

# Concomitant Ulnar Styloid Fracture and Distal Radius Fracture Portend Poorer Outcome

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## Abstract

The literature on the effect of ulnar styloid fractures (USFs) on concomitant distal radius fractures (DRFs) is mixed.

We conducted a study to determine if associated ipsilateral USFs affect outcomes of DRFs. We retrospectively evaluated 315 DRFs treated (184 operatively, 131 nonoperatively) over a 7-year period. Concomitant USFs were identified. Mean follow-up was 12 months. Disabilities of the Arm, Shoulder, and Hand (DASH) and 36-Item Short Form Health Survey (SF-36) outcome scores, and grip strength and wrist range of motion data, were collected. Statistical analysis was performed with Student *t* test and analysis of variance.

Incidence of concomitant USF and DRF was higher ( $P < .0002$ ) in the operative group (64.6%) than in the non-

operative group (39.1%). Patients with USFs had worse mean (SD) pain score, 1.80 (2.43) versus 0.80 (1.55) ( $P = .0001$ ), DASH score, 17.03 (18.94) versus 9.21 (14.06) ( $P = .001$ ), and SF-36 score, 77.16 (17.69) versus 82.68 (16.10) ( $P = .022$ ). In the operative group, patients with USFs had more pain and poorer DASH Functional scores than patients without USFs. Results were similar in the nonoperative group. There was no difference in healing time between intra-articular and extra-articular fractures or between presence and absence of USFs.

Concomitant occurrence of USFs and DRFs—which is associated with worse pain scores and lower functioning compared with USFs without DRFs—should prompt clinicians to counsel patients about delayed recovery.

Distal radius fracture is a common injury treated by orthopedic surgeons. Fifty percent or more of distal radius fractures (DRFs) occur with concomitant ulnar styloid fractures (USFs)<sup>1-3</sup> (Figure). The base of the ulnar styloid is the insertion site for portions of the triangular fibrocartilaginous complex (TFCC), which is a primary stabilizer of the distal radioulnar joint (DRUJ).<sup>4,5</sup>

Although the topic has received significant attention in the literature, there remains a lack of consensus on the prognostic and clinical significance of USF occurring with DRF. In a series reported by May and colleagues,<sup>6</sup> all patients with DRUJ instability after DRF also had an USF. Some authors have reported USF as a poor prognostic indicator for DRF, as the occurrence of USF was taken as a proxy for DRUJ instability.<sup>7,8</sup> Conversely, other authors have reported that USF nonunion has no effect on the outcome of volar plating of DRF.<sup>9-11</sup> In a retrospective cohort study of 182 patients, Li and colleagues<sup>12</sup> found no clinically significant difference in outcome between presence or

Figure. Comminuted distal radius fracture (A) with and (B) without ulnar styloid fracture.



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absence of USF with DRF. They also reported that the quality of the DRF reduction was the main determinant of clinical outcome in patients with USF.

We examined a large cohort of patients treated for DRF to identify any possible effect of an associated USF on clinical outcome. All patients provided written informed consent for study inclusion.

## Materials and Methods

We retrospectively evaluated 315 cases of DRFs treated (184 operatively, 131 nonoperatively) by members of the Trauma and Hand divisions at our institution over a 7-year period. All cases had sufficient follow-up. In each group, patients with concomitant USF were identified.

At presentation, all displaced fractures underwent closed reduction and immobilization with a sugar-tong splint. Baseline demographic data, injury information, and baseline functional scores on the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire and the 36-Item Short Form Health Survey (SF-36) were recorded. Complete histories were taken and physical examinations performed. Standard radiographs of the injured and contralateral wrists were obtained at time of initial injury.<sup>13</sup>

Surgery was indicated in patients with an open fracture and in patients with an inherently unstable fracture pattern, using the instability criteria of Cooney and colleagues.<sup>14</sup> According to these criteria, unstable fractures have lost alignment after closed reduction or have more than 20° of dorsal angulation, more than 10 mm of longitudinal shortening, or more than 2 mm of articular displacement.<sup>14</sup> Patients were treated with either a volar locked plate or bridging external fixation with supplemental Kirschner-wire fixation (usually 2 or 3 wires). Patients in both groups (operative, nonoperative) participated in a formal outpatient therapy program that emphasized active and passive range of motion (ROM) of the finger, wrist

motion (if clinically appropriate), and forearm motion. Mean clinical follow-up was 12 months (range, 8-18 months). At each clinic visit, we used a handheld dynamometer to measure ROM, grip strength, and other parameters and compared them with the same parameters on the uninjured side, along with functional outcome.

