

# Comparison Study of Functional Outcome of Intra Articular Distal Radius Fracture Treated by Percutaneous Fixation and Open Reduction and Internal Fixation

Druvan S<sup>1</sup>, Melvin J George<sup>2</sup>, Chandrababu K K<sup>3</sup>, Bhaskaran V K.<sup>4</sup>

## ABSTRACT

**Introduction:** Distal radius articular fractures are a common occurrence. The treatment options available are also varied. Open reduction and Internal Fixation (ORIF) and Closed Reduction and Percutaneous Pinning (CRPP) are the commonly done operative procedures. Many papers are published claiming one method superior to the other and vice versa. We sought to compare clinical and radiographic outcomes for both partial and complete articular distal radius fractures treated with open reduction internal fixation with volar locking plates (VLP) versus closed reduction and percutaneous pinning (CRPP) with Kirschner wires.

**Materials and Methods:** We created the cohort of patients with AO type B and C1 distal radius fractures prospectively. 42 patients were included in the study. Out of the 42 patients, 25 patients underwent Closed Reduction and Percutaneous Pinning and 17 underwent ORIF with Volar Locking Plate. Functional and anatomical outcome of these patients were assessed at 6 weeks, 3 months, 6 months and 12 months. Anatomical results were based on criteria of Stewart et al. Gartland and Werley demerit point system was used for functional scoring.

**Result:** Patients who underwent ORIF with VLP had statistically significant better results when compared to those who underwent CRPP. Both anatomical and functional results, as well as radiographic assessment were superior in the ORIF group.

**Conclusion:** With ORIF, anatomical results were much better than with percutaneous fixation. Functional results were significant between the two groups with p value of 0.004 and both subjectively and objectively ORIF was better than percutaneous fixation. VLPs showed significant advantage over CRPP in patients with simple fracture types between 3 and 12 months.

**Keywords:** Distal radius, Percutaneous fixation, ORIF, Functional Outcome, Volar locking plate, K wires.

## INTRODUCTION

Articular fractures of distal radius is one of the most common fractures. Extra articular fractures can be managed by closed reduction and immobilization. But articular fractures both partial articular and complete articular fractures need accurate reduction and stabilization. Many techniques have been described for treating these fractures. The decision depends on many factors like, fracture pattern, age and functional demand of the patient. The current trend to treat articular fractures is to achieve anatomical reduction and stable fixation. The result of non anatomical reduction would be malunion, limited range of motion, weakness, pain and post traumatic arthritis in long term (1).

Objectives of the research were to compare the functional

outcome of intra-articular distal radius fracture treated by percutaneous fixation and open reduction internal fixation and to compare the radiological outcome between the two groups.

## MATERIALS AND METHODS

Informed consent of the patients obtained. Ethical Committee clearance of the Institution obtained. No funds or grants obtained for any part of the study.

### Sample Size

The present study consists of those cases selected from the Department of Orthopaedics, Amrita Institute of Medical Science and Research Centre, Kochi from 2011 to 2013. During the study period 25 cases with percutaneous fixation and 17 cases with ORIF was included in the study. Patients with age group ranging from 18 years to 79 years participated in the study, with a mean age of 47 years in the percutaneous group and 50 years in ORIF group. More than 90% of the patients belong to 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup> decade. There were 28 males and 14 females. Percutaneous group had 25 patients and ORIF group had 17. In all our patients the dominant side was the right side. The number of patients in both percutaneous (17) and ORIF group (11) with right side involvement (28) was double in number as compared to those with left side (14) involved. The common mode of injury was due to fall on an outstretched hand in both the groups (71.4%). The patients were followed for an average period of 1 year. During the follow up, X rays were taken and the patients were assessed both subjectively and objectively. Study design was prospective comparative study

### Inclusion Criteria

All skeletally mature patients of age > 16 years were included in the study.

Those patients with minimum of 2mm of either step off or gap were included.

