

## Effect of ulnar styloid fixation on functional and radiologic outcomes after distal radius fractures

Cagri Ozcan<sup>1</sup>, Fatih Arslanoglu<sup>2</sup>, Serkan Aykut<sup>3</sup>, Kahraman Ozturk<sup>3</sup>

### ABSTRACT

**Background:** The aim of this study was to compare the functional and radiological outcomes of ulnar styloid fractures, with or without internal fixation, that followed distal radius fractures.

**Methods:** Between January 2011 and June 2017, 206 distal radius fractures were operated on in our hospital. In total, 71 patients were included in the study. Thirty-five ulnar styloid fractures were fixed, and Thirty-six could not be fixed. The mean age of patients was 45 years (20–64 years), and the mean follow-up time of patients was 19 months (12–30 months)

**Results:** In the unfixed ulnar styloid fracture group, the QuickDASH score was 20.8 and Mayo wrist score was 65. On the other hand, in the fixed ulnar styloid fracture group, the Quick DASH score was 11 and Mayo wrist score was 75. When comparing the groups, no statistically significant differences were found between their Quick DASH scores, Mayo wrist scores, grip strength, and wrist movements ( $p>0.05$ ). In the unfixed group, 10 nonunions were observed, while in the fixed group, 9 nonunions were observed.

**Conclusion:** In our study, ulnar styloid fracture fixation did not affect the functional outcomes of distal radius fractures. Surgeons should be more selective for ulnar styloid fixation in patients with ulna styloid fracture combined wrist fractures.

**Key words:** *Distal radius fracture, ulnar styloid, DRUJ instability, ulnar neck fracture, TFCC*

### Introduction

Distal radius fractures (DRF) are the most common fractures of the upper extremity [1-3]. In young adults, it usually results from high energy trauma, such as a vehicle accident or falling from a great height. In elderly patients, these are the second most common fractures after hip fractures and might occur as a result

of low energy trauma [4]. In 55% of these fractures, ulnar styloid fractures (USF) also exist [5]. The ulnar styloid is an important anatomical structure that provides stability to the distal radioulnar joint (DRUJ) by an anchor effect.

The impact of USF on the outcomes of DRF is still a matter of debate. Although some literature claims that

**Author affiliations** : Department of Orthopaedics and Traumatology, <sup>1</sup>Health Science University Umraniye Training and Research Hospital, <sup>2</sup>Medipol Mega University, Istanbul, Turkey <sup>3</sup>Department of Hand Surgery, Health Science University, Metin Sabancı Baltalimani Bone Diseases Training and Research Hospital, Istanbul, Turkey

**Correspondence** : Cagri Ozcan, MD, Department of Orthopaedics and Traumatology, Health Science University Umraniye Training and Research Hospital, Istanbul, Turkey. e-mail: cagriozcann@gmail.com

**Received / Accepted** : May 16, 2019 / March 08, 2020

USF do not affect the outcome, other literature states that USF will have a negative impact unless there is surgical intervention [6-8]. DRUJ instability is an important determinant in styloid fractures requiring surgical correction. Moreover, the results for styloid fractures with DRUJ instability are much worse than for styloid fractures without DRUJ instability [9]. The role of surgical fixation of ulnar styloid fracture remains unclear. Does ulna styloid fracture in DRF actually cause symptomatic instability in wrist function in patients without internal fixation? Given the potential implant complications in surgical patients, is ulna styloid fixation really necessary? The answers to these questions are constantly debated in the literature. The purpose of this study is to compare the functional and radiological results of ulnar styloid fractures, with or without internal fixation, following DRF.

#### **Materials and Methods**

This study was approved by the Ethical Committee of Umraniye Training and Research Hospital. Informed consent was obtained from all patients for being included in the study.

In our study patients who were admitted to the emergency department for radius distal fracture January 2011 and June 2017 were reviewed at our hospital, 206 DRF (AO classification 23-B and 23-C) cases received surgical intervention.

