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A comparative study of volar plate fixation versus percutaneous Kirschner wire fixation in the management of distal radius fracture in adults

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Abstract

Fracture distal radius is the most common fracture approximately 25% of all fractures treated at an emergency department, which constitutes 17% of all fractures and 75% of all forearm fractures. Conventional method of reduction and cast treatment for distal radius fracture has resulted in unsatisfactory anatomical and functional results, varying degrees of deformity and disability with secondary loss of reduction during ongoing treatment. Fixed angle volar plating and k wiring represents a valuable treatment modality for the most frequent types of unstable fractures of the distal radius. Patients admitted were randomly assigned to either k wiring group (Group A) or Volar plating group (Group B). In group A, percutaneous k wiring done after closed reduction under image intensifier whereas in group B, volar plating done after open reduction through modified Henry approach. All the patients were regularly followed up. Functional outcome is determined on the basis of disability arm, shoulder and hand score (DASH). The overall mean age of the patients was 44.5 ± 11.94 years. The age group 41-50 years comprised the highest number of patients (37.09%). AO Type A fracture constituted the highest number of patients (45.2%) followed by type C fractures (37.1%). The mean time to operation from the date since injury for all fractures was 5.09 ± 2.82 days. The duration taken for surgery for k wire group was 20.194.88 days and for volar plate group was 49.83 ± 7.0 days. The average blood loss was higher for volar plating group. For k wire group average blood loss was 8.09 ± 3.59 ml and for volar plate was 155.48 ± 18.76 ml. Duration of fracture union in k wire group and volar plate group was seen by 7.38 ± 1.02 and 6.67 ± 0.83 weeks respectively. The mean DASH score at the end of follow up was 6.03 ± 1.87 for volar plate group and 7.00 ± 2.38 for the k wire group. At 12 weeks from the procedure, clinical results seem to favour patients treated with plating, but there were no significant difference between the two types of treatment at long term follow up. Unstable intra-articular radius fractures that cannot be reduced or held reduced with pinning should be treated with locking volar plate, however k wiring remains a simple and inexpensive option for simple fracture patterns.

Keywords: DASH, K wire, AO type

Introduction

Distal radius fracture is the most common fracture, approximately 25% of all fractures seen at an emergency department ^[1] and constitutes 17% of all the fractures and 75% of all forearm fractures. A bimodal peak in incidence is described first peak is seen in young men related to high energy trauma and second much more important peak is recorded in postmenopausal females. The most common cause is a fall onto an outstretched hand especially in osteoporotic patients but high velocity trauma such as a fall from a height, motor vehicle accidents and contact sports are other aetiological factors. Pathological fractures, except those in osteoporosis, are rare in the distal radius ^[2]. Management of these fractures has remained a controversial issue. They are often treated by closed reduction and immobilization for the 6 weeks and more time required to gain the functions of forearm, wrist and hand by physiotherapy. The treatment modality which restores and maintains anatomy and allows early functional mobility should be considered, which allows the patient to carry out his activities of day to day life with minimal discomfort.

Numerous methods of treating distal radius fracture are closed percutaneous pinning, external fixation, buttress plating ^[3]. The two most common forms of surgical fixation are kirschner

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wire fixation and locking plate fixation. Kirschner wire fixation is a longstanding technique in which wires are passed across the fracture site percutaneously. Other technique is locking plate fixation, in which a plate is attached to the bone with fixed angle screws [4]. Locking plates are widely considered to provide stronger fixation, which facilitates earlier return to normal activities.

Aim and Objectives

- To assess the efficacy, functional and anatomical outcome of the volar locking compression plate and percutaneous k wire in the management of distal radius fracture in adults.
- To evaluate various complications related to volar locking compression plates and percutaneous k wire fixation of distal radius fracture in adults.

Methods and Materials

Design of the study: This is a prospective study.
 Place of the study: Patliputra Medical College and Hospital, Dhanbad
 Period of study: August 2017 to August 2019

Inclusion Criteria

Patients at least 18 years of age with unstable distal radius fractures.

Fractures are deemed unstable if they had displaced after initial treatment with closed reduction and splinting or if three of the following criteria as described by Lafontaine *et al.* [5] are met:

- Dorsal angulation >20 degrees.
- Dorsal comminution.
- An intra-articular fractures.
- An associated ulnar styloid fracture.
- An age of more than 60 years.

Exclusion criteria

- Fractures with neurovascular injury.
- Non displaced fractures.
- Pathological fractures.
- Open fracture with severe soft tissue loss.
- Fractures with immature skeleton.
- Pre existing Impairment of function of the same limb.
- Distal radius fracture extending to the shaft of the radius and concomitant fracture of the same.
- Multiple injured patients.
- Fracture with incomplete follow up.

