



FUNCTIONAL OUTCOME OF CLOSED REDUCTION AND CAST APPLICATION VERSES CLOSED REDUCTION AND PERCUTANEOUS K-WIRE FIXATION FOR DISTAL END OF RADIUS FRACTURES

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ABSTRACT

Introduction: Fracture of the distal radius is the most common fracture. Mal-union of the distal radius has been associated with pain, stiffness, weak grip strength and carpal instability even after the fracture has healed. There are multiple treatment options in the treatment of distal radius fractures, including closed reduction and cast immobilization, percutaneous K-wire fixation (kapandji intra-focal pinning, trans-radial styloid pinning, pinning via the Lister's tubercle or trans-ulnar pinning), fixation with volar or dorsal plates (locking or non-locking), bridge plating, use of an external fixator by means of ligamentotaxis to realign fracture displacement. Still there are treatment controversies as there is no single definitive modality which is considered the standard of care. **Material and Method:** This randomized prospective comparative study had 56 patients with fractures of distal radius (Frykman type I-VIII) were included in the study. All the patients were randomly divided into two groups. In the group A, patients were treated by closed reduction percutaneous K-wire application with below elbow slab application, while in the group B, patients were treated by closed reduction and below elbow cast application. All the patients were followed up and functionally evaluated by the demerit scoring system of Gartland and Werley (1951) at 6 weeks, 12 weeks and 6 months. **Results:** Out of 56 patients in this study, 30 patients were females and 26 were males. Mean age with standard deviation of group A and group B was 40.66±16.72 and 48.81±14.65 respectively. In group A and group B, fracture distribution according to FRYKMAN classification, type I-II fracture was 33.3% and 54.5% and type VII-VIII fracture was 17.9% and 4.5 % respectively. 36 had intra-articular fracture and the remaining 20 patients had extra-articular fracture. According to Gartland and Werley demerit scoring, at 6 month follow up, 40%+48.6% patients had excellent and good results in group A as compared to 47.6%+38.1% patients in group B. Comparable number of patients had deformity in both the groups i.e 12 in group A and 10 in group B. Finger stiffness was found in 3 patients in group A and 2 patients in group B. In group A 11 patients had arthritis as compared to group B had 15 patients. Median nerve compression was found in 1 patient in each group. **Conclusion:** Closed reduction and k-wire stabilization is marginally superior to closed reduction and Cast application in terms of final functional outcomes. CR and casting can be an easy, non-invasive and safe option to treat fractures of distal radius if patients are carefully chosen.

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INTRODUCTION

Fracture of the distal radius is the most common fracture encountered, approximately one sixth of all fractures seen in emergency.^{1,2} Mal-union of the distal radius has been associated with pain, stiffness, weak grip strength and carpal

instability even after the fracture has healed, in a significant number of patients. Long term consequences include degenerative arthritis in up to 50% of patients with even minimal displacement in the young adult population.³

There are multiple treatment options in the treatment of distal radius fractures, including closed reduction and cast immobilization, percutaneous K-wire fixation (Kapandji intra-focal pinning, trans-radial styloid pinning, pinning via the Lister's tubercle or trans-ulnar pinning), fixation with volar or dorsal plates (locking or non-locking), bridge plating, use of an external fixator by means of ligamento-taxis to realign fracture displacement.⁴ Still there are treatment controversies as there is no single definitive modality which is considered the standard of care. There are numerous factors to consider before selecting the treatment modality, it includes patient's age, lifestyle, associated medical conditions, functional demands, dominance of hand, type of fracture, alignment of fracture, condition of soft tissues, whether the fracture is open or closed and concomitant fractures. All these factors play a paramount role in the final decision in the treatment of the distal radius fracture.⁵

The goal of treatment for distal radius fractures is to obtain sufficient pain-free motion, allowing return to activities while minimizing the risk for future degenerative changes or disability. The functional outcome following a plaster cast immobilization is determined by stability of fractures. The treatment of complex fractures in plaster casts gives a rate of malunion that is more than 70%. For un-displaced distal radial fractures, little or no immobilization is necessary. If reduced fractures are stable, re-displacement is unlikely to occur.⁶ Percutaneous K-wire stabilization is a widely accepted treatment option. It is attractive because it is minimally invasive and relatively simple and quick to perform compared with the other modalities. The time of plaster immobilization can be shortened, it can be used in all fractures that can be reduced by closed means and minimizes the use of fluoroscopy. However, additional procedures are necessary to remove the pins and complications can occur, such as further fracture displacement, tendon ruptures and pin breakage.⁷

Since, there is no consensus on its functional outcome in comparison to closed reduction and casting. It is unclear whether percutaneous pinning produces superior results to conservative treatment.⁸ Only a few studies have compared closed reduction and casting with K-wire fixation after closed reduction. This Study aims to determine the functional outcome of closed reduction and cast application verses closed reduction and percutaneous K-wire fixation for distal end of radius fractures.

