

Original Research Article

Closed reduction and percutaneous k-wire fixation for distal end radius fractures

Tanveer Ali, Mohmmad Sikander Baketh, Maneer Ahmad Mir*

Department of Orthopaedics, GMC, Jammu, Jammu and Kashmir, India

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***Correspondence:**

Dr. Maneer Ahmad Mir,

E-mail: dr.tanvirm90@outlook.com

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ABSTRACT

Background: To evaluate radiological and functional outcome in fractures of the distal radius treated by K-wire fixation.

Methods: Forty patients (16 males, 24 females) with different types of fractures of distal radius were treated. K-wire fixation was performed under axillary block or general anaesthesia. Anatomical restoration was evaluated by postero-anterior and lateral radiographs obtained preoperatively and at 09 months of follow up to evaluate Radial Height (RH), Radial Inclination (RI) and Volar Tilt (VT). Functional outcome was evaluated using Mayo scoring system.

Results: According to Mayo score 72.5% (n=29) of our patients had excellent to good outcome while as 17.5% (n=7) had fair outcome and 10% (n=4) patients had poor outcome.

Conclusions: Kirschner wire fixation is an inexpensive procedure that provides anatomic reduction, fracture fixation, and maintenance of reduction with an adequate method of immobilization.

Keywords: AO classification, Distal radius fracture, K-wiring, Lidstrom criteria, MAYO score, Radiological evaluation

INTRODUCTION

The optimal management for displaced distal radius fractures has not yet been established.^{1,2} Although the association between radiological and functional outcome is controversial, restoration of normal anatomy has been recommended in active patients.³ K-wire fixation is a simple, minimally invasive technique to maintain the reduction in extra and intra articular fractures. Clinical guidelines from the American Academy of Orthopaedic Surgeons (AAOS) moderately recommend an anatomically stable surgical fixation, instead of cast fixation, to be followed by early wrist motion for treatment of patients with displaced distal radius fractures.⁴ Radial length is a radiological parameter that has been shown to correlate with functional outcome.^{5,6}

METHODS

This was a prospective study of 40 patients with distal radius fractures who were treated by K-wire fixation in Government Medical College and Hospital, Jammu for a period of one year from September 2018 to October 2019.

Patients with fractures of distal end radius of either side or both sides, with or without ulnar styloid fracture, of age group 18 - 85 years, of either sex having closed fractures of up to 3 cm from distal articular surface of radius willing for treatment were enrolled for this prospective open randomized case control comparative study. Patients less than 18 years or more than 85 years, having compound fractures associated with vascular

injuries or had associated multiple injuries were excluded from the study.

All fractures were classified according to AO (the Association for Osteosynthesis) classification system by getting Postero-Anterior (PA) and Lateral (Lat) views of radiographs of the wrist at the time of the initial injury.⁷ (Figure 1) Some patients needed CT scan of wrist for further evaluation of intra-articular fractures.



Figure 1: Pre-op AP and lateral X-ray.

The patients were admitted to the hospital and were operated on as soon as possible, depending on the condition of the local tissue, hematoma, tissue oedema and other associated injuries. Under axillary block or general anesthesia, the patient was placed in the supine position with the involved limb in traction with a finger trap through the index finger, and provided counter traction. An accurate reduction in the fracture was the first step in the treatment plan. The K-wires were placed under C-arm guidance (Figure 2).



Figure 2: Visualization under C-Arm.

In the post-operative period, the limb was kept strictly elevated for a period of 2 days. Patient was encouraged to begin active finger movements as soon as the effect of anaesthesia wore out. Patient at the end of 2 days was asked to mobilize his elbow. At this time the pin sites were inspected and then dressed. If pin sites and

mobilization were satisfactory, the patient was then discharged the next day.

The final results of the patients with excellent and good functional outcome were considered satisfactory. The patients underwent follow-up at our outpatient clinic at 2-week intervals following hospital discharge. The healing of the fracture was assessed both clinically and radiographically at each follow-up. At the end of four weeks a check X-ray was taken (Figure 3) and if satisfactory signs of union were present, the pins were removed as was the slab and patient given a crepe bandage.



