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# The Effect of Transulnar Pinning in Preventing Postoperative Radial Collapse and Wrist Motions in Distal Radius Fracture

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## ABSTRACT

**Introduction:** It is thought that transulnar (a Kirschner wire from radius to ulna) pinning provided less collapse at the fracture site in the percutaneous pinning of distal radius fracture. In this study, we compared the radiological and clinical results of the patient groups with and without transulnar pinning for percutaneous pinning of distal radius fracture.

**Methods:** Patients who underwent 16 isolated radius pinning and 11 radius pinning and additional transulnar pin between 2016 and 2021 were included in the study. Disabilities of the arm, shoulder, and hand (DASH) score, range of motion of the injured wrist at final examination and radiological parameters in terms of ulnar variance, radial height, and volar tilt of the operated wrist were evaluated. The results were compared between the two groups.

**Results:** There was no statistical difference in terms of DASH score, radial height, volar tilt, radial inclination, pronation, supination, and flexion degrees between the two groups. The final extension degrees were found to be statistically higher in the transulnar pinning group.

**Conclusion:** It was observed in our study that radius collapse and radial shortening were less in patients who underwent transulnar pinning in addition to radius pinning; but the difference was not statistically significant.

**Keywords:** Distal radius fracture, percutaneous pinning, colles fracture treatment

## Introduction

Distal radius fractures (DRFs) are among the most common fractures seen in the emergency department and account for nearly one-sixth of all fractures (1,2). Conservative management with closed reduction and casting is considered the first-line treatment (3). However, radial shortening is the most common complication of conservative treatment (4). Shortening of the distal radius could lead to poorer clinical outcomes such as pain, restricted wrist movements, and arthrosis (5,6). Surgical treatment of DRF restores the anatomy of the distal radius and includes closed reduction and percutaneous pinning (CRPP) or external fixation and open reduction-plate osteosynthesis (7,8).

CRPP is a minimally invasive surgical treatment (7,9); however, the distal radius may collapse even after pin removal (5). Transulnar pinning with CRPP of the DRF was previously reported to be the most biomechanically stable method and prevents radial shortening (10-12).

In this study, we assessed the functional and radiological outcomes of adding transulnar pinning and compare its outcomes with those of CRPP without transulnar pinning. Our hypothesis is that additional transulnar pinning prevents fracture collapse and results better radiologic and clinical outcomes.

## Methods

This retrospective study was approved by the Acıbadem University Institutional Review Board with (approval number: 2021-08/42, date: 21.04.2021) and informed consent was obtained from the patients included in the study. Data of patients who were treated with CRPP for DRF between January 2016 and July 2021 were reviewed. Patients with dorsally displaced DRF without articular involvement or with minimally displaced articular involvement, had failed initial closed reduction attempt at the emergency department, and who were treated with CRPP were included in the study. Patients with a history of surgery at the same upper extremity had a distal ulnar shaft fracture, aged <18 years, and did not want to participate in the study were excluded. Finally, 27 patients were included in the analysis. Patient registration data consisting of radiological and physical examination findings (postoperative day 1, 3 weeks, 6 weeks, and 12 weeks) were retrospectively evaluated. The patients were divided into two groups. Group 1 consisted of patients who received isolated radial pinning with K-wires, whereas group 2 had additional transulnar K-wires.

All patients underwent surgery under general or regional anesthesia. Closed reduction was performed manually or with finger straps under

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fluoroscopy. The reduction was confirmed. After achieving optimal reduction, two (1.6-2 mm) K-wires were inserted percutaneously from the styloid process of the radius to engage with the opposite cortex. Thereafter, one (1.6-2 mm) K-wire was percutaneously inserted to strengthen the stability at a different angle (from the dorsal cortex of the radius (medial to Lister's tubercle) to the volar and lateral opposite cortex of the radius or from the opposite direction). However, patients in group 2 were introduced with an additional transulnar K-wire to prevent the collapse of the fracture. This K-wire was inserted from the radius to the ulna parallel to the joint line and controlled under fluoroscopy. K-wires were bent and cut. Following the K-wire fixation, a short arm cast was applied to the patients to allow elbow movements. Finger range of motion (ROM) exercises were started on the day of surgery.

Patients underwent clinical and radiographic assessments (bone healing, wire positions, collapse of the fracture, wound checks) at 3, 6, and 12 weeks postoperatively. The union was defined as spotting at the fracture gap or callus tissue between the fractured proximal and distal cortices or trabeculae on standard X-ray images. The K-wires and casts were removed at week 6 of follow-up, and physiotherapy was initiated (Figure 1, 2).

