

# Investigation of the Parameters Affecting the Functional Results in Conservatively Followed Distal Radius Fractures

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## Abstract

**Background and Objectives:** Distal radius fractures are the most commonly treated fractures by orthopedic surgeons. We investigated the relationship between demographic and radiological parameters and functional outcomes in conservatively treated distal radius fractures. **Methods:** The study included 101 patients with displaced distal radius fractures who were treated conservatively. All fractures were grouped according to demographic (sex and age) and radiological parameters (Arbeitsgemeinschaft für Osteosynthesefragen (AO) classification, accompanying ulna styloid fracture, radial inclination, radial height, volar tilt, and ulnar variance). The effects of these parameters on functional results were evaluated statistically. Mayo and QuickDASH scores were used for functional assessment. **Results:** Of 101 cases, 39 were male and 62 were female. The mean age of the patients was 50 (20–79). According to the AO classification, 82 (81.2%) were type A, 4 (4%) were type B, and 15 (14.9%) were type C. While 54 (53.5%) cases had ulna styloid fractures, the remaining 47 (46.5%) did not. The mean radial height of all cases was 11 mm, the radial inclination was 21°, and the volar tilt was 6°. The mean Mayo score of all cases was 80 and the QuickDASH score was 13.6. **Conclusion:** The functional outcomes of displaced distal radius fractures were not always correlated with radiological parameters. Malunion results were often nonsymptomatic, especially in elderly patients with AO types A and B. Care should be taken to ensure the reduction is complete in AO type C fractures in young male patients.

**Keywords:** Distal radius fracture, functional results, radiological parameter

## INTRODUCTION

Distal radius fractures are the most commonly treated fractures by orthopedic surgeons.<sup>[1]</sup> Malunion is the most common complication in distal radius fracture treatment.<sup>[2,3]</sup> Distal radius fractures are often treated conservatively, but complete anatomical reduction may not always be achieved with closed reduction. However, complete anatomical reduction is not always necessary for good results. There are many radiological parameters for the evaluation of anatomical reduction of the fracture including the presence of an ulna styloid fracture, radial height, ulnar variance, radial inclination, and dorsal/palmar tilt. AO/orthopedic trauma association classification is frequently used in the treatment of displaced distal radius fractures. This classification is an important predictive factor in the treatment selection for distal radius fractures.<sup>[4]</sup> In this study, demographic and radiological parameters as well as the association of ulna styloid fractures and AO

classification were evaluated for effects on functional outcomes after fracture union in displaced distal radius fractures that were treated conservatively. This study sought to comprehensively report which parameter is most important by addressing all the factors affecting conservative treatment.

## MATERIALS AND METHODS

This study was designed retrospectively. The radiographs of the patients who were followed up conservatively in the

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clinic between 2017 and 2021 were examined on the picture archiving and communication system. All patients with a complete fracture union were designated as the control, and their functional scores were checked. Patients with distal radius fractures treated conservatively with closed reduction and a cast in the clinic was included as the study group. Cases who underwent corrective osteotomy during the follow-ups or were recommended for the operation but chose not to for social reasons and had to be followed conservatively were excluded from the study. Ethics committee approval was obtained for the study.

A closed reduction was performed by applying hematoma blockade (10 ml of 1% procaine). Then, the short arm cast was made up to the metacarpophalangeal joint level with the wrist in ulnar deviation and slight flexion. Fracture reductions were performed by an experienced orthopedist and technician. After casting, anterior to posterior/lateral radiographs of the wrist were taken and the patients who were suitable for reduction were followed up. The patients were called for reduction control radiographs once a week. Rereduction was performed in unstable cases (intra-articular stepping more than 2 mm, volar tilt  $<-10$ , and radial shortness  $>3$  mm) who experienced reduction loss in the 1<sup>st</sup>- and 2<sup>nd</sup>-week follow-ups after reduction. Those who were not reduced or considered unstable underwent surgery. Those requiring secondary reduction due to fracture reduction loss and those recommended for surgical correction were excluded from the study. The cast was changed to the neutral position in the 3<sup>rd</sup> week in cases without reduction loss in the follow-ups. After an average of 40 days, the plaster was removed after the union of the fracture. Then, wrist exercises were started.

