

SURGICAL OUTCOMES OF VOLAR LOCKING PLATE VERSUS K-WIRES FIXATION FOR DISTAL RADIUS FRACTURES

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Abstract

Background and Objective: The most common hand fractures among adult population are distal radius fractures and optimal management of these fractures remains controversial. Several surgical strategies are available to treat these fractures. Two most commonly used procedures volar locking plates and percutaneous K-wire fixation are used to treat distal radius fractures. The objective of this study was to compare outcome in distal radius fractures in volar locking plate and in K-wire fixation and in terms of functional and clinical outcome.

Methods: We conducted a randomized control trial at department of orthopedic surgery, Services Institute of Medical Sciences Lahore. After approval from the Ethical Review Board, a total number of 80 patients with distal radius fractures fulfilling the inclusion criteria were included. In Group A, distal radius fractures were fixed with volar locking plate and in Group B, K-wires were used to fix the distal radius fractures. Patients with polytrauma, head injury and spine injury were excluded from the study. Follow up was done at 2, 4, 6 weeks, 3 months and final at 6 months. Functional and clinical outcomes were measured with DASH Score and PREW Score at 3 months and 6 months.

Results:- Age range was 18-80 years, mean age was 61.3 ± 14.5 years. Mechanism of injury was fall on outstretched hands in 45 (56.2%) patients, fall from height in 20 (25.0%) patients, motorbike accidents in 7 (8.8%) patients, injury after fight in 4 (5.0%) patients and 4 (5.0%) patients were having machine injury. No difference in radiological outcomes was recorded in the final follow up. There was no difference in volar tilt loss. It was 0.5o in plate group and 0.7o in K-wires group ($p = 0.92$). Radial length loss was 1mm in Group A and 1.2mm in Group B ($p = 0.55$). The loss of angle of radial inclination was 1.2° in Group A and 1.5° in Group B ($p = 0.35$) at the final follow up. There were 04 cases of superficial infection in Group B (10%) versus 01 in Group A (2.5%, $p = 0.001$).

Conclusion:- Our study shows that no mode of treatment in distal radius fractures is superior to other. The results of volar locking plate as compared to K-wire fixation were slightly better in the initial period but on long term bases both of these techniques have excellent and comparable results. DASH Score and PREW Score were almost equal in both of these techniques. The functional outcomes were almost equal in both of these techniques. The complication rate although slightly more in K-wires group but it was insignificant from functional point of view.

Keywords:- Distal Radius Fracture, Volar Locking Plate, K-wire, ORIF, and closed reduction.

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The most common hand fractures among adult population are distal radius fractures and it they

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accounts for 25% of fractures in pediatric population and up to 18% elderly people. The incidence still is increasing as life expectancy is increasing resulting in increased number of patients who are at risk of these fractures.¹ These are the second most common fractures after hip fractures. At the times of Hippocrates and Gallen, distal radius fractures were considered as wrist dislocation. In 1783 Pouteau described a series of

forearm fractures including distal radius fractures. These distal radius fractures were termed as Pouteau Fractures in French history. In 1814 the distal radius fractures were reassessed by an Irish surgeon and anatomist Abraham Colles. He described it as a fracture and subsequently it was given the name of Colles Fracture. Jupiter also emphasized with the importance of distal radius fracture reduction in his research published in the journal of bone and joint surgery in 1986. The term distal radius fracture is described as a fracture of the radius around the wrist joint, however the term is misleading as there are several types of distal radius fractures. All these fractures present in different way and have different mechanism of injury and even the management also varies.^{9,10,11} A lot of classifications are used for grading these fractures.^{20,22} However all these are unhelpful for grading the injury and describing the further management. There is no consensus developed up till now regarding the best classification system for distal radius fractures. Frykman classification and other similar classifications do not describe the management plan and interobserver reliability.^{5,6,7,8,9} Different types of distal radius fractures are Colle's Fracture, Smith Fracture, Chauffeur fracture, styloid process fracture, Die-punch fracture and Barton fractures.¹⁴ The most common fractures are distal radius fractures occur as the consequence of fall on an outstretched hand and termed as a Colles fracture and it is a metaphyseal in location about 1.5cm above the wrist articulation along with a dorsal angulation and displacement of distal radial fragment. There is a typical Dinner Fork deformity on X-rays as opposite to Smith fracture which is also called Reverse Colles fracture that occurs due to force applied to dorsum of the hand.^{24,25}

Chauffeur fracture is a fracture with an intra-articular involvement and it also includes the distal styloid process as a consequence of fall on an outstretched hand or there is a blow on back of wrist resulting in dorsiflexion and abduction of wrist joint with the resultant compression of scaphoid against radial styloid process. Another type of fracture called Die-punch fracture which is an intra-articular fracture that involves Lunate fossa of distal radius occurring due to Axial

loading of the lunate that results in impacted fracture of lunate facet of the radius. Another intra-articular fracture is a Barton fracture involving the rim of distal radius which can be volar or dorsal fracture. These are unstable fractures and presentation is usually with dislocation of wrist.