Patients admitted were randomly assigned to either k wire group (Group A) OR Volar plate group (Group B).In the K wire group, after closed reduction under image intensifier k wires were applied. In the volar plating group, using modified Henry approach the fracture site is opened and volar plate (3.5mm) applied with the help of image intensifier.

All the cases were regularly followed up at 2weeks, 6 weeks, 3 months, 6 months, 12 months and 24 months. The results were evaluated using functional and radiological grading of DASH [6]. Dash score at 12 months was the primary outcome variable used to determine statistical power.

Results

62% patients with fracture distal radius were included in the study, out of which 31 patients were randomized into group A, which are treated by closed reduction and percutaneous k wires fixation under image intensifier supplemented by cast

and 31 patients in group B were treated by volar locking plate. The mean age of incidence was 44.5±11.94 years, ranging from 30-65 years. In our study, accidental fall (50%) was the commonest mode of injury followed by RTA (45.2%) and other injuries (4.8%). 64.52% patients were female. There was a significant difference between the two group in respect of operative time and blood loss illustrating that percutaneous fixation is much shorter procedure with mean operative time of 30 minutes compared to 60 minutes of open reduction and fixation with volar locking plate and has less blood loss being 15-20ml to 155-200ml with volar plating.

Type of fracture according to Frykman classification.

28 (45.2%) cases were extra-articular (Type I and II) followed by 20 (32.3%) cases were intra-articular fracture involving radiocarpal and radioulnar joint (Type VII and VIII).

Table 1: Showing distribution according to Frykman classification.

Type	K wire group	Volar plate group	Total	Percentage
I	9	6	15	24.2
II	5	8	13	21
III	6	1	7	11.3
IV	1	3	4	6.5
V	2	1	3	4.8
VI	0	0	0	0
VII	4	8	12	19.4
VIII	4	4	8	12.9

AO Classification

28 cases were type A (Extra-articular) and 23 cases were type B (completely intra-articular).

Table 2: Showing distribution of fracture according to AO classification.

Type	K wire	Volar plate	Percentage
A (Extra articular)	14	14	45.2
B (Partial articular)	6	5	17.7
C (complete articular)	11	12	37.1

Duration of Surgery

The mean time taken for k wire group was comparatively lesser than those operated by volar locking plate. P value is 0.001.

Table 3: Showing duration of surgery among different groups.

Duration	K wire	Volar plate
Minutes(Mean)	20.19±4.88(15-30)	49.83±7.0(40-60)

Average Blood Loss

Average blood loss is higher for volar plating group and p value is 0.001.

Table 4: Showing amount of blood loss during surgery among different groups.

Blood Loss	K wire	Volar plate
Amount in ml	8.09±3.59(5-10)	155.48±18.76(120-200)

Duration of Fracture Union (Radiological)

In k wire group 12 (38.7%) patients union is seen by 8 weeks and in volar plate group 9 (29%) patients was seen by 8 weeks. Mean time to complete cortical bridging or radiological union little lower for volar plate group. P value is .004.

Table 5: Showing mean time for union among different groups.

Time of union	K wire	Volar plate
In weeks	7.38±1.02(5-8)	6.67±0.83 (5-10)

Complications

There was no intraoperative or immediate postoperative complication. Late complication encountered in 11 cases of k wire group and 4 cases of volar plate group.

Table 6: Showing different complications among different groups.

Complications	K wire	Volar plate	Percentage
Complex regional pain syndrome	3	0	4.83
Carpal tunnel syndrome	1	0	1.61
Hypertrophic scar	0	3	4.83
Infection	3	0	4.83
Malunion	4	1	8.06
Total	11	4	24.16

Functional outcome

The DASH score was not significantly different between the two groups at 12 months.

Table 7: Showing DASH score of different groups.

DASH score	K wire	Volar plate	P value
3 Months	27.61±4.27 (20-33)	8.16±2.0 (6-12)	<.001
6 Months	15.96±2.88 (9-19)	5.48±1.9 (3-9)	0.008
12 Months	7.00±2.38 (6-16)	6.03±1.87 (4-11)	0.08

Discussion

Fixed angle volar plating and k wire fixation are the important treatment modality for unstable fractures of the distal radius. There is superior radiological outcome with volar plating but did not show the better functional outcome than wire fixation.

In our study, the overall mean age for all patients was 44.5±11.94 years. The age group 41-50 years comprised the highest number (37.09%) of patients. The mean age in k wire group was 46.22±9.44 years and in volar plate group was 42.77±13.94. Costa *et al.* [7] reported that the mean age of patients were 59.7%±16.4 years in patients undergoing wiring method and 58.3±14.9 years in patients undergoing plating method.

