

## PERCUTANEOUS PINNING FOR NON-COMMINUTED EXTRAARTICULAR FRACTURES OF DISTAL RADIUS

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### Abstract

**Background:** Displaced Colles' fractures are managed by the process of manipulation and the insertion of a cast below the elbow. Percutaneous pinning is a straightforward and less invasive procedure used to stabilize fractures. It helps to prevent the displacement of the fracture, which in turn reduces the likelihood of complications. Multiple therapeutic approaches have been documented for the management of extra-articular distal radius fractures, each with its own advantages and disadvantages. The aim is to evaluate the efficacy of percutaneous pinning in treating non-comminuted extraarticular fractures of the distal radius. **Materials and Methods:** A total of 50 patients with extra-articular distal radius fractures were included in the research using a prospective enrollment process. A total of 50 patients underwent closed manipulation and percutaneous pinning using crossed K-wires as the major surgical method. All 50 patients who were enrolled in the trial remained in the study to the end and did not drop out. 40 patients had a mode of trauma characterized by a straightforward fall on the extended hand, whereas 10 patients had a mode of trauma connected to sports injuries. All of the fractures were closed. The fractures were categorized based on the AO classification, using the preoperative anteroposterior and lateral x-rays. **Result:** The average dorsal angulation before reduction was  $22.34 \pm 2.67$  degrees, and the average ulnar variance was  $3.75 \pm 0.45$  mm. Following the surgical procedure, the average dorsal angulation was measured at  $-6.21 \pm 0.32$  degrees, while the ulnar variation was found to be  $1.13 \pm 0.11$  mm. After six months, the dorsal angulation measured  $-5.46 \pm 0.21$  degrees and the ulnar variance was  $1.53 \pm 0.09$  mm (Table 3). The mean dorsal angulation and ulnar variance decreased by  $-0.75 \pm 0.08$  degrees and  $-0.40 \pm 0.05$  mm, respectively, following surgery and during the six-month follow-up. Pin loosening occurred in 8 instances. Two cases of pin tract infection, two cases of malunion, two cases of joint stiffness, and two cases of diminished grip strength were the additional problems identified. **Conclusion:** Overall, the use of percutaneous pinning and immobilization to treat noncomminuted distal radius fractures is a straightforward technique. The wrist is kept in a neutral posture for 4 weeks, followed by early physiotherapy. This approach is effective for fractures that occur outside of the joint and are not fragmented. This technique offers precise realignment and stabilization of fractures, enabling faster recovery without compromising the proper alignment of the fracture.

## INTRODUCTION

The rapid expansion in the number of motor vehicles in society has led to a higher occurrence of motor vehicular accidents. As a result, distal radial fractures

are often seen as injuries after road traffic accidents.<sup>[1]</sup> Other potential causes of this sort of fracture may include incidents such as falling from a significant height or experiencing comparable occurrences of forceful impact. Pathological

fractures should always be considered in situations with distal radial fractures, especially when there is no history of sufficient trauma.<sup>[2]</sup> Possible etiologies for these pathological fractures include bone cysts, osteoporosis, and hyperparathyroidism, among other factors. These fractures often occur in individuals under the age of 30, since they are more prone to motor vehicle accidents and sports activities that entail high-speed impacts or falls on extended hands.<sup>[3]</sup>

Fractures are especially prevalent in elderly people, especially those who are over 60 years old. In these circumstances, the major cause of fracture is the fragility of the bones rather than the severity of the trauma. Patients suffering from distal radial fractures often experience discomfort, edema, and limited mobility in the wrist joint after a high-velocity trauma or a fall from a height. Distal radial fractures may often be diagnosed by examining anteroposterior (AP) and lateral X-rays of the wrist and forearm. For complicated instances, cross-sectional imaging, such as computed tomography, may be necessary to precisely evaluate distal radial fractures.<sup>[4,5]</sup> An essential aspect of treating these fractures is achieving precise reduction. To achieve precise reduction, these fractures were often treated using closed reduction and internal fixation with K-Wires.<sup>[6]</sup> Malunion and inferior functional result are often seen as consequences of these fractures. It is often challenging to reach the same level of functioning as before the injury in most of these cases.<sup>[7]</sup> Distal radial fractures frequently result in impaired wrist mobility and reduced handgrip strength. External fixators may also be used for reduction, however their usage is seldom owing to the high incidence of complications such as pin loosening, infections, delayed union, and sympathetic dystrophy.<sup>[8]</sup> The quest for alternate techniques of treating patients with poor functional result and problems such as malunion has been driven by researchers. A viable option for addressing these instances is Percutaneous pinning, followed by immobilization of the fracture for a duration of 3 weeks.<sup>[9]</sup> This approach is characterized by its simplicity and affordability, and it is known to provide outstanding functional results. The technique of percutaneous pinning and immobilization was first introduced by Green DP, who used it in the treatment of 75 patients with comminuted fractures of the distal radius.<sup>[10]</sup> The author put pins into the metacarpals and proximal ulna to perform reduction. The pins were integrated into a cast that extended from the elbow to the knuckles. The act of pinning facilitated mobility of the fingers and the elbow in the impacted instances. We observed that 50 patients who had pinning and immobilization treatment achieved favorable or outstanding outcomes. Given this context, we undertook prospective research to examine the results of patients with Non-Comminuted Extra-Articular Distal Radial fractures who were treated with closed reduction, Percutaneous Pinning, and immobilization.