Radiographic measurements were performed using the Picture Archiving and Communication System of the institution. Radiographic measurements were performed on postoperative day 1 and postoperative weeks 3rd, 6th and 12th. Ulnar variance (mm), radial inclination angle (degrees) and volar tilt angle (degrees) were measured the preoperative X-rays and compared with values measured at 12th weeks postoperative radiographs. Radial shortening was calculated as the difference in ulnar variance measurements obtained immediately after surgery and at 12 weeks after surgery. Radiographic ROM of the wrist joint (flexion-extension and forearm supination pronation) was assessed using a goniometer at the final follow-up. At the final follow-up, the disabilities of the arm, shoulder, and hand (DASH) questionnaire was used to assess functional outcome scores.

### Statistical Analysis

Statistical analyzes were performed using SPSS (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0., Armonk, NY: IBM Corp.) program. The radial height, ulnar variance, and functional outcomes of the two groups were compared and analyzed using Mann-Whitney U test. P-value <0.05 was considered significant.

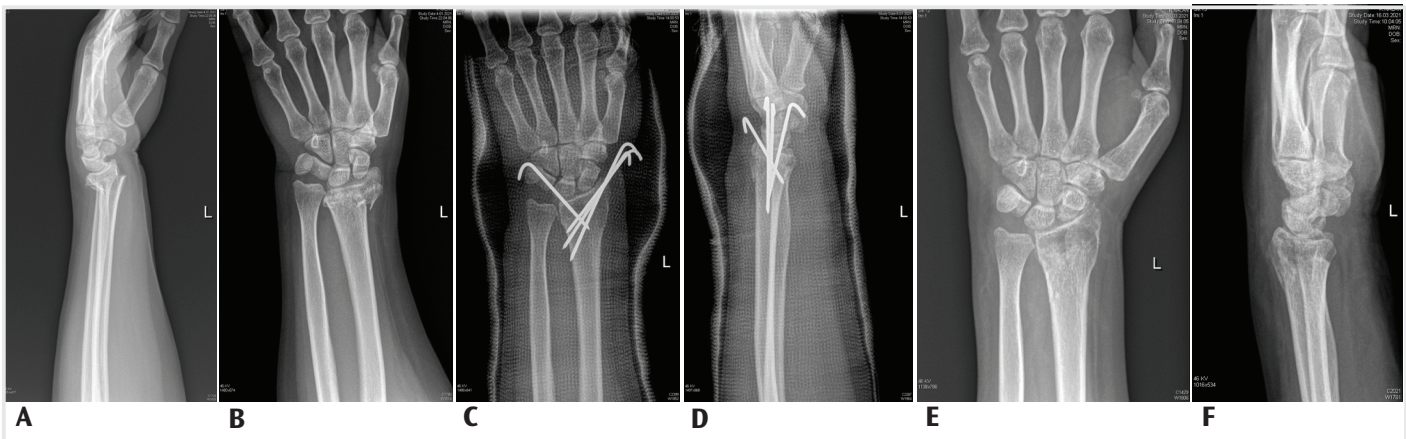


**Figure 1.** Displaced distal radius fracture operated with isolated radial pinning technique. (A) Preoperative anteroposterior X-ray. (B) Preoperative lateral X-ray. (C) Early postoperative anteroposterior X-ray, (D) Early postoperative lateral X-ray. (E) Postoperative 12th week anteroposterior X-ray, (F) postoperative 12th week lateral X-ray