16 patients with open fractures, 8 patients with bilateral fractures, 14 patients who also had fractures in the same or opposite extremity, 2 patients with multiple trauma, 6 patients without an ulnar styloid fracture, 12 patients with revisional surgery and who received reoperation for pseudoarthrosis, 42 patients with less than 1 year of follow-up, and 35 patients with AO classification 23-A were excluded from the study. In total, 135 patients were excluded from the study from 206 patients who did not meet the study criteria. After careful examination, a total of 71 patients who fit the inclusion criteria were chosen for the study. These cases were evaluated retrospectively nonrandomised.

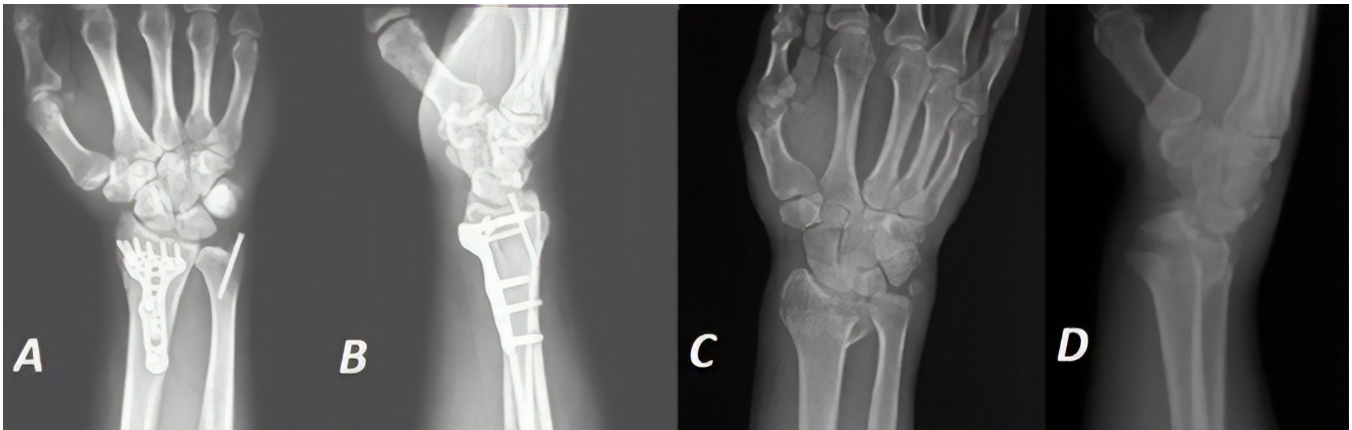
Open reduction and internal fixation were performed in all cases with more than 10 degrees of dorsal angulation, less than 15 degrees of inclination, less than 5 mm of radial height and more than 2 mm of displacement in the joint [10]. In patients who have decided to operate; The fixation of the ulna styloid fracture was left to the surgeon's preference. Measurements were performed by two different surgeons using posteroanterior and lateral wrist views via digital X-rays (PACS INFINITT).

Axillary blocks were applied to all patients undergoing surgery. Under tourniquet, a volar Henry incision was used for surgical access. A distal locked volar plate (size 2.4 mm) was used to perform the internal fixation after DRF reduction (Figure 1). After the internal fixation was done, ulnar styloid reduction was carried out and internal fixation performed on patients with ulnar styloid base fractures. Fixation of USF was done with a K wire or a 2.3 mm titanium screw (Figure 2). DRUJ inspection was performed on all patients after their internal fixation. During inspection, the surgeon positioned the forearm in a neutral position while gripping the distal end of the radius with one hand and clutching the distal ulna with the other hand to control the movements of the ulna to dorsal and volar. DRUJ trauma existed in two patients. Fixation was carried out with a K wire in supination for patients with DRUJ injury. After 3 weeks of long arm and 3 weeks of short arm plaster cast treatments, the K wire was pulled and wrist movements were induced. Ulnar styloid fixation was performed for these 2 patients concomitantly. Three weeks of short arm splinting follow-up was performed after splints were removed, and mobilization was started in patients without DRUJ injury. Six weeks later, wrist exercises were started for these patients. In terms of rehabilitation procedures, there was no difference in the treatment for patients with or without ulnar styloid fractures.

