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Fractures of the distal end of radius in elderly patients: A comparative study of anatomical and functional results

Koji Fujii, Tatsuhiko Henmi, Yoshiji Kanematsu, Takuya Mishiro, Toshinori Sakai and Tomoya Terai
Department of Orthopaedic Surgery, Health Insurance Naruto Hospital, Tokushima, Japan

ABSTRACT

The functional and anatomical results of distal end of radius fractures with severe displacement in 22 elderly patients are reviewed in this retrospective study. The mean age of the patients was 69.4 years (range, 60–88 years) and the mean follow-up period was 24 months (range, 12–53 months). According to the sum of demerit points (Saito, 1983), the latest follow-up functional end results were 'excellent' in 64% of fractures and 'good' in 36%. As for the anatomical results at follow-up, the average radial tilt was 20.7°, ulnar variance was 4.0 mm, and palmar tilt was –2.7° respectively. Though most of the patients had satisfactory outcome and the functional results did not correlate with the radiographic evidence of minor deformities, the functional results of the patients with radial shortening of 6 mm or over were poor. Furthermore, the grip power was the most significant factor related to subjective evaluation and did not improve significantly in patients with the non-dominant hand injured.

Key words: *fracture/distal end of radius, elder patient, comparative study, grip power*

INTRODUCTION

About 190 years have passed since Colles described a fracture of the distal end of the radius, and it is one of the most common fractures encountered by the orthopaedic surgeon. Though most reports of the results for conservative treatment of minimally displaced and stable fractures of distal end of radius in elderly patients have shown good outcome, there has been controversy about the appropriate treatment for severely displaced and unstable radius end fractures. The reason is that it is unclear how severe residual deformities result in poor functional outcome in elder patients with fractures of distal radius. The purpose of this study is to disclose the correlation between anatomical and functional outcome in elderly patients with fractures of distal radius.

MATERIALS AND METHODS

Between 1996 and 1999, 76 patients over 60 years old with fractures of distal end of radius were treated at our hospital. Of these, 25 patients with minimal displaced and stable fractures were treated conservatively and they were satisfied with their outcome. 11 patients declined surgical treatment in spite of severely displaced fractures. The other 40

Address correspondence and reprint requests to: Dr. K. Fujii, Department of Orthopaedic Surgery, Health Insurance Naruto Hospital, 32 Kotani Kurosaki, Naruto, Tokushima 772–8503, Japan. E-mail: fujii5@tk3.nmt.ne.jp

patients with severely displaced and unstable fractures were operated at the beginning or after redisplacement that occurred during the conservative treatment of cast immobilization. 25 patients out of 40 were available for direct follow-up study and 22 patients who were operated by closed and / or percutaneous reduction and pinning were selected for this study. For the other 3 patients treated by open reduction and internal fixation with plate or external fixation, there might be other factors affecting functional outcome, for example, invasion of soft tissues and periostea, and reflex sympathetic dystrophy. 11 patients with displaced fractures treated conservatively had postoperative long immobilization and / or general complications; for these reasons they were excluded from this study.

Of the 22 patients, there were 21 women and one man with mean age of 69.4 years (range, 60–88 years). 10 patients had fractured the dominant hand and 12 patients had fractured the non-dominant hand. All 22 fractures occurred as a result of fall. All fractures were classified according to the Frykman system[6]: 3 fractures classified as type I, 5 as type II, 3 as type III, 10 as type IV, and 1 as type VIII. These fractures included 20 Colles's, 1 Smith's, and 1 reversed Barton fractures. The palmar tilt was less than 20° and / or ulnar variance was more than 5 mm at preoperative radiographs of each patient. All 22 patients had comminuted fragments at the fracture site and suffered from osteoporosis. And redisplacement occurred in some of them after manual reduction followed by cast immobilization. As a result of these findings we considered them as unstable and treated them surgically. The average duration of immobilization was 5 weeks. The mean follow-up period was 24 months (range, 12–53 months).

Functional assessment

The functional results were determined using the demerit point system of Saito. [13] (Table 1) This system consisted of subjective evaluation, objective evaluation, and complications. And the subjective evaluation was graded as excellent, good, fair, or poor according to the demerit points. We used this system except residual deformity which is one of the objective evaluations for functional assessment in this study.

