

## RESEARCH ARTICLE

## Fixing ulnar Styloid Fracture with Stable Distal Radioulnar Joint: A Randomized Clinical Trial

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**Abstract**

**Background:** The association between ulnar styloid fracture and distal radius fracture is common while the necessity of ulnar styloid fixation is still controversial. We have aimed to elucidate the effect of ulnar styloid fracture fixation on final outcome of distal radius fracture treatment.

**Methods:** In a two-arm randomized clinical trial, patients with Fernandez type I distal radius fracture associated with ulnar styloid fracture in the base were divided into two groups of fixed (group A) and unfixed (group B) ulnar styloid fracture. They were followed up for 12 months using pain visual analogue scale (VAS), quick form of the Disabilities of the Arm, Shoulder, and Hand (DASH) score questionnaire, and Mayo performance score as well as wrist range of motion and grip strength evaluation.

**Results:** Quick DASH score was  $35.4 \pm 14.0$  in group A and  $30.5 \pm 5.82$  in group B ( $P=0.027$ ) at 3-month follow-up and  $29.8 \pm 18.2$  in group A and  $18.3 \pm 8.40$  in group B At 6-month follow-up ( $P=0.001$ ). VAS score for pain was declined  $4.46 \pm 2.17$  and  $3.64 \pm 0.96$  after 6 months ( $P=0.339$ ) and  $4.00 \pm 1.73$  and  $2.50 \pm 0.81$  after 12 months ( $P=0.352$ ) in groups A and B, respectively. The mean Mayo wrist scores were measured as 59.3 and 57.8 in group A and B three months after the fracture, respectively ( $P=0.504$ ). We found no significant difference in the wrist range of motion and grip strength between two groups after three months ( $P>0.05$ ).

**Conclusion:** According to our findings, ulnar styloid fixation using pin and wire have an adverse effect on distal radius fixation outcomes.

**Level of evidence:** I

**Keywords:** Clinical outcome, Distal radius fracture, Fernandez type I distal radius fracture, Pin and wire fixation

**Introduction**

Distal radius fracture (DRF) is one of the most common fractures in upper extremities and is seen in one out of six patients in emergency department (1). It is associated with synchronous ulnar styloid fracture in 50 to 65% of the cases (2). The fundamental anatomical and biomechanical role of the ulnar styloid is stabilization of the distal radioulnar joint (DRUJ) as triangular fibrocartilage complex (TFCC) attaching to it (2, 3). However, there is still debate over whether treating the associated ulnar styloid fracture in

distal radius fractures would be a valid decision.

It can be left unfixed or fixed using external fixator, plate, or pin and wiring (4). Some studies have reported that the treatment of ulnar styloid fracture accompanying DRF has no effect on the final outcomes (4-7). In contrast, considering the anatomy of DRUJ, ulnar styloid fracture will increase the risk of DRUJ instability (8, 9).

Since the decision of fixing ulnar styloid fracture as well as the factors affecting it has been a matter of debate, in the current clinical trial, we have aimed to compare the

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final clinical outcomes of two different approaches of DRF treatment (fixing and not fixing the ulnar styloid fracture).

### Materials and Methods

Patients with concomitant distal radius and ulnar styloid fractures in three trauma hospitals in 2016-2017 were enrolled in this clinical trial. All patients had distal radius fracture associated with ulnar styloid fracture in the base. Inclusion criteria were: adult patient with concomitant type I distal radius fracture based on Fernandez classification (10) with ulnar styloid fracture in the base and stable distal radioulnar joint. Exclusion criteria were: age less than 18, open fracture, and previous hand or wrist surgery or deformity.

After signing informed consent forms, patients were randomized into two groups using PASS application and envelopes to assign participants into two groups (group A: with ulnar styloid fixation and group B: without fixation of the ulnar styloid fracture). The study was approved by our university review board (IRCT2016061828510N1).

