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TREATMENT OF DISTAL END RADIUS FRACTURES BY EXTERNAL FIXATION: A PROSPECTIVE STUDY

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ABSTRACT **Objective:** To evaluate radiological and functional outcome in fractures of the distal radius treated with external fixation.
Material and Methods: Twenty two patients (8 males, 14 females) with different types of fractures of distal radius were treated with external fixation. Anatomical restoration was evaluated by postero-anterior and lateral radiographs obtained preoperatively and at 09 months of follow up to evaluate Radial Height (RH), Radial Inclination (RI) and Volar Tilt (VT). Functional outcome was evaluated using Mayo scoring system.
Results: Out of 22 patients, 4 had type A, 5 had type B and 13 had type C fractures (AO classification). Average procedure time was 45 minutes. According to Mayo scoring 72.7% (n=16) patients had excellent to good outcome while as 27.3% (n=6) had fair outcome.
Conclusion: The external fixator is simple and inexpensive. It effectively stabilizes fractures yet allowing for hand motion and prevents stiffness. Although some cases have residual joint stiffness, pain and arthritis can be prevented. we conclude that external fixation is an effective method in treating unstable extra-articular fractures and partial articular fractures of the distal end of radius.

KEYWORDS: Distal Radius Fracture, External fixator, Mayo Score, Radiological outcome.

INTRODUCTION:

Distal radius fractures disturb the mechanical foundation of the human's most elegant tool, the hand. The same ligaments, retinaculae, tendons, and periosteum that envelop the fracture which are the surgical barriers for open reduction of the fracture fragments, help achieve reduction of the fracture by ligamentotaxis.[1] Most fractures of the distal end radius are relatively uncomplicated and can effectively be treated by closed reduction and immobilization in cast. However, unstable/intra-articular fractures can jeopardize the integrity of the articular congruence and/or kinematics of these articulations thus making closed reduction an impossible option in these cases. The objectives of management for a distal end radius fracture should be restoration of range of motion and grip strength while facilitating the patient's early reinstation to normal daily activities and minimizing the chances of post traumatic arthritis. Preservation of the articular congruity is the principle prerequisite for successful recovery.[2]

External fixation is generally accepted as superior to plaster immobilization in young patients with intra-articular comminuted displaced distal radius fracture.[3] The successful use of external fixation in the management of unstable intra-articular fractures necessitates careful assessment of the fracture pattern, appropriate patient selection, meticulous surgical technique, appropriate choice of fixation devices, judicious augmentation with internal fixation and bone grafting, careful postoperative monitoring, and aggressive early rehabilitation. [4,5,6]

The main aim of this study is to evaluate the functional and radiological outcome in distal radius fractures treated with external fixation in terms of restoration of anatomy of distal end radius (radial inclination, volar tilt, and radial length) and Mayo scoring.

MATERIAL AND METHODS:

This was a prospective study of 22 patients with distal radius fractures who were treated by external fixation in Government Medical College and Hospital, Jammu for a period of one year from September 2018 to October 2019.

Patients with fractures of distal end radius of either side or both sides, with or without ulnar styloid fracture, of age group 18 – 85 years, of either sex having closed fractures of up to 3 cm from distal articular surface of radius willing for treatment were enrolled for this prospective open randomized case control comparative study. Patients less than 18 years or more than 85 years, having compound fractures associated with vascular injuries or had associated multiple injuries were excluded from the study.

All fractures were classified according to AO (the Association for Osteosynthesis) classification system [7] by getting Postero-Anterior (PA) and Lateral views of radiographs of the wrist at the time of the initial injury. Some patients needed CT scan of wrist for further evaluation of intra-articular fractures.

The patients were admitted to the hospital and were operated on as soon as possible, depending on the condition of the local tissue, hematoma, tissue oedema and other associated injuries. After obtaining informed written consent, external fixation was performed via volar approach. Procedure was performed under brachial plexus block or general anesthesia under fluoroscopic guidance. All the surgeries were performed by the same surgeon who was well versed with procedure and the implants used.

Surgical procedure:

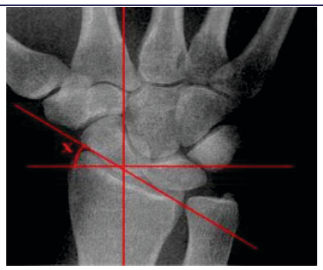
Under brachial block or general anaesthesia the upper extremity was prepared and draped. The fracture was reduced manually. A 2-3 cm incision over dorso-radial aspect of index metacarpal base was made followed by blunt dissection while taking care to preserve the radial sensory nerve. 3mm half pins were inserted at 30-45 dorsal to frontal plane of hand and forearm. Pin position and length were confirmed fluroscopically. A 4cm incision 8-10cm proximal to wrist joint was given. 3mm half pins were inserted between radial wrist extensors at 30 dorsal to frontal plane of forearm. Incision was closed and external fixator frame was applied. Postoperatively wrist was immobilized in supination for ten days and the fixator removed at 6 weeks. Active and passive motion was started on the first postoperative day.