### Exclusion Criteria

Those patients with history of previous fracture of wrist,

<sup>1</sup>Assistant Professor, <sup>2</sup>MNAMS, Trauma Fellow, <sup>3</sup>Professor and HOD, <sup>4</sup>Professor, Department of Ortho, Amrita Institute of Medical Sciences and Research Centre, Kochi, India

**Corresponding author:** Dr. Melvin J George, F1, Rohini Apartments, Meenchira Road, AIMS Ponekkara PO, Kochi – 682041, India

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congenital anomaly or other severe problems of the wrist. Open fractures with neurovascular and tendon injuries were excluded from the study. No pathological fractures were included in the study.

**Radiological Outcome assessment**

The routine minimal evaluation for distal radius fracture must include 2 views AP and lateral. Five components of the deformity have been used for radiographic assessment for accurate treatment and sufficient radiological follow up. Methods of Measuring:<sup>16,19</sup> A reference line is drawn along the central longitudinal axis of radius on both AP and lateral x-rays.

**Operative techniques**

**1. Closed Reduction Percutaneous Pinning (CRPP)**

Patient was positioned supine on OT table. Under General Anesthesia or regional anesthesia parts were painted and draped. The fracture alignment was achieved by traction and counter-traction and the reduction was confirmed by image intensification. 1.5 or 2mm K wire was passed from the radial styloid crossing the fracture site obliquely to exit the dorsoulnar cortex of the radial shaft. Another K wire was passed from the dorsoulnar aspect of the distal radius between fourth and fifth extensor compartment and directed so that it engages the volar radial cortex of the proximal fragment. Then B/E cast was applied. K wire was removed after 3 weeks and patients were started on ROM exercises. ( Fig. No: 1)

**2. Open reduction and internal fixation ( ORIF )**

In all our patients treated with open reduction internal fixation fracture was exposed through a volar approach. After anesthesia, under tourniquet control, parts painted and draped. 7.5cm longitudinal incision was made on the radio-volar aspect of the distal forearm. The plane was developed between flexor carpiradialis and Palmaris longus. After retracting the flexor pollicis longus tendon radial ward and median nerve and other tendon ulna ward, the Pronator quadrates was released to expose the fracture site. After reducing the fracture it is fixed provisionally with K wires. Reduction was visualized under fluoroscopic radiograph. Then the volar locking plate was applied and fixed to the proximal fragment, the distal transverse part will act as a buttress and hold the fracture reduced. ( Fig. No: 1) The reduction of the fracture and restoration of the articular surface was confirmed by direct observation and by AP and lateral radiograph. Pronator quadratus was sutured back and the wound was closed. B/E POP slab was applied. Sutures were removed after 2 weeks

and slab removed after 3 weeks for ROM exercises.

We identified 42 patients among whom 28 patients were male with 16 of these fractures fixed with percutaneous fixation and 12 with ORIF. The female patients were 14 in number with 9 of these fractures fixed with ORIF and 5 with percutaneous Fixation. The age group of percutaneous fixation ranged from 18 to 79 years and for ORIF 19 to 43 years. In both the groups the post operative physiotherapy protocol was similar (4).

The patients were followed at 3 weeks, 6 weeks, 6 months and 12 months. During each follow up radiograph were taken and clinically assessed both subjectively and objectively for the range of movements, grip strength, all the variables in AP and lateral radiographs were measured. The final anatomical results were obtained based on the criteria of Stewart et al. The functional results were assessed based on Gartland and Werley (1951) demerit point system.

**STATISTICAL ANALYSIS**

To test the statistical significance of the association of various functional outcome variables (intra articular distal radius fractures and radiological outcome) with type of treatment, chi-square test with yate’s correction factor was applied.

To test the statistical significance of the difference in mean value of age between the two group Student’s t test was applied.

**RESULTS**

We based our analysis of Anatomical results according to the criteria of Stewart et al. Table No:3 shows the system of anatomical scoring. Functional assessment and the scoring was done based on the demerit point system described by Gartland and Werley. (14) (Table No:1). The objective evaluation in based on the following ranges of motion as being the minimum for normal function.