Distal radius fractures in both groups were fixed with cross percutaneous pinning. In group A, the ulnar styloid fracture was fixed using pin and tension wiring through longitudinal incision over the ulnar styloid fracture. A long arm cast in supination was applied for 6 weeks. In group B, only distal radius fracture was fixed and then a long arm cast in supination was applied for 6 weeks. Both groups received the same physical therapy on fingers and shoulder for 6 weeks following the surgery. Clinical check-ups were carried out at 2, 4, 6, 8, 12, 24, and 48 weeks postoperatively. Before surgery, the patients were asked to rate their pain intensity on VAS. Three months after the surgery, patients were invited for a follow-up session in which they filled out pain visual analogue scale (VAS), quick form of the Disabilities of the Arm, Shoulder, and Hand (DASH) score and Mayo performance score. Their wrist ranges of motion and grip strength in both the affected and normal sides were examined. The patients' VAS and quick DASH scores were recorded similarly at month 6 and 12.

### Tools

**Pain VAS score:** the visual analogue scale is a single-item questionnaire ranging from 0 (no pain) to 10 (the worst pain the patient can experience) at the time of visit, which demonstrates pain severity (11).

**Quick DASH score:** this questionnaire is an 11-item patient-reported outcome tool assessing the disabilities in upper extremities. The final score is calculated based on five response option questions, differing from 0 (no disability) to five (severe disability). The final score can be ranged from 0 (no disability) to 100 (most severe disability) (12). The validated Persian version of Quick-DASH questionnaire was used in this study (13).

**Mayo wrist score:** evaluates pain, range of motion, grip strength, and return to work. Total score differs from 0 to 100. Score 90 to 100 is considered excellent, 80 to 89 good, and 65 to 79 acceptable (14).

**Grip strength:** evaluates the upper extremities strength after surgery by using specific measuring tools. We used hydraulic grip dynamometer (Lafayette Instrument

Company, Indiana, USA) to measure hand force. The examination was repeated in excess of three attempts and we expressed the results based on the affected to unaffected hand force ratio.

**The wrist range of motion:** the wrist flexion-extension and ulnar-radial deviations are calculated utilizing orthopedics ruler in degrees for both sides.

### Population

Demographic characteristics and clinical outcomes of patients are shown in Table 1. The mean age was  $52.2 \pm 15.4$  years; and 37 out of 75 patients (49.3%) were men. Patients were divided into two groups. Group A patients (n=39) underwent ulnar styloid pin and

**Table 1. Demographic characteristics and Clinical Outcomes of patients (N=75)**

<b>Sex (N, %)</b>	Male	43.0 (57.3)
	Female	32.0 (42.7)
<b>Cause of injury (N, %)</b>	MVA	14.0 (18.7)
	Falling	61.0 (81.3)
<b>Affected side (N, %)</b>	Right	28.0 (37.3)
	Left	47.0 (62.7)
<b>Age (Mean, SD)</b>		52.2 (15.4)
<b>Mayo Wrist Score (Mean, SD)</b>		24.2 (10.0)
<b>DASH Score (after 3 month) (Mean, SD)</b>		3.30 (11.1)
<b>DASH Score (after 6 month) (Mean, SD)</b>		24.3 (15.4)
<b>DASH Score (after 12 month) (Mean, SD)</b>		1.59 (5.90)
<b>Flexion (normal side) (Mean, SD)</b>		50.0 (8.14)
<b>Flexion (affected side) (Mean, SD)</b>		25.0 (8.27)
<b>Extensions (normal side) (Mean, SD)</b>		35.0 (6.83)
<b>Extensions (affected side) (Mean, SD)</b>		10.0 (10.8)
<b>Grip (normal side) (Mean, SD)</b>		14.0 (7.67)
<b>Grip (affected side) (Mean, SD)</b>		3.20 (149)
<b>Supination (normal side) (Mean, SD)</b>		90.0 (0.00)
<b>Supination (affected side) (Mean, SD)</b>		15.0 (16.3)
<b>Pronation (normal side) (Mean, SD)</b>		20.0 (8.08)
<b>Pronation (affected side) (Mean, SD)</b>		10.0 (12.7)
<b>Ulnar Deviation (normal side) (Mean, SD)</b>		20.0 (5.36)
<b>Ulnar Deviation (affected side) (Mean, SD)</b>		5.00 (5.78)
<b>Radial Deviation (normal side) (Mean, SD)</b>		15.0 (4.88)
<b>Radial Deviation (affected side) (Mean, SD)</b>		5.00 (3.58)
<b>VAS Score (after 6 month) (Mean, SD)</b>		4.06 (1.74)
<b>VAS Score (after 12 month) (Mean, SD)</b>		0.51 (1.38)