Anatomical assessment

Radiographs were evaluated in a retrospective analysis before reduction immediately after operation and at follow-up. The measurement methods of radial tilt, ulnar variance, and palmar tilt,[1] which were radiographic parameters for residual deformity, are shown in Fig. 1. If each parameter showed out of normal range, the demerit point was 1 point. The maximum sum of demerit points was 3.

Statistics

Functional parameters including subjective evaluation, range of motion, grip power, arthritic change, and complications were compared with anatomical parameters using the Chi-square test, the nonparametric Mann-Whitney's test, and Kruskal-Wallis test. A P value <0.05 was considered significant. Statistical analyses were performed by using a commercial software package (StatView, Abacus Concepts, Berkeley, CA) on a Macintosh computer.

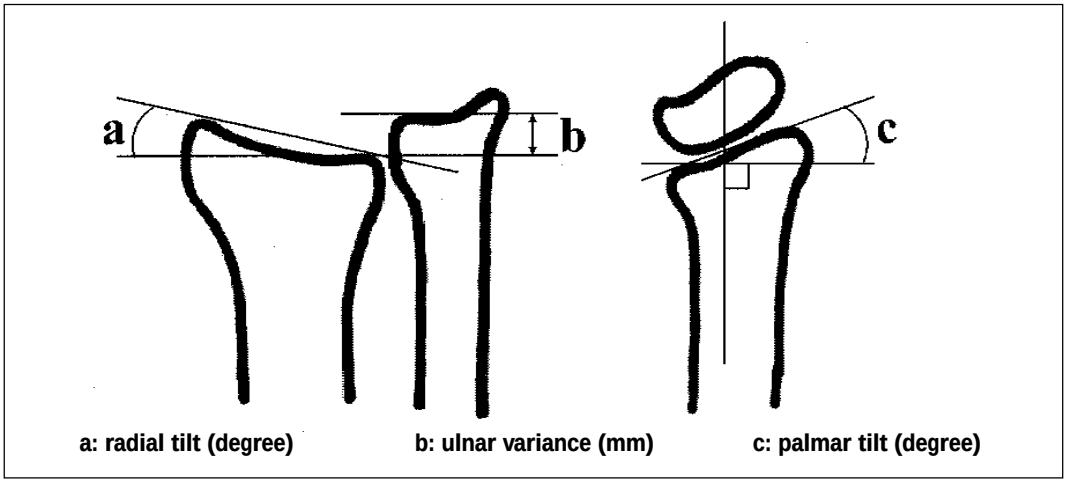

Figure 1 Measurement used for the anatomical results. In the fracture radiographs dorsal angulation was considered as a negative palmar tilt.

Table 1
Demerit point system (Saito)

Subjective Evaluation		**Points**
Excellent	no pain, no disability, no limitation of motion	0
Good	occasional pain, no disability, slightly limitation of motion	2
Fair	occasional pain, no particular disability if careful, some limitation of motion, feeling of weakness in wrist, activities slightly restricted	4
Poor	pain, disability, limitation of motion, activities markedly restricted	6
Objective Evaluation		
I. Residual Deformity	out of the range of	
Ulnar variance	0 ± 2mm	1
Palmar tilt	11 ± 10°	1
Radial tilt	23 ± 10°	1
II. Range of Motion		
Dorsiflexion	< 45°	1
Palmarflexion	< 30°	1
Ulnarflexion	< 15°	1
Radialflexion	< 15°	1
Supination	< 50°	1
Pronation	< 50°	1
III. Grip Power		
Dominant hand	< the power of the opposite hand	1
	< 2/3 of the power of the opposite hand	2
Non-dominant hand	< 2/3 of the power of the opposite hand	1
	< 1/2 of the power of the opposite hand	2
IV. Arthritic Change		
None		0
Minimal	irregularity of the articular surface, sharpening of the articular margin	1
Moderate	narrowed joint space; osteophyte	2
Severe	marked osteophyte formation; ankylosis	3
Complication		
Nerve complication		1–2
Stiff fingers		1–2
Ruptured tendons		1–2
End Result		**Point range**
Excellent		0–3
Good		4–9
Fair		10–15
Poor		16–26

RESULTS

Functional assessment

The functional outcome was almost satisfactory. Subjective evaluations were excellent in 10 patients, good in 10 patients, and fair in 2 patients. 21 patients had 0 demerit points and one patient had 1 demerit point in range of motion. Grip power was 0 demerit points in 13 patients, 1 demerit point in 8 patients, and 2 demerit points in one patient. 16 patients had 0 demerit points and 6 patients had 1 demerit point in arthritic change. All patients had 0 demerit points in complications (Fig. 2).

