



## A new index for the assessment of distal radius fractures involving the ulnar styloid

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**Objective:** The aim of this retrospective study was to evaluate the relation between a new index we created for the assessment of distal radius fractures involving the ulnar styloid, and the clinical outcome.

**Methods:** We devised a radiographic separation index (RSI), to evaluate the displacement of the ulnar styloid. We used this index in 44 patients (28 men and 16 women; mean age: 43.2 years; range: 24-64 years) with distal radius fractures involving the the ulnar styloid. In all cases, the distal radius fracture was fixed using a volar locking plate. The styloid fracture was treated conservatively. The relation between the RSI value and clinical results was then investigated.

**Results:** In the 44 patients there were clinically 38 excellent, 4 good, and 2 moderate results. RSI ratios ranged from 2% to 11%. The patients with an excellent result had an RSI ratio of less than 5%. We found a significant correlation between the RSI ratio values and the clinical outcomes.

**Conclusion:** Our results suggested that the RSI can be used as a predictor of the clinical outcome in patients with distal radius fractures involving the ulnar styloid.

**Key words:** Distal radius fracture; RSI; TFCC; ulnar styloid.

Distal radius fractures are the most common wrist fractures.<sup>[1-3]</sup> These fractures may also involve the distal ulnar styloid process, which is important in wrist function. The ulnar styloid process supports the triangular fibrocartilaginous complex (TFCC) and its fracture may be an indicator of an intrasubstance tear of the TFCC in displaced distal radius fractures.<sup>[3-6]</sup> Thus, treatment of the ulnar styloid process must be considered in the surgical treatment plan of radius fractures.<sup>[6]</sup> Ekenstam et al. believed that ulnar styloid fractures do not affect the function of the wrist after distal radius fracture treatment.<sup>[7]</sup> However, Yanagida et al. and Shaw et al. stated that the treatment of ulnar styloid fractures should be included in distal radius fracture treatment.<sup>[8,9]</sup>

We devised a radiographic separation index (RSI) to evaluate the displacement of the ulnar styloid in patients with distal radius fractures involving the ulnar styloid. The aim of our retrospective study was to evaluate the relation between our new index and clinical outcomes.

### Patients and methods

We reviewed the records of patients who underwent surgical treatment for distal radius fractures at our institution between February 2006 and December 2007. All fractures resulted from a fall and no patients had osteoporosis or soft tissue injuries associated with the fractures. Patients with distal radius fractures treated conservatively, and patients with

fractures of both wrists or with pathologies due to fractures other than those involving the wrists were excluded from the study.

Our study consisted of 64 patients, 44 (28 men and 16 women; mean age: 43.2 years; range: 24-64 years; side: 21 right, 23 left) of which had a concurrent distal ulnar styloid fracture. Of these 44 patients, 24 had fractures involving the ulnar styloid edge (Type 1), and 20 the fovea (Type 2). Patients with styloid fractures extending to the metaphysis and with specific surgical indications were excluded from the study. According to the Frykman classification, 37 of the 44 ulnar styloid fractures were Type 8 (84.1%) and 7 were Type 4 (15.9%).

The 20 patients (6 men and 14 women; mean age: 48 years; range: 38-57 years; side: 17 right, 3 left) without accompanying ulnar styloid fractures comprised our control group.

Osteosynthesis was performed on all distal radius fractures using locking volar titanium plates. The anatomical reposition of the distal radius fracture was confirmed by intraoperative fluoroscopy. After the fixation of the radius fracture, the distal radioulnar joint (DRUJ) stability was evaluated. During surgery, the radioulnar joint was restored and stabilized. After surgery the wrist was immobilized in a splint, with the wrist in flexion and ulnar deviation to stabilize the ulnar styloid fracture. All styloid fractures were followed conservatively.

Splint immobilization was maintained for 6 weeks. After 3 weeks, an exercise and rehabilitation program was introduced. Hyperflexion and extreme ulnar deviation were not allowed before 12 weeks. At the postoperative 6th, 12th, and 18th weeks, clinical outcomes were evaluated using Gartland and Werley's evaluation scores and radiological controls conducted according to the radiological assessment criteria of Stewart et al. (Table 1).<sup>[10,11]</sup>

During the operation, an anteroposterior radiograph with the forearm in pronation was taken before and after osteosynthesis. We devised an RSI, to evaluate the displacement of the ulnar styloid (Fig. 1).

We measured the distance between the ulnar styloid and a longitudinal line through the shaft of the radius for both the intact and injured wrists,  $X_1$  and  $X_2$  respectively and calculated their difference. We calculated the RSI as the ratio of this difference to  $X_1$  distance.

**Table 1.** Stewart's radiological assessment criteria.

| Dorsal angulation | The loosening of radial length | The loosening of radial angulation | Score |
|-------------------|--------------------------------|------------------------------------|-------|
| Neutral           | <3 mm                          | 0-4                                | 0     |
| 1-10              | 3-6 mm                         | 5-9                                | 1     |
| 11-14             | 7-11 mm                        | 10-14                              | 2     |
| >14               | >11 mm                         | >14                                | 4     |

Results: Excellent: 0 point, Good: 1-3 points, Intermediate: 4-6 points, Fair: 7-12 points.

