Section: Orthopaedics

Original Research Article

COMPARISON OF FUNCTIONAL OUTCOMES FOR DISPLACED DISTAL RADIUS FRACTURES TREATED WITH OPEN REDUCTION AND INTERNAL FIXATION USING PLATES VERSUS PERCUTANEOUS K-WIRE FIXATION: A RANDOMIZED PROSPECTIVE STUDY

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ABSTRACT

Background: Distal radius fractures represent a significant portion of orthopedic injuries, accounting for 8-15% of all fractures in adults. These fractures, typically occurring near the wrist, are often caused by domestic falls, road traffic accidents, or sports injuries. Standard treatment involves closed reduction and immobilization using Plaster of Paris (POP) casts, but complications such as re-angulation and re-displacement remain prevalent. This study aims to compare the functional outcomes of two surgical approaches—open reduction and internal fixation (ORIF) with plating versus closed reduction and percutaneous pinning with K-wire fixation (CRPP)—for displaced distal radius fractures.

Materials and Methods: This prospective, randomized, comparative study was conducted over an 18-month period, enrolling 60 patients with displaced distal radius fractures who consented to participate. Patients were randomly assigned to either Group-A (ORIF with plating) or Group-B (CRPP with K-wire). Functional outcomes were assessed using the Disabilities of Arm, Shoulder, and Hand (DASH) score at 4, 8, and 12 weeks postoperatively. Radiological assessments and postoperative complications were also monitored throughout the follow-up period.

Results: The study revealed a significant difference in functional outcomes between the two treatment groups. At 4 weeks postoperatively, patients in the ORIF group exhibited a markedly lower DASH score (25.3 ± 6.37) compared to those in the CRPP group (75.9 ± 8.69). This trend continued at 8 weeks (ORIF: 19.6 ± 4.52 vs. CRPP: 42.5 ± 7.84) and 12 weeks (ORIF: 13.7 ± 2.99 vs. CRPP: 23.1 ± 2.50), with ORIF showing superior functional recovery. Additionally, the ORIF group had fewer complications, with only 3.3% experiencing non-union, compared to 6.7% in the CRPP group.

Conclusion: ORIF with plating resulted in better functional outcomes and fewer complications than CRPP with K-wire fixation for displaced distal radius fractures. The findings suggest that ORIF should be considered as the preferred method for achieving optimal functional recovery, particularly for patients who require a faster return to daily activities. The results of this study contribute to the growing body of evidence favoring ORIF over CRPP for this common injury, offering valuable insights into treatment selection in clinical practice.

Key words: Distal radius, K wires. Internal fixation, Plates.

INTRODUCTION

Among the fractures treated in the emergency department, about 20% of the fractures are of the distal radius.[1] These distal radius fractures are also the most common injuries observed in orthopedic practice, which account for between 8−15% of all bony injuries among adults.[2,3] Domestic falls, road traffic accidents, or sports injury are the main causes of distal radius fractures.[3]

These distal radius fractures can be classified into different types, which include Colles' fracture, Smiths' fracture, Barton's fracture, Reverse Barton's fracture, and Chauffeur's fracture depending on the angle of break,[3] Supination, pronation, and abduction determine the force direction, compression of the carpus, and different positions of ligament injuries.

The majority of these fractures are treated with Plaster of Paris (POP) cast after closed reduction under local anesthesia. The outcome of these fractures appears to be worse regardless of the treatment. For this, a thorough understanding of the anatomy and biomechanics of the wrist appears to be a prerequisite. Recent studies indicated a high rate of re-angulation, re-displacement, and re-manipulation following a closed reduction under local anesthesia and cast immobilization.[4,5]

Hence, this prospective randomized comparative study of open reduction & internal fixation and closed reduction & percutaneous K-wire fixation of displaced distal radius fractures was conducted to identify the functional outcome difference between them.

MATERIALS AND METHODS

This is a hospital-based comparative randomized prospective study. The study was conducted for 18 months, i.e., from January 1st 2023, to June 30th 2024. About sixty (60) patients with displaced distal radius fractures admitted for surgery and who gave consent to participate during the study period were included. Patients were divided into two groups, 30 patients in each group. Group-A consisted of 30 patients treated with treatment protocol-A, and group-B consisted of 30 patients treated with treatment protocol-B. A simple block randomization by computer- generated sequence was used. Patients were randomized to either open reduction and internal fixation with plating or closed reduction with percutaneous pinning with K-wires through sealed envelope selection.