Anatomical assessment

At follow-up, all 22 patients had healed with an average radial tilt of 20.7° and had restored and maintained good reduction as for radial tilt. The average ulnar variance was 4.0 mm and most patients had loss of correction and showed radial shortening. The palmar tilt averaged –2.6° and about half of patients showed dorsal tilt deformities (Fig. 3). The average losses of correction between the postoperative and follow-up radiographs were 4.6° in radial tilt, 2.4 mm in ulnar variance, and 9.1° in palmar tilt.

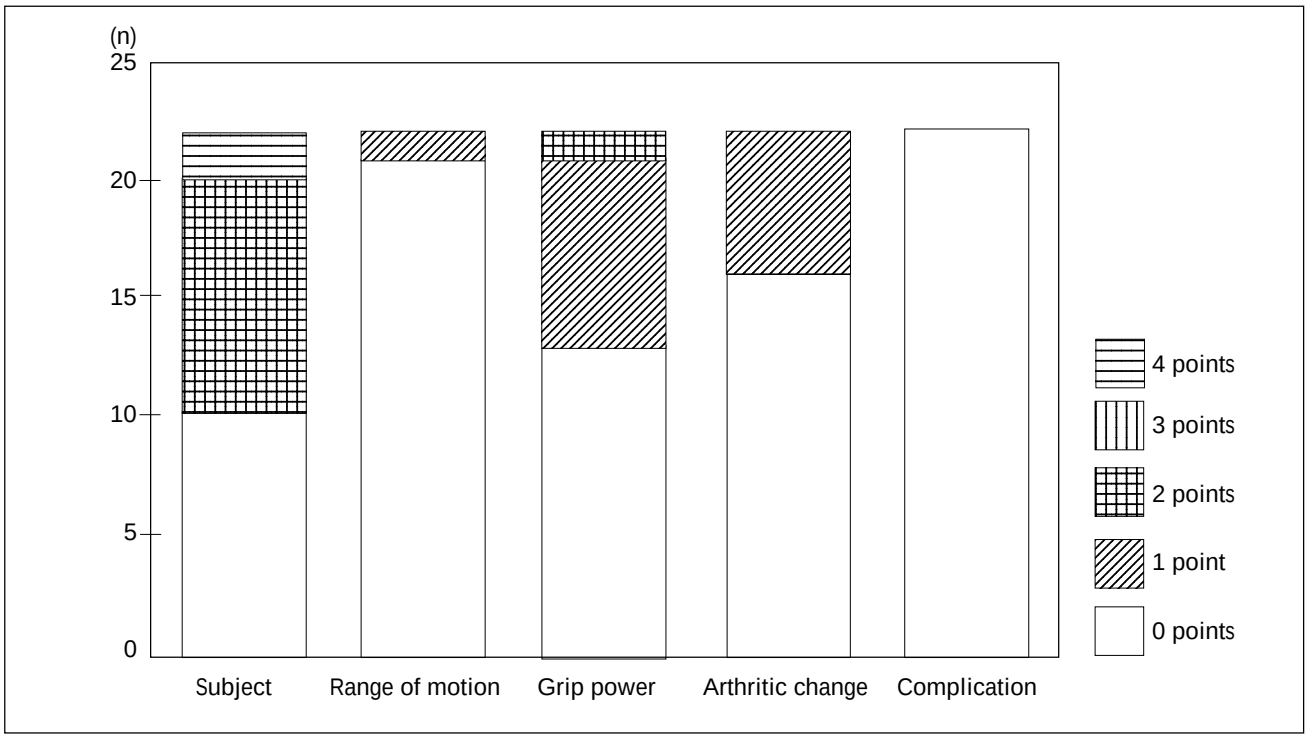

Figure 2 Functional outcome by the demerit point system of Saito.

