

## Original Research Article

# Comparison of outcome of extra articular lower end radius fracture with percutaneous pinning and volar locking plate

Saranjeet Singh Jagdev, Rishabh Kedia, Subodh Kumar Pathak\*, Abhijeet Salunke

Department of Orthopedics, Pramukhswami Medical College, Karamsad, Gujarat, India

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### \*Correspondence:

Dr. Subodh Kumar Pathak,

E-mail: [drsubodh08@gmail.com](mailto:drsubodh08@gmail.com)

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## ABSTRACT

**Background:** As fractures of the distal radius are the most common fractures of the upper extremity with no clear guidelines for mode of intervention it was decided to compare two of the most common methods of treatment. The aim of this study was to review a group of patients sustaining extra articular lower end radius fracture treated with percutaneous wiring and volar plating and compare their functional outcome at a significant follow up time.

**Methods:** A prospective study was conducted at tertiary care center. A sample of 45 patients who had a displaced extra articular distal radius fracture and were subjected to treatment with either a plate (n =24) or k wiring (n =21). Outcome assessments were conducted at 6 months. Outcomes were measured on the basis of scores on the DASH questionnaire, wrist range of motion, and radiographic parameters.

**Results:** Patients in the plate group had significantly better DASH scores ( $p=0.0431$ ) and range of motion at six months compared with patients in the k wiring group. Collapse in radial length was observed in 2 patients with percutaneous wiring which led to suboptimal range of motion and increased DASH scores. Significance arc of motion at 6months in dorsiflexion and palmar flexion were  $p=0.0038$  and when compared with opposite limb were significant in all three planes  $p=0.0217$ ,  $p=0.0126$  and  $p=0.0029$ .

**Conclusions:** Based on our observation we found that treatment of dorsally displaced, unstable extra articular radius fractures across all age groups, volar-locked plates achieve a superior radiological and functional outcome with minimal complications.

**Keywords:** Distal radius fractures, Extra articular, Locking plates, DASH score, K wire

## INTRODUCTION

Fractures of the distal radius are common fractures seen in orthopedics outpatient and trauma care. Data suggests that around 6% of women by age of 80 years will sustain such fracture and 9% women by age of 90.<sup>1</sup> As the population continues to age, these figures are likely to increase still further. Its growing incidence may be attributed to a parallel rise of osteoporosis and high energy accidents.<sup>2,3</sup> The epidemiology has changed from the times of Colle's fracture to present date due to increased life expectancy and increased in high energy trauma. Various authors have stated the age specific

incidence, that ranged from 9 to 100 per 10,000 per year.<sup>4-6</sup> Various operative and non-operative treatment options are available, without there being a consensus as to an optimal method according to the patients demographics and fracture pattern.<sup>7,8</sup> Despite this being a topic of discussion there have been very few studies focusing on the functional outcomes following percutaneous K wiring and volar plating in extra articular fractures. Each having their own merits and demerits.

Percutaneous wire fixation being a relatively quick and minimally invasive procedure that could be carried out in limited operative environment. However, since the

fixation is not rigid, the patients often have to be immobilised in plaster cast for around 6 weeks and chances of radial collapse in osteoporotic bone is higher as they are not load bearing devices. There is also a risk of collapse when the wires are removed, leading to loss of reduction and deterioration of functional capabilities.<sup>9</sup>

In case of Locking plate open reduction helps in better manipulation of fragments and restoration of normal anatomy. Volar locking plate produces a rigid construct through screws that provide better fixation and support the healing bone through the remodelling phase, hence reducing the chances of loss of reduction.<sup>10</sup> Patients can be mobilized earlier thereby decreasing the incidence of post-operative stiffness. However this technique requires increased operative time and surgical expertise. There are chances of flexor or extensor tendon irritation and infection.

The aim of this study was to review a group of patients sustaining extra articular lower end radius fracture treated with percutaneous wiring and volar plating and compare their functional outcome at a significant follow up time.

