

# Assessment of Functional Outcome of Distal Radius Fracture Treated with Kirschner's Wire

Kandel S, Shrestha DK, Karki P, Shrestha S, Yogi S

## ABSTRACT

**Introduction:** Distal radial fractures are most common fracture which accounts 8-15 % of all bony injuries. There is a wide variety of treatment options and selection mainly depends on age, occupation, type of fracture. Fracture realignment is most important element for good functional outcome. Closed reduction and percutaneous k-wire fixation is most convenient method as it is cost effective. **Aims:** To evaluate the functional outcome of distal radial fractures treated with closed reduction and percutaneous pinning. **Methods:** This prospective observational study was conducted in Nepalgunj medical college Teaching hospital, Kohalpur from September 2021 to August 2022. Patient aged above 18 and below 70 years who had isolated distal radius fracture with k wire fixation. Functional results were assessed at a follow up of 6 months, by modified Gartland and Werley scoring system. **Results:** In this study out of 45 cases there were male preponderance 29 (65%). The mean age of our patient was 36.8 (SD±12.80) years. K-wires were removed between four to six weeks of operation depending upon the union and followed for six months. On final follow up variables assessed according to Modified Gartland and Werley scoring system which shows, 25 patients had excellent (51.11%) and 13 good (33.33%) functional outcome. Overall, 84.44% of the patients achieved an excellent to good functional outcome. Still residual pain and dorsal angulation were complications post-operatively and was in acceptable limits in majority of cases. **Conclusion:** Closed reduction and percutaneous pinning for distal radius fractures have shown to achieve good functional outcome. Most of the complications after the procedure were within the acceptable limits. Further studies are required to assess its efficacy in various other fracture types.

**Keywords:** Closed reduction, Distal radius fracture, k- wire fixation, modified Gartland, Werley scoring system

## Author:

1. Dr. Sandip Kandel
2. Prof. Dinesh Kumar Shrestha
3. Dr. Prateek Karki
4. Dr. Sabin Shrestha
5. Dr. Sushil Yogi

Department of Orthopedics, Nepalgunj Medical College and Teaching Hospital, Nepalgunj, Banke, Nepal

## Address for Correspondence:

Dr. Sandip Kandel  
 Department of Orthopedics  
 Nepalgunj Medical College and Teaching Hospital  
 Nepalgunj, Banke, Nepal  
 Email: kandelsandip48@gmail.com

## INTRODUCTION

Fractures of the distal radius are the most common of all orthopedic injuries accounting for nearly 15% of all fractures presenting in the Emergency Department.<sup>1</sup> First treatment principles involve obtaining an anatomic reduction and then maintaining that reduction with appropriate methods of immobilization. In addition, immobilization for a short period and achieving good functional results are the main goals of management.<sup>2</sup> The optimal method of obtaining and maintaining an accurate restoration of distal radial anatomy still remains a topic of considerable controversy. Wide ranges of techniques, include open reduction and internal fixation, percutaneous pinning and plaster casting, external fixation, and combinations of all these.<sup>3</sup>

K-wire fixation meets the criteria of biological osteosynthesis as a less invasive procedure that prevents soft-tissue damage.<sup>4</sup> Additionally, fixation of K-wires allows a shorter operation time, ease of hardware removal, excellent cosmetic outcomes, and early motion after removal.<sup>2</sup> The principal prerequisite for successful recovery is preservation of the articular congruity. However, the best method of obtaining and maintaining an accurate restoration of articular anatomy still remains a topic of considerable debate.<sup>5</sup> The present study aimed to evaluate the functional outcome of distal radial fractures treated with closed reduction and percutaneous pinning.

## METHODS

This study is a cross-sectional observational study done in 45 patients with distal radius fracture between 18 to 70 years

of age, who were admitted in Nepalgunj Medical Teaching Hospital, Kohalpur, Banke from September 2021 to August 2022 who had extra-articular distal radius fractures. All of them underwent closed reduction and k wire fixation under C arm guidance. Informed written consent was taken from the patient and those fulfilling inclusion criteria and willing to take part in this study were included. The patients were followed up for an average period of 6 months. During the follow up X-rays were taken and the patients were assessed for functional outcome by modified Gartland and Werley scoring system.

