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A randomized prospective study of 40 patients who presented to a tertiary care hospital in Gwalior with fracture of distal end of radius

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Abstract
Background: Distal radius fractures are among the most common fractures of the upper extremity. The incidence of distal radius fractures increases with increasing age, but till now no standard protocol for treatment has been established for different age groups. The challenge of treating a displaced distal fracture is well known to the clinician. Perhaps no fracture in the body is as obiquitous and fraught with potential complications as the distal radius fracture. We conducted a study with the aim to compare the result of close reduction with cast alone and close reduction, K-wire fixation with cast application in fracture of distal radius.
Material and Method: A total of 40 patients presented to GR Medical College, Gwalior from September 2005 to September 2006 with distal radius fracture were included in the study and were treated with either closed reduction with below elbow pop cast application or close reduction with K-wire fixation with below elbow pop cast application. These patients were followed up for at least 6 months after injury. Functional results were evaluated according to Demerit system of Gartland and Werely as modified by Sarmiento *et al*.
Result: The functional outcome was excellent in 10%, good in 60% and fair in 30%cases treated with K-wire fixation and cast application, compared to excellent in 5%, good in 35%, fair in 50% and poor in 10% cases treated with close reduction and cast application. The radiological outcome was excellent in 25%, good in 65% and fair in 10%cases treated with K-wire fixation and cast application, compared to excellent in 10%, good in 50%, fair in 30% and poor in 10% cases treated with close reduction and cast application.
Conclusion: Closed reduction with percutaneous K-wire fixation resulted in better functional and radiological outcome in our series followed up for at least 6 months when compared to closed reduction and cast application alone, probably as the K-wires prevented angulation and collapse which can occur with cast alone when swelling subsided.

Keywords: Distal radius fracture, closed reduction, K wire fixation

1. Introduction
Distal radius fractures are among the most common fractures of the upper extremity. Common mechanism of injury in younger patients include falls from a height, motor vehicle accidents, or injuries sustained during athletic participation. In elderly patients, distal radial injuries may arise from low energy mechanisms, such as a simple fall from standing.
The incidence of distal radius fractures increases with increasing age, nearly in parallel with the increased incidence of hip fractures. But till now no standard protocol for treatment has been established for different age groups. There are equal number of proponents for conservative and operative groups. Various operative treatment modalities like Kirschner wire fixation, volar or dorsal plating and ligamentotaxis have been advocated. The challenge of treating a displaced distal fracture is well known to the clinician. Perhaps no fracture in the body is as obiquitous and fraught with potential complications as the distal radius fracture.
Hence, we conducted a study with the aim to compare the result of two common methods of treatment, i.e., close reduction with cast alone and close reduction, K-wire fixation with cast application in fracture of distal radius. We also evaluated the functional result of fracture of distal end radius treated with these two modalities.

2. Material and method

The present study is a prospective study, which was done in Department of Orthopaedics, G.R. Medical College and J.A. group of Hospitals, Gwalior from September 2005 to September 2006. Patients with closed and compound injuries, irrespective of age and sex were included. A representative cross section of patients of displaced fractures of lower end of radius coming to the hospital were included in the study. The methods of treatment used were closed reduction with below elbow pop cast application or close reduction with K-wire fixation with below elbow pop cast application.

Only those patients who were followed up for at least 6 months after injury were included in the series. Out of 60 patients, only 40 patients fulfilling the criteria of six months follow-up were included in this study. 20 patients were treated with close reduction and pop cast application and 20 patients by application of K-wire fixation with cast application after close reduction.

The fracture was classified according to "AO" classification scheme and were type A-16, type B-20 and type C-4. The initial radiographs were assessed for changes in the radial length and displacement of the distal fragment as described by W. Van Der Linden and R. Erickson [1] and were compared with normal side. The follow up examination included subjective and objective evaluation by Demerit system of Gartland and Werely [2] as modified by Sarmiento *et al.* [3].

The outcome of each fracture was graded as excellent, good, fair or poor. Grip strength was assessed by comparing it to normal side and graded as mild, moderate or severe loss. Most authors have relied on the functional evaluation system of Gartland and Werely [2] who, in turn, had modified the demerit point-system of McBride, which was based on disability evaluation charts. These system evaluate a number of subjective, objective, and radiographic parameters, but they lack objectivity.