All displaced distal radius fractures with or without distal radioulnar injury and Patients with Gustilo Anderson Type -1 & 2 compound fractures were included in the study. Patients with undisplaced distal radius fractures and Patients with distal radius fractures associated with neurovascular injuries were excluded from the study. Approval was obtained from the Institutional Ethical Committee in prior.

Surgical Procedure: The patient was kept in a supine position on the O.T. table, with the limb on a side table. Under regional anesthesia, the parts were painted and draped. Fracture alignment was achieved through traction and counter traction and reduction checked with image intensifier

Treatment Protocol-A: (GROUP-A)

1. Volar Henry's approach
2. Open reduction and internal fixation with angular stability plate
3. Immobilization with volar wrist support for 15days
4. Functional rehabilitation 15 days after surgery

TREATMENT PROTOCOL-B: (GROUP-B)

1. Closed reduction and percutaneous K-wire fixation
2. Two parallel 1.5 mm K-wires were inserted through the radial styloid process, with one wire inserted from the dorsoulnar corner of the radius crossing at approximately 90 degrees for distal stabilization of the radio-ulnar joint.
3. Brachio-metacarpal plaster cast
4. Wires and cast removal after 30 days and then functional rehabilitation

Postoperative Protocol: During the postoperative period, the operated limb was kept elevated for three days. After surgery, group-A patients treated with ORIF were placed in a volar plaster splint and encouraged to perform active finger and wrist range of motion according to the treating surgeon's discretion.

Group-B patients were encouraged to actively make finger movements as soon as the anesthesia effect wore out. Patients were asked to mobilize the elbow at the end of three days. During this process, pin sites were inspected and then dressed. If the pin sites and mobilization were satisfactory, the patient was then discharged. Patients were asked to review weekly for pin site inspection and follow up.

After discharge, all the operated patients were radiologically assessed regarding fracture union, which was done at 4, 8 & 12 weeks until fracture union. Functional assessment was made at the end of follow-up by using Disabilities of Arm, Shoulder, and Hand (DASH) score.

Data was collected regarding personal details, history, and radiological findings of displaced distal radius fracture, confirmed by Antero-posterior & lateral view X-ray of the wrist with a forearm. A predesigned, pretested, and semi-structured proforma was used to collect the data through a personal interview method before the surgery. Later during each follow-up visit, the degree of motion range in aspects like flexion, extension, ulnar deviation, radial deviation, pronation, and supination was collected. DASH score was obtained during follow-up visits in 4, 8 & 12 weeks respectively.

RESULTS

Based on gender, majority 61.7% (37) were females, and 38.3% (23) were males, respectively. It was also observed that the incidence of fracture of distal end of radius was higher among females than males.

Based on age, majority 46.7% (28) were in 46-60 years age group followed by 33.3% (20) in 61-75 years age group, 11.7% (7) in 31-45 years age group, 5% (3) in 18-30 years age group and 3.3% (2) of the subjects were above 75 years of age respectively. [Table 1]

Table 1: Distribution of subjects based on age group

AGE GROUP	NUMBER OF SUBJECTS	PERCENTAGE
18-30 YEARS	3	5.0
31-45 YEARS	7	11.7
46-60 YEARS	28	46.7
61-75 YEARS	20	33.3
>75 YEARS	2	3.3
TOTAL	**60**	**100**
MEAN & STANDARD DEVIATION OF AGE (YEARS) = 56.86 + 12.07		

Distribution based on the fracture side of the distal end of the radius; the majority, 56.7% (34) of the patients, had a fracture of the radius's distal end left side. In comparison, 43.3 (26) of the patients had a fracture of the distal end of the radius on the right side. [Figure 1]