The cases were divided into two groups: fixed USF and unfixed USF. For the unfixed ulnar styloid fracture group, the fracture displacement grade was measured



**Figure 1.** Distal radius fracture without ulnar styloid fixation in a 24-year-old male patient- a) Postop 12 months follow up Lateral view and b) Postop 12 months follow-up AP (anteroposterior) view c) Preop AP view d) Preop Lateral view.



**Figure 2.** Distal radius fracture with ulnar styloid fixation in a 40-year-old male patient- a) Postop 14 months follow up AP view and b) Postop 14 months follow-up Lateral view c) Preop AP view d) Preop Lateral view.

using the method by Meyer et al [11]. In this measurement, the longest distance between the most proximal lateral part of the ulnar styloid fracture fragment and the distal lateral end portion of the ulna was measured. In the last follow-up, wrist flexion and extension, radial deviation and ulnar deviation movements were checked, and grip strength was measured comparatively with a Jamar hand dynamometer. QDASH (Disabilities of the Arm, Shoulder and Hand) score, Mayo wrist score and ulnar side provocation tests (ulnar impaction test-sign of piano key) were evaluated and noted by a surgeon [12,13]. The ulnar styloid radiologic findings were evaluated on final control radiographs. The radiographs of patients were measured by two different

surgeons, and two different surgeons made the measurements after being blinded.

IBM SPSS 22.0 (SPSS software, IBM Corporation, Armonk NY) was used to compare the values between the two groups. Mann-Whitney U tests were conducted for comparison of the groups, and values above  $P < 0.05$  were accepted as significant. X-ray values of patients were measured by two different surgeons; afterwards, values were measured through concordance assessment by using intraclass correlation coefficient (ICC) tests. The assessed ulnar styloid displacement length and evidence of malunion ( $ICC > 0.80$ ) were seen as having perfect unity. The first surgeon's measurements were taken into consideration.

**Results**

Out of a total of 71 cases, the ulnar styloid fracture was fixed in 35 cases (examined retrospectively) and unfixed in 36 cases. In 20 of the 35 fixed cases, a 2.3 mm titanium cannula screw was used, and in the remaining 15 cases, fixation was performed by K wire. Out of a total of 71 cases, 35 patients were men and 36 were women. In the unfixed group, 20 patients underwent right wrist surgery and 16 had left wrist surgery. In 26 patients with a fractured wrist, 16 fractures occurred in the dominant side and 10 occurred on the nondominant side. In the fixed group, the right wrist was surgically corrected in 20 cases and the left wrist in 15 cases. In the same group, 20 patients sustained the fracture on their dominant side and 15 of them on their nondomi-

nant side (Table 1).

The mean age of patients was 45 years (20–64 years). The total follow-up time for all cases was 19 months (12–30 months) (Table 2). In the last follow-up, the QDASH and Mayo wrist scores were 20.8 and 65, respectively, for the unfixed group. On the other hand, in the fixed group, the QDASH and Mayo wrist scores were 11 and 75, respectively. Ulnar provocation tests were positive in 10 cases in the unfixed group and in 4 cases in the fixed group.

None of the patients encountered infection or pseudoarthrosis. Lysis around the screw was seen on the last follow-up in one patient treated with ulnar styloid fixation. This patient had ulnar styloid nonunion.

Comparison of ages and follow-up periods between

**Table 1.** Demographic variables.

Demographic Variables	Fixed Ulnar Styloid Group (n=35)	Unfixed Ulnar Styloid Group (n=36)	P value*
Gender	Male:15, Female:20	Male:20, Female:16	
Right Hand	20	20	P:0,288
Left Hand	15	16	
Dominant Hand	20	26	P:0,187
Nondominant Hand	15	10	

\*Mann-Whitney U Test p<0.05 was considered significant.