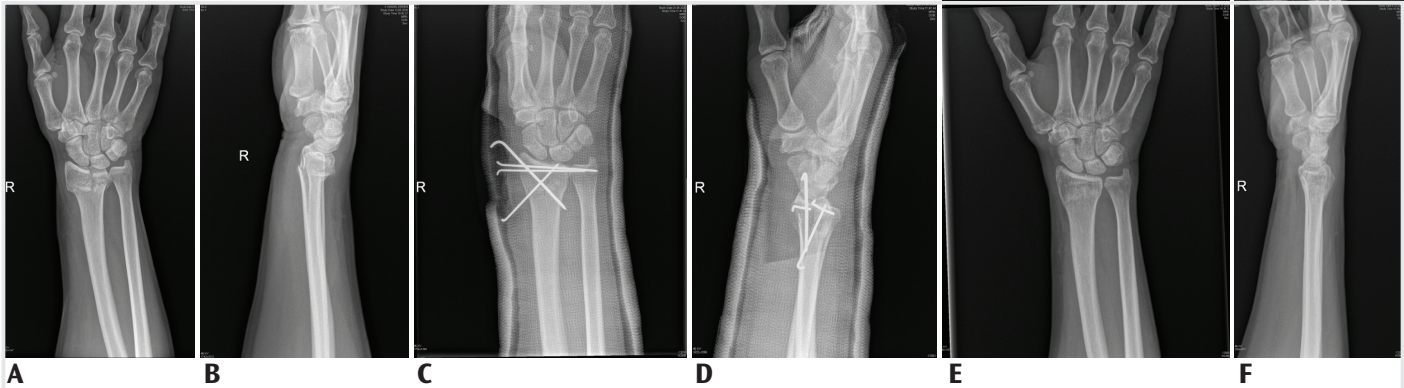


**Figure 2.** Displaced distal radius fracture was operated with the transulnar radial pinning technique. (A) Preoperative anteroposterior X-ray. (B) Preoperative lateral X-ray. (C) Early postoperative anteroposterior X-ray, (D) early postoperative lateral X-ray. (E) Postoperative 12th week anteroposterior X-ray, (F) postoperative 12th week lateral X-ray

## Results

In group 1, 16 patients received isolated radius pinning, while in group 2, 11 patients were treated with additional transulnar pinning. There were seven men and nine women in group 1 and four men and seven women in group 2. The average age of the patients was 55.2 years in group 1 and 58.5 years in group 2. Fracture occurred in 57.1% of the patients in group 1 and in 56.2% in group 2. The mean follow-up duration was 22.4 and 20.2 months in groups 1 and 2, respectively. The mechanism of injury was a simple fall in 9 patients, motor vehicle accidents in 7 patients, falling from a height in 5 patients, and sports injury in 6 patients (Table 1).

Ulnar variance values were -1.46, -1.35, -1.32, and -1.32 mm in group 1 and -1.37, -1.32, -1.30, and -1.30 mm in group 2 on postoperative day 1 and weeks 3, 6, and 12, respectively. No significant difference was found between the two groups in terms of ulnar variance (Table 2). Radial collapse of 0.13±0.17 mm (0.03-0.78) was noted in group 1 and of 0.07±0.04 mm (0.02-0.14) in group 2. No significant difference was noted in radial shortening between the two groups (p=0.12). However, radial shortening was lower in the transulnar pinning group. There was no significant difference at 12th week radial inclination angle (p=0.73). No significant difference was found for 12th week volar tilt angle (p=0.34). The wrist flexion angle and pronation and supination ROM were significantly similar between the two groups. However, a significant difference was noted for the wrist extension ROM between the two groups at the final follow-up (p=0.039) (Table 3).

DASH scores were 13.6 and 14.2, respectively. The DASH scores were not significantly different by treatment types. No significant differences in functional scores were found except for wrist extensions.

**Table 1. Demographic characteristics of the patients**

| | Group 1 | Group 2 |
|---|---|---|
| Number of the patients | 16 | 11 |
| **Sex** | | |
| Male | 7 | 4 |
| Female | 9 | 7 |
| Age (years) | 55.2 | 58.5 |
| Follow-up (months) | 22.4 | 20.2 |
| **Mechanism of injury** | | |
| Simple fall | 5 | 4 |
| Motor accident | 4 | 3 |
| Fall from height | 3 | 2 |
| Sports injury | 4 | 2 |

**Table 2. Measurement of ulnar variance in different time periods**

| | Ulnar variance in group 1 (mm) | Ulnar variance in group 2 (mm) | p-value |
|---|---|---|---|
| Preoperative | 3.47±0.65 | 3.71±0.29 | 0.36 |
| Postoperative 1st day | -1.46±0.27 | -1.37±0.35 | 0.51 |
| Postoperative 3rd week | -1.35±0.24 | -1.32±0.37 | 0.68 |
| Postoperative 6th week | -1.32±0.24 | -1.30±0.36 | 0.9 |
| Postoperative 12th weeks | -1.32±0.24 | -1.30±0.37 | 0.89 |

No non-union was noted in our cohort, and no K-wires were broken during the postoperative period. One patient in the transulnar fixation group had superficial pin site infection, which was treated with debridement, pin removal, and antibiotherapy.