## MATERIALS AND METHODS

A total of 50 patients with extra-articular distal radius fractures were included in the research using a prospective enrollment process. The average age of the patients was  $38.98 \pm 4.56$  years (ranging from 18 to 65 years). A total of 50 patients underwent closed manipulation and percutaneous pinning using crossed K-wires as the major surgical method. The research included cases that met the specified criteria and were seen in the emergency and outpatient departments of the orthopaedics department. All 50 patients who were enrolled in the trial remained in the study to the end and did not drop out.

40 patients had a mode of trauma characterized by a straightforward fall on the extended hand, whereas 10 patients had a mode of trauma connected to sports injuries. All of the fractures were closed. The fractures were categorized based on the AO classification, using the preoperative anteroposterior and lateral x-rays.

All patients participating in the research provided informed consent. Fracture displacement was classified as displaced if there was a dorsal angulation of more than 10 degrees and a positive ulnar variance of more than 3 millimeters. A satisfactory outcome after closed reduction would be a fracture with a dorsal angulation of 0 degrees or less and an ulnar variation of 3 millimeters or less. Goniometric measurements were conducted using radiography.<sup>[1]</sup>

### Methodology

The operations were performed in the operating theater under either general anesthesia or regional anesthesia. The upper limb was sterilized and covered, leaving the area from the elbow exposed. The surgeon and helper were dressed in surgical gowns and wearing gloves. A hand table was used to provide convenient access for the C-arm of the image intensifier, providing support for the limb. The fracture was reduced by applying longitudinal traction and direct pressure to the displaced fragment while the patient was under anesthesia. The reduction was assessed using an image intensifier in both the anteroposterior and lateral planes. While the assistant stabilized the fractured wrist, careful examination of the alignment and positioning of the inner surface of the fracture was a crucial aspect of evaluating the reduction. After restoring the length and dorsal angle of the radius, the fracture was repaired using two 1.8 mm smooth K-wires that were inserted percutaneously using a power drill in a crossing pattern. If necessary, an additional K-wire was inserted from the dorsolateral side, passing from the distal to proximal segment.

The wires were pierced to connect with the corresponding cortex. The K-wires were bent at a 90-degree angle and trimmed to a shorter length outside the skin to facilitate their removal. The stability was ultimately assessed by doing wrist flexion and extension under fluoroscopy. Aseptic dressing,

consisting of sponge padding, was placed to mitigate skin irritation. A dorsoradial below elbow plaster of Paris slab was placed up to the knuckles while keeping the wrist in a neutral posture. Radiographs are taken after surgery from the front-to-back and side views.

After the surgery, the limb was raised above the level of the heart for a period of 24 hours. Early mobilization of the fingers, shoulder, and elbow was initiated. Patients were released from the hospital 24 hours after surgery after it was confirmed that there was enough blood flow to the fingers.

At the 4-week follow-up, radiographs were obtained in both the anteroposterior and lateral planes to assess the alignment of the fracture. The slab was extracted and active finger, wrist workouts, and forearm pronation and supination exercises were initiated. The handgrip was enhanced by the use of soft ball activities. At the 6-week mark, radiographs were taken again from both the anteroposterior and lateral perspectives. The K-wires were subsequently removed without the need of anesthesia. The wrist physiotherapy and handgrip exercises were extended for an additional duration of 2 to 4 weeks.

The postoperative dorsal angle and ulnar variance were measured using radiographs and compared to the radiographs obtained at the final examination after six months to quantify the degree of collapse. We used the functional assessment approach outlined by WP Cooney, which was adapted from the Green and O'Brien score. At the six-month mark, a comprehensive evaluation of the patient's clinical and functional status was conducted using the Cooney Wrist Score.

## RESULTS

A total of 50 patients with Type II fractures underwent closed manipulation and percutaneous pinning using crossed K-wires as the main surgical

method. Out of the total of 50 patients, 31 were female and 19 were male. The age range of the individuals varied from 18 to 65 years. The mean age was  $38.98 \pm 4.56$  years. Out of the total number of patients, the right wrist was affected in 22 cases, while the left wrist was affected in 28 cases.