**Inclusion criteria:** Age group >18 and <70 years, all gender, patients presented within one weeks of injury, Unstable extra-articular with significant metaphyseal comminution and failure to maintain reduction after initial attempt at closed reduction and cast application.

**Exclusion criteria:** Open fracture, Intra-articular fracture extension, Patient unable to adhere to trial procedures or complete questionnaires, such as in cognitive impairment, Cases with associated fracture of ipsilateral 2<sup>nd</sup> metacarpal or fracture shaft radius.

**Surgical techniques:** All patients with suspected distal radius fracture were investigated from the emergency, outpatient department (OPD). After general condition of the patient was established, detailed history was taken to determine the demographic details, mode of injury and clinical evaluation was done to determine status of soft tissue, fracture pattern, and neurovascular status. The diagnosis of isolated distal radius fracture was confirmed by appropriate X-rays. After diagnosis was confirmed, patients meeting inclusion criteria were planned for percutaneous pinning either that very day or subsequent day of injury. Under axillary block, supraclavicular block or general anesthesia, the patient was kept in supine position, with the affected limb kept in traction with manual traction and counter traction. After an accurate reduction of fracture was achieved treatment was proceeded. In dorsally displaced fracture, the reduction was achieved by pushing the distal fragment distally and volarly holding the proximal fragment. The goal was to restore anatomical position that is neutral position and also to attain the radial height. It was not mandatory to keep position in radial and palmer direction to hold the reduction.

Image intensifier fluoroscopy (C-ARM) was used to visualize the reduction and to assess the accuracy of the reduction. After acceptable reduction of the fracture was achieved, two or more K-wires were inserted percutaneously through the radial styloid and lister tubercle with the wrist in traction to maintain the reduction. Additional k-wire were used in case of more complex fracture like to maintain radial height or distal radio-ulnar joint instability. Fluoroscopy was used to assist the insertion of the K-wires throughout the procedure and reduction was maintained in every steps. The wires were introduced through the radial styloid until they penetrated the intact cortex of the shaft. 1.5 to 2.0 mm diameter K-wires were used, Insertion of wire was performed with a power drill. K-wires were bent with bender just above the skin and excess

was cut by wire cutter then dressing of pin was done, below elbow slab / cast was applied. During procedure sterility was maintained. Usually, a total of 2 or 3 K-wires were used with this technique but in cases of distal radius fractures Fernandez II anatomical reduction was difficult and it took more time in compare to others to attain within acceptable limits and also 1 or 2 extra k-wires required to attain reduction and stability.

After operative procedure patient were asked for strict limb elevation for 24 hours. Patients were encouraged to do active finger movements as soon as the effect of anesthesia wore out. At time of discharge patients were asked to do active movement of elbow. If there were no any signs of complication like swelling, severe pain or numbness patients were discharged next day. After close reduction and percutaneous pinning, on 1st postoperative day and in subsequent follow up (2<sup>nd</sup>, 4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> week) X-ray wrist AP and lateral was asked and radiological evaluation was done, to check for maintenance of acceptable reduction and sign of union.

#### Criteria for acceptable reduction were<sup>6</sup>:

- $\leq 2$ mm articular incongruity
- $<10^\circ$  loss of radial inclination ( $> 15^\circ$  radial inclination)
- $<2$ mm volar or dorsal translation
- $<10^\circ$  residual dorsal tilt (b/w  $15^\circ$  dorsal tilt and  $20^\circ$  volar tilt)
- $<5$  mm radial shortening

