

A prospective study on functional, clinical and radiological evaluation of distal radius fracture treated with five percutaneous k-wire

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Abstract

Background: Distal radius fracture has been treated with many surgical techniques of which K-wire fixations was the most common method. Different methods of K-wire fixations were tried but without desired results. Hence, we evaluated the latest modification of 5 k-wire technique for its clinical functional and radiological outcome on distal radius fractures. **Materials and Methods:** 45 Patients between 20 to 70 years of age with AO Type A (2,3), B (1,2,3) and C (1, 2) fractures were included in the study and age less than 20 and more than 70 years, AO Type A1 fractures and patients with Severe Osteoporosis were excluded from the study. **Results:** The mean age of patients in our study was 55.22yrs. The male to female ratio was found to be 0.45 There was no statistically significant association between the age of the patient ($p=0.233$), sex ($p=0.782$), the side of the fracture ($p=0.138$) or type of fracture (0.359) and functional outcome. Clinical assessment showed that patients had mean grip strength of 86.11% of the normal. 88.9% patients had comparable strength to that of the normal side. 33 out of 45 patients had no pain but 10 had mild pain and 2 had moderate pain at 3 months follow up. The functional outcome analysis with the demerit scoring system of Gartland and Werley 41(91.1%) and Mayo Wrist score (93.3%) patients had excellent results Radiological assessment of Sarmiento modification of Lindstrom criteria showed 16 of the 45 patients has excellent result (35.6%) and 29 had good (64.4%) and no fair or poor results. Only one patient had pin tract infection. **Conclusion:** This technique of K-wire fixation was found to be more stable than the usual K-wire technique due to the 5th K-wire which counters the effect of supinator, pronator and the biceps preventing re-displacement of the fracture enabling early active mobilization of the wrist and fingers preventing stiffness. (43.50)

Key Words: Distal Radius Fractures, K-wire Fixation, 5-K-wire technique

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INTRODUCTION

Fracture of distal radius occurs about an inch from the radio carpal joint. It is one of the most commonly treated fractures globally. Approximately 1/6 of all

fractures and 1/5 of all hand injuries in developed countries are distal radius fractures.^{1,2,3,4} Fracture of distal end of radius is usually a result of high-energy trauma, such as road traffic accident. In elderly individual, this fracture is due to low-energy or moderate trauma, such as trivial fall on outstretched hand.¹ Although the fracture pattern shows a bimodal age distribution it is more seen with an increasing age. Eight-fold increased risk of sustaining a fracture for females compared to males¹, a higher incidence in the winter with snow¹ and in areas with a high prevalence of osteoporosis.^{1,2} Numerous classifications have been devised to define and group different fracture patterns¹ One of the most commonly used classification systems is the AO (Arbeitsgemeinschaft fur Osteosynthesefragen) system which has been used in

this study for classification. In ancient times wood splints and cloth were used for immobilising the fractures for 20 days. The importance of reduction was realised in the middle ages. Closed manipulative reduction and below elbow cast immobilization has been the mainstay of treatment ever since but malunion and poor functional outcome of the wrist was a major challenge. All these were attributed to radial collapse due to unstable reduction. After much refinement in treatment of distal radius fractures many problems remain unsolved, especially in unstable fractures. Complications are as common as the controversies regarding the management of these fractures. Many surgical techniques have been used in the treatment of distal radius fracture². The corner stone in the management is the anatomical reduction¹, maintaining the reduction until union and early mobilization¹ Failure to maintain reduction of the fracture fragments and instability of distal radio ulnar joint are the major pitfalls in obtaining satisfactory results. Wrist and hand functions are adversely affected in malunion by disrupting the mechanical advantage of the extrinsic hand musculature.² This result in weakness of handgrip and return to pre-injury activity level is almost impossible. Early mobilization prevents stiffness of the wrist¹ Percutaneous K-wire fixation was the earliest form of internal fixation established to provide better stability. It is a cost effective, minimally invasive, simple technique which uses limited operative hardware with adequate stability. Percutaneous pinning involves the percutaneous insertion of Kirschner wires after closed manipulative reduction. Many authors have proved percutaneous fixation of wrist fractures to be a more stable method of fixation.¹⁻⁵ A variety of different pinning techniques have been described in the literature. The latest modification of percutaneous pinning is using 5 pin technique which is said to maintain the reduction and provide complete stability to radio ulnar joint. Hence a descriptive study to evaluate this new technique of treatment in fractures of distal radius by using five percutaneous Kirschner wire fixation is planned. Criteria for an acceptable reduction and the optimum technique to achieve and maintain it, are not clear for each fracture types in each age groups. The main extra articular criteria include the volar tilt, radial inclination, and the radial height. Although extra-articular criteria are important, there is a great deal of evidence that the most important is the accuracy of the restoration of the articular surface. However, the largest tolerable articular stepoff is 2mm. Lafontaine's radiographic criteria for instability include Dorsal angulation >20°, Dorsal comminution >50%, Palmar comminution, Intra-articular comminution, Initial