MATERIALS AND METHODS

This randomized prospective comparative study had 56 patients and was conducted in the Department of Orthopedics, Dayanand Medical College and Hospital, Ludhiana from January 2017 to June 2018. Patients with fractures of distal radius (Frykman type I-VIII) were included in the study after fulfilling all the inclusion and exclusion criteria. All patients were examined for deformity, swelling, tenderness, bony irregularities of distal radius and relative position of radial and ulnar styloid process. Patients of all age groups after skeletal maturity (>18 years) were included in this study with both intra-articular (radio-carpal and distal radio-ulnar joint) and extra-articular fractures of distal radius (Frykman type I-VIII). All the patients were randomly divided into two groups. In the group A, patients were treated by closed reduction percutaneous K-wire application with below elbow

slab application, while in the group B, patients were treated by closed reduction and below elbow cast application. All the patients were followed up and functionally evaluated by the demerit scoring system of Gartland and Werley (1951) at 6 weeks, 12 weeks and 6 months. On each follow up all patients were clinically assessed with range of movements of the wrist, hand, fingers, pain deformity and for any complication arising from fracture.

RESULTS

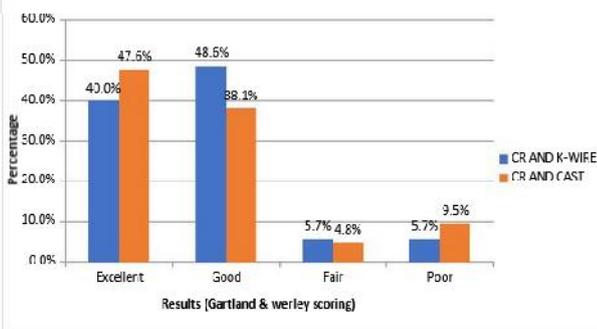
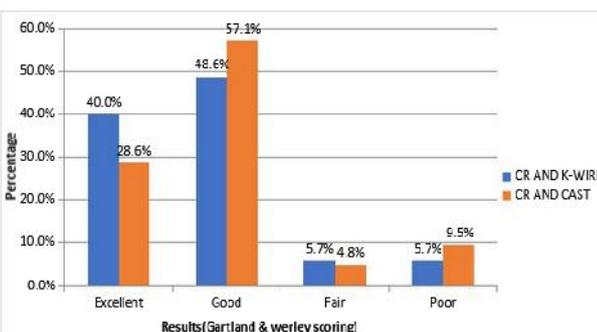
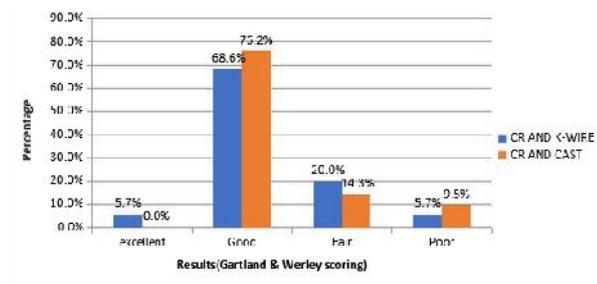
Out of 56 patients in this study, 30 patients were females and 26 were males. Gender distribution in both the groups were comparable with F:M ratio was 1:1.15. Mean age with standard deviation of group A and group B was 40.66 ± 16.72 and 48.81 ± 14.65 respectively. However, patients with age between 21-30 years were more (25.6%) in group A as compared to 9.1% in group B. Conversely, patients with age >60 years were more (31.8%) in group B as compared to 15.4% in group A. Side involvement was comparable in both the groups, 17 (60.7%) patients had right side involvement and 11 (39.3%) patients had left side involvement in group A as compared to group B in which 19 (67.9%) patients had right side involvement and 9 (32.1%) patients had left side involvement. Road Side Accident (RSA) was the cause of injury in 29 patients while in 27 patients suffered injury due to fall. In group A, 11 (39.3%) patients sustained injury by fall and 17 (60.7%) patients by RSA, as compared to group B, in which 18 (64.3%) patients sustained injury by fall and 10 (35.7%) patients by RSA. Both the groups were comparable with respect to mode of injury. In group A and group B, fracture distribution according to FRYKMAN classification, type I-II fracture was 33.3% and 54.5% and type VII-VIII fracture was 17.9% and 4.5 % respectively.