- Dorsi flexion – 45°      Palmar flexion – 30°
- Radial deviation – 15°      Ulnar deviation – 15°
- Pronation – 50°      Supination – 50°

**Subjective evaluation**

The subjective results were excellent in more than 50% of patients treated with ORIF. In those patients treated with percutaneous fixation subjective results were fair to good in majority (Table No:1)

**Objective evaluation – (Table No:2)**

Dorsiflexion - The mean loss of dorsiflexion in percutaneous group was 20 degree and in ORIF group was 13 degree. Considering the minimum dorsiflexion to be 45 de-

Percutaneous Fixation		8 patients had prominent ulnar head 2 patients had residual dorsal tilt 1 patient had radial deviation of hand			
ORIF		4 patients had prominent ulnar head 2 patients had residual dorsal tilt			
<b>Subjective evaluation scores</b>	<b>Total</b>	<b>Excellent</b>	<b>Good</b>	<b>Fair/poor</b>	<b>p-value</b>
Percutaneous Fixation	25	5 (20%)	11 (44%)	9 (36%)	0.080
ORIF	17	9 (53%)	5 (29%)	3 (17%)	
<b>Table-1:</b> showing residual deformity - Functional Results according to Gartland and Werley and subjective evaluation scores in both groups.					

gree for normal function the two groups were compared as follows.

Palmar flexion - The mean loss of palmarflexion in percutaneous group was 22 degree and in ORIF group 19 degree. Considering the minimum palmarflexion to be 30 degree for normal function the two groups were compared as follows.

Pronation - The mean loss of pronation in percutaneous group was 25 degree and in ORIF group was 15 degree.

Supination - The mean loss of supination in percutaneous group was 23 degree and in ORIF group was 15 degree.

**Anatomical Results: Stewart et al. – (Table No:3)**

The mean radial length in percutaneous group was 9.9 mm and in ORIF group was 10.9mm. Mean radial angulation in percutaneous group is 17.9 degree and in ORIF group is 20.4. The overall mean step off is 0.9mm.

**Functional results (Point range)**

The functional results were compared based on Gartland and Werely criteria. The Chi square was found to be 10.81, p value 0.004 highly significant. (Table No:3)

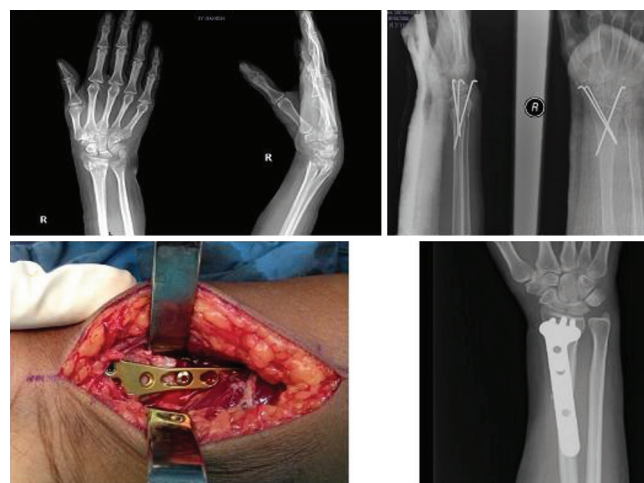
**DISCUSSION**

Distal end radius fractures were treated by closed reduction and POP immobilisation. This lead to complications like malunion, limited range of motion, weakness, pain and post traumatic arthritis. Thus was introduced the concept of percutaneous pinning and Open Reduction and Internal Fixation with volar locking plate. Volar locking plates (VLPs) are associated with fewer complications, better function and improved patient satisfaction than other treatment methods.<sup>3,11,15</sup> Other options would be external fixation, remodelable bone cement, electric current, teriparatide and beta-tricalcium phosphate bone graft substitutes.<sup>2-8,10-16</sup> Studies have been published favouring both CRPP and ORIF with VLP as the better option for treating these fractures. Kreder et al suggested CRPP method has got more rapid return of

function and better functional outcome. Different studies are difficult to compare as different outcome tools are used, study group included variety of fractures and different techniques of fixation were employed.