Differences in demographic characteristics were evaluated with 2 tests—the  $\chi^2$  test for categorical variables (eg, USF incidence, sex, hand dominance, fracture pattern) and the Student *t* test for continuous variables. Mann-Whitney *U* tests were used to assess differences between groups in DASH and SF-36 scores at long-term follow-up, as well as differences in ROM and radiographic measurements. Statistical significance was set at *P* < .05.

## Results

DRFs occurred in the dominant-side wrist more commonly (*P* < .05) in the nonoperative group than in the operative group, though there was no difference in hand dominance and presence or absence of USF. There was a significant correlation of intra-articular fractures in the operative group (70%) compared with the nonoperative group (34%), though no association was found between presence of USF and intra-articular fracture location.

The percentage of concomitant USF was higher (*P* < .0002) in patients treated operatively (64.1%) than in those treated nonoperatively (38.9%). Mean (SD) pain score was higher (*P* = .0001) for patients with USF, 1.80 (2.43), than for patients without USF, 0.80 (1.55). This relationship held in both the operative group, 1.95 (2.48) versus 1.04 (1.58) (*P* = .027), and the nonoperative group, 1.29 (2.09) versus 0.66 (1.53) (*P* = .048). Similarly, at long-term follow-up for the entire patient cohort, mean (SD) DASH score was negatively affected by presence of USF, 17.03 (18.94) versus 9.21 (14.06) (*P* = .001), as was mean (SD) SF-36 score, 77.16 (17.69) versus 82.68 (16.10)

**Table. Subgroup Analysis of Distal Radius Fracture Outcomes**

Distal Radius Fracture Outcome, mean (SD)	Ulnar Styloid Fracture			Operative Treatment of Ulnar Styloid Fracture			Nonoperative Treatment of Ulnar Styloid Fracture		
	Yes (n = 169)	No (n = 146)	<i>P</i>	Yes (n = 118)	No (n = 66)	<i>P</i>	Yes (n = 51)	No (n = 80)	<i>P</i>
Score									
Pain	1.80 (2.43)	0.80 (1.55)	.0001 <sup>a</sup>	1.95 (2.48)	1.04 (1.58)	.027 <sup>a</sup>	1.29 (2.09)	0.66 (1.53)	.048 <sup>a</sup>
DASH	17.03 (18.94)	9.21 (14.06)	.001 <sup>a</sup>	16.69 (17.07)	9.57 (13.73)	.014 <sup>a</sup>	17.85 (23.13)	8.73 (14.67)	.048 <sup>a</sup>
SF-36	77.16 (17.69)	82.68 (16.10)	.022 <sup>a</sup>	77.73 (16.49)	82.76 (15.43)	.084	75.79 (20.43)	82.57 (17.13)	.122
% of contralateral									
Wrist flexion	55.09 (17.98)	55.81 (14.71)	.778	55.06 (18.58)	55.85 (15.97)	.813	55.19 (16.13)	55.75 (12.92)	.889
Wrist extension	56.50 (17.63)	59.51 (14.64)	.236	56.09 (18.02)	57.61 (15.25)	.641	57.88 (16.49)	62.29 (13.48)	.286
Pronation	83.57 (6.14)	83.16 (7.60)	.687	83.15 (6.82)	84.68 (3.59)	.178	85.00 (2.45)	81.00 (10.75)	.069
Supination	80.06 (10.28)	81.84 (7.45)	.209	79.68 (10.96)	82.39 (7.12)	.151	81.35 (7.56)	81.07 (7.95)	.895
Grip strength	45.45 (31.92)	52.88 (30.03)	.132	53.01 (28.00)	51.82 (29.15)	.504	37.79 (20.58)	54.52 (31.89)	.035 <sup>a</sup>

Abbreviations: DASH, Disabilities of the Arm, Shoulder, and Hand; SF-36, 36-Item Short Form Health Survey.