**Table 2.** Functional scores and examination.

	Fixed Ulnar Styloid Group (n=35)	Unfixed Ulnar Styloid Group (n=36)	P value*
Follow-up Time (Months)	21 (12-28)	17 (12-30)	0.04
Age (Years)	43 (20-62)	48 (27-64)	0.303
QuickDASH	11,0	20,8	0.79
MAYO	75,0	65,0	0.71
Ulnar Provocation (Percent)	11,0	27,0	0.086
Grip Strength	82,0	58,0	0.353
Ulnar Deviation	25,0	23,0	0.6
Radial Deviation	10,0	10,0	0.877
Wrist Flexion	56,0	34,0	0.114
Styloid Displacement	3,14	3,07	0.715
Styloid Nonunion (Percent)	25,7	27,7	0.808

\*Mann-Whitney U Test p<0.05 was considered significant.

the fixed and unfixed groups was carried out using Mann-Whitney U tests. In both groups, no statistically significant difference was found between the ages of patients ( $p=0.303$ ); however, a statistically significant difference was found when comparing the follow-up periods between groups ( $p=0.04$ ). For groups with and without fixation, the QDASH score, Mayo wrist score and grip strength were compared. No statistically significant difference was found between the groups (Table 2). Additionally, no statistically significant difference was found during comparison of wrist activity (Table 2).

In the unfixed group, in 10 out of 36 cases, nonunion was observed during the last follow-up. In the fixed group, in 9 out of 35 cases, nonunion was observed during the last follow-up. When compared for nonunion using Mann-Whitney U tests, there was no statistically significant difference between the groups ( $p=0.808$ ). For the unfixed group, the ulnar styloid displacement mean was 3.07 mm after the first reduction, whereas for the fixed group, it was 3.14 mm after the first reduction. In both groups, the Mann-Whitney U test was conducted and no statistically significant difference was seen (Table 2). Ulnar provocation tests were positive in 10 patients in the unfixed group (27%), whereas in the fixed group, they were positive for 4 patients (11%). No statistically significant difference was obtained by Mann-Whitney U test. When the dominant and non-dominant sides were compared between the two groups, no significant difference was observed (Table 1). In the fixed group; No significant difference in QDASH scores and Mayo scores was found between the K-wire and the screw-treated patients were compared ( $p=0.192$ ).

### Discussion

Fracture of the ulnar styloid is a controversial issue in the literature, as the fracture leads to chronic wrist instability or affects the functioning of the distal radius. The ulnar styloid is an important anatomical structure for triangular fibrocartilage stability. In patients with USF who were followed conservatively, van Valburg et al. noted a greater recurrence of radial shortening was

seen after the first reduction [14]. These results warrant early radiologic follow-up in patients in order to evaluate dislocation of the distal radius. It is a supporting structure of the triangular fibrocartilage complex (TFCC) both in wrist biomechanics and the DRUJ. For this reason, some authors advocate the surgical restoration of the TFCC in cases of ulnar styloid fracture with more than 2 mm of displacement [15,16]. Palmer et al. studied 61 cadavers and showed evidence of DRUJ instability and ulnar cartilage erosion in cadavers with TFCC lacerations [17]. In this sense, the ulnar styloid is one of the keystone structures of the DRUJ.

Although the biomechanical importance of the ulnar styloid in the wrist has been proven, it is not clinically clear if USF accompanying DRF impact the functional results. In the literature, various studies on this particular topic have found that USF do not affect the functional results [7,17]. In contrast, some studies articulate that USF will have a negative impact on functional outcomes and create instability, but none of these studies are randomized prospective controlled trials [8].