Out of 56 patients, 36 had intra-articular fracture and the remaining 20 patients had extra-articular fracture. In group A 17 (60.7%) patients had intra-articular fracture as compared to 19 (67.8%) patients in group B. According to Gartland and Werley demerit scoring, at 6 weeks of follow up, excellent and good results in group A and group B was $68.6\% + 5.7\%$ and $76.2\% + 0\%$ respectively. $20\% + 5.7\%$ and $14.3\% + 9.5\%$ patients had fair and poor results in group A and group B respectively. Though no patient showed excellent result in group B but overall functional results at 6 weeks of follow up was comparable in both the groups and was found to be statistically insignificant ($p=0.612$). According to Gartland and Werley demerit scoring, at 12 weeks of follow up $40\% + 48.6\%$ patients had excellent and good results in group A as compared to $28.6\% + 57.1\%$ patients in group B. In group A $5.7\% + 5.7\%$ patients had fair and poor results as compared to $4.8\% + 9.5\%$ patients in group B respectively. Though more patient had excellent and good result in CR and k-wire group at 12 weeks of follow up but overall result was found to be statistically insignificant ($p=0.812$).

According to Gartland and Werley demerit scoring, at 6 month follow up, $40\% + 48.6\%$ patients had excellent and good results in group A as compared to $47.6\% + 38.1\%$ patients in group B. In group A $5.7\% + 5.7\%$ patients had fair and poor results as compared to $4.8\% + 9.5\%$ patients in group B. The overall results at 6 month follow up were found to be statistically insignificant ($p=0.825$).

In group A, 1 patient had infection compared to no patient in group B. Comparable number of patients had deformity in both the groups i.e 12 in group A and 10 in group B. Finger stiffness was found in 3 patients in group A and 2 patients in group B. In group A 11 patients had arthrititis as compared to group B had 15 patients. Median nerve compression was found in 1 patient in each group.

	GROUP A	GROUP B
INFECTION	1 (3.6%)	0
DEFORMITY	12 (42.8%)	10 (35.7%)
FINGER STIFFNESS	3 (10.7%)	2 (7.1%)
ARTHRITIS	11 (39.3%)	15 (53.6%)
MEDIAN NERVE COMPRESSION	1 (3.6%)	1 (3.6%)



DISCUSSION

Distal radius fractures are among the most common orthopedic forearm injuries but the treatment options are variable.⁹ Anatomical reduction can usually be achieved by closed methods, however methods of immobilization are controversial. An external support such as a cast is generally acceptable treatment especially for extra-articular fractures but some studies point out that reduction may not be maintained.¹⁰ Percutaneous pinning is an another widely accepted alternative to maintain the reduction. The functional outcome is considered to depend mainly on radiographic results whereas many studies advocate that the functional outcome is independent of the radiological outcome.¹¹

In our study, age varied from 18 to 95 years with a mean age in group A was 40.66±16.12 as compared to 48.81±14.65 in group B. This however was statistically insignificant with p-value of 0.223. Out of total 56 patients, 30 (53.6%) patients were females and the remaining 26 (46.4%) patients were males. Fractures of distal radius has always been related to Age. Young adults usually sustain this injury as a result of high-energy trauma, such as a traffic accident. In older adults, especially females, the fracture more often results from low-energy or moderate trauma, such as falling from standing height. This reflects the greater fragility of the bone, resulting from post-menopausal osteoporosis.¹²

