

Additional Ulna-Radial Pinning for Prevention of Metaphyseal Collapse in Distal Radius Fracture: A Comparative Study

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Abstract Fracture distal radius is one of the common fractures encountered by an orthopedic surgeon. It accounts about 20% of cases. In 1814, Abraham Colles first diagnosed the distal radius fracture and since then there are lots of debates in the management of the distal radius fracture. Till today the best treatment method for distal radius fracture is not known. Close reduction and plaster application is commonly done but has many complications. Close reduction and percutaneous pinning technique is widely accepted but one of the late complications of this technique is metaphyseal collapse. The study was done to check if additional ulno-radial pinning prevents metaphyseal collapse compared to simple two K wire fixation technique. There were total 30 patients in this study who had distal radius fracture. These patients were randomly divided into two groups. First group (Group A) patients were treated with simple two K wire technique and the next group (Group B) were given additional ulno-radial pin and their outcome were compared. The data was analyzed by using PASW version 16.0. Difference in radial height and ulnar variance of two groups at different time point were analyzed using independent sample T-test. p value <0.05 were considered statistically significant. In the study, the radial height was better preserved in Group B (who underwent additional ulno-radial pinning). The difference was statistically significant in 6 weeks and 3 months follow up. Additional ulno-radial pinning had better preservation of radial height compared to simple two K wire technique.

Keywords: *distal radius fracture, ulno-radial pinning, metaphyseal collapse*

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1. Introduction

Distal radius fracture accounts about one sixth of the fracture managed as emergency in orthopedics department [1]. It is one of the commonest fractures in orthopedics accounting about 20% of cases [2]. According to Cummings SR et al the risk of distal radius fracture in a life time for an individual is 17% [3]. Distal radius fracture has a bimodal age distribution with peak age of 5-14 years and after 60 years; the male female ratio is 1:4 [4]. In younger age group, the usual mechanism is high velocity injury whereas in elderly people it is usually due to the osteoporosis.

Close reduction and cast application was considered as the gold standard method of treatment in fracture distal radius but this method had complications like malunion, wrist and finger stiffness with poor functional outcome [5]. Collapse of the radius is one of the commonest complications in close reduction cast application [6,7]. There are many studies that showed significant restriction of movement and wrist pain if radial shortening is more than 4mm and dorsal angulations of 11 degrees [8,9,10].

Fixation with percutaneous pinning in distal radius fracture is considered as one of the earliest form of management that provides stability without vascular compromise. Many studies have proved that percutaneous fixation of distal radius is more stable fixation [11,12]. Since the results with two extra focal K wire fixation in distal radius fracture are not excellent, these days these types of two fixations is considered to be unstable construct [13]. In this technique, there is also the chance of collapse of fracture even after the removal of the K wires [14].

In 1990, Graham et al evaluated percutaneous pinning for extra articular distal radius fractures biomechanically and concluded that if ulna is involved during percutaneous fracture fixation, it provides better resistance for fracture displacement [15]. In 1993, Rayhack compared different pinning method and he concluded that the stiffest construct was transulnar pinning method [16]. Depalma first described the ulno-radial pinning technique where he drilled the ulno-radial pin at 45 degrees angle and 4 cm proximal to ulnar styloid process [17]. There was temporary blockage of supination and pronation in this technique [18].

2. Method and Methodology

2.1. Setting and Design

This was a comparative prospective study conducted at Department of Orthopedics, Manipal Teaching Hospital, Pokhara, Nepal for a period of 6 months between December 2014 and June 2015, after ethical clearance from institutional research board.

2.2. Surgical Technique

The patients with distal radius fracture who attended the emergency or outpatient department were alternately divided into two groups. First group (Group A) consists of patient with only two K wire whereas second group (Group B) were given additional ulno-radial pinning.

tubercle to proximal radial cortex or from the proximal radius to the lister's tubercle crossing the fracture line. The position of K wire was checked in both AP and lateral views (Figure 1, Figure 2 & Figure 3). The wires were bent and cut.



Figure 1. Introduction of 1st K wire from radial styloid in AP view



Figure 2. Introduction of 2nd K wire from Lister tubercle in AP view

In first group, patients were taken in operating room and anesthetized with either regional block or general anaesthesia; close reduction was done by traction and counter traction. C arm was used to check the reduction. Holding the reduction a K wire (size of 1.5 to 2 mm) was passed from radial styloid process to proximal radial cortex. The other K wire was passed either from lister's



Figure 3. Lateral view



Figure 4. Introduction of Ulno-radial pin in AP view



Figure 5. Position of wire in Lateral view

Similar procedure was repeated in second group too but in this group additional K wire was applied from distal ulna 2 to 4 cm proximal to ulnar styloid process at 45 degrees of angulations and parallel to the wrist joint up to the radius (Figure 4, Figure 5).

Position of wires checked in image both AP and lateral views. The wires were bent and cut and dressing of the part was done. Below elbow volar slab was applied. Finger movement was started from post-operative day 1 and patients were discharged on 2nd post-operative day if there was no swelling.

All patients were followed up in 2 weeks, 6 weeks and 3 months. K wires and volar slab were removed on 6 weeks and aggressive physiotherapy was done then after. Last follow up was done on 3 months' time. Radial height and ulnar variance were measured and recorded pre operatively, post operatively and in each follow up. Metaphyseal comminution was recorded in each patient preoperatively.