The most frequent cause of damage was falling on an extended hand. The preoperative patient assessment occurred during a timeframe of 0-7 days (with an average duration of 1.87 days). The previously shown fracture reduction was more straightforward. The duration of hospitalization after surgery varied from one to 2.5 days.

The mean hospitalization duration was  $1.76 \pm 0.45$  days. The majority of patients were released the next morning after the surgical procedure. The presence of additional medical conditions in some individuals resulted in delays in their surgical treatment and their release from the hospital. The average dorsal angulation before reduction was  $22.34 \pm 2.67$  degrees, and the average ulnar variance was  $3.75 \pm 0.45$  mm. Following the surgical procedure, the average dorsal angulation was measured at  $-6.21 \pm 0.32$  degrees, while the ulnar variation was found to be  $1.13 \pm 0.11$  mm. After six months, the dorsal angulation measured  $-5.46 \pm 0.21$  degrees and the ulnar variance was  $1.53 \pm 0.09$  mm (Table 3). The mean dorsal angulation and ulnar variance decreased by  $-0.75 \pm 0.08$  degrees and  $-0.40 \pm 0.05$  mm, respectively, following surgery and during the six-month follow-up. Pin loosening occurred in 8 instances. Two cases of pin tract infection, two cases of malunion, two cases of joint stiffness, and two cases of diminished grip strength were the additional problems identified. No cases of reflex sympathetic dystrophy were found. No signs of post-traumatic arthritis in the wrist, dislocation of the distal radio-ulnar joint, or penetration of a blood vessel were seen.

[Table 5] show that most of the patients were show good and excellent results 38(76%) followed by poor 8(16%) and fair 4(8%).

**Table 1: Cooney Wrist score used for the assessment and functional evaluation of the wrist at final outcome**

Functional Evaluation	Points
Pain (25)	
No pain	25
Mild occasional	20
Moderate tolerable	15
Severe to intolerable	0
Functional status(25)	
Return to regular employment	25
Restricted employment	20
Able to work, unemployment	15
Unable to work because of pain	0
Range of motion (Percentage of normal side)	
100%	25
75 – 100%	15
50 – 75%	10
25-50%	5
0-25%	0
DF-PF arcs of injured wrist	
120 degrees or more	25
90 – 120 degrees	15
60 – 90 degrees	10
30 – 60 degrees	5

30 degrees or less	0
Grip strength (Percentage of normal side) (25)	
100%	25
75% - 100%	15
50 - 75%	10
25 - 50%	5
0 - 25%	0

**Table 2: Demographic profile of the patients**

	Number	Percentage	P value
Gender			0.16
Male	19	38	
Female	31	62	
Age			0.36
Below 25	7	14	
25-35	20	40	
35-45	17	34	
45-55	4	8	
Above 55	2	4	
Mean Age	38.98±4.56		
Wrist Involve			0.26
Right	22	44	
Left	28	56	

**Table 3: Variations in the Dorsal Angle and Ulnar Variance**

	Mean±Sd
Pre-reduction dorsal angle	22.34±2.67
Pre-reduction ulnar variance	3.75±0.45
Postoperative dorsal angle	-6.21±0.32
Postoperative ulnar variance	1.13±0.11
Dorsal angle at 6 months	-5.46±0.21
Ulnar variance at 6 months	1.53±0.09

**Table 4: Comparison of Changes in the Dorsal Angle and Ulnar Variance at the Postoperative Period and Six Months**

	Mean
Change in dorsal angle postop vs six months	-0.75±0.08
Change in ulnar variance postop vs six months	-0.40±0.05

**Table 5: Score after Treatment**

	Number	Percentage
Excellent	6	12
Good	32	64
Fair	4	8
Poor	8	16

## DISCUSSION

A distal radius fracture is a frequently occurring injury. Clinical investigations and laboratory assessments of force and stress have both confirmed the significance of achieving anatomical reduction. Previous investigations have documented unsatisfactory outcomes in fractures with articular displacement above 2 mm, radial shortening exceeding 5 mm, or dorsal angulation exceeding 20.<sup>[11]</sup>

The first and essential stage in the treatment of distal radial fractures is achieving precise anatomical alignment of the broken bones. There are several choices available to sustain this first decrease. The most conventional approach is closed reduction and cast immobilization, which often proves ineffective in preventing early radial collapse and carries a substantial risk of malunion, joint stiffness, and sore wrist. There is substantial data indicating that re-displacement is a frequent occurrence and that the

cosmetic outcomes are much less than ideal. According to research, 70% of instances who get conservative therapy see a notable shift or movement.<sup>[12]</sup>

Green,<sup>[13]</sup> first advocated for the use of percutaneous pinning using K-wires as a straightforward and cost-effective technique. There are several techniques for percutaneous pinning. During our investigation, the patients received a procedure called closed manipulation and stabilization, which included the use of percutaneous pinning principally with two K-wires. Prior to the surgery, no manipulation was conducted. The fractures were realigned and secured using the same anesthetic. Patients who sought medical attention sooner saw a more straightforward reduction process, highlighting the need of early action in managing the condition.