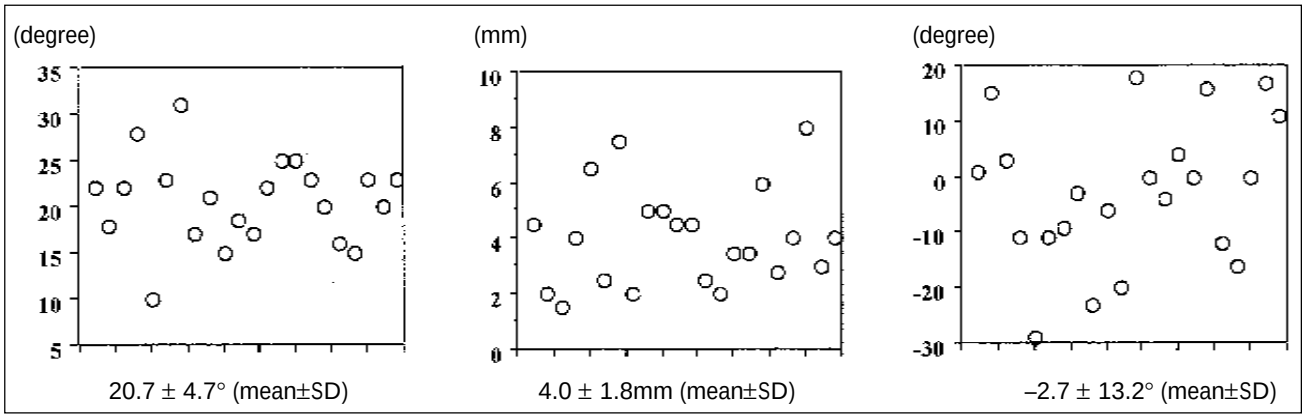

Figure 3 Anatomical outcome at follow-up. **(a)** Radial tilt. **(b)** Ulnar variance. **(c)** Palmar tilt.

Correlation between functional and anatomical results

Fig. 4 shows the correlation between the demerit points of residual deformities and the other factors of the Saito system. There was no statistical relation between deformities and subjective evaluations. As for range of motion and complications, only one patient had range of motion limited and no patient had complications. Thus, range of motion and complications were good in spite of grades of deformities. Some patients had decrease in grip power and arthritic change. And residual deformities did not correlate significantly with grip power and arthritic change. We compared the values of radiographic parameters that included radial tilt, ulnar variance, and palmar tilt with subjective evaluation, range of motion, grip power, arthritic change, and complications. But we could not find any correlation among them (Table 2). Though the correlation coefficient between ulnar