Patient were asked to follow up to orthopedics outpatient clinic every 2 weeks, on all visit pin sites were examined to see if there is any loosening, discharge or irritation. At the end of four weeks, check x-ray was done for any satisfactory signs of union if so then, the pins and slab were removed and ROM of wrist was given. If at four weeks union was not satisfactory then, patient was followed up at five and then six weeks. At the end of which, the k-wires were removed and patient were asked to mobilize the wrist. Usually by 5 to 6 weeks fracture healing was achieved which was confirmed clinically and radiographically. Both percutaneous wires and plaster were removed after 5 to 6 weeks of immobilization on an OPD basis without local anesthesia under aseptic condition. Patient were then asked to mobilize the wrist gently at home. Patients were to follow up one month after removal of pins and we assessed for range of motion at wrist joint. In case there were no satisfactory results than they were asked to visit at our physiotherapy department for active assisted motion.

The functional results and radiographic results were evaluated. Wrist function was evaluated by Gartland and Werley scoring system.<sup>7</sup>

## RESULTS

Total 45 cases of distal radius fractures were involved in this study The mean age was  $36.8 \pm 12.8$  years (ranged from 18 to 68 years). The age wise distribution is shown in table I.

Age	Number	Percentage
18-29	15	33.33
30-39	6	13.33
40-49	9	20
50-59	9	20
60-70	6	13.33
Total	45	100

**Table 1: Age distribution**

There were 29(64.45%) males and 16(35.55%) females. The male to female ratio was 1.8:1. The right limb was fractured in 28(62.22%) and the left limb was fractured in 17(37.78%) subjects. The most common mode of injury was fall (30) 66.66% followed by road traffic accidents (15)33.33%. The most common fracture was Fernandez type II seen in 40% (18) followed by Fernandez type I (16)35.55% followed by Fernandez type III (11)24.45%. The average operative time was 23.15±5.45 minutes with range from 18 to 32 minutes. Duration of immobilization was 4 weeks in 15(33.33%) followed by 5 weeks in 18 (40%) and 6 weeks in 12(26.67%) patients.

The end result depending upon the fracture type is shown in table II. Type II Fernandez had the excellent outcome most 12 (66.66%), while type I had 8 (50%) excellent outcomes followed by type III 5 (45.45%) had excellent outcome.

Fernandez type	End result				Total (n)
	Excellent	Good	Fair	Poor	
I	8	5	3	0	16
II	12	5	1	0	18
III	5	3	2	1	11
Total (n)	25	13	6	1	45

**Table II: End results according to Fernandez classification**

Final radiological parameter after k wire removal is shown in table III. There was 3.96 degree (4.10 SD (±)) mean loss in palmer tilt followed by 2.32 mm (mean) SD (±) 2.08 shortening in radial height and 5.60 degree mean SD (±)2.82 loss in radial inclination.

Parameters	Mean	SD (±)
Loss of palmer tilt (degree)	3.96	4.10
Radial shortening (mm)	2.32	2.08
Loss of radial inclination (degree)	5.60	2.82

**Table III: Radiological parameter**

The functional outcome according to modified Gartland and Werley scoring system is shown on table IV. Most of the patient with excellent 25(55.55%) functional outcome, followed by good result in 13(28.88%), fair in 6(13.33%) and poor outcome in 1(2.22%) patient.

End result	Frequency(n)	Percent (%)
Excellent	25	55.55
Good	13	28.88
Fair	6	13.33
Poor	1	2.22
Total	45	100

**Table IV: End results of final outcome in Gartland and Werley score**

The most common complication encountered was residual pain 13(28.28%) followed by pin tract infection 9 (20%) and pin loosening in 7(15.55%). There was restricted ROM of wrist joint in 4 (8.88%), Reflex sympathetic dystrophy disorder (RSD) in 2 (4.44%) and carpal tunnel syndrome in 1(2.22%). patient with residual pain were managed with short course of analgesic and assisted mobility of wrist. Pin tract infection were managed with alternate day dressing and oral antibiotics, which resolved after a week. RSD were managed conservatively with physical therapy and NSAIDs. One case of carpal tunnel syndrome was managed with night splint and NSAIDs, symptoms resolved after one month. There were no any cases like nonunion or distal radio-ulnar joint instability.