SD= standard deviation

DASH= the disabilities of arm, shoulder, and hand

VAS= visual analogue scale

MVA=Motor vehicle accident

**Table 2. Bivariate Analysis: Differences between clinical outcomes and demographic characteristics of fixation and non- fixation groups**

Variables		Fixation	Without fixation	P-value
<b>Clinical outcomes</b>				
Mayo Wrist Score		59.3 (11.9)	57.8 (7.60)	0.504
DASH Score (after 3 months)(Mean, SD)		35.4 (14.0)	30.5 (5.82)	0.027
DASH Score (after 6 months)(Mean, SD)		29.8 (18.2)	18.3 (8.40)	0.001
DASH Score (after 12 months)(Mean, SD)		13.5 (7.92)	6.02 (2.00)	0.198
VAS Score (Befor surgery)(Mean, SD)		3.00 (1.57)	3.58 (1.57)	0.113
VAS Score (after 6 months)(Mean, SD)		4.46 (2.17)	3.64 (0.96)	0.339
VAS Score (after 12 months)(Mean, SD)		4.00 (1.73)	2.50 (0.81)	0.352
Flexion (Mean, SD)		43.8 (8.23)	42.8 (8.40)	0.58
Extension (Mean, SD)		36.7 (11.2)	37.4 (10.5)	0.861
Supination(Mean, SD)		45.5 (18.1)	48.1 (14.2)	0.499
Pronation (Mean, SD)		74.6 (11.8)	76.4 (13.7)	0.181
Grip (Mean, SD)		42.5 (206)	11.3 (12.2)	0.975
Ulnar deviation (Mean, SD)		17.8 (5.48)	16.9 (6.13)	0.536
Radial deviation (Mean, SD)		11.3 (3.93)	11.8 (3.20)	0.342
<b>Demographic characteristics</b>				
Age (Mean, SD)		51.5 (14.8)	52.9 ( 16.2)	0.754
Cause of injury (N, %)	MVA	7.00 (17.9%)	7.00 (19.4%)	0.868
	Falling	32.00(82.1%)	29.00(80.6%)	
Affected side (N, %)	Right	15.0 (38.5%)	13.0 (36.1%)	0.830
	Left	24.0 (61.5%)	23.0 (63.9%)	
Sex (N, %)	Female	13 (33.3%)	19 (52.8%)	0.089
	Male	26 (66.7%)	17 (47.2%)	

DASH= the disabilities of arm, shoulder, and hand

VAS= visual analogue scale

MVA=Motor vehicle accident

wire fixation while 36 patients in group B were treated without ulnar styloid fracture fixation. Motor vehicle accident (MVA) (81.3%) was the major cause of injuries. Demographic variables including age, sex, cause of the injury, and affected side are shown in Table 2.

In the first (three months after fracture) and second (after six months) follow-up sessions, 75 patients (39 in group A and 36 in group B) were available. However, only 11 of those patients were present (7 in group A and 4 in group B) for the 12 months follow-up visits, hence, more than 85% of the patients were absent in the last follow-up session.

### Statistical analysis

Data analysis was performed using SPSS version 16.0

(SPSS Inc., Chicago IL). Differences in categorical variables (sex, affected side, and causes of the injury) were tested by fisher exact test. According to data distribution, continuous and ordinal variables were calculated using Manne-Whitney U test or the Student t-test.

### Results

Quick DASH score was calculated at 3, 6, and 12 months after surgery. In the first follow-up session, the Quick DASH score was  $35.4 \pm 14.0$  in group A and  $30.5 \pm 5.82$  in group B ( $P=0.027$ ). At 6-month follow-up, the Quick DASH scores were  $29.8 \pm 18.2$  and  $18.3 \pm 8.40$  in group A and B, respectively ( $P=0.001$ ) [Table 2].