displacement >1cm, Initial radial shortening >5mm. Associated ulnar fracture, Severe osteoporosis Displacement of >2mm, shortening of >5mm, and dorsal angulation of >20° have shown to cause an increased incidence of arthritis and decreased wrist motion, 50% decrease in grip strength and wrist instability in the long run.

MATERIALS AND METHODOLOGY

The present study was conducted for a period of 24 months after getting scientific and ethical clearance from institutional research board in a tertiary care centre. Written informed consent was taken from all participants enrolled for the study.

Inclusion Criteria:

- AO classification A (2,3), B (1) and C (1, 2)
- Age group between 20 to 70 years

Exclusion Criteria:

- AO Classification A1 B2,3 and C3
- Severe Osteoporosis
- Age less than 20 and more than 70 years

Sample size:

Previous studies on 3 and 4 K-wire showed >90% increase in functional outcome. The required sample size is calculated using the formula $4pq/d^2$ for a precision of 9 is 42.7, approximately taken to be 45.

OBSERVATIONS AND RESULTS

A total of 45 cases of distal radius fracture with AO type (2,3), B 1 and C (1, 2) with age group between 20 to 70 years from October 2012 to April 2015 were evaluated from my study. The following observations were made after analysis of the data using statistical package, SPSS 17. Percentage and frequency were used to assess the demographic data like age, sex, mechanism of injury, fracture type etc. The functional outcome was assessed with Mayo's wrist score and Demerit point system of Gartland and Werley. Majority of the patients with distal radius fracture falls into the age group of 51 to 60yrs with a mean age of 55.2 years, 68.9 percent being females and 31.1 males, 68.9 percent of the patients were housewives followed by a 13.3 percent of community workers 66.7 percent right side and 33.3 percent on the left side. The fracture was extra-articular in 24.5%, 31.1 % partial articular and 44.4% intraarticular fractures. Fracture distribution shows that majority of the fracture falls into AO type C1 followed by B1 and A2. The Functional Outcome was assessed using Demerit point system of Gartland and Werley and Mayo wrist score which include individual assessment of pain intensity, functional status, range of motion and grip strength. 33 out of 45 patients had no pain but 10 has mild pain and 2 has moderate pain at 6 months

follow up. 68% of the patient were able to return to their previous work without any functional disability 26.7 patients had restricted functional ability even though they returned to the same profession but 4.4% i.e. 2 patients had to quit job due to functional disability but have not taken up further jobs. 44 (95.6 %) of 45 patients have >120-degree range of motion of the wrist and only 1 patient had ROM of 115. 40 (88.9%) patients has comparable strength to that of the normal side but 5(11.1%) had grip strength between 75 to 99% of the normal.