There is no agreement on specific treatment of distal radius fracture despite adequate data is available on different treatment modalities depending on the age, fracture pattern and stability of the fracture. A stable and minimally displaced fractures, mostly the conservative treatment is used by applying plaster of paris (POP) cast and for the a comminuted and grossly displaced fractures external fixator and pin plaster procedure with external fixation devices is used. Additionally a K-wires fixation with or without bone graft where necessary can be used.⁶ Intrafocal pinning and arthroscopic assisted reduction of the fractures is also used for distal radius fractures.^{15,16} Internal fixation with plates are reserved for gross comminution or displacement with unacceptable reduction. Locking plate and fixed angle plates are also other options for these fractures.^{2,3,4,5,23} Dorsal plating with low profile plates and fragment specific plates are also successful in treating these fractures.^{17,18,19}

Distal radius fractures can occur at any age but usually children less than 14 years and adults 50 years and above are the most commonest age groups involved. The peak incidences of these fractures among children are 10-12 years in girls and in boys usually 12-14 years. It is because of decreased bone density and mineralization during this pubertal growth spurts. Usually at this age bone length is increases with a slow rate of mineralization, making radius bone to become susceptible to fracture even with minor trauma.²¹ Second peak occurs in patients above 40-50 years. In females, osteoporosis is a factor responsible for these fractures and it accounts for 40% of these fractures and a 10 years fragility fracture risk of around 15% is usually indicated by a T-score of -2.5 and other risk factors for these fractures includes an old age, dementia, corticosteroid intake, diabetes mellitus etc.

Among young adults distal radius fractures,

usually occur as consequences of high energy trauma such occurring in road traffic accident, fall from height and sports injuries. The incidence is more common in males before 40 years as compared to females but after 40 years, the incidence of distal radius fractures increases in females.^{2,3,4} In older population the cause of these fractures is low energy trauma to bone with osteoporosis. Fracture pattern, management and complications differ according to age groups.^{12,13}

METHODS

We conducted this prospective randomized control trial at department of orthopedic surgery Services Hospital Lahore. After permission from hospital ethical review board, through temporal sampling 80 patients with distal radius fractures, admitted through emergency department of this hospital were reported during the period of study and they were all recruited. After written consent each patient was counseled regarding the procedure. The age of the patients in both groups was 18-80 years. After admission each patient had x-ray of radius and ulna with wrist and elbow joints both AP and Lat views. In Group A all patients underwent volar locking plate fixation for distal radius fractures and in Group B distal radius fractures were fixed with K-wire. All these patients were operated in the emergency operation theater within 6 hours after the admission. Patients with polytrauma, open fractures, head injury and patients with associated spine injuries were excluded from the study. The patients were discharged between 3-5 days after the surgery.

Follow Up

Each patient was followed at 2, 4, 6 weeks, 3 months and final follow up at 6 months. At each follow up functional and clinical outcomes were measured with DASH Score and PREW Score at 3 months and 6 months. X-rays were done post-operatively at 2, 4, 6 weeks, 3 and at 6 months. Radial length, volar tilt and angle of inclination were assessed on these follow up visits.

Statistical Analysis:-

Statistical evaluation was conducted using SPSS.

DASH and PREW score was presented as Mean and standard deviation and frequency and percentages for nominal variables like complications. Student t-test was used to compare DASH and PREW score for functional outcome. A p-value of ≤ 0.05 was considered as significant.

RESULTS

Age range was 18-80 years mean age was 61.3 +14 years. Mechanism of injury was fall on outstretched hand in 45 (56.2%) patients, fall from height in 20 (25.0%) patients, motorbike accidents in 7 (8.8%) patients, injury after fight in 4 (5.0%) patients and 4 (5.0%) patients were having machine injury. Functional outcome was measured by DASH and PRWE Scores in both of these groups. After 3 months of follow up DASH score was almost equal in both groups. It was 7.4 in Group A and 7.3 in K-wire group ($p < 0.001$). There is no clinically important difference at 3 months in both of these groups. At 6 months, the mean DASH Score was 3.5 in volar locking plate group and 3.8 in K-wires group ($p < 0.004$) which was still unimportant clinically at the final follow up at 6 months. (table no: 1). There was also no difference in both of these groups in terms of patient rated risk evaluation score (PRWE) either at 3 months and at final follow up at 6 months.

Wrist movements were almost equal in both of these groups. Flexion and supination loss at 3 month follow up was 3.9° in volar locking plate group and was 4° in K-wires group. No difference was found at 6 months follow up in both of these groups. Similarly no difference was found in wrist pronation and extension, radial or ulnar deviation at 3 and 6 months follow up.