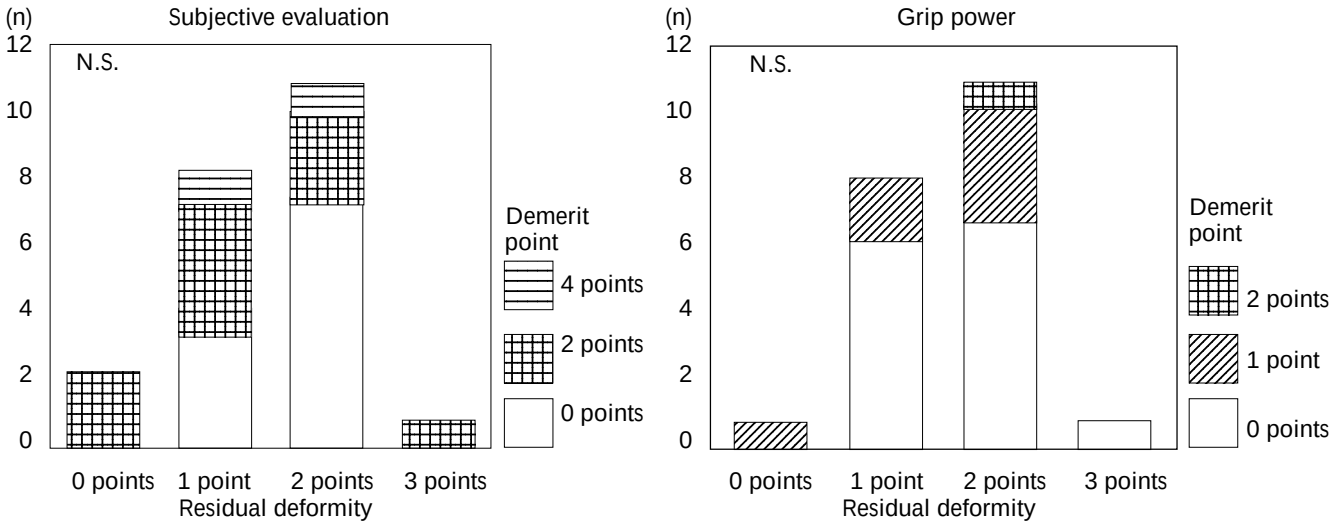

Figure 4 Correlation between functional and anatomical results. **(a)** Subjective evaluation did not correlate significantly with residual deformity. **(b)** Grip power did not correlate significantly with residual deformity.

Table 2
Correlation between the anatomical and functional results

Functional \ Anatomical	Radial tilt		Ulnar variance		Palmar tilt	
	r	p value	r	p value	r	p value
Subjective evaluation	0.043	0.852	0.283	0.204	0.261	0.243
Range of motion	0.111	0.626	–0.192	0.396	–0.141	0.536
Grip power	0.126	0.581	0.051	0.824	0.230	0.308
Arthritic change	0.145	0.523	0.210	0.354	–0.118	0.604
Complication	–	–	–	–	–	–

r =correlation coefficient

variance and subjective evaluation was 0.283, of the 4 patients with ulnar variance of 6 mm or over, 2 patients had 2 demerit points and 2 patients had 4 demerit points in subjective evaluation. We made further investigations on the type of fracture and age. There was no statistical relation between these factors and subjective evaluations, range of motion, grip power, arthritic change, or complications.

We could not find any significant factors that would affect the clinical outcome in this study using the demerit point system of Saito. Then we made a detailed analysis of patients with fair subjective evaluation. Neither of them had loss of wrist motion or complications including nerve complications, stiff fingers, and ruptured tendons. But both of them had loss of grip power and it was considered as the cause of fair evaluation. One had to give up playing golf due to loss of grip power (injured: 15 kg, uninjured: 25 kg) and the other could not return to his previous occupation which involved physical labor due to loss of grip power (injured: 15 kg, uninjured: 29 kg). Furthermore, both of them had injured their non-dominant hand. Loss of grip power was considered a significant factor related to poor outcome. Then we made an additional investigation on grip power. The grip power of the injured side was compared with that of the uninjured side, and it was recorded as a percentage of the uninjured side. The average grip power of the patients who injured the dominant hand was 106.1% and that of the patients who injured the non-dominant hand was 76.4% (Fig.5). Grip power of the patients who injured the dominant hand was significantly stronger than that of the patients who injured the non-dominant hand ($p<0.01$).