## METHODS

The study is a prospective study conducted at tertiary care center from October 2014 to September 2016, with the approval from ethical committee. Patients with distal radius fractures presenting to the orthopedic outpatient and emergency services were included in this study. Out of total 168 patients who presented 48 were included in the study after applying the inclusion /exclusion criteria. Patients with closed, unilateral, dorsally displaced, extra-articular distal radius fractures (AO classification type A) were included in this study. Patients with AO type B and C fractures, open fractures, pathological fractures, bilateral wrist fractures and patients with preexisting wrist arthritis, were excluded. Fracture displacement was based on radiological parameters such as radial length, radial inclination and volar tilt. Fractures were classified based on AO classification.

All procedures were performed in operation theatre using either regional or general anesthesia and were covered with prophylactic intravenous antibiotics with the aid of an image intensifier. All procedures were done by orthopedic surgeons with minimum 5 years of working experience.

Fixation using percutaneous wires was performed after indirect reduction with traction and manipulation under the guidance of image intensifier. The wires were not buried. All fractures fixed by wiring were given a below elbow cast for 6 weeks. The plaster and k wires were then removed in the outpatient department and all patients were referred to physiotherapist for rehabilitation.

Locking plate fixation was achieved through Henry's volar approach under tourniquet control. The fracture was

reduced under direct vision. The fracture was maintained with help of locking plates, these patients were treated with 2 weeks of cock up splint followed by early mobilization. This group was also under the rehabilitation of a skilled physiotherapist.

All patients were followed up on a regular basis post operatively and final outcome assessments were conducted at 6 months. Outcomes were measured on the basis of scores on wrist range of motion and radiographic parameters whereas disability was measured based on DASH questionnaire.

## Statistical analysis

The statistical analysis was performed by a medical statistician. Data was summarised as mean, median and SD was calculated. Groups were compared using the student's t test. The p value of <0.05 was considered as significant. The data was assessed using the STATA 14 software.

## RESULTS

A total of 48 patients met the criteria for inclusion. Of these, all agreed to participate. 3 patients were lost to follow up. A total of 24 patients were placed into the plate group and 21 into the K-wire group. Male patients predominated female patients (males =29, females=16) and the mean age of patients was 43.2 years with the range being 20-74 years (Table 1). Fractures were more common on right side (64.44%). 57.77% of fractures occurred due to road traffic accident (n =26) (10 in K wire group and 16 in plate group) while 17 fractures occurred due to simple fall (7 in K wire group and 10 in plate group). 2 patients sustained fracture due to fall from height (both in plate group). The mean range of motion of plate group and K wire group was noted (Table 2). The range of motion of the plate group at six months compared with patients in the K wiring group showed significant difference in the arc of motion in dorsiflexion and palmar flexion (p=0.0038) and when compared with opposite limb were significant in all three planes (p=0.0217, p=0.0126, and p=0.0029) (Table 3) (Figure 1 and 2).

**Table 1: Demographic data of patients.**

		K wire group	Plate group
Age	Range	20-76 years	32-74 years
	Mean	48	42
Sex	Male	12	17
	Female	9	7
Fracture side	Right	11	18
	Left	10	6

The radiological assessment was performed at a 6-month interval between the two groups. Radiological assessment showed that the immediate postoperative reduction was

better in the plate group than in the K- wire group in terms of radial inclination ( $p=0.01$ ) but there was no statistically significant difference between the plate group and the K-wire group when considering volar tilt

( $p=0.760$ ) and radial length ( $p=0.0697$ ). However, in the K-wire group, there was loss in radial length and fracture alignment in three patients as with comparison with plate group which showed none such incidence.

**Table 2: Mean range of motion in different fixation groups.**

Mode of fixation (N)	K wire group	Plate group
<b>Mean range of movement in degrees</b>		
Mean dorsiflexion	73.30±6.10	76.66±5.52
Mean palmar flexion	66.15±7.94	71.02±7.99
Mean supination	73.92±5.02	76.38±3.74
Mean pronation	71.46±5.50	71.88±3.14
Mean radial deviation	16.53±1.98	17.94±1.92
Mean ulnar deviation	26.76±3.24	26.27±2.29

**Table 3: Mean difference in arc of motion as compared to opposite limb.**

Difference in arc of motion (degrees) at final follow-up compared to opposite limb.	K wire group	Plate group	P value
<b>Dorsiflexion and palmar flexion</b>	13.13	6.35	0.0217
<b>Supination and pronation</b>	12.02	5.80	0.0126
<b>Radial and ulnar deviation</b>	6.26	3.10	0.0029