Stein and Katz found outstanding outcomes in their comparative research, which examined the effectiveness of percutaneous pinning for distal radius fractures compared to casting alone. The researchers verified the reduction in radial

shortening, preservation of the typical volar tilt, and improved range of motion by percutaneous pinning. Dixon, Allen, and Bannister observed that the radial shortening was reduced to less than 3 mm in 86% of patients (79/92) following manipulation and casting, and this improvement was sustained in 48% (44/92) of patients after three months.<sup>[14]</sup> Azzopardi, et al. conducted a prospective randomized trial with 57 patients who were over 60 years old and had unstable, extra-articular fractures of the distal radius. The purpose of the study was to assess the results of immobilization using just a cast with closed reduction percutaneous pinning.<sup>[15]</sup>

The average pre-reduction dorsal angulation was  $22.34 \pm 2.67$  degrees, and the average ulnar variance was  $3.75 \pm 0.45$  mm. Following the surgical procedure, the average dorsal angulation was measured to be  $-6.21 \pm 0.32$  degrees, while the ulnar variation was found to be  $1.13 \pm 0.11$  mm. After six months, the dorsal angulation measured  $-5.46 \pm 0.21$  degrees and the ulnar variance was  $1.53 \pm 0.09$  mm. The mean dorsal angulation and ulnar variance measured after surgery and at the six-month follow-up were  $-0.75 \pm 0.08$  degrees and  $-0.40 \pm 0.05$  mm, respectively. There were 8 instances when the pins became loose. Two cases of pin tract infection, two cases of malunion, two cases of joint stiffness, and two cases of diminished grip strength were the additional problems identified.

Kwan K et colleagues performed a research at a single tertiary teaching institution to evaluate the outcomes of surgical therapy for distal radial fractures using a 2.4-mm locking plate system.<sup>[16]</sup>

In a retrospective analysis done by Glickel et al, 55 patients with distal radius fractures underwent closed reduction and pinning. Out of these patients, 33 damaged their dominant hand while 22 injured their non-dominant hand, in contrast to our study. The patient's range of motion was assessed during their post-operative follow-up. The measurements showed that the wrist had a flexion of 69 degrees, extension of 65 degrees, radial deviation of 22 degrees, ulnar deviation of 34 degrees, pronation of the forearm of 82 degrees, and supination of the forearm of 81 degrees. There was a slight difference in flexion and supination compared to a normal limb, but it was not clinically significant. The outcome was evaluated using the DASH score, which was recorded during the final follow-up and had an average score of 9.7. In our study, the group of patients who had K wires inserted had a DASH score of 19 at the 6-month follow-up. AK et al conducted a research to investigate the functional result of percutaneous K-wiring for extra-articular distal radius fractures, with immobilization in a neutral wrist posture. 93.75% of the cases had excellent to good outcomes, whereas 6.25% had fair results.<sup>[17]</sup> The patients in our study were instructed in the practice of cleaning the pin sites, which they carried out between four to six times daily. The intervention effectively reduced the occurrence of pin site problems, with just two instances of superficial tract infection seen, which

resolved with administration of antibiotics. The benefit of having the ends of the K-wires positioned externally was the convenience of their extraction. Two instances in our study had pin tract infection, however, it was just superficial and did not need the early removal of the pins. The infection resolved after the removal of the pins at 6 weeks in both instances. Both of these patients had malunion, which resulted in substantial radial shortening, stiffness in the wrist joint, and a decrease in grip strength. The functional outcome achieved in these patients at the conclusion of the follow-up period was satisfactory.

During the removal of the pins, 8 instances showed a loosening of one of the K-wires. However, this did not pose a risk to the alignment of the fracture. An further circumferential cast for immobilization was deemed unnecessary.

## CONCLUSION

Overall, the use of percutaneous pinning and immobilization to treat noncomminuted distal radius fractures is a straightforward technique. The wrist is kept in a neutral posture for 4 weeks, followed by early physiotherapy. This approach is effective for fractures that occur outside of the joint and are not fragmented. This technique offers precise realignment and stabilization of fractures, enabling faster recovery without compromising the proper alignment of the fracture.

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