It was observed in our study that 35% patients were treated by plating had injury on the left side while 65% patients had an injury on the right side. Patients who were treated by k wire fixation, 36% patients had an injury on the left side while 74% patients had an injury on the right side. Costa *et al.* [7] reported that in patients undergoing wiring, 44% patients had injury on the right side and 53% patients had an injury on the left side. In patients undergoing plating, 44% patients were reported to have injuries on the right side and 54% patients had an injury on the left side. K K Wong *et al.* [8] reported that half of the patients had dominant limb fractures.

In our study accidental fall was the most common (50%) mode of injury followed by a road traffic accident (45.2%). Costa *et al.* [7] also reported accidental fall as a main mode of injury followed by a road traffic accident. Jorge L Orbay *et al.* [9] reported the causes of the fractures in 24 patients were simple falls on the outstretched hand (n=9), work related accident (n=2), motor vehicle accident (n=3).

In our study 45.2% patients were having AO type A fracture followed by type C fracture (37.1%). Costa *et al.* [7] also reported the same 66% cases of Type A fracture in their studies. In Jorge L Orbay *et al.* [9] also found maximum cases

in extra-articular group (17 out of 24 cases).

The mean time to operation from the date since injury for all fractures was 5.09±2.82 days. Mean time was 4.41±2.4 days in k wire group whereas it was 5.77±3.06 days. This is similar to findings of KK Wong *et al.* [8] where the mean time between injury and surgical stabilization was 6.6 days. In study of Anakwe R *et al.* [10], the mean time to surgery was 4 days (range 2-12).

The mean duration of surgery in k wire group was 20.19±4.88 whereas in volar plate group it was 49.83±7.0 days.

The average blood loss was higher for volar plating group. For k wire group average blood loss was 8.09±3.59 ml and for volar plate group was 155.48±18.76 ml.

In our study duration for fracture union in k wire group and volar plate group was 7.38±1.02 and 6.67±0.83 weeks respectively. This was similar to findings of Jorge L Orbay *et al.* [9] where the average time to radiographic union as 7.1 weeks (5-10 weeks).

DASH score of volar plate group at the end of 12 months was 6.03±1.87 whereas DASH score for k wire group was 7.00±2.38. The mean DASH score of the two groups at the end of 12 months was not significantly different. Jorge L Orbay [9] *et al.* found mean DASH score 8.28 and Rozental TD *et al.* [11] found mean DASH score 14 in their studies.

There was pin tract infection in 3 patients underwent k wire fixation, which was managed by antibiotic, early removal of implant. 3 cases of complex regional pain syndrome and 1 case of carpal tunnel syndrome in wiring group which were managed with active physiotherapy and injection of steroid. 3 cases of hypertrophic scar in case of volar plating group which was managed by excision at the time of implant removal. Loss of reduction causing malunion is seen in 4 cases of k wire group and 1 cases of volar plate group due to unstable fixation, high comminution and reduction of postoperative edema with subsequent tissue causing less stretching of the ligaments holding the reduction in place. Costa *et al.* [7] reported that in patients who underwent volar plating, 6% had neurological injuries, 2% had tendon injury and 8% had superficial injuries. Hull *et al.* [12] reported that 33% patients that underwent plating had numbness or tingling and 6% had superficial infection. 11% patients that underwent k wiring were reported to have numbness or tingling and superficial infection.

The patients who were treated with volar plating returned to the pain free independent work 6 weeks earlier than the patients of k wiring.

Conclusion

Open reduction and internal fixation with volar locking plate and closed reduction and percutaneous k wire fixation provide comparable excellent clinical and radiological results in patients with distal radial fractures in early follow up period. The study found no difference in significant functional outcome in patients with displaced fractures of the distal radius treated with k wire fixation or volar plates in the long run. At 12 weeks from the procedure, clinical results seem to favour patients treated with plating, but there were no significant differences between the two types of treatment at long term follow up. The overall results of this review do not demonstrate a clear superiority of either fixation method for the surgical management of distal radius fractures. ORIF with volar locking plating provide better radiological outcomes with more stable fixation thus lesser degree of loss of reduction in comparison to percutaneous k wiring. It also had better range of motion at wrist initially however this

difference is not significant in later months. Distal radius fractures that can be reduced and held reduced with closed reduction and pinning have been shown by this study to have equal functional outcomes compared to those treated with volar locking plates. At medium term follow up there is no difference between groups despite a better radiographic outcome. Volar locking plate is more expensive with more operative time and blood loss as compared to pinning. Unstable intra-articular fractures that cannot be reduced or held reduced with pinning should be treated with locking plate systems. However, K wiring remains a simple and inexpensive option for simple fractures patterns.

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