Outcome analysis of Intra-articular distal end radius fracture treated with volar plating

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Abstract—*Fractures of distal end radius are most common fractures of the upper limb. Various techniques have been described including closed reduction, percutaneous fixation and open reduction and fixation. This study was conducted to assess the functional and radiological outcomes of volar plate osteosynthesis to manage intra-articular distal end radius fracture. For this study, 30 patients with intraarticular distal end radius fractures involving radiocarpal joint operated with open reduction and internal fixation with the volar plate were taken. Minimum follow up 6 months were done. During the follow-up, radiological parameters were assessed in terms of radial length, radial inclination, radial (palmar) tilt, articular step-off, functional parameters were assessed in terms of range of motion i.e.dorsifleion, plantar flexion, pronation, supination radial