The correlation between the RSI values and Gartland and Werley clinical outcome scores was then analyzed. All results were statistically evaluated with Pearson's chi-square ( $\chi^2$ ) test.

## Results

The RSI values and the clinical results of the patients with Type 1 and Type 2 styloid fractures and without styloid fractures are presented in Tables 2, 3 and 4, respectively. Return to work or ability to perform daily routine activities was possible at an average of 56 postoperative (range: 30-150) days.

Examination at a mean follow-up of 18 weeks showed that of the 44 patients with ulnar styloid



**Fig. 1.** 18th week postoperative images of the wrist showing distal radius and ulnar styloid fractures and the uninjured wrist: The distance between the ulnar styloid and the longitudinal midline of the radius of the fractured arm is shown as ( $X_2$ ), and the distance between the ulnar styloid and the longitudinal midline of the radius of the normal arm is shown as ( $X_1$ ).



Seventeen of the 24 patients with ulnar styloid fractures had a non-union. In these patients, the outcome was evaluated as good in 2 and excellent in 15. Union was observed in all 20 styloid process fractures involving the fovea.

According to the Gartland and Werley criteria, the outcome for the control group of patients without ulnar styloid fractures, was judged as excellent in 17 patients (85%) and good in 3 (15%) (Table 4).

There was no intraoperative neurovascular injury complication. One patient suffered an infected incision during the early postoperative period which was treated on the twelfth postoperative day with wound debridement and oral antibiotics. Three of the patients developed reflex sympathetic dystrophy. Although the duration of postoperative follow-up was short, no arthritis was observed, either clinically or radiologically.

## Discussion

Ulnar styloid fractures accompany distal radius fractures in an average of 50% of cases,<sup>[12]</sup> although Frykman reported a rate of 66%.<sup>[13]</sup> The TFCC provides a continuous gliding surface across the entire distal face of the two forearm bones for flexion-extension and translational movements and its dorsal and palmar ligaments stabilize the DRUJ.<sup>[5,12-20]</sup>

If adequate tension in the ligaments is achieved during the surgical reduction of the ulnar fragment of the radius, functionality might not be impaired and surgical repair of the styloid may not be needed. In this situation, osteosynthesis with a locking screw plate provides a more stable anatomic fixation of the region and stabilizes the DRUJ.

We devised the RSI to assess the DRUJ stability, which may be affected during distal radius fractures. The results according to the Gartland and Werley criteria were excellent in patients with RSI values lower than 5%. In addition, radiological evaluation results of the same group were found to be perfect. This proportional relationship was significant ( $p < .05$ ). The relation between a low RSI value and good results suggests the importance of styloid displacement.

In the control group, 17 cases (85%) showed excellent and 3 cases (15%) good clinical results. The clinical results in the control group were signif-

icantly different from the results in patients with ulnar styloid fractures.

Styloid non-union developed in 17 of our patients, 3 of whom had a moderate result with an RSI of  $>10\%$ . Clinical results of the remaining 14 patients were either good or excellent. Contrasting with reports stating that non-union is the source of wrist pain due to DRUJ instability, we observed that even in cases of non-union, the outcomes of treatment in patients with RSIs of  $<5\%$  were excellent.<sup>[20-22]</sup>

We believe that using a radius reference point enables the assessment of the TFCC ligaments and DRUJ integrity along with the styloid displacement.<sup>[23]</sup> Whereas Yanagida's measurements assess the relation between the styloid process and the ulna, they do not assess the DRUJ and TFCC.<sup>[8]</sup> However, Sammer et al. determined that the main criterion of the deviations in numeric measurements is the ulnar diaphysis.<sup>[24]</sup> Our measurement criterion was the straight line passing through the middle of the radial diaphysis.

Sammer et al. deduced, based on measurement results, that ulnar styloid fractures have no effect on function after the fixation of distal radius fractures.<sup>[24]</sup> In our study, however, the displacement of the ulnar styloid correlated significantly with worse results ( $p < .05$ ). This difference can be explained by the different reference points used in these studies. We believe that any measurement for the styloid fracture should use a radial reference point. The relation between the styloid fracture and the results of radius fractures should be assessed with such a measurement. Our conclusions are consistent with the clinical evaluation criteria of Gartland and Werley and the correlations were shown to be significant ( $p < .05$ ). In addition, the RSI is correlated to Stewart's radiological evaluation criteria.

With our case series, we can not form a conclusion on the surgical implications of RSI values. However, our results suggested that values between 6% and 10% may be considered good and surgery in this group may be necessary for symptomatic TFCC tears. Values greater than 10% may suggest an inadequate DRUJ or ulnar styloid reposition and may be an indication for surgical treatment. Thus, RSI may be an important tool affecting and directing treatment choice.

In short, our results suggested that the RSI can be used as a predictor of the clinical outcome in patients with distal radius fractures involving the ulnar styloid.

**Conflicts of Interest:** No conflicts declared.

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