Tzukazaki et al. compared two different groups: one with ulnar styloid fracture causing ulnar wrist pain and the other without ulnar styloid fracture during their conservative follow-up of 109 unilateral Colles fractures [6]. No significant difference was found between the two groups. They revealed that ulnar pain depends mostly on dorsal angulation. Kim et al. retrospectively studied 138 cases of DRF that were surgically corrected [7]. After comparing 62 cases without ulnar fractures, 47 cases with terminal fractures (non-base) and 29 cases with base fractures, no statistically significant difference was found between the groups. Gogna et al. compared 28 radius distal fracture cases with ulnar styloid fracture to 19 radius distal fracture cases without ulnar styloid fracture and found no statistically significant difference between the two groups with respect to DASH scores and functional outcomes [18]. In the literature, the authors compared USF that were not fixed with surgery with intact ulnar styloids.

However, there is a lack of literature on fixed ulnar styloid fractures. The findings of our study corroborated those of previous literature when cases of unfixed USF were compared with cases of fixed ulnar styloid fractures. No statistically significant difference was found between the two groups with respect to QDASH score and grip strength (Table 2).

In contrast, Bellotii et al. compared two groups with and without USF and found poor results for those with USF [5]. In this study, USF were not fixed. Only radius distal fracture was fixed with radioulnar K wire in patients with DRUJ instability. However, poor results were observed for DRUJ instability with ulnar styloid fractures.

Ulnar styloid fracture nonunion might have occurred separately from DRF nonunion. Generally, it is directly related to the distance of the ulnar styloid from the anatomical rupture point after fracture. In our study, in the fixed ulnar styloid fracture group, nonunion was observed in 9 out of 35 patients (25,7%). In the unfixed ulnar styloid fracture group, nonunion was seen in 10 of 36 patients (27,7%). In a study by Buijze et al., the ulnar styloid was not fixed in 36 cases, and 20 (55%) patients had nonunion [19]. In the literature, in cases with and without rehabilitation, the frequency of nonunion varies depending on several factors. However, a meta-analysis by Wijffels et al. showed that there was no difference in functional wrist scores and pain-related disturbances between USF and cases of nonunion [20].

Surgeons; Radius distal fracture and Ulna styloid fracture have the prejudice that there will always be worse results in coexistence. But styloid fractures should not be the focus of so much attention in these fractures. Especially if DRUJ is stable, Ulna styloid fractures stabilization does not provide an extra contribution to wrist functional outcomes [21]. Treatment of DRUJ stability is the most important issue in these patients. In our study, patients were examined in detail for DRUJ instability. Fixation was performed in patients with DRUJ instability. We do not think that styloid

fixation provides an extra contribution to functional scores and range of motion of the wrist in these patients. According to our study, surgical fixation of ulna styloid fracture does not improve functional scores. We also recommend that the surgeon be more selective for ulna styloid fixation in patients with styloid fracture combined wrist fractures.

Limitations of this study include its retrospective and nonrandomised design. In this study, surgeries were performed by different surgeons. We found that the number of patients studied in both groups was adequate based on comparison to similar studies in the literature.

In our study, we found that there was no statistically significant difference in the association of nonunion with ulnar styloid fracture fixation (Table 2), but this could not be evaluated because of the insufficient number of patients to compare the functional scores. This is an incomplete aspect of our work. Based on our results, we recommend that there should be more randomized control studies on the ulnar styloid as an anchor of the TFCC.

#### **Conflict of interest statement**

The authors have no conflicts of interest to declare.

#### **References**

1. Misir A, Ozturk K, Kizkapan TB, Yildiz KI, Gur V, Sevencan A. Fracture lines and comminution zones in OTA/AO type 23C3 distal radius fractures: The distal radius map. *J Orthop Surg (Hong Kong)* 2018;26:1-6.
2. Bouvet C, Steiger C, De Smet A, Loret M, Vostrel P, Beaulieu J. Treatment of highly comminuted distal radius fractures with temporary distraction plate. *Hand Microsurg* 2017;6:110-9.
3. Bentohami A, Bosma J, Akkersdijk GJ, van Dijkman B, Goslings JC, Schep NW. Incidence and characteristics of distal radial fractures in an urban population in The Netherlands. *Eur J Trauma Emerg Surg* 2014;40:357-61.
4. Bruyere A, Vernet P, Botero SS, Igeta Y, Hidalgo Diaz JJ, Liverneaux P. Conservative treatment of distal fractures after the age of 65: a review of literature.