No difference in radiological outcomes was recorded in the final follow up. There was no difference in volar tilt loss. It was 0.5° in plate group and 0.7° in K-wires group ($p = 0.92$). Radial length loss was 1mm in Group A and 1.2mm in Group B ($p = 0.55$). The loss of angle of radial inclination was 1.2° in Group A and 1.5° in Group B ($p = 0.35$) at the final follow up.

The numbers of complications in Group A were less as compared to Group B. There were 04 cases of

superficial infection in Group A (10%) versus 01 in Group B (2.5%, $p = 0.001$). All these infections were treated with I/V antibiotics and all these settled after 7 days.

DISCUSSION

The most frequently occurring upper limb fractures treated by orthopedic surgeons are Distal Radius Fractures. These account for 15-25% of all fractures¹. For decades conservative treatment and closed surgical intervention with K-wired has been used to fix distal radius fractures but the volar locking plate osteosynthesis was claimed to be a gold standard. In comparison to percutaneous K-wires osteosynthesis, no difference could be established with volar locking plate for these

in both of these treatment modalities in consistent with Abe et al study.¹⁴ The overall complication rate was lower in Group A but still these differences were not statistically significant.

M. Sanjay et al in 2017 used volar locking plate and K-wires for fixation for distal radius fractures with K-wires and volar locking plate concluded in their study that both these techniques give the similar results. Volar plate requires more precision and soft tissues dissection. However, crossed K-wires do not require the opening of fracture site and have provided a sort of biological fixation.²

Franceschi F et al. in systematic review at quantitative synthesis on volar locking plate versus K-wires fixation for fracture treatment of distal radius is also found out no statistical difference regarding radiological findings, range of motion (ROM), grip strength, and complications. The study concluded a non-superiority for either of these fixation techniques in surgical management of distal fractures of radius.⁹

M.L. Costa et al. in their study reported 461 patients with distal radius fractures that were dorsally displaced treated either with volar locking plate or fixed with K-wires showed no statistically significant difference in wrist function, pain or quality of life for these patients.⁴

The study of Brennan SA et al on the volar plating as compared to K-wires for fixation of distal radius fractures although showed that the volar plate treatment had superior radiological outcomes but these did not translated into superior functional outcomes.⁵

Anderson MS (2017) in his study is of the view that the fixation with K-wire fixation is relatively a low cost treatment along with reproducible similar radiological and clinical outcomes when compared to volar locking plate.⁸

In a meta-analysis treatment of distal radius fractures by volar locking plate or fixation with K wire DJ Youlden et al concluded that outcome of volar locking plate or fixation with K-wire demonstrate similar radiological and functional outcomes in distal radius fractures in short and intermediate terms.¹⁰

Table 1: Functional outcome DASH Score

Functional outcome N=80		Group A (n=40) (volar locking plate) Mean $\pm$ SD	Group B (n=40) (K-Wire plate) Mean $\pm$ SD	P Value
DASH Score	3 month	7.4 $\pm$ 1.8	7.3 $\pm$ 1.5	P = 0.001
	6 month	3.5 $\pm$ 0.45	3.8 $\pm$ 1.5	P = 0.004
PRWE Score	3 month	28.6 $\pm$ 10.49	30.8 $\pm$ 12.71	P = 0.401
	6 month	16.4 $\pm$ 11.50	14.9 $\pm$ 10.62	P = 0.546

fractures^{3,7}. Previously, K – wire treated distal radius fracture with volar locking plate have been a trend among surgeons up till now reason being that the main theoretical advantages is early recovery of function due to internal fixation of these fractures offered by these locking plate and a possibility of obtaining an optimum restoration of wrist anatomy due to a constant maintenance of reduction and a direct visualization of fracture.^{11,17-19} A lot of studies show that both of these techniques are comparable to each other for fixation of distal radius fractures. DASH Score was almost comparable in our study in 3 and 6 months follow up in both modes of treatment. Regarding the PRWE Score, there was also no difference in both of these groups.²³

In the radiological outcomes Radial height, angle of inclination and volar tilt among both groups (K-wire and Volar locking plates) were not significantly different. Both of these techniques provide excellent results and there was no statistical significant difference

All these studies are comparable to our study that K-wire fixation versus volar locking plate for treatment of distal radius fractures fixation yield similar radiological and functional outcomes. Our study contradicts the increasing use of locking plate for distal radius fractures fixation and improved functional outcomes. This study concluded that there was no statistical or clinical difference between the functional and subjective outcomes for both techniques.^{12,13}

CONCLUSION

Our study shows that no mode of treatment in distal radius fractures is superior to other. Though the result of volar locking plate in comparison to K-wire fixation was slightly better in the initial period but on long term bases both of these techniques have excellent and comparable results. DASH Score and PREW Score were almost equal in both of these techniques. The functional outcomes were almost equal in both of these procedures. The complication rate although slightly more in K-wires group but it was insignificant from functional point of view.

Conflict of Interest

None

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