The objective evaluation is not quantitative and does not compare the injured extremity with the contralateral side. Patients presenting to us were examined thoroughly by taking history, clinical examination to look for clinical signs of fracture, radiological evaluation was done as described by W. Van Der, R. Erickson [1]. Complete blood investigations like Hb%, TLC, DLC, ESR, CT, BT, Blood sugar and urea were performed.

We used general anesthesia and brachial block for close reduction and operative techniques. Group-1: Treated conservatively by close reduction and Colle's cast application.Group-2: Treated by close reduction and K-wire fixation with Colle's cast application.

Table 1: We used radiographic scoring system of Lidstrom modified by Sarmiento *et al.*

Final Dorsal Angle (^{0})	Loss of Radial Length (mm)	Loss of Radial Inclination	Score for each Measurement
Neutral	< 3	0-4	0
1-10	3-6	5-9	1
11-14	7-11	10-14	2
> 15	≥12	≥ 15	4

Excellent-0, Good 1 to 3, fair 4-6 poor 7-12.

We used the Demerits point system of Gartland and Werely [2] as modified by Sarmiento *et al.* [3] for follow-up evaluation of the fracture of the distal end of the radius.

Final follow up was done by Demerit system of Gartland and Werely [2] as modified by Sarmiento *et al.* [3].

3. Results

In our study out of 40 cases, 20 cases were treated by close reduction with POP cast and 20 cases by K-wire fixation with POP cast. Most of the cases (50%) treated with close reduction with cast application were above 46 years of age, wherein most of the cases (55%) treated with K-wire fixation and cast application were between 26-45 years of age. The extra articular fracture of distal end radius occurs in middle and old age due to low velocity trauma because of osteoporosis. Young individuals may also be affected with extra articular fracture of lower end radius due to low velocity trauma. In contrast, the comminuted intra-articular fractures of distal end radius occur in young and middle aged individuals who are physically active and good bone stock. They are usually associated with high velocity trauma.

In our study, fall on out stretched hand in the most common mode of injury in either sex, 10 (55.5%) cases in males and 15 (68.18% cases in females). In our study, left limb was predominantly involved (55%). The involvement of the dominant or non-dominant limb does not affect the treatment or results. Functional impairment and compromised anatomical and results in the dominant limb would disable the person to greater extent as compared to that in the non-dominant hand.

In our study, 80% of fractures were closed. The violent compression forces and direct trauma of vehicular and occupational injuries may lead to more communication, loss of soft tissue and peri-articular damage and increased incidence of open injuries. The amount of trauma to the soft tissue and peri-articular structures greatly alters the aftermath of any fracture for it affect the functional outcome.

In our study, most of the cases 24 (60%) cases reported to hospital within 5 days of injury and 11 (45.83%) of these cases were treated with closed reduction and cast application and remaining 13 (54.16%) cases were treated with K-wire fixation and cast application. Good to excellent results was seen in patients who reported within one week of injury and were treated with K-wire fixation and cast application, compared to fair to poor outcomes seen in patients who reported after 1 week of injury and treated with close reduction and cast application.

The functional outcome was excellent in 2 (10%) cases treated with K-wire fixation and cast application and in 1 (5%) case treated with close reduction and cast application. Good functional outcome was found in 12 (60%) causes treated with K-wires and cast application and in 7 (35%) cases treated with close reduction and cast application. Fair functional outcomes was found in 6 (30%) cases treated with K-wire fixation and cast application and in 10 (50%) cases treated with CR and cast application. Poor functional outcome was not seen in any of the cases treated with K-wire and cast application but in 2 (10%) cases treatment with CR and cast application.

The radiological outcome was excellent in 5 (25%) cases treated with K-wire fixation and 2 (10%) case treated with case reduction and cast application, good in 13 (65%) cases treated with K-wire fixation and 10 (50%) cases treated with close reduction and cast application, fair in 2 (10%) cases treated with K-wire fixation and cast application and 6 (30%) cases treated with close reduction and cast application and poor in nil cases treated with K-wire fixation and cast

application and 2 (10%) cases was treated with close reduction and cast application.

In our study, finger stiffness was the most common complication seen in 12 (60%) cases treated with K-wire fixation and cast application and 16 (80%) cases treated with close reduction and cast application.

4. Discussion

Distal radius fractures are among the most common injuries treated by orthopedic surgeons. Despite the common nature of these injuries, the treatment options are variable and remain subjected to debate. Orthopaedic advances over the past decade have resulted in the conception that the results after a fracture can be improved by maintaining anatomical reduction. The distal end radius should not be an exception. Close reduction and cast application alone and close reduction, K-wire fixation and cast application are standard technique & treatment of distal end radius.