RADIOLOGICAL EVALUATION:

Radiological assessment was done in terms of residual Radial Inclination (RI), Radial Height (RH) and Volar Tilt (VT) and the results were graded according to the Lid Strom Criteria. Radiological parameters included measurement of through PA and lateral radiographs.

PA view provides information about RI (Radial Inclination) and RH (Radial height). RI is a measurement of the radial angle. A line is drawn along the articular surface of the radius perpendicular to the long axis of the radius, and a tangent is drawn from the radial styloid. The normal angle is 15-25º. RH is a measurement between 2 parallel lines that are perpendicular to the long axis of the radius. One line is drawn on the articular surface of the radius, and the other is drawn at the tip of the radial styloid. The normal radial height is 9.9-17.3 mm.[8]

In the Lateral view, the VT (Volar Tilt) of the distal radius articular surface is measured. A line perpendicular to the long axis of the radius is drawn, and a tangent line is drawn along the slope of the dorsal-to-volar surface of the radius. The normal angle is 10-25º. [8]



Fig; Radial inclination

Fig: Radial Height

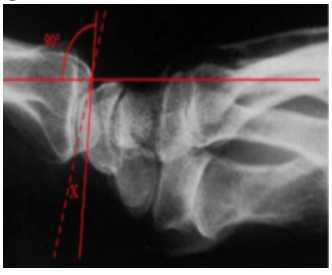


Fig: Volar tilt

These measurements were taken pre operatively and at 9 months follow up. At the end of the study all the data was compiled and analyzed statistically by a one-way measure ANOVA test.

FUNCTIONAL EVALUATION:

Patients were evaluated by using Modified Mayo Wrist Score. It is a physician-rating scoring system which gives us a total score of a 100; 25 for the assessment of pain, 25 for the active extension/flexion arc of the wrist, 25 for grip strength, and 25 for the ability to return to regular activities. The pain is rated according to patient's description.

Category	Findings	Score
Pain (25 points)	No pain	25
	Mild occasional	20
	Moderate	15
	Severe	0
Work status (25 points)	Regular job	25
	Restricted job	20
	Able to work but unemployed	15
	Unable to work due to pain	0
Range of motion (25 points)	>120	25
	100 to 119	20
	90 to 99	15
	60 to 89	10
	30 to 59	5
	0 to 29	0
Grip strength (% of normal) (25 points)	90 to 100	25
	75 to 89	15
	50 to 74	10
	25 to 49	5
	0 to 24	0
Final result (total points)	Excellent	90-100
	Good	80-89
	Fair	65-79
	Poor	<65

RESULTS:

A total of 22 patients underwent this surgery comprising of 8 males and 14 females. The mean age and Standard Deviation (SD) at the time of the injury was 53.13 ± 13.86 years (range from 20 to 81 years). Fourteen (63.6%) fractures involved right side while eight (36.4%) fractures occurred on the left. Mode of injury was road traffic accident and fall in majority of the cases.

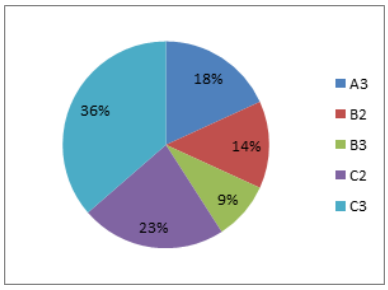


Fig. 1: Radiological subtype of fractures.

According to AO classification, most of the cases were of C (n = 13) 59.1% and B (n = 5) 22.7% type probably because of increased incidence of high velocity injuries. (Figure 1)

Distal radius deformity was assessed by measuring RH, RI and VT at different stages of treatment. We found a mean radial inclination of 20.31±3.79°, radial height of 11.18±3.99mm and volar tilt of 8.5±2.73° (Table 1).

Table 1: Radiological evaluations of RH, RI and VT.

	External fixator group
Radial Inclination	20.31±3.79°
Radial Height	11.18±3.99 mm
Volar Tilt	8.5±2.73°

Table 2: Values on the basis of type of fracture.