<sup>a</sup>Statistically significant.

( $P = .022$ ). This relationship also held in the operative and nonoperative groups with respect to pain and DASH scores, though there were only trends in this direction with respect to SF-36 scores. At final follow-up, there was no significant correlation of pain, SF-36, or DASH scores with presence of an intra-articular fracture as compared with an extra-articular fracture.

Time to radiographic healing was not influenced by presence of USF compared with absence of USF (11 vs 10.06 weeks;  $P > .05$ ). Similarly, healing was no different in intra-articular fractures compared with extra-articular fractures (11 vs 10 weeks;  $P > .05$ ).

Wrist ROM at final follow-up was not affected by presence of USF; there was no significant difference in wrist flexion, extension, or forearm rotation. In addition, mean (SD) grip strength was unaffected ( $P = .132$ ) by presence or absence of USF with DRF overall, 45.45% (31.92) of contralateral versus 52.88% (30.03). However, grip strength was negatively affected ( $P = .035$ ) by presence of USF in the nonoperative group, 37.79% (20.58) versus 54.52% (31.89) (Table).

## Discussion

In this study, we determined that presence of USF was a negative predictor for clinical outcomes after DRF. Given the higher incidence of USF in operatively treated DRFs, USF likely represents a higher-energy mechanism of injury. We think these inferior clinical results are attributable to other wrist pathologies that commonly occur with these injuries. These pathologies, identified in the past, include stylocarpal impaction, extensor carpi ulnaris tendinitis, and pain at USF site.<sup>6,10,15</sup> In addition, intracarpal ligamentous injuries, including damage to scapholunate and lunotriquetral ligaments, have been shown to occur in roughly 80% of patients who sustain DRFs, with TFCC injuries occurring at a rate of 60%.<sup>16</sup>

Patient outcome is multifactorial and depends on initial injury characteristics, reduction quality, associated injuries, and patient demographics and lifestyle factors. Li and colleagues<sup>12</sup> showed that the quality of the DRF reduction influenced outcomes in these injuries, as the ulnar styloid and its associated TFCC are in turn reduced more anatomically with a restored DRF reduction. This concept applies to injuries treated both operatively and nonoperatively. Similarly, Xarchas and colleagues<sup>17</sup> identified malunion of the ulnar styloid as causing chronic wrist pain because of triquetral impingement, which was treated successfully with ulnar styloidectomy. The poor results at final follow-up in their study may reflect severity of the initial injury, as reported by Frykman.<sup>18</sup>

Additional factors may compromise clinical outcomes after such injuries. For example, the effect of USF fragment size on outcome has been suggested and debated. In a retrospective series, May and colleagues<sup>6</sup> identified fractures involving the base of the ulnar styloid or fovea as potentially destabilizing the DRUJ and in turn leading to chronic instability. This mechanism should be considered a potential contributor to protracted clinical recovery. Other studies have shown that, irrespective of USF fragment size, presence of USF with DRF is not a reli-

able predictor of DRUJ instability.<sup>2,10,19</sup> In the present study, we simply identified presence or absence of USF, irrespective of either stability or fragment size. In cases in which there was an USF without instability, we fixed the DRF in isolation, without surgically addressing the USF. Our data demonstrated that, even in the absence of DRUJ instability, presence of USF was a negative prognostic indicator for patient outcome.

This study had several limitations. First, its design was retrospective. A prospective study would have been ideal for eliminating certain inherent bias. Second, USF represents a higher association with DRUJ instability.<sup>6</sup> As there are no validated tests for this clinical entity, identification is somewhat subjective. We did not separate patients by presence or absence of DRUJ instability and thus were not able to directly correlate the connection between USF, DRUJ instability, and poor outcomes in association with DRF. In addition, management of an unstable DRUJ after operative fixation of DRF is controversial, with techniques ranging from splinting in supination to pinning the DRUJ. This inconsistency likely contributed to some error between groups of patients in this study. Last, we did not stratify patients by USF fragment size, as previously discussed, which may have affected outcomes within patient groups.

Our data add to the evidence showing that USF in association with DRF portends poorer clinical outcomes. Concomitant USF should alert the treating physician to a higher-energy mechanism of injury and raise the index of suspicion for other associated injuries in the carpus.

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