We performed a randomized prospective trial to assess differences in outcome in these 2 treatment modalities in fractures of distal end radius. Only those cases which were followed up to at least six month after treatment were included in our study. In our study, out of 40 cases, 20 cases (50%) were treated by closed reduction and cast application alone and 20 cases (50%) with closed reduction, K-wire fixation and cast application. Several studies concluded that both technique produce identical result in the treatment of distal end radius fracture. Either of technique may be used according to the need of the patient (D.V.C. Stoffelen and P.L. Broos)

4.1 Age

In our study, most of the patients were between 46-55 years of age with a mean age of 47.9 years. E. Lenoble *et al.* [4] reported average age of 57.66 years in his study. T. Fritz *et al.* [5] reported a mean age of 64 years in his study.

4.2 Sex

In our study, more patients were females (55%) with male-to-female ratio of 1:1.22. T Fritz *et al.* [5] in his study also reported female predominance with male female ratio of 1:4. Similarly, E. Lenoble *et al.* [4] reported female predominance (68%) with male female ratio of 1:2.1. Burk T. Young *et al.* [6] also reported female predominance with male female ratio of 1:3.1 in his study.

4.3 Mode of Injuries

In our study, most of the cases resulted following a fall on out stretched hand (62.00%). Burk T. Young *et al.* [6] also reported fall on out stretching hand as most common (40%) mechanism of the injury in his study.

4.4 Limb involvement

In our study, left limb involvement was marginally more (55%). Similarly it was reported by Burk T. Young *et al.* [6] in his study that involvement of the left limb is 66%, whereas, Lenoble *et al.* [4] reported predominant involvement of left hand (94%) in his study.

4.5 Severity of Injury

In our study, 80% of the fracture were closed and 75% of fracture were without any associated injuries. Most of the patients reported to the hospital within 5 days of injury and discharged within 48 hours of treatment.

4.6 Complication

In our study of 20 cases treated by K-wire fixation and cast application, the common complications were finger stiffness seen in 12 cases (60%). Minor problems seen were residual pain in distal radio-ulnar joint in 5 cases (25%), malunion in 2 cases (10%) and infection in 3 cases (15%).While in 20 cases treated by closed reduction and cast application, the main complication were finger stiffness in 10 cases (80%), residual pain was found in 6 cases (30%) and malunion in 5 cases (25%).

Maurizio Altisimi *et al.* [7] performed a similar study on 297 cases of fracture of distal end of radius and reported the following complications: Osteoarthritis in 51% cases, pain in distal radioulnar joint in 36.4%, radial deviation of wrist in 69%, dorsal Angulation in 64%, prominent ulnar styloid in 56% cases.

4.7 Outcome

Sarmiento *et al.* [8] found 82% excellent to good results in their series by immobilization the fore arm in supination. In our study, we found 42% excellent to good result for 20 out of 40 patient who were treated with closed reduction and below elbow cast application. It was found that the majority of the patient had finger stiffness (80%), which was due to poor compliance during early post-operative rehabilitation period. Out of 20 cases who were treated with closed reduction and cast application, 5 patients (25%) had malunion. Position of wrist immobilization is also a matter of debate. Conventionally the wrist is immobilized in palmar flexion and ulnar deviation.

Ajay Gupta[9] studied position of wrist immobilization found that dorsiflexion of wrist is better position for immobilization. He reported 88% excellent to good result when wrist is immobilized in dorsiflexion and 67% excellent to well with wrist in palmar flexion. We immobilized the wrist in palmar flexion and ulnar deviation and achieved 40% excellent to good results.

4.8 Length of immobilization

Most of authors advocate 6-8 weeks of immobilization. In study of early mobilization of Colles' fracture by TB Mc Auliffe, KM Hilliar *et al.* [10] found 59% excellent or good results after mobilizing the limb after 3-5 week. According to them, even if displaced fracture requiring reduction, functional outcome was good with 3 weeks of immobilization.

In our study, we immobilized the limb for 3-5 weeks and found 40% excellent to good results. Although several studies on the use of percutaneous K-wire fixation for the stabilization of distal radial fracture have been published, their use in elderly population remains controversial. Some believed that distal radial fracture have good outcome regardless of treatment modality (Peltier) [11] but in common with others (Cassebaum) [12], we believed that outcome varies with type of fracture and type of treatment. Most surgeons advocate reduction of fracture but they question whether this is always necessary particularly in elderly patients with a restricted functional requirement.