## DISCUSSION

Closed reduction and casting have been the standard method of treatment in distal radius fracture but due to failure in achieving acceptable reduction and re-displacement, closed reduction and K-wire fixation has been evolving. There are wide ranges of option for its treatment, Percutaneous pinning with K-wires fixations in compare to other treatment choices it is safe, cost-effective and chances of re-displacement is largely decreased.<sup>8,9</sup>

In this study mean age of patient was 36.8 (SD±12.8) years with range of 18-70. In other studies, done by Subramaniam et al<sup>10</sup> and das et al<sup>11</sup> similar mean age 32.5 and 41.4 was noticed respectively. The possible reason for this cluster in this age in young people because of the activity they pursue, who are likely to be involved in road traffic accident, fall from height and also osteoporosis especially in females.

Male predominance 29(64.45%) was observed in our study compared to Females 16(35.55%) of our study subjects. Similar result was seen in other studies. Logic behind seems to be that males are commonly involved in road traffic accident (RTA) as they move more commonly than females.<sup>12,13</sup>

Majority of cases in this study fracture was due to fall on outstretched hand 30(66.66%) which is similar with the study done by Krishna et al.<sup>14</sup> Whereas in some studies results showed RTA is common mode of injury. This study difference is likely to demographical inconsistency. Mean duration of immobilization in our study was 34.5 days. Similar result was not found in other studies like in Subramaniam et al<sup>10</sup> (mean =39.4 days). This finding is due to delay in follow up by patients.

While classifying fracture type according to Fernandez

classification our cases were of type I (35.55%), type II (40%) and remaining were type III (24.45%). To know common type from this study was not possible as we only included those cases which could meet inclusion criteria. Moreover, end results according fracture types were inconsistent. This variability is mainly due to fact, that outcomes depend on realignment of fracture and its maintenance till sign of union is seen.<sup>5,15</sup> Mean range of movement of wrist after 6 months of follow-up in our study was decreased by 12° in dorsiflexion, 9.8° in ulnar deviation, 11.7° in supination, 13.8° in palmer flexion, 5° in radial deviation and 9.2° in pronation. Similar comparable finding was seen in other studies.<sup>7,16</sup> Mean limitation of range of motion was less than 20% in this study which gives minimum point according to Gartland and Werley's scoring system.<sup>7</sup> All variables according to modified Gartland and Werley's scoring system<sup>7</sup> was calculated and in 45 patients, 25 had excellent (51.11%), 13 good (33.33%), 6 fair (13.33%), 1 poor (2.23%) functional outcome. Almost 84.44% patient had excellent and good outcome which is comparable to studies done by das et al<sup>11</sup> where he had 93.75% excellent and good outcome and Gupta et al<sup>17</sup> where he had 92% of excellent and good outcome. In our study residual pain was most common complication followed by pin-tract infection and dorsal angulation. Pain was not of severe in nature and only in one case it hampered daily activities. Finding was comparable in other studies.<sup>10,12</sup> Sequential radiographs of distal radius fracture treated with close reduction and k wire fixation.



**Figure 1: before surgery, distal radius fracture**

**Figure 2: x-ray on first post-operative day**



**Figure 3: X-ray on two week follow**

**Figure 4: X-ray on five week follow**



**Figure 5: X-ray on five week follow up after k wire removal**

## LIMITATIONS

The main limitation of this study is single hospital-based study, small sample size, study design and duration of follow-up. Also, this study doesn't include other complex intra-articular fractures. Comparison of other surgical modalities of treatment would have made this study for valid.

## CONCLUSION

Closed reduction and percutaneous pinning for distal radius fractures have shown to achieve good functional outcome. It is an easier and advantageous method of treatment of extraarticular distal radius fracture. All complication which was seen after close reduction and percutaneous pinning was within acceptable limit. Further studies are required to assess its efficacy in various other fracture types.

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