Table 1: Functional Outcome by Gartland and Werley

Functional Outcome	Frequency	Percent
Excellent	41	91.1
Good	4	8.9
Total	45	100.0

According to Demerit scoring system of Gartland and Werley, 41 patients had excellent results and 4 patients had good results. None of the patients have fair or poor results. The residual deformity, subjective evaluation of pain and disability, objective evaluation of range of motion of the wrist and complication were considered while determining the score.

Table 2: Functional scoring by Mayo wrist score

Mayo Wrist Score	Frequency	Percent
Excellent	42	93.3
Good	2	4.4
Satisfactory	1	2.2
Total	45	100.0

Functional scoring system by Mayo Wrist score shows a 93.3 percent of excellent results and 4.4 percent of good results. We had one satisfactory result in one patient with pin tract infection which lead to the early removal of the K-wire.

Sarmiento`s modification of Lindstrom criteria took into consideration residual deformity, loss of palmar tilt, radial shortening and loss of radial deviation for radiological assessment. Out of the 45 patients 43 of them did not have any deformity and only 2 had slight deformity. Out of the 45 patients 44 had loss of palmar tilt of less than 10 degree with one patient having 11 degree which was in the patient with pin tract infection. 20 patients had less than 3mm of radial shortening, 24 patients between 3 to 6 and only one patient had 8mm of radial shortening which is the maximum shortening attributed to the early removal of the K-wire due to pin tract infection. 25 out of the 45 patients had loss of radial inclination of < 5 degree and 19 patients had between 5 and 9 degree. Only one patient had 11-degree loss of radial inclination who had pin tract infection and lead to early removal of the K-wires.

Table 3: Radiological assessment by Lindstrom criteria

Radiological evaluation	Frequency	Percent
Excellent	16	35.6
Good	29	64.4
Total	45	100.0

16 of the 45 patients has excellent result (35.6%) and 29 had good (64.4%) and no fair or poor results were there on the radiological evaluation by Sarmiento modification of Lindstrom criteria.

DISCUSSION

Forty-five patients who underwent percutaneous k wire fixation with 5 K-wire technique were evaluated for clinical, functional and radiological outcomes in our study. The mean age of patients in our study was 55.22yrs. There was no statistical significance to the age of the patient (p=0.766). The male to female ratio was found to be 0.45 and majority of it were females who had domestic fall on outstretched hand. No significant association between the age of the patient (p=0.233), sex (p=0.782), the side of the fracture (p=0.138) or type of fracture (0.359) and functional outcome were established. Maximum number of the type of fracture was C1 (24.4%) followed by B1 (17.8%) and A2 (17.8%). Clinical Examination found that our patients had mean dorsiflexion of 94.46%, palmar flexion of 94.52% and radial deviation of 80% and ulnar deviation of 84.77% of normal. Mean Supination is 91.25 and pronation is 94.22% and mean grip strength of 86.11 of the normal. All patients had 89% near normal range of movements on clinical examination. Excellent to good functional outcome by Demerit Point System of Gartland and Werley and by Mayo wrist score were demonstrated in the study. Radiological assessment with Sarmiento`s modification of Lindstrom criteria also showed good to excellent results. Only one patient had pin tract infection which had been treated with 3rd generation cephalosporins and early removal of the K-wire due to loosening. This shows that this technique of K-wire fixation was is far superior when compared with the results of the previous technique. It not only maintained the reduction but help in early active mobilization of the patients affected limb thereby reducing the number of complications.

CONCLUSION

Our prospective study on 45 patients was able to demonstrate excellent results with 91.1% patients and 8.9% patients with good results based on Demerit Point System of Gartland and Werley and 93.3% excellent results and 4.4% good results with mayo wrist score. The mean range of movements was found to be within 2SD of the normal and the complications were within

acceptable limits. This technique of K-wire fixation was found to be more stable than the usual K-wire technique due to the 5th K-wire which counters the effect of supinators, pronators and the biceps preventing re-displacement of the fracture resulting in early active mobilization of the wrist and fingers preventing stiffness. It is a simple closed technique with better functional and radiological results than the conventional K-wire techniques in AO type A (2,3), B1 and C(1,2) fractures.

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