Figure 6. Preoperative X-rays



Figure 7. Post-operative X-rays

2.3. Inclusion Criteria

1. Age group more than 15 years and less than 75 years.
2. Isolated fracture of distal radius.
3. Intra articular gap of less than 2 mm (post reduction)

2.4. Exclusion Criteria

1. Patient with ipsilateral ulnar shaft fracture.
2. Intra articular gap of more than 2 mm (post reduction).
3. Age less than 15 years and more than 75 years.
4. Patients not giving consent.

2.5. Statistical Analysis

Data was collected in a performed semi constructed Performa and analyzed using PASW version 16.0. Difference in radial height and ulnar variance of two groups at different time point were analyzed using independent sample T-test. p value <0.05 were considered statistically significant.

2.6. Sample Size Calculation

In a study done prior to the original study showed a standard deviation of 0.9 for Group A (Cross pinning) and 0.8 for Group B (Ulna radial pinning) with a mean difference 1 and effect size 1.18. the requires sample size was 15 per group for 95% confidence interval, 5% significance level and 90% power [19].

3. Results

A total of 30 patients were included in the study. Half of the patients were randomized to group A (only two K wire) and other half to group B (additional ulno-radial pinning). The mean age of total study population was 47.2 (17.8) years. The age of the patient ranged from 17 to 74 years. The mean age of the patient in Group A was 44 (16.2) years while the mean age of the patients in Group B was 50.4 (19.4) years. Out of 30 patient 13 (43.3%) were male and 17 (56.7%) were female. 9 out of 15 patients in Group A were male while 4 out of 15 patients in Group B were male.

In our patients, 19 (63.3%) had right sided fracture while 11 (36.7%) had left sided injury. Metaphyseal comminution was present in 60% (18 out of 30) patents.

The mechanism of injury is shown in Table 1.

Table 1. Mechanism of Injury and Frequency

Mechanism of injury	Frequency	Percentage (%)
Fall from height	12	40
Low velocity injury	8	26.7
Road traffic accident (RTA)	10	33.3
Total	30	100

In our patients, the radial height was better preserved in Group B (who underwent additional ulno-radial pinning). The difference was statistically significant in 6 weeks and 3 months follow up as shown in Table 2.

Our study did not reveal statistically significant difference in ulnar variance in the patients undergoing these different modalities in treatment as shown in Table 3.

Table 2. Measurement of Radial Height in Different Group at Different Time Period

Duration	Radial Height in Group A	Radial Height in Group B	p-value	95% confident interval
Pre-operative	7.73 (0.94)	7.26 (1.09)	0.222	-1.24; 0.29
Post-operative	12.87 (0.99)	13.40 (1.18)	0.191	-0.28; 1.34
2 weeks follow up	12.87 (0.99)	13.40 (1.18)	0.191	-0.28; 1.34
6 weeks follow up	11.33 (0.89)	12.26 (0.82)	0.06	0.28; 1.57
3 months follow up	9.96 (0.81)	11.60 (0.91)	<0.001	0.98; 2.27

Table 3. Measurement of Ulnar Variance in Different Group at Different Time Period

Duration	Ulnar variance in Group A	Ulnar variance in Group B	p-value	95% confident interval
Pre-operative	2.30	2.53	0.44	-0.37; 0.84
Post-operative	-0.33	0.00	0.19	-0.18; 0.84
2 weeks follow up	-0.20	0.07	0.21	-0.16; 0.69
6 weeks follow up	0.13	0.33	0.34	-0.22; 0.62
3 months follow up	0.26	0.60	0.26	-0.26; 0.93

4. Discussions

Abraham Colles in 1814 first diagnosed the distal radius fracture [20]. Since then there has been lots of studies done regarding the best possible treatment option for its management but the best treatment method for distal radius fracture is still in debate. However any treatment given to the patient should have good functional outcome.

Close reduction and casting technique is an earliest treatment method but usually leads to metaphyseal collapse of the radius [21]. Since close reduction and percutaneous pinning provides better stability, it is considered as one of the best treatment option [22]. But still one of the late complications in fixation of distal radius with pinning technique is metaphyseal collapse. There is very less study done on fixation of distal radius that engages ulna. The aim of this study was to check if ulno-radial pinning in distal radius fracture prevents late metaphyseal collapse.

Graham et al studied biomechanics of percutaneous pinning in distal radius fracture and concluded that fixation that engages ulna had better resistance biomechanically to displacement [15]. Similar finding was found in our study; the group that had additional ulno-radial pinning had preserved better radial height compared to simple two pin fixation.

In 1993, Rayhack compared different pinning methods, where he compared simple radial styloid pinning with that of radial styloid plus posteromedial pinning and trans-ulnar pinning technique and concluded that the best pinning technique was trans-ulnar pinning method [16]. We compared simple two pinning technique with additional ulno-radial pinning method and we found that ulno-radial pinning was statistically better than simple two pinning method.

In this study there was statistical significance in the change of radial height in 6 weeks and 3 months follow up in both the group whereas there was no significant change in the ulnar variance in two groups, the reason may be that the sample size of this study is smaller and also in both groups normal range of ulnar variance could be achieved.

5. Conclusion

Percutaneous pinning technique is one of the best techniques for management of distal radius fracture. Since percutaneous pinning method is less invasive technique, less time consuming and does not need big incisions as in plating this technique is widely used. In our study we found that additional ulno-radial pinning has better preservation of radial height than simple two pinning technique.

Declaration of Conflicting Interests

The authors declare that there is no potential conflicts of interest with respect to the research, authorship and /or publication of this article.

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