VAS Scores were calculated before surgery and then 6 and 12 months after surgery in both groups. The

VAS alterations in group A and B were  $4.46 \pm 2.17$  and  $3.64 \pm 0.96$  after 6 months ( $P=0.339$ ) and  $4.00 \pm 1.73$  and  $2.50 \pm 0.81$  after 12 months ( $P=0.352$ ), respectively [Table 2].

Three months after fracture, the mean Mayo wrist scores were measured 59.3 and 57.8 in groups A and B, respectively ( $P=0.504$ ) [Table 2]. Also, there was no significant difference in flexion, extension, supination, pronation, ulnar deviation, radial deviation, and grip strength between the two groups after three months [Table 2].

### Discussion

In this clinical trial, we investigated the effect of ulnar styloid fracture fixation on final outcomes of distal radius fracture treatment. Three and six months after surgery, ulnar styloid fixation showed a negative effect on Quick DASH score and no other significant differences were found between the two groups.

In current study, pain was evaluated using VAS score. Although the pain score following surgery was higher in fixation group, the difference between the two groups was not significant. There is a probability that manipulation during fixation causes residual pain, so, provided that the surgery is performed by a skilled surgeon, the manipulation and following pain can decrease (5, 7). In addition, the triangular fibrocartilage complex (TFCC) injuries caused by high energy traumas, elongates the wrist pain even after treatment (6). Although in this study the VAS results in double fixation group (group A) were worse than group B, some studies claimed that the most important factor affecting patient satisfaction is distal radius fracture fixation (4). On the other hand, the most crucial factor leading to poor outcomes in these cases is the coincidence of ulnar styloid fracture (3).

Disability was evaluated using Quick DASH score. Upper extremity function was significantly improved after three and six months follow up [Figure 1]. But, the DASH score was not statistically significant after one year which can be due to the high number of missing patients in our study (64 out of 75 patients lost to follow up). In contrast,

some studies have suggested that the DASH score has no impact on either ulnar styloid fixation or non-fixation treatments (5). Unequal surgery or ulnar styloid fracture types in various studies may result in controversial outcomes. To sum up, if the fracture occurs at the base of the ulnar styloid, the risk of radioulnar joint instability would increase. Instability plays a vital role in the final outcomes, therefore, repairing the associate ulnar styloid fracture prevents further discomfort or disabilities (7).

In our study, there was no difference regarding the wrist range of motion or grip strength between the two groups. This is consistent with previous studies (4, 5, 15) [Table 3]. It might be somehow related to no differences between distal radius fractures with and without ulnar styloid fracture as observed in Okoli et al. cohort (16). They found that the presence, type, or bony union of ulnar styloid fracture are irrelevant to patients' outcome and function in a 14-month follow-up (16). It was also seen that non-union of proximal half of the ulnar styloid has no effect on wrist motion, strength, and pain in a 6-month follow-up (17). Although in a meta-analysis of 12 articles, the DASH score was reported 3.4 in favor of patients without ulnar styloid fracture, PRWE scores were not statistically different between the two groups as for the range of motion, grip strength, DRUJ instability, and wrist pain (18). However it should be kept in mind that none of the mentioned studied has evaluated the fixation of ulnar styloid fracture.

Our study had some limitations. First, most of the patients were lost to the final follow-up which intensively blemished the final results. Second, although there are various types of treatment such as using screw or plate, we used pinning and casting for ulnar styloid fixation. Perhaps, more rigid fixation methods would give better outcomes. We only included Fernandez type I DRF; however, other types may behave differently. We believe that extending the follow-up duration to at least two years or investigating the outcomes by arthroscopy will present better evaluation of outcomes. Tension band wiring was used for fixation; whether a more robust fixation would have different outcomes and needs further evaluations.

