \leq 0.001$, Goodman-Kruskall gamma test), and with the occurrence of complications ($P \leq 0.001$). The range of motion also depended on the deformity ($P \leq 0.05$), whereas the grip strength was independent of the other parameters.

The presence of deformity had the highest influence on the final functional score, and the influence of the fracture type on the total score

Table 3. Relation between the radial length distal to ulna at follow-up and the functional result in 154 patients with distal radius fracture

	Length of radius (mm)			
	≥12	12–7	7–5	≤5
Excellent or good	22	58	24	34
Fair	0	4	7	7

Mann Whitney test, $P \leq 0.05$.

Table 4. Relation between dorsal angulation at follow-up and functional score in 154 patients with distal radius fracture

	Dorsal angulation (degrees)			
	≤0	0–10	10–25	≥25
Excellent or good	63	35	30	8
Fair	2	2	9	5

Table 5. Functional score in 154 patients with distal radius fracture. Fracture type according to Older et al. (1965); functional score modified after Gartland and Werley (1951). Values are mean (SD)

Type	n	Total score	Deformity	Subjective evaluation	Range of motion	Grip strength	Complications
1	63	1.7 (2.3)	0.3 (0.6)	0.8 (1.2)	0.0 (0.3)	0.3 (0.9)	0.3 (0.6)
2	50	3.3 (3.4)	0.9 (0.9)	1.3 (1.6)	0.2 (0.5)	0.4 (1.0)	0.6 (0.8)
3	22	4.0 (3.0)	1.4 (1.0)	1.4 (1.5)	0.3 (0.7)	0.4 (0.8)	0.5 (0.5)
4	19	6.2 (4.5)	1.9 (1.2)	1.5 (1.6)	0.9 (0.9)	0.6 (1.5)	1.3 (1.9)

was mostly due to an increased deformity. The fracture type influenced the range of motion and the presence of late complications to a lesser degree. A detailed analysis of the individual complications showed that instability and tenderness in the distal radioulnar joint (41 patients) were recorded most frequently, but in only one case was a Darrach procedure performed. Five patients had symptoms from median nerve compression, one requiring transection of the transverse carpal ligament.

Eleven patients had a slight joint crepitation, and several had minor arthrotic changes. The presence of radiographic arthrosis was correlated with the fracture type and indirectly affected the final score through an influence on the range of motion and the presence of deformity.

Measurements of the radiographs at fracture union and at follow-up showed no changes; the average dorsal angulation on both occasions was 6° and the average length of the radial styloid was 8 mm. The previously performed analysis of the radiographic end result was confirmed (Solgaard 1985).

In 23 patients the radiographs showed minor arthrotic changes, whereas 5 patients had moderate arthrosis. Three of the latter cases were Type 4 fractures with residual deformity.

Discussion

The present study confirmed that the initial displacement influences the function of the wrist several years after fracture (Solgaard 1985). The comparison of radiographs at fracture union and at follow-up demonstrated that no further displacement of the fracture occurred after 6 weeks of immobilization. Consequently, immobilization for 6 weeks seems adequate.

The frequency of radiographic arthrosis was the same as in previous series (Gartland and Werley 1951, Lidström 1959, Frykman 1967, Cooney et al. 1980). Almost half the patients with Types 3 and 4 fractures had signs of arthrosis, and slightly decreased function. Lidström (1959) and Frykman (1967) reported similar results.

I modified the scoring system of Garland and Werley (1951) because it proved difficult, particularly for recording the range of motion and complications. Previous studies of normal wrist motion have demonstrated that the standard deviation of repeated measurements of normal wrist motion was from 5 to 10° (Solgaard et al. 1986). Normal daily activities can be accomplished within 10° of flexion and 35° of extension (Brumfield and Champoux 1984) and within 100° of forearm rotation (Morrey et al. 1981). Based on these data, we modified the Gartland and Werley system.

The grip strength was included in the scoring system. Sarmiento et al. (1975), Bünger et al. (1982), and Stewart et al. (1984) also modified the original Gartland and Werley (1951) scoring system to include grip strength, but merely recorded if it was decreased or not. In this study the grip strength was quantified using a nomogram and was given the same priority as the range of motion in the total score. We found a high correlation with the final functional score; and in agreement with other investigations, we found the grip strength unrelated to the other parameters (Scheck 1962, Bünger et al. 1982).

Other methods for evaluation of the functional result after wrist trauma have been described by Porter and Stockley (1984) calculating a functional index. Although the index is purely objective, they found a close correlation with the original point system of Gartland and Werley (1951).

Several previous papers on distal radius fractures have demonstrated a correlation between the functional and radiographic end result (Bacorn and Kurtzke 1953, Bünger et al. 1982). This

was confirmed in the present study with a long follow-up; more than 3 years after fracture, function was influenced by the radiographic result. The most important parameter in the functional score was the presence of deformity. The initial displacement expressed as fracture type, the quality of reduction, and the position of the fracture at union all influenced the final functional score, but only through an influence on the score for deformity. Consequently, it seems rational to improve the functional result by a better reduction of the fractures and prevention of secondary displacement.

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Acknowledgements

The statistical analysis was performed by cand. stat. Svend Kreiner, Department of Data Processing, Herlev Hospital, Denmark. Financial support was received from Den regionale Lægevidenskabelige Forskningsfond for Frederiksborg Amtskommune.