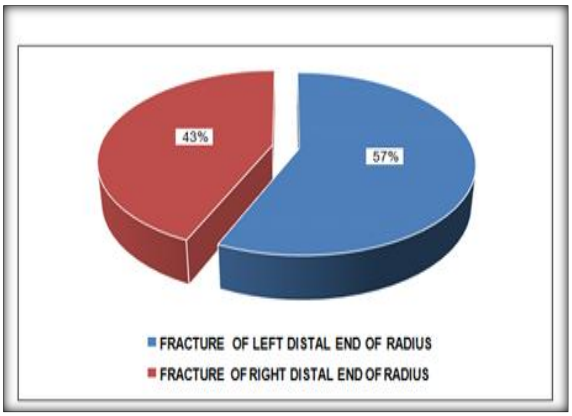

Figure 1: Distribution of subjects according to fracture side

Based on the injury mode; about 75% (45) of the patients had an injury due to domestic fall. In comparison, 25% (15) of the patients had an injury due to a road traffic accident, respectively (Figure 2)

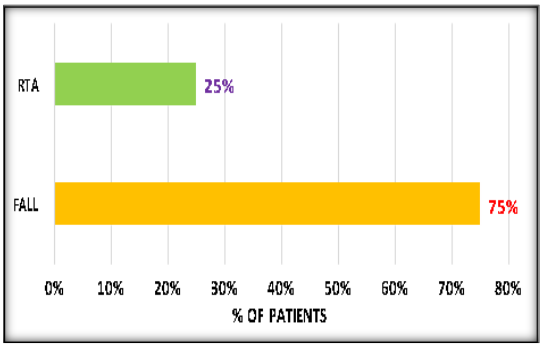

Figure 2: Mode of injury

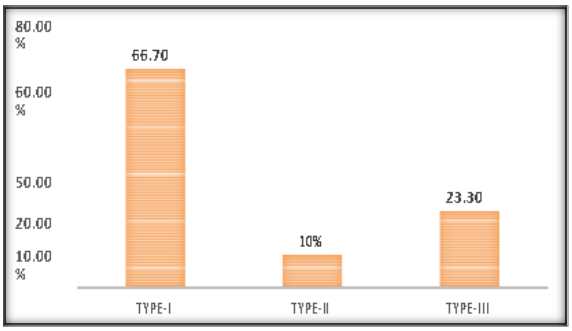

Figure 3: Fernandez Type of Fracture

Distribution of the patients based on FERNANDEZ TYPE OF FRACTURE, about 66.7% (40) of the patients had a Type-I fracture, followed by 23.3% (14) of the patients who had a Type-III fracture and 10% (6) of the patients had a Type-II fracture respectively. [Figure 3]

Based on Disabilities of Arm, Shoulder, and Hand (DASH) score concerning the type of implant used; among the patients of Closed Reduction Percutaneous with K-wire, the mean DASH score at four weeks follow-up was 75.9 + 8.69 while 25.3 + 6.37 among patients of Open Reduction & Internal Fixation with a plate. Among the patients of CRPP with K-Wire, the mean DASH score at eight weeks follow-up was 42.5 + 7.84 while 19.6 + 4.52 among patients of ORIF with a plate. Among the patients of CRPP with K-Wire, the mean DASH score at 12 weeks follow-up was 23.1 + 2.50 while 13.7 + 2.99 among patients of ORIF with a plate. There was an extreme statistically significant difference between the implant groups in all the three follow-up visit DASH scores(p-value<0.05). [Table 2]

Table 2: Based on dash scores concerning type of implant used

DASH SCORE	IMPLANT USED				t	p-value
	CRPP WITH K-Wire		ORIF WITH PLATE			
	Mean	Standard Deviation	Mean	Standard Deviation		
4-WEEKS	75.93	8.69	25.30	6.37	25.741	**0.0001**
8-WEEKS	42.57	7.84	19.63	4.52	13.882	**0.0001**
12-WEEKS	23.13	2.50	13.73	2.99	13.198	**0.0001**

Based on postoperative complications concerning implant used; among the patients of Closed Reduction Percutaneous with K-wire, 90% (27) of the patients had no complications while 6.7% (2) of the patients had non-union and 3.3% (1) of the patients had malunion of fracture. Among the patients of Open Reduction Internal Fixation with plate, about 96.7% (29) had no complications. In comparison, 3.3% (1) of the patients had non-union, and there were no patients with mal-union. Among the patients with ORIF with plate, postoperative complications were minimal compared to patients with CRPP with K-wire.