All fractures were grouped as types A, B, and C according to the AO classification, and the Mayo and QuickDASH scores of these fracture types were compared. All patients included in the study had their radial elevation, volar tilt, radial inclination, and ulnar variance evaluated radiologically at the final checkup. Posterior-anterior and lateral radiographs were taken in all patients with shoulder abduction and the forearm in neutral

rotation [Figures 1 and 2]. The comparison of functional scores for cases with malunion was evaluated statistically.

## RESULTS

A total of 101 patients were included in the study; 39 were male and 62 were female. The mean age of the patients was 50 (20–79). The mean follow-up period of the patients was 35.6 (24–57) months. The mean radial height was 11 mm, the radial inclination was  $21^\circ$ , and the volar tilt was  $6^\circ$ . According to AO classification, 82 (81.2%) were type A, 4 (4%) were type B, and 15 (14.9%) were type C. There were ulna styloid fractures in 54 (53.5%) cases and no ulna styloid fractures in 47 (46.5%) cases. The ulnar variance was negative in 19 (18.8%) cases, positive in 27 (26.7%) cases, and neutral in 55 (54.5%) cases. The mean radial height was 11.0 (5–18) mm, the mean radial inclination was  $21$  ( $11^\circ$ – $30^\circ$ ), and the mean volar tilt was  $6$  ( $0^\circ$ – $32^\circ$ ) [Table 1].

The Mayo score of the patients with accompanying ulna styloid fractures was 80.80 and the QuickDASH score was 13.6. In the conservative treatment of distal radius fractures, there was no statistically significant difference in the presence of ulna styloid fracture. The QuickDASH scores of ulnar variance (+) cases were minimally higher than ulnar variance (-) and neutral cases, but no statistically significant difference was observed. QuickDASH scores were significantly higher in cases with increased volar tilt after fracture union. In other words, functional scores were lower in malunion cases with increased volar tilt compared to malunion cases with dorsal tilt. QuickDASH scores were 11.4, 14.8, and 38.6, and Mayo scores were 80, 85, and 65, respectively, in AO type A, B, and C fractures. Functional results of AO type C class fractures were significantly worse than types A and B. Functional scores of elderly patients were significantly lower [Table 2]. In other words, functional results were worse in older patients.

## DISCUSSION

The most important complication in distal radius fractures is malunion. However, publications are reporting that functional



**Figure 1:** Posterior-anterior X-ray image of a patient with radial height loss



**Figure 2:** Lateral X-ray image of a patient with malunion in the dorsal tilt position

**Table 1: Demographic and clinical information of the patients**

	Minimum–maximum	Median	Mean±SD/n (%)
Age	20.0–79.0	50.0	50.3±13.9
Gender			
Male			39 (38.6)
Female			62 (61.4)
QuickDASH	4.5–43.2	13.6	16.5±11.8
Mayo score	45.0–100.0	80.0	77.7±12.1
Radial height (mm)	5.0–18.0	11.0	11.3±2.5
Radial inclination (degree)	11.0–30.0	21.0	21.3±4.0
Volar tilt	0.0–32.0	6.0	6.9±6.4
Casting time (day)	40.0–46.0	42.0	42.3±1.8
Extension loss	0.0–35.0	0.0	1.8±5.0
Flexion loss	0.0–20.0	0.0	2.6±5.0
Ulnar variance			
Negative			19 (18.8)
Positive			27 (26.7)
Neutral			55 (54.5)
Volar/distal malunion			
Volar			16 (45.7)
Distal			19 (54.3)
Normal			66
Dominant hand			
Yes			59 (58.4)
No			42 (41.6)
DM			
Yes			17 (16.8)
No			84 (83.2)
Side			
Right			52 (51.5)
Left			49 (48.5)
Ulnar styloid fracture			
No			54 (53.5)
Yes			47 (46.5)
Fracture type (AO)			
A			82 (81.2)
B			4 (4.0)
C			15 (14.9)
Fracture type (Fernandez)			
I			82 (81.2)
II			3 (3.0)
III			14 (13.9)
IV			1 (1.0)
V			1 (1.0)

