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Functional evaluation of surgical fixation of distal radius

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ABSTRACT

Background: Distal radius fractures are the most recurrent fractures happening in the upper extremity. We conducted a prospective hospital-based clinical study on the management of distal radius fractures with surgical fixation. To assess functional outcome and to assess the effectiveness of surgical fixation in the intra-articular distal end of radius fractures.
Methods: This prospective study comprised 40 patients treated with surgical fixation. The patients were followed up at six weeks, three months, 6 months and one year after surgery. The assessment of pain, range of motion, grip strength and activity were assessed and scored according to Gartland and Werley scoring systems. Radiographic measurements were also evaluated.
Results: Gartland and Wereley scoring were used to evaluate the overall functional results. Excellent to good results were in 85% of patients, and fair to poor results were seen in 15% of patients. Two patients developed pin site infections.
Conclusions: Surgical fixation used for ligamentotaxis is an effective method of treating intra articular distal radius fractures.

Keywords: Surgical fixator, Gartland and wereley scoring system, Closed reduction, Trauma, Distal radius fracture, Comminuted fracture

INTRODUCTION

Fractures of the distal radius are the most common skeletal injuries treated by orthopedic surgeons. It has bimodal age distribution with a peak incidence among young patients with high energy trauma and elderly patients with low energy falls.[1] Distal radius fractures boost up substantial economic costs annually which is gradually increasing with the aging of the population gradually.[2] In the past, closed reduction with immobilization in a plaster cast was considered to be the treatment of choice. However, fractures that involve the articular surfaces and relatively unstable can jeopardize the integrity of the articular congruence and the kinematics of these articulations. Restoration of volar angulation, radial length, radial inclination is essential for the good functional outcome at the wrist joint.

Unstable fractures of the distal part of the radius have shown an inherent tendency towards loss of reduction after non-operative treatment.[3] In 1929, Bohler lamented that "reduction of this type of fracture-dislocation is obtained relatively easily. However, in the most severe cases, the fragments cannot usually be maintained in a good position by an unpadded plaster cast." It has been recognized that, often, the ultimate functional result will depend, in large part, on the anatomical restoration of the fractured radius. Maintenance of articular congruity and stable fixation decrease the incidence of osteoarthritis and helps with earlier rehabilitation.[4]

Surgical fixation has been popular for the treatment of distal radius intraarticular fractures because it combines a minimally invasive procedure with reduction by ligamentotaxis.[5] In view of minimally invasive surgery, we set out to evaluate functional outcome of this method to treat distal radius intraarticular fractures.

METHODS

It was a prospective hospital-based clinical study performed between January 2021 and August 2021 on patients with distal radius fractures who visited Tertiary care hospital. The patient criteria for inclusion in this study were age 18-65 years without any other skeletal injury and with fractures with increased volar/dorsal comminution, >10 degrees angulation of major fragments, more than 2mm of articular incongruity, those patients in whom reduction could not be maintained by closed methods, open distal radius fractures. Patients with any other associated injury/fracture, distal radius fractures associated head injury and patients with comorbid conditions rendering them unfit for surgery, patients not willing for the study were excluded from the study.

Fracture management

In the emergency department an initial closed reduction and application of below elbow slab was done for all patients. Radiographs of the forearm with wrist joint in posterior anterior and lateral view were taken.

Methodology

Under general or regional anesthesia, the patient in a supine position with the injured arm placed on the sidearm board. The longitudinal traction is given with elbow in 90 degrees of flexion while the fracture is being reduced with the wrist in flexion and ulnar deviation. Two 2.5-mm Schanz pins in the second metacarpal and two 3.5-mm pins in the radius proximal to the fracture were inserted. The pins were interconnected and tightened with solid connecting rod and link joints after attaining satisfied closed reduction using image intensifier. In cases of incomplete reduction (eg., step off deformity greater than 2 mm, dorsal tilting, or radial shortening greater than 2 mm) after closed manipulation, we used a percutaneous K-wire, which was inserted through a small incision, to manipulate the fragments and for fixation of radial styloid fractures. One uniplanar bridging EF system was used throughout the study.

The patients were discharged 10 days after surgery under proper antibiotic coverage and active finger movements were advised. The patients were recalled to see the reduction in fracture radiologically after 6 weeks. Acceptable criteria for fracture reduction were: radial inclination of >15°, radial shortening of <5 mm compared to the contralateral side, the sagittal tilt between 15° dorsal and 20° volar tilt and intra-articular step-off of <2 mm.[5]

All surgical fixators were removed at 6- 8 weeks and monitored physiotherapy started. All the patients were followed for 6 weeks, 3 months, 6 months and 1 year after surgery and assessed for pain, grip strength, wrist range of motion (ROM) and activity, and scored according to Gartland and Werley.[6] After the application of a frame, the final reduction was checked in the C-arm in antero-posterior and lateral views. Sterile betadine dressing of the pin tract site was performed.

Statistical analysis

Statistical analysis was performed by using Statistical Package for Social Sciences (SPSS) version 22.0 (SPSS Inc., Chicago, IL, USA). Independent sample t-test was used to compare quantitative between two groups. Fisher's exact test was used to compare number qualitative variables reported between the two groups. P<0.05 was considered statistically significant.

RESULTS

Figure 2 shows 6 weeks and 6 months post op X-ray comparison the process properly explained in methodology.