## Discussion

The best fixation method for the surgical fixation of DRFs is controversial (13,14). CRPP is one of the surgical treatment options for DRFs (15-17). It is minimally invasive and leads to similar long-term outcomes compared with open reduction and plate osteosynthesis (18). However, stabilization with K-wires is considered unstable (19), and radial shortening may occur even after K-wire removal (5). Fracture collapse and radial shortening may result in lower functional outcomes and arthrosis of the wrist joint (5,6). Thus, we examined the effect of additional transulnar pinning to prevent radial shortening while performing CRPP of DRFs. This study showed that transulnar pinning prevented radial shortening more than isolated radial pinning; however, the results did not show any significant difference. Functional results were also comparable.

Onta et al. (20) examined the effects of transulnar fixation pinning to prevent postoperative radial shortening in their prospective and comparative study and reported that additional ulno-radial pinning significantly prevented radial shortening compared with the two simple K-wire technique. Kim and Tae (21) retrospectively evaluated the clinical and radiological outcomes of DRFs treated with closed reduction and percutaneous transulnar fixation using K-wires and assessed the effectiveness for preventing fracture settling. They revealed that the method effectively prevented the collapse of the fracture site and the functional outcome was favorable. Our study evaluated both the effects of transulnar pinning in preventing radial shortening and clinical outcomes because the distal radioulnar joint (DRUJ) is temporarily

**Table 3. The table demonstrates the radial collapse, radial inclination angle, volar tilt angle and wrist range of motions of the patients**

| | Group 1 (isolated radial pinning group) | Group 2 (transulnar pinning group) | p-value |
|---|---|---|---|
| Radial collapse (mm) | 0.13±0.17 | 0.07±0.04 | 0.12 |
| Preoperative radial inclination angle at (degrees) | 14.8±4.6 | 15.1±4.1 | 0.51 |
| 12th week radial inclination angle (degrees) | 20.4±3.2 | 19.9±3.8 | 0.73 |
| Operative volar tilt angle (degrees) | -21.64±8.18 | -18.74±6.83 | 0.42 |
| 12th week volar tilt angle (degrees) | 7.8±3 | 8.1±2.9 | 0.34 |
| Wrist extension ROM at final follow-up (degrees) | 62.8±2.1 | 64.7±2.0 | **0.04** |
| Wrist flexion ROM at final follow-up (degrees) | 72.7±2.1 | 72.7±2.0 | 0.64 |
| Pronation ROM at final follow-up (degrees) | 73.7±1.8 | 74.3±1.9 | 0.32 |
| Supination ROM at final follow-up (degrees) | 74.8±1.6 | 74.0±1.7 | 0.16 |

ROM: Range of motion

immobilized with a K-wire and the effect of DRUJ pinning on functional outcomes is not fully understood. We showed that transulnar pinning better prevented radial shortening compared with cross-pinning alone of the distal radius. However, our study showed no significant difference between the two groups in terms of radial shortening and functional outcomes. This is the study strength.

### Study Limitations

However, this study has some limitations. First, this study followed a retrospective design and analyzed few patients. Second, comparing these fixation methods with plate and screw fixation groups could have strengthened the study. However, this study was designed to compare available techniques in patients who cannot be fixed with a plate and screw, such as patients with morbid diseases, advanced age, cardiac problems, and diabetes and had a preference. Third, although the aim was to prevent radial collapse with transulnar pinning, DRUJ arthrosis and pin breakage may occur. We did not experience any DRUJ arthritis at the last follow-up and any transulnar pin breakage, but further evidence can be obtained with long-term follow-up.

## Conclusion

This study revealed that transulnar pinning did not significantly prevent radial collapse compared isolated radial pinning for DRFs. Radial collapse could not be completely prevented in both methods. In contrast to the radiological results, patient-reported results were similar in both groups. We predicted that similar functional results and more successful radiological results can be obtained with transulnar pinning in patients who planned to undergo closed reduction and pinning of DRFs.

**Ethics Committee Approval:** This retrospective study was approved by the Acıbadem University Institutional Review Board (approval number: 2021-08/42, date: 21.04.2021).

**Informed Consent:** Informed consent was obtained from the patients included in the study

**Peer-review:** Externally peer-reviewed.

**Authorship Contributions:** Surgical and Medical Practices - M.E., K.K.; Concept - M.E.; Design - K.K.; Data Collection or Processing - M.E.; Analysis or Interpretation - M.E., K.K.; Literature Search - M.E.; Writing - M.E., K.K.

**Conflict of Interest:** No conflict of interest was declared by the authors.

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