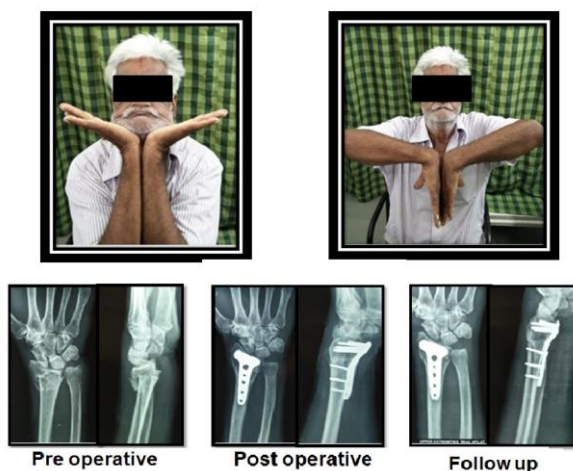
There was no statistical significant difference between the change of measurements from post-operation to 6 months when comparing the plate and the K-wire groups. All radiographic variables were not statistically significant between the plate group and the K-wire group at 6 months.

Patients in the plate group had significantly better DASH scores ( $p=0.0431$ ) (Table 4).

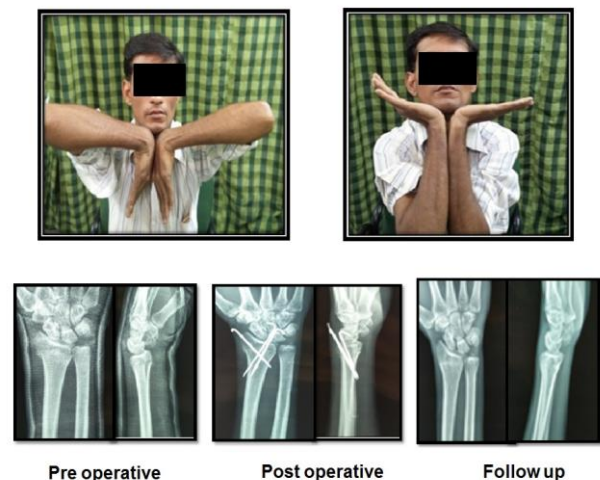
**Table 4: Mean DASH score.**

6 months mean score	K wiring	Plating	P value
<b>DASH</b>	5.20	2.35	0.0431

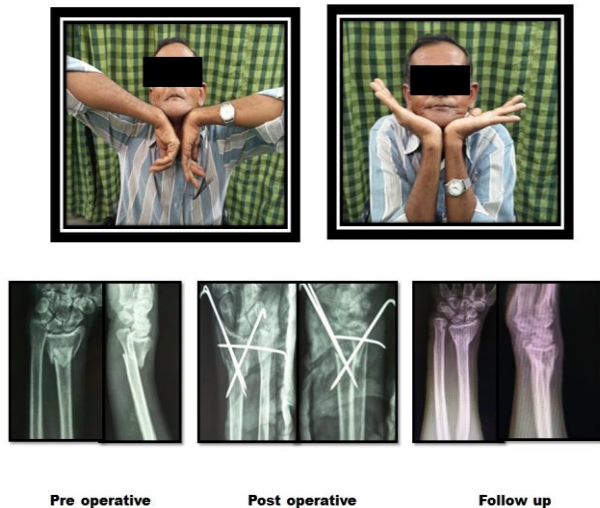
Within plate fixation group one patient had tenosynovitis and one had reflex sympathetic dystrophy during treatment phase which subsided during follow up period after conservative treatment, one patient had features of tenosynovitis initially which was treated with anti-inflammatory drugs and the same patient had prominent plate in final follow up. In K wire group, two patients had loss of reduction after initial fracture fixation (Figure 3), one patient had DRUJ subluxation during treatment phase which was treated with above elbow slab in supination followed by physiotherapy. One patient had reflex sympathetic dystrophy during treatment phase which subsided during follow up period after conservative management.