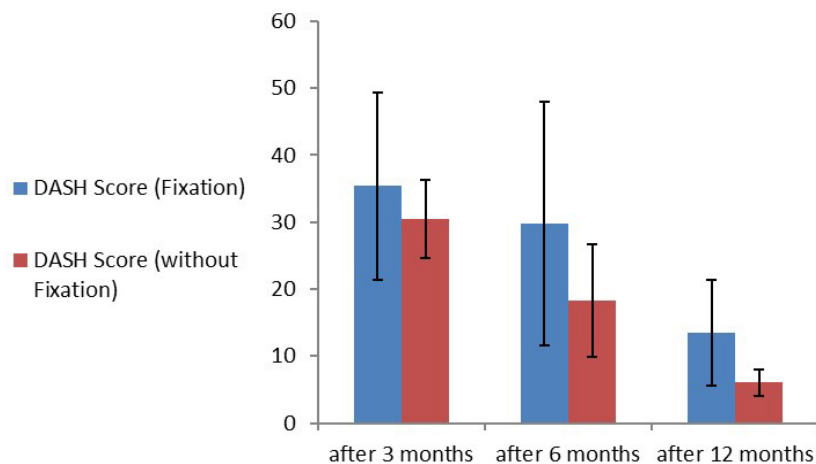


Figure 1. DASH improvement among fixation group and non-fixation group.

**Table 3. Differences between our study and similar studies**

Author	Year	Sample size	Treatment	Follow up	Results
Zyluk A (4)	2014	70 patients (35 patients had an isolated fracture of the distal radius and 35 had an associated fracture of the ulnar styloid)	All patients underwent percutaneous, "augmented" K-wire fixation of the distal radius fracture; the ulnar styloid fracture was left untreated	3, 6 months postoperatively	An unrepaired ulnar styloid fracture does not influence the outcome of a distal radius fracture fixed by the "augmented" K-wire method.
Zenke Y (5)	2012	48 patients were enrolled, including 20 cases in fixation group and 28 cases in non-fixation group	Patients treated by internal fixation or treated without internal fixation.	one, two, three, four, six, eight, and 12 weeks; in addition to six months postoperatively	All the clinical outcomes or measured parameters were similar between the two groups, except the grip strength which was significantly better in the non-fixation group than in the fixation group.
Ozasa Y (15)	2013	19 patients, 8 Patients Without Ulnar Styloid Fracture and 11 Patients With Ulnar Styloid Nonunion	Patients had simultaneous radial closing-wedge in addition to ulnar shortening osteotomies. The accompanying ulnar styloid nonunion was not internally fixed.	1 year	No differences were found in postoperative radiographic measurements, motion, strength, pain scores, Mayo scores, or DASH scores between the 2 groups.
Sawada H (7)	2016	16 patients included in case group and 48 patients assigned as control group	In control group patients did not undergo fixation for ulnar styloid fractures. In case group, patients underwent fixation for ulnar styloid fractures.	1 year	The radiological parameters and clinical results were not significantly different between the groups. Bone-healing was significantly higher in the case group than in the control group.
Belloti JC (16)	2010	100 patients	Patients with unstable and reducible distal radius fractures, with or without an ulnar styloid fracture, were randomly assigned to treatment with transarticular bridging external fixation or transulnar percutaneous pinning.	1 year	patients having both fractures had worse wrist pain and DASH scores than the patients with an isolated distal radius fracture; in contrast less wrist pain and better DASH scores were shown in those treated by pinning against the patients treated by fixation.
Li S (17)	2012	75 patients with ulnar styloid fracture and 107 patients without ulnar styloid fracture included in group A and B, respectively	Group A: closed reduction and splintlet or cast fixation in 42 cases, and open reduction and internal fixation in 33 cases/ Group B: closed reduction and splintlet or cast fixation in 63 cases, and open reduction and internal fixation in 44 cases/ All ulnar styloid fractures were not treated.	21 months on average in group A and 20 months on average in group B	There was no significant difference in the palmar tilt angle, the ulnar inclination angle, the radial length wrist flexion-extension, radial-ulnar deviation, pronation-supination, and grip and pinch strength between groups A and B.

Our study revealed that ulnar styloid fixation can positively improve clinical outcomes, but it does not have a significant effect on wrist pain and function and may decrease the limb function.

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