Figure 3: Post-op AP and lateral X-ray.

The treatment complications were recorded. After bony union, patients underwent further follow-up for 9 months. A check X-ray was done (Figure 4). The residual deformity and the subjective evaluation were recorded in the same way as the original scoring system.



Figure 4: AP and lateral X-ray after K-wire removal.

Radiological evaluation

Radiological assessment was done in terms of residual Radial Inclination (RI), Radial Height (RH) and Volar Tilt (VT) and the results were graded according to the Lidstrom Criteria. Radiological parameters included

measurement through Postero-anterior and lateral radiographs. PA view provides information about RI (Radial Inclination) and RH (Radial height). RI is a measurement of the radial angle. A line is drawn along the articular surface of the radius perpendicular to the long axis of the radius, and a tangent is drawn from the radial styloid. The normal angle is 15-25°. RH is a measurement between 2 parallel lines that are perpendicular to the long axis of the radius. One line is drawn on the articular surface of the radius, and the other is drawn at the tip of the radial styloid. The normal radial height is 9.9-17.3 mm.⁸ In the Lateral view, the VT (Volar Tilt) of the distal radius articular surface is measured. A line perpendicular to the long axis of the radius is drawn, and a tangent line is drawn along the slope of the dorsal-to-volar surface of the radius. The normal angle is 10-25°.⁸ These measurements were taken pre operatively and at 9 months follow up. At the end of the study all the data was compiled and analyzed statistically by a one-way measure ANOVA test. p-value less than 0.05 was considered to be statistically significant.



Figure 5: Dorsiflexion and palmar flexion at 12 weeks follow-up.



Figure 6: Pronation and supination at 12 weeks follow-up.

Functional evaluation

Patients were evaluated by using Modified Mayo Wrist Score (Table 1). It is a physician-rating scoring system which gives us a total score of a 100; 25 for the assessment of pain, 25 for the active extension/flexion arc

of the wrist, (Figure 5, 6) 25 for grip strength, and 25 for the ability to return to regular activities. The pain is rated according to patient’s description.

Table 1: Mayo Score.

Category	Findings	Score
Pain (25 points)	No pain	25
	Mild occasional	20
	Moderate	15
	Severe	0
Work status (25 points)	Regular job	25
	Restricted job	20
	Able to work but unemployed	15
	Unable to work due to pain	0
Range of motion (25 points)	>120°	25
	100° to 119°	20
	90° to 99°	15
	60° to 89°	10
	30° to 59°	5
	0° to 29°	0
Grip strength (% of normal) (25 points)	90 to 100	25
	75 to 89	15
	50 to 74	10
	25 to 49	5
	0 to 24	0

RESULTS

A total of 40 patients underwent this procedure comprising of 16 males and 24 females. The mean age and Standard Deviation (SD) at the time of the injury was 59.35±13.40years (range from 27 to 84 years). Twenty four fractures involved left side while sixteen fractures occurred on the right. Mode of injury was road traffic accident and fall in majority of the cases.

According to AO classification, most of the cases were of C (n = 16) 40.0% and A (n = 15) 37.5% type probably because of increased incidence of high velocity injuries. (Table 2).

Table 2: Types of fracture.

Radiological type (AO)	Frequency	Percent
A2	5	12.5%
A3	10	25.0%
B1	3	7.5%
B2	6	15%
C1	10	25.0%
C2	6	15.0%
Total	40	100.0%

Distal radius deformity was assessed by measuring RH, RI and VT at different stages of treatment. We found a mean radial inclination of 21.1±4.56°, radial height 10.67±2.97 mm of and volar tilt of 9.42±3.19° (Table 3).

Table 3: Radiological evaluations of RH, RI and VT.

K-wiring group	
Radial inclination	21.1±4.56°
Radial height	10.67±2.97 mm
Volar tilt	9.42±3.19°

Table 4: Values on the basis of type of fracture.