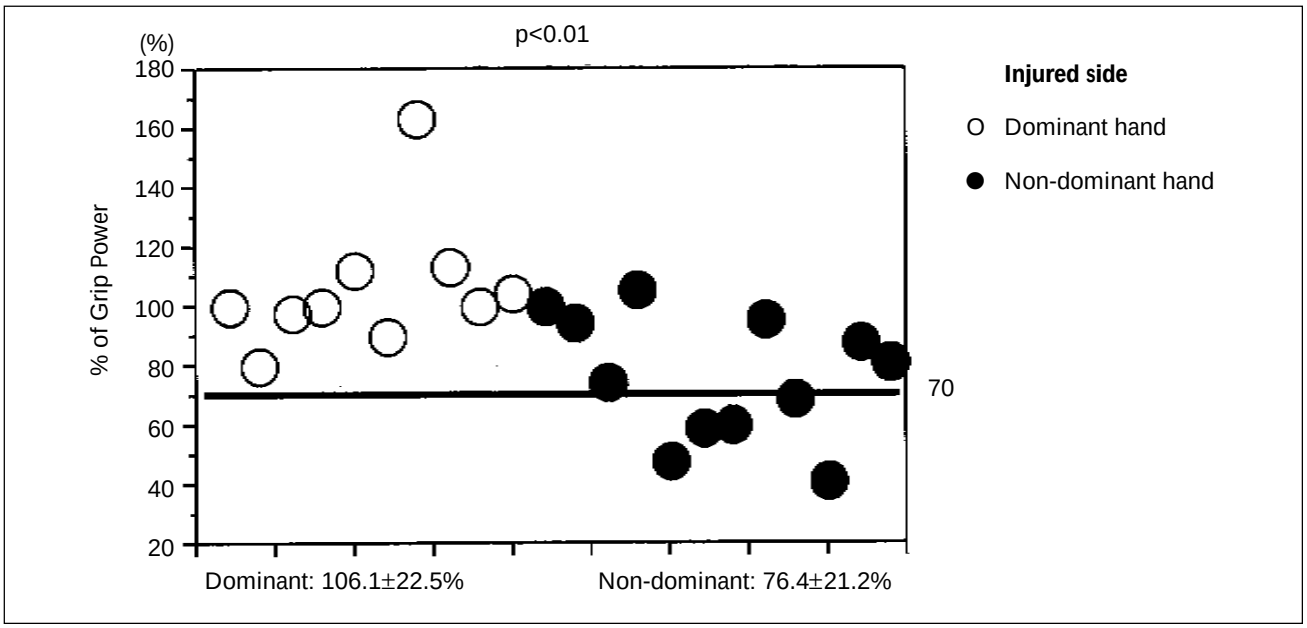

Figure 5 Grip power at follow-up (recorded as a percentage of the uninjured side). Grip power of the patients who injured the dominant hand was significantly stronger than that of the patients who injured the non-dominant hand (p<0.01).

DISCUSSION

Because multiple variables influence the results of treatment of injuries such as fractures of distal end of radius, definitive conclusions about such treatment and factors affecting the outcome are difficult to reach. [3] Several studies clearly showed that restoration of the radial length is the most important factor in achieving a good end result. [2,4,10,11,14,15] However, shortening of the radius is associated with poor results only in cases of severe shortening deformities after conservative treatments. [1,8,9,14] The results of this study indicated that most of the elderly patients with moderate radial shortening and dorsal angulation obtained satisfactory functional outcome and did not show a significant correlation between functional outcome and anatomical outcome.[5] But of the 4 patients with ulnar variance of over 6 mm, 2 patients had 2 demerit points and 2 patients had 4 demerit points in subjective evaluation. Thus severe shortening of the radius is supposed to be associated with poor functional results.

Consequently, though most of the elderly patients with fractures of distal end of radius could achieve excellent functional results regardless of variable residual deformities, the functional results of the patients with radial shortening of over 6 mm were poor. Based on this study, though the relationship of the anatomical results and the functional results is unclear, axial shortening of the radius of over 6 mm affects the functional outcome and should be reduced even in elderly patients. Percutaneous pinning is simple, minimally invasive, and prevents redisplacement of fracture fragments adequately. Therefore this method is supposed to be an appropriate treatment for elderly patients with severely displaced and unstable fractures of distal end of radius. [7]

Furthermore, the present study demonstrated that grip power was one of the most important factors in achieving a good subjective evaluation. Most patients with the non-dominant hand injured showed loss of grip power as compared to the uninjured side. Petersen et al. concluded that the 10% difference in maximal voluntary isometric contraction of grip power between dominant and non-dominant hand was valid only for right–handed healthy individuals. [12] All 22 patients in this study were right-handed and the injured sides of all 5 patients with loss of grip power by 30% or more compared to the uninjured side were the non-dominant hands. Hand dominance is important to treatment for fractures of distal end of radius. Elderly patients might not need too much power with their non-dominant hand, nor do they use the non-dominant hand frequently after trauma. Most of the patients with minor weakness did not complain about disabilities, but intensive physiotherapy seems to be necessary for physical laborers and sport lovers with the non-dominant hand injured.

CONCLUSION

This study demonstrated that minor deformities with an average radial shortening of 4 mm and dorsal tilt of 3° are not significantly related with functional results in elder patients over 60 years. But the functional results of the patients with radial shortening of over 6 mm were poor. Therefore, the axial shortening of the radius should be reduced and maintained less than 5 mm. About one fourth of patients lost grip power by 30% or more compared to the uninjured side and all of them had injured their non-dominant hand. If patients who fractured their non-dominant hand need to regain the grip power, intensive physiotherapy seems to be necessary even in the elderly.

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