DISCUSSIONS

About sixty (60) patients with displaced distal radius fractures admitted for surgery and who gave consent to participate during the study period were included. Patients were divided into two groups, 30 patients in each group. Group-A consisted of 30 patients treated with treatment protocol-A, and group-B consisted of 30 patients treated with treatment protocol-B. Patients were randomized to either open reduction & internal fixation with plating and closed reduction & percutaneous pinning with K-wires through sealed envelope selection. Simple block randomization by computer-generated sequence was used.

FERNANDEZ TYPE OF FRACTURE

In the present study, the majority, 66.7% of the patients, had a type-I fracture, followed by 23.3 % of the patients with a type-III fracture and 10 % of the patients with a type-II fracture. Similar results were observed in JUPITER JB et al,[6] studies. They reported the indication for closed reduction percutaneous fixation and open reduction internal fixation.[6]

DASH SCORES VS TYPE OF IMPLANT USED

In the present study, among the patients of CRPP with K-wire, the mean DASH score at four weeks follow-up was 75.9 + 8.69 while 25.3 + 6.37 among patients of ORIF with a plate. Among the patients of CRPP with K- Wire, the mean DASH score at eight weeks follow-up was 42.5 + 7.84 while19.6 + 4.52 among patients of ORIF with a plate. Among the patients of CRPP with K-Wire, the mean DASH score at 12 weeks follow-up was 23.1 + 2.50 while 13.7 + 2.99 among patients of ORIF with a plate. There was an extreme statistically significant difference between the groups in all the three follow-up visit DASH scores (p-value<0.05).

In the study conducted by KARANTANA A et al,[7] DASH scores tend to show similarity at the end of 12 weeks. No significant difference existed in DASH scores at 12 weeks.

In the study conducted by Shrestha B et al,[8] CRPP with K-wire group had DASH Scores of 75.4 ± 3.89 in 1.5 months follow up while ORIF with locking plate fixation group had DASH scores of 26.2 ± 2.75 in the same duration. ORIF with locking plate fixation group has fewer DASH Scores than CRPP with K-wire group at all follow-up evaluations. But the significant difference was found to be at 1.5 months interval with a p-value <0.05. Over a period, there was a gradual reduction in DASH Scores in both groups.

DASH scores were significantly lower for all the three follow-ups measurements over 12 weeks postoperatively. The patients who had undergone ORIF with locking plate compared to patients with CRPP with K- wire. The difference in DASH scores between the two groups decreased over time. The higher DASH scores for patients with CRPP over the initial postoperative phase were delayed onset of wrist ROM exercises. Therefore, the ORIF with plate fixation technique could be considered for the patients who require a faster return to function.

In the present study, among the patients of CRPP with K-wire, the mean degree of pronation at four weeks follow-up visit was 9.60+1.81 while 24.86 + 4.10 among patients of ORIF with a plate. Among the patients of CRPP with K-Wire, the mean degree of pronation at eight weeks follow-up was 33.5 + 6.57 while 54.1 + 4.77 among patients of ORIF with a plate. Among the patients of CRPP with K-Wire, the mean degree of pronation at 12 weeks follow-up was 72.9 + 4.83 while 73.2 + 3.66 among patients of ORIF with a plate. There was a statistically significant difference between the implant groups in the 4th & 8th week follow-ups visit degree of pronation (p- value<0.05) with a better degree of pronation in ORIF with plategroups.

In the present study, among the patients of CRPP with K-wire, 90% of the patients had no complications, while 6.7% of the patients had non-union and 3.3% of the patients had malunion of fracture. Among the patients of ORIF with plate, about 96.7% of the patients had no complications, while 3.3% had non-union, and there were no patients with mal-union. Among the patients with ORIF with plate, postoperative complications were minimal compared to patients with CRPP with K-wire.

In the study conducted by Shrestha B et al,[8] & Campochiaro G et al,[9] the complications were reported among CRPP with the K-wire group compared to a group of patients who had undergone an ORIF with plate fixation, similar to the present study.

CONCLUSION

Both open reduction & internal fixation with plate and closed reduction & percutaneous pinning with K-wire for distal end of radius fractures had been reported to achieve a good anatomical outcome. ORIF with plate was observed to give a better functional outcome with fewer postoperative complications than CRPP with K-wire. The complications due to the operative procedure were within acceptable limits. The financial impact on the patient was less as compared with other modes of operative treatment.

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