Type of fracture	No. of cases	Radial inclination	Radial height	Volar tilt
Type A	15	20.3mm	11.3mm	9.1°
Type B	9	21.9mm	10.9mm	9.0°
Type C	16	21.4mm	9.9mm	9.9°

Authors had 15 type A, 9 type B and 16 type C fractures and obtained almost similar results in all three types. (Table 4).

According to Mayo score 72.5% (n=29) of our patients had excellent to good outcome while as 17.5% (n=7) had fair outcome and 10% (n=4) patients had poor outcome. (Table 5).

Table 5: Mayo score following k-wire fixation.

Result	Frequency	Percentage
Excellent	9	22.5%
Good	20	50.0%
Fair	7	17.5%
Poor	4	10.0%
Total	40	100.0%

Complications

Six of our patients suffered from stiffness who were sent for subsequent physiotherapy. Five patients had pin site infection which needed regular dressing and antibiotics (Table 6).

Table 6: Complications seen during k-wire fixation.

Complications	Frequency	Percentage
Nil	29	72.5%
Stiffness	6	15.0%
Pin site infection	5	12.5%
Total	40	100.0%

DISCUSSION

Fractures of the distal radius are one of the most common fractures encountered in the emergency department. Most of the fractures are caused by a fall on the outstretched hand with the wrist in dorsiflexion. These fractures can cause significant distress to the patient and lead to disability if not managed adequately and in time. The management of fractures of distal radius has always been a debatable and challenging issue for orthopaedic

surgeons. The ultimate goal is to restore grip strength and motion and allow quick return of function and to minimize the risk for future degenerative changes in the wrist joint.

Closed reduction followed by fixation of the fracture with percutaneous pins and cast, is a widely used method. The pins may be inserted by a variety of methods; across fracture fixation or with the intrafocal Kapandji technique.^{9,10} Percutaneous pinning is best suited for extra-articular fractures without substantial comminution. Percutaneous pinning is associated with complications like pin site infection, radial nerve lesions, pin loosening, redisplacement and complex regional pain syndrome (CRPS). It requires about 5 weeks' of immobilization, which often results in temporary wrist joint stiffness.

Our study comprised of 40 patients with 16 male and 24 female patients. Right side was involved in sixteen patients (40%) and left side in twenty four patients (60%). In 85% of cases, the mode of injury was fall with road traffic accident and assault compromising the other 15%. According to AO classification, most of the cases were of C (n = 16) 40.0% and A (n = 15) 37.5% type probably because of increased incidence of high velocity injuries.

Distal radius deformity was assessed by measuring RH, RI and VT at different stages of treatment. We found a mean radial inclination of 21.1±4.56°, radial height 10.67±2.97 mm of and volar tilt of 9.42±3.19°. Our results are in concordance with the study conducted by Abulaban OA et al. They found post-operative radial inclination, radial height and volar tilt to be 22.18±4.84°, 11.65mm and 9.19±6.10° respectively in their study group managed by K wiring.¹¹ There were minor variations in the anatomical parameters (volar tilt, radial inclination and radial height) in our study which were comparable with the other studies but did not affect functional results significantly.¹²⁻¹⁴

According to Mayo score 72.5% (n=29) of our patients had excellent to good outcome while as 27.5% (n=11) had fair to poor outcome. Kumar P et al had a similar outcome in their study about Percutaneous kirschner wire fixation of distal radius fractures and found excellent to good results in 75% cases and fair to poor outcomes in 25% patients.¹⁵ Most of our patients had a smooth recovery. Six patients suffered from stiffness and five patients had pin site infection.

CONCLUSION

Closed reduction with percutaneous kirschner wire fixation provides excellent clinical and radiographic results in patients for both extra articular and intra articular distal radial fractures without substantial comminution. Kirschner wire fixation is an inexpensive procedure that provides anatomic reduction, fracture

fixation, and maintenance of reduction with an adequate method of immobilization.

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