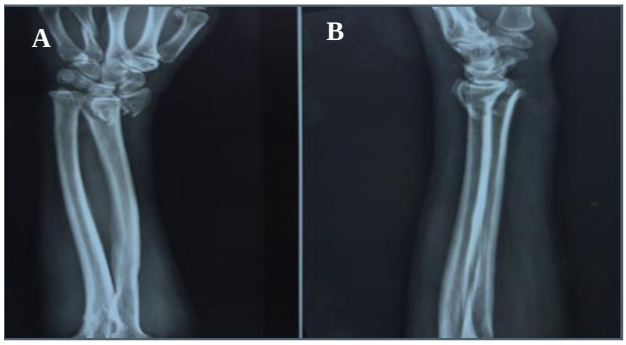

Figure 1 (A and B): Pre-operative X-ray of distal radius.

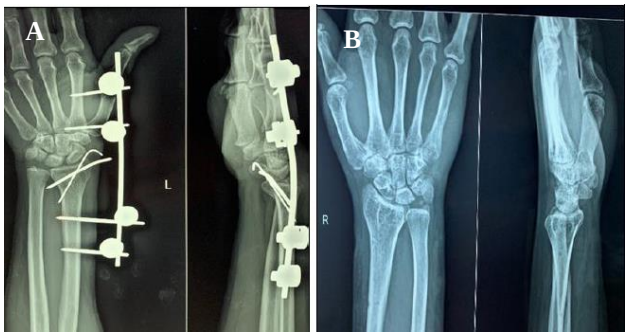

Figure 2 (A and B): Post-operative X-ray comparison 6 weeks and 6 months.

Table 1: Age and gender wise distribution of study participants.

Age groups (years)	Male	Female	Number (%)
18-20	2	0	2 (4)
21-30	4	2	6 (12)
31-40	10	6	16 (40)
41-50	8	2	10 (24)
>50	5	1	6 (12)

As per Table 1 forty cases were included and all of them were followed up to one year, most of them were in the age group of 31 to 40 years. Among them 10 were males and 6 were females. In 31 patients' dominant side was affected and in 9 patient's non-dominant side affected. Mode of injury was due to road traffic accidents in 31 patients and in 9 patients it was due to fall.

Table 2: Functional outcome of patients.

Functional outcome	Number (%)	p value
Excellent	8 (14)	0.01*
Good	26 (64)	
Fair	4 (6)	
Poor	2 (2)	

As per Table 2 functional outcome in 8 patients was excellent, 26 patients had good outcome and 4 patients had fair outcome according to Gartland and Werleys scoring system and it was statistically significant ($p<0.05$).

DISCUSSION

Distal end radius fracture is the most common fracture we treat. Closed reduction and cast immobilization is still the mainstay of treatment for nondisplaced, stable fractures which are characterized by minimal radial metaphyseal comminution, minimal or no loss of height, and no substantial displacement or angulation. Management of comminuted intra-articular fractures has always posed a challenge to the orthopaedic surgeon in terms of fracture reduction, maintenance of reduction while the fracture unites and achieving a functional range of movement of joint after the union of the fracture. Patient's expectations are very high and good results are not always possible due to the severity of injury, soft tissue damage and periarticular fibrosis that result in the process of healing. Failure in management may cause permanent disability.[6] High energy injury patho mechanism involved axial load transfer from hand to the articular surface of the distal radius. This cause shearing force which leads to impacted fracture and marked displacement.[7] The male population is 1.7 times more prone to such injuries as is supported by other studies.[8,9] Usual indications of surgical fixator are.[10] Actual or predicted instability in the dorsally displaced extra-articular or minimal articular fracture of the distal radius. Severe articular fractures and open injuries.

Knirk et al found that radiological arthritis developed in 91% of wrists which had any degree of articular step and in all of those with a step greater than 2 mm.[11] Their work and that of Melone had resulted in the acceptance of a step in the articular surface up to 2 mm.[12] Mehta et al in their arthroscopic assisted treatment of intra-articular fractures of the distal radius demonstrated that the incidence of pain is significantly related to the size of the step.[13] Patients with no step, <1 mm step and >1 mm step had an incidence of pain of 18%, 38% and 100%, respectively in their study. In our study, we found that intra-articular step of more than 2 mm leads to residual pain and arthritis, and recommend anatomical reduction and acceptance of a step of <2 mm since the size of the step is related to the incidence of pain.

Wright et al and Rizzo et al reported better recovery in open reduction and internal fixation (ORIF) compared with EF group in ulnar variance and volar tilt.[14,15] Lin et al reported that surgical fixation is widely used to treat these fractures for its minimally invasive technique.[16] The unnecessity for further implant removal surgery is considered to be a favorable factor in some developing countries. Therefore, health care cost would be reduced. EF is also able to prevent further complications that could arise from secondary surgery (implant removal) since EF removal is feasible to be done in office setting under local anesthesia manner.

CONCLUSION

Surgical fixation has good functional outcome after 1 year of follow-up. Surgical fixation as a method in the management of distal radius fracture is an effective method when performed with strict surgical guidelines, under aseptic precautions, and proper reduction of fracture with minimal complication rates and good functional outcome based on Gartland and Werley scoring. The procedure is quick, and the technical learning curve is shorter. Complications like pin site infections can be managed with appropriate antibiotics.

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Ethical approval: The study was approved by the institutional ethics committee

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