Michael et al (1997) in their series of 30 fractures treated with percutaneous fixation showed 50% excellent result, 40% good result and 3% fair result. Jakob et al. (2000) in his series of 74 fractures treated with ORIF showed excellent result in 90%, good in 8% and fair in 2%. In our study of 17 fractures treated with ORIF, 12(70.5%) patients showed excellent, 5(23.4%) good result and there were no patients either with fair or poor results. The fractures treated with percutaneous fixation were 25, among which 13(52%) patients showed excellent results, 11(44%) good results and 1(4%) fair result.

In analyzing the radiographic data on our patients immediately after the operation and at the end of the follow-up, we saw that there was no statistically valid variation in the parameters analyzed, thus showing that, on average, the initial reduction was sustained. The critics of percutaneous fixation using Kirschner wires, say that the great problem would be precisely the lack of stability of the method, which would lead to loss of the reduction in the initial phases of consolidation. Our study did not demonstrate such complication and we attribute this to the type of assembly that we used in most of our cases. Several patterns for placement of Kirschner wires have been described in the literature, with differences in how they are applied and the number used. In our study, 67.6% of the cases were treated using three crossed bicortical Kirschner wires: two through the radial styloid process and one introduced dorsally through the ulnar edge of the radius.



**Figure-1:** X ray AP and lateral view showing distal end radius fracture and post operative images of Kwire fixation and ORIF with volar LCP.

Dorsiflexion	Total	<45°	>45°	p-value
K wire Fixation	25	4 (16%)	21 (84%)	0.632
ORIF	17	1 (5.8%)	16 (94.2%)	
Palmar flexion	Total	<30°	>30°	p-value
K wire Fixation	25	3 (12%)	22 (88%)	0.635
ORIF	17	1 (5.8%)	16 (94.2%)	
Pronation	Total	<50°	>50°	p-value
K wire Fixation	25	12 (48%)	13 (52%)	0.201
ORIF	17	4 (23.5%)	13 (76.5%)	
Supination	Total	<50	>50	p-value
K wire Fixation	25	7(28%)	18(72%)	1.000
ORIF	17	5(29%)	12(71%)	

**Table-2:** Showing the range of dorsiflexion, palmarflexion, pronation, supination obtained in both the groups.

Functional result	Total	Excellent	Good	Fair	Poor	p-value
Percutaneous Fixation	25	7(28%)	15(60%)	2(8%)	1(4%)	0.004
ORIF	17	13(76.4%)	2(11.7%)	2(11.7%)	0	
Anatomical result	Total	Excellent	Good	Fair/poor		p-value
Percutaneous Fixation	25	13(52%)	11(44%)	1(4%)		0.400
ORIF	17	12(70.5%)	5(29.4%)	0		

**Table-3:** Showing the final functional and anatomical results of both groups.

## Complications

In John Bradway(7) series of distal radius fracture 2 patients had pin tract infection related to K Wire, 1 patient with superficial wound infection after plate fixation and no complication related to external fixation. In Keating(9) series 40.5% of patients had complications among which reflex sympathetic dystrophy and median nerve compression and malunion was the commonest. In Bishay(13) series of external fixation 2 patients had irritation of superficial radial nerve and 2 patients with pin tract infection.

In our study we encountered pin tract infection in 3 patients after K wire fixation, 2 patients with superficial wound infection which required regular dressing after plate fixation.

## Limitations and strengths

Much better statistically significant results would have been obtained with a larger sample size and longer follow up. Also our cohort was not randomised.

## CONCLUSION

In majority of the patients right limb which is the dominant side involved. Fall on an outstretched hand was the most common mode of injury followed by RTA. Majority of the patients belong to 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup> decade have better functional outcome as compared to elderly age group. Need of immobilization was for longer duration for those treated with percutaneous fixation as compared to ORIF. Functional and anatomical results were better in less comminuted fracture. Pain in the distal radioulnar joint was the most common complication encountered. Grip strength and pinch strength was much better in those treated with ORIF. Overall mean grip strength was 58% of normal and mean pinch strength was 60% of normal. With ORIF anatomical results were much better than with percutaneous fixation. Functional results were significant between the two groups with p value of 0.004. Both subjectively and objectively ORIF was better than percutaneous fixation.

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