The results of closed reduction and cast immobilization of distal radial fracture are poor in 13% to 37% of cases (Gartland and Werely [2], Frykman [13], Maurizio Atlissimi *et al.*) [7]. In 20 cases, we fixed the fracture with percutaneous K-wire after closed reduction. DePalma[14] defended ulnoradial percutaneous K-wire fixation. Kapandji[15] proposed the intrafocal placement of K-wires to allow early mobilization with little risk of secondary displacement.

In this series, we aimed to compare the outcome between close reduction and cast application and K-wire fixation with cast application. The outcome was evaluated using functional and radiological parameters.

In evaluating the functional outcome, we used the Demerit system of Gartland and Werely [2] as modified by Sarmiento *et al.* [3] and we found that the functional outcome was excellent in 2 cases (10%) treated with K-wire fixation and cast application and in 1(5%) case treated with closed reduction and cast application, good in 12 cases (60%) treated with K-wire fixation and cast application and 7 cases (35%) treated with closed reduction and cast application, fair in 6 cases (30%) treated with K-wire fixation and cast application and in10 cases (50%) treated with closed reduction and cast application and poor functional outcome was not seen in any case of K-wire fixation but in 2 cases (10%) treated with closed reduction and cast application. For evaluating the radiological outcome, we used the Radiological scoring system of Lid storm criteria modified by Sarminto *et al.* [3] and it found that outcome was excellent in 5 cases (25%) treated with K-wire fixation and 2 cases (10%) treated with closed reduction and cast application, good in 13 cases (65%) treated with K-wire fixation and 10 cases (50%) treated with closed reduction and cast application, fair in 2 cases (10%) treated with K-wire fixation and 6 cases (30%) treated with closed reduction and cast application and poor in none of cases treated with K-wire fixation and in 2 cases (10%) treated with closed reduction and cost application.

The radiological outcome was better in patients treated with K-wire fixation and cast application as compared to closed reduction and cast application. This was probably due to prevention of displacement, angulation and collapse by the K-wires, which may occur in cases treated with cast alone, particularly as the cast loosened with subsidence of oedema.

Similar result was reported by D.V.C. Stoffelen and P.L. Broos [16] in his study, the lateral shift and radial shortening showed significant changes between the two treatment groups. The stable and the unstable fractures treated with K-wire fixation had an average shortening of 2 mm compared with less than 1 mm in the closed reduction and plaster group. The lateral shift was 1.5 mm in the closed reduction and plaster compared to 0.5 mm in the closed reduction and plaster compared to 0.5 mm in the K-wire fixation group.

5. Summary and Conclusion

The present study is a randomized prospective study of 40 patients who presented to the J.A. hospital, Gwalior with fracture of distal end of radius. The mean age of the patient was 47.9 years. Females were predominantly involved with male female ratio of 1:1.22 and mean age of females affected was 41.8 years and increased incidence is seen as the age increased. Most of the patients (62.5%) were injured due to fall on out stretched hand. Females are most commonly injured due to fall on out stretched hand, while males suffered road side accident. Left limb involvement was slightly predominant (55%).Majority of cases (80%) were closed. 25% of the cases were having associated injuries. Most of the cases (60%) presented to the hospital within one week of injury and functional outcome of the patients treated within one week was better than those who presented late.

Most of the patients had type B fracture of A.O. classification. 70 percent of patient treated with K-wire fixation and cast application had excellent to good functional outcome and 40% of cases treated with closed reduction and cast application had excellent to good functional outcome. Finger stiffness was seen in 60% of cases of K-wire fixation and 80% cases of closed reduction and cast application. Minor problems noticed in patient were residual pain at distal radio ulnar joint, restricted movements of wrist. Malunion was seen in 25% cases treated with closed reduction and cast application and 10% cases of K-wire fixation.

Infection was seen in 15% of cases treated by K-wire fixation. Of these, two had only superficial infection which healed with dressing and appropriate antibiotics. One patient with compound fracture had deep infection which resulted in fair result. Closed reduction with percutaneous K-wire fixation resulted in better functional and radiological outcome in our series followed up for at least 6 months when compared to closed reduction and cast application alone, probably as the K-wires prevented angulation and collapse which can occur with cast alone when swelling subsided.

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