36 (64.2%) patients had their dominant hand involvement as compared to 20 (35.7%) patients in whom non-dominant side was involved. There was no statistical correlation of injury to dominant hand with the final functional outcome. As excellent or good results at 6 month follow up were achieved in 31 (86.1%) out of 36 patients involving dominant side as compared with 18 (90%) out of 20 patients having injury to non-dominant limb. Das et al also observed similar trends in their study to evaluate percutaneous pinning in non-comminuted extra-articular fractures of distal radius. Mean age in their study was 41.4 years (range 18-70 years). 18 patients were males and 14 were females. Of the total 32 patients, 21 patients had involvement of Dominant hand as compared to 11 patients who sustained injury to non-dominant hand.² Demographic trends observed by knirk and Jupiter, in their retrospective study the mean age was 27.6 years. 25 fracture (58%) involved the dominant limb, 27 fractures occurred as a result of fall (15 falls being of substantial height) in non-dominant limb. Motor vehicle accidents caused 13 fractures. They found no statistical correlation between limb dominance and final result. In their study, excellent or good results were achieved in 15 (60%) out of 25 patients that involved dominant side as compared with 11 (61%) out of 18 patients in non-dominant limb.¹³ Majority of fractures in our present study were Frykman type I and II (46.4%), followed by Frykman type III and IV (18.2%) involving only radio-carpal joint. Only 23.2% of patient were having Frykman type VII and VIII fractures. In present study the follow-up examination included subjective, objective, deformity and complication evaluations. These subjective, objective, deformity and complication findings were then quantified by the Demerit Scoring System of Gartland and Werley (1951). At 6 month follow up, excellent outcomes in 40% patients, good outcomes in 48.6% patients, fair in 5.7% patients and poor outcomes in 5.7% patients in group A and group B, excellent outcome in 47.6% patients, good outcome in 38.1% patients, fair outcome in 4.8% patients and poor outcome in 9.5% patients. Group B had more excellent results as compared to Group B, but number of patients having poor results were also more in Group B. Overall number of satisfied patients 88.6% were slightly higher in group A as compared to 85.7% group B. Our findings very well correlated with Azzopardi et al. who found that the improvement in functional outcomes for grip strength, range of movements and pain in patients treated by supplementary wires was not statistically significant, except for the range of movement in ulnar deviation. He correlated these with the small differences in radiological parameters which were therefore of no clinical significance. He concluded that supplementary fixation by K-wire was only marginally superior to cast immobilization alone in reducing displacement of the fracture after closed manipulation.

And that supplementary K-wires did not provide better clinical outcomes in unstable, extra-articular, dorsally angulated, fractures of the distal radius.¹¹ Similar inferences were made by Stoffelen et al. Closed reduction and plaster cast was used in 50 patients. 48 patients were treated by Kapandji pinning. 74% patients were found to have Good and excellent scores in closed reduction and plaster cast group as compared to 75% in the kapandji-pinning group. So, they concluded that both treatments gave similar end results at 1 year follow up.⁷ Our findings were in contrast with Rodríguez-Merchán EC et al found that functional results in the pinning group were better (excellent, 12; good, 6; fair, 2) than in the plaster group (excellent, 3; good, 8; fair, 5; poor, 4). Anatomic results also were better in the pinning group. He concluded that the best anatomic and functional results were obtained by percutaneous pinning. Although the cost of pins and plaster treatment is significantly greater than plaster treatment, the author believed that the positive end result justifies the cost.¹⁴ Deformity was observed in 22 (39.3%) of our patients which we believe resulted from mal-union of fractures. Patients invariably remained less satisfied whenever deformity was present. There was positive correlation between degree of deformity and subjective evaluation of patients. Presence of deformity seemed to be unrelated to the type of treatment utilized as both CR and K-wire and CR and Cast group had comparable incidence of 42.8% and 35.7% respectively. Hence deformity can be attributed directly to mal-union of distal radius fractures as a result of initial displacement of fracture. McQueen and Caspers conservatively treated patients for displaced distal radius fractures and concluded that a mal-union of Colles' fracture results in weak, deformed, stiff, and painful wrist and these patients had difficulty in daily living.¹⁵ Arthritis was another important complication which was seen in 26 (46.4%) of our patients. It was more prevalent in group B (53.6%) when compared to group A (39.3%).

However, only 16% patients were disturbed by this arthritic pain and were dissatisfied. Daycian et al also noted arthritic changes in 63 (58.3%) of their patients but only 12 (19%) of these were in dissatisfied group. They also stated that due to this complication further surgical treatment was not always necessary. Also, arthritic wrists were not always painful or cause symptomatic disability.⁹ Gartland and Werley also noted arthritis in 88% of their cases (group II and III). The development of traumatic arthritis was largely determined by the amount of bone damage incurred at the time of injury. However, in many cases this complication can be avoided by accurate reduction and efficient immobilization. Thus, if traumatic arthritis does develop, it can result only from one of time following causes, or a combination of them: severe trauma to the distal radial articular surface, inadequate reduction, or inefficient immobilization.¹² Finger stiffness was present in 8.9% of patients. Only a marginally higher incidence 10.7% was seen in group A as compared to group B (7.1%). Stoffelen et al also compared finger stiffness between the 2 groups but there was no significant difference between the two in terms of finger stiffness. They concluded that even though plaster was only applied for 1 week after Kapandji pinning, finger movements were still restricted as long as the pins were in place.⁷

Conclusion

Closed reduction and k-wire stabilization is only marginally superior to closed reduction and Cast application in terms of

final functional outcomes. CR and casting can be an easy, non-invasive and safe option to treat fractures of distal radius if patients are carefully chosen.

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