- Eur J Orthop Surg Traumatol 2018;28:1469-75.
5. Belloti JC, Moraes VY, Albers MB, Faloppa F, Dos Santos JB. Does an ulnar styloid fracture interfere with the results of a distal radius fracture? *J Orthop Sci* 2010;15:216-22.
  6. Tsukazaki T, Iwasaki K. Ulnar wrist pain after Colles' fracture. 109 fractures followed for 4 years. *Acta Orthop Scand* 1993;64:462-4.
  7. Kim JK, Koh YD, Do NH. Should an Ulnar Styloid Fracture Be Fixed Following Volar Plate Fixation of a Distal Radial Fracture. *J Bone Joint Surg Am* 2010;92:1-6.
  8. Oskarsson GV, Aaser P, Hjal A. Do we underestimate the predictive value of the ulnar styloid affection in Colles fractures? *Arch Orthop Trauma Surg* 1997;116:341-4.
  9. Sammer DM, Shah HM, Shauver MJ, Chung KC. The Effect of Ulnar Styloid Fractures on Patient-Rated Outcomes After Volar Locking Plating of Distal Radius Fractures. *J Hand Surg Am* 2009;34:1595-602.
  10. Mulders MA, Rikli D, Goslings JC, Schep NW. Classification and treatment of distal radius fractures: a survey among orthopaedic trauma surgeons and residents. *Eur J Trauma Emerg Surg* 2017;43:239-48.
  11. Meyer H, Krämer S, O'Loughlin PF, Vaske B, Krettek C, Gaulke R. Union of the ulnar styloid fracture as a function of fracture morphology on conventional radiographs. *Skeletal Radiol* 2013;42:1135-41.
  12. Budd HR, Larson D, Chojnowski A, Shepstone L. The Quick DASH score: a patient-reported outcome measure for Dupuytren's surgery. *J Hand Ther* 2011;24:15-20.
  13. Brown KV, Tsekas D, Gorgoni CG, Di Mascio L. The treatment of perilunate ligament injuries in multiply injured patients. *Eur J Trauma Emerg Surg* 2019;45:73-81.
  14. Van Valburg MK, Wijffels MM, Krijnen P, Schipper IB. Impact of ulnar styloid fractures in non operatively treated distal radius fractures. *Eur J Trauma Emerg Surg* 2013;39:151-7.
  15. May MM, Lawton JN, Blazar PE. Ulnar styloid fractures associated with distal radius fractures: incidence and implications for distal radio ulnar joint instability. *J Hand Surg Am* 2002;27:965-71.
  16. Mikic ZD. Treatment of acute injuries of the triangular fibrocartilage complex associated with distal radioulnar joint instability. *J Hand Surg Am* 1995;20:319-23.
  17. Palmer AK, Werner FW. The triangular fibrocartilage complex of the wrist anatomy and function *J Hand Surg Am* 1981;6:153-62.
  18. Gogna P, Selhi HS, Mohindra M. Ulnar styloid fracture distal radius fractures managed with volar locking plates: to fix or not? *J Hand Micro Surg* 2014;6:53-8.
  19. Buijze GA, Ring D. Clinical impact of United versus non united fractures of the proximal half of the ulnar styloid following volar plate fixation of the distal Radius. *J Hand Surg Am* 2010;35:223-7.
  20. Wijffels MM, Keizer J, Buijze GA, Zenke Y, Krijnen P, Schep NW. Ulnar styloid process nonunion and outcome in patients with a distal radius fracture: a meta-analysis of comparative clinical trials. *Injury* 2014;45:1889-95.
  21. Yuan C, Zhang H, Liu H, Gu J. Does Concomitant ulnar styloid fracture and distal radius fracture portend poorer outcomes? A meta-analysis of comparative studies *Injury* 2017;48:2575-81.