**Figure 1: Clinical and radiological images of patient with volar locking plate.**



**Figure 2: Clinical and radiological images of patient with K wire with good functional outcome.**



**Figure 3: Clinical and radiological images showing loss of reduction with K-wire.**

## DISCUSSION

Biomechanical studies have demonstrated that volar locking plates are considerably more stable than percutaneous pins in unstable distal radius fractures.<sup>11</sup> The locking screws creating a stable construct that allows the transfer of axial load across the fracture site, as implants possess a mechanical strength comparable to that of a normal bone.

Prior to the recent expansion in locking-plate technology, percutaneous pinning remained the most popular form of treatment for distal radial fractures.

The growth in popularity of volar locking plates has led manufacturers to focus further on the development and marketing of increasingly sophisticated plate designs, with the most contemporary systems offering fragment specific fixation via polyaxial screw configurations.<sup>12</sup>

We have used both patient derived functional outcome measures as well as range of motions to have both objective as well as subjective assessments. Radiological parameters were also assessed at various intervals to notice the effect of various parameters on change in functional outcome.

On analyzing the result and comparing with other studies, interesting factors were unrevealed. The data collected used for the comparison with the data of studies mentioned below are obtained by regular follow up of the patients with last follow up being 6 months.

In our study, the distal radial fracture was more common in the third and fifth decade with an average of 43.02 years. These findings are comparable with other similar published studies.<sup>13-15</sup> Incidence of distal radius fractures were seen higher in males in our study.

In our study 57.77% (n =26) fractures were due to road traffic injuries. As our center is located on the national highway which puts men at higher risk for such injuries due to road traffic accidents increasing their incidence.

There has been one prospective randomized study by mcfayden et al which has only focused on extra articular radius fractures and compared results of 56 volar plating and percutaneous K wiring as per DASH score which showed there were significantly better in the plate group than in the K-wire group at 3 and 6 months.<sup>16</sup>

Two other retrospective reports exist, directly comparing fixation with volar-locked plates and percutaneous pinning but their comparison included both extra as well as intra articular fractures. Oshige et al examined dorsally angulated displaced fractures in 62 patients in a non-randomised cohort of elderly patients.<sup>17</sup> The use of volar-locked plates produced a better range of motion and grip strength, in addition to maintaining radial height.

Voigt and Lill et al also examined the outcomes of both intra-articular and extra-articular fractures treated with volar-locked plates or percutaneous pinning in a series of 43 patients.<sup>18</sup> Their analysis did not demonstrate any significant difference at 26 months postoperatively in either functional or radiological outcome. DASH score suggests a higher degree of patient satisfaction after K-wire fixation (7 [0-87] points) than after ORIF (17 [0-82] points), which was not confirmed by fracture-specific evaluation but there was a significantly earlier return to the "activities of daily living" (4 as against 8 weeks) after volar plating as compared to percutaneous k wires which in contrast when compared to our study showed a significant difference between the two group with mean DASH score significantly better in plating group as compared to K wiring group at the end of 6 months follow up period.

Another prospective study by Rozental et al which compared functional outcomes for unstable distal radial fractures treated with open reduction and internal fixation or closed reduction and percutaneous fixation included both intra as well as extra articular fracture.<sup>19</sup> Their analysis demonstrated that patients in the open reduction and internal fixation group had superior DASH scores at six, nine, and twelve weeks.

Another randomized controlled study by Alexia Karantana et al of one hundred and thirty patients including both intra as well as extra articular radius fracture showed that patients in the volar locking plate group had significantly better Quick DASH scores and range of motion at six weeks compared with patients in the K wiring group, but there were no significant differences between the two groups at twelve weeks or one year.<sup>20</sup> The volar locking plate was better at restoring palmar tilt and radial height which when compared to our study which shows significant difference in DASH score and arc of motion at the of six months.



We have found superior functional outcomes at 6 months post-injury in injuries treated within locked internal fixation. Patients in this group also had significantly less complications than those treated with percutaneous pinning.

## CONCLUSION

The ability of fixed-angle volar plates to maintain fracture reduction has previously been demonstrated in clinical studies, which have included intra as well as extra-articular lower end radius fracture. In the plate group, there was no significant loss of fracture reduction, clearly demonstrating the in vivo stability of the fixed angle volar plate in extra-articular fractures, even in osteoporotic bone compared to percutaneous pinning which had 3 cases of loss of reduction leading to suboptimal range motion and higher DASH score as compared to the plate group.

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