SD: Standard deviation, AO: Arbeitsgemeinschaft für Osteosynthesefragen, DASH: Disability of Arm, Shoulder and Hand Questionnaire

results can be good even if there is malunion.<sup>[5]</sup> There is no consensus in the literature on the necessity of surgery when deciding on conservative treatment and follow-ups. The AO classification is not sufficient to guide surgical or conservative treatment decisions. More studies are needed on which radiological parameters should be taken into account during follow-ups.<sup>[6]</sup>

In recent publications, it has been reported that functional results are good even with malunion in elderly patients.<sup>[7,8]</sup> Here, it was concluded that the abnormalities in the radiological parameters of elderly patients can be tolerated better. In this study, functional results were good when all radiological parameters (volar tilt, ulnar variance, and radial shortening) were taken into account in elderly patients. Functional outcomes were worse in younger patients when radial shortness, volar tilt, and positive ulnar variance were not appropriate. In addition, it was observed that smaller deviations in these parameters may adversely affect functional results in young patients.

Approximately 60%–70% of distal radius fractures are accompanied by an ulna styloid fracture.<sup>[9,10]</sup> However, it is still controversial whether ulna styloid fracture displacement changes the treatment or affects the functional outcome. In their study of 166 patients with >2 mm ulna styloid fracture displacement, May *et al.* found an association with distal radial ulnar joint (DRUJ) instability.<sup>[10]</sup> In the retrospective study of Souer *et al.*, it was reported that it did not affect functional outcomes.<sup>[11]</sup> In this study, there was no statistical difference in functional results between cases with and without ulna styloid fractures.

In the literature, the decrease in radial height disrupted the DRUJ kinematics and caused damage to the triangular fibrocartilage in cadaver studies.<sup>[12]</sup> In addition, many studies have reported that radial height loss adversely affects clinical functional outcomes.<sup>[13,14]</sup> Radial height, which is also directly related to ulnar variance, is the most associated radiological parameter with poor outcomes, according to the literature.<sup>[15]</sup> In addition, the functional outcomes of cases with radiological disruption of volar tilt and dorsal or volar angulated union are associated with poor outcomes.<sup>[16]</sup> In our cases, the functional outcome was not affected by the volar tilt measurements. Furthermore, elderly patients, especially tolerated it well and the results were satisfactory.

The most important result in this study is that the results were poor when deviations in radiological parameters of young patients with AO type C fractures were observed. Apart from this, the results were satisfactory even if there were deviations in radiological parameters in other fracture types and advanced age cases.

## CONCLUSION

In the conservative treatment of radius fractures, the anatomical union of the fracture should be considered in young and AO type C fractures. Malunion is better tolerated in advanced age AO type A and B cases.

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## Conflicts of interest

There are no conflicts of interest.

**Table 2: Comparison of QuickDASH and mayo scores with the patient data**

	Age	Radial height (mm)	Radial inclination (degree)	Volar tilt	Casting time (day)	Extension loss	Flexion loss
QuickDASH							
<i>r</i>	-0.320	0.194	0.143	0.006	0.052	0.189	-0.107
<i>P</i>	0.001	0.051	0.154	0.950	0.604	0.058	0.287
Mayo score							
<i>r</i>	0.008	-0.081	0.002	-0.010	-0.144	-0.302	-0.171
<i>P</i>	0.934	0.422	0.985	0.919	0.152	0.002	0.088

Spearman's correlation. DASH: Disability of Arm, Shoulder and Hand Questionnaire

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