Type of fracture	No. of cases	Radial Inclination	Radial Height	Volar Tilt
Type A	4	20.5mm	14.75mm	10.75°
Type B	5	20.8mm	14.6mm	10.6°
Type C	13	20.07mm	8.77mm	7.0°

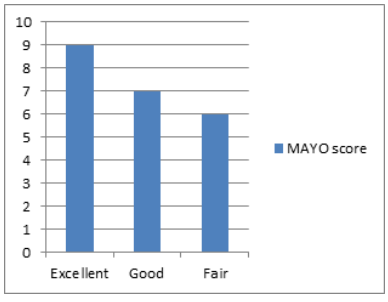


Fig. 2: Mayo score following external fixation.

According to Mayo scoring 72.7% (n=16) patients had excellent to good outcome while as 27.3% (n=6) had fair outcome.

Out of our 22 patients, 3 patients presented with pin site infection while as 4 had joint stiffness. Furthermore 3 patients had loosening of the fixator device.

DISCUSSION:

The external fixator is a versatile tool in the management of intra-articular fractures of the distal radius. It is reliable in terms of maintaining the reduction as well as of radial length. [9,10] External fixation uses principle of ligamentotaxis to reduce fracture fragments and maintain alignment.

The procedure is performed during a short hospital stay. Unsatisfied with the available methods of treatment, Cooney *et al*., in 1979, critically reviewed external fixation for the treatment of distal radial fractures and reported a good result for 51 (85%) of sixty patients, with decreased radial shortening and improved volar tilt.[8] Since then, external fixation has become a popular and reliable method for the treatment of these frequently seen fractures.

Distal radius deformity, as assessed by measuring RH, RI and VT at

different stages of treatment revealed a mean radial inclination of 20.31±3.79°, radial height of 11.18±3.99mm and volar tilt of 8.5±2.73°. The results were better in type A and type B fractures as compared to type C fractures. (Table 2)

In our study of twenty two patients, 9 (40.9%) patients had excellent outcome, 7 (31.8%) had good outcome while as 6 (27.3%) patients had fair outcome. Overall, we had a high rate of favourable outcomes with relatively less rate of complications.

We evaluated our results and compared them with those obtained by various other studies following the same modality of treatment. Almost similar results were obtained by Banapatti DB et al in 2018. They found 78% Excellent to Good results. 14 patients had Fair results while 8 patients had Poor results. [11]

The relatively long period of immobilization (6–8 weeks) had no apparent adverse effects on the long-term functional outcome pointing to the fact that the fixator can therefore be left according to the radiologic evidence of fracture healing. Moreover, external fixation allows wound observation and coverage procured during open fractures without compromising the reduction achieved.

CONCLUSION:

The external fixator is simple and inexpensive. It effectively stabilizes fractures yet allowing for hand motion and prevents stiffness. Although some cases have residual joint stiffness, pain and arthritis can be prevented. So, **we conclude that external fixation is an effective method in treating unstable extra-articular fractures and partial articular fractures of the distal end of radius.** Limitations of the study were small number of patients and duration of the follow-up. We believe that a larger group of patients with longer follow-up would be more conclusive.

CASE 1:

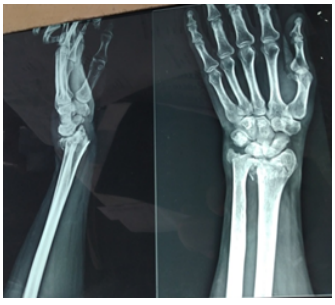


Fig. 3: Pre-op lateral and AP X-ray.

Fig. 4: Post-op AP and lateral X-ray.

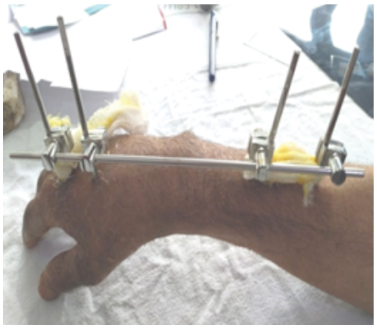


Fig. 5: Pin site inspection at 3 weeks.

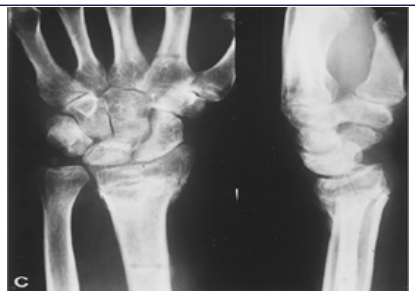


Fig. 6: AP and lateral X-ray after removal of fixator at 12 weeks follow-up.

Fig. 7: Dorsiflexion and plamer flexion at 12 weeks follow-up.

Fig. 8: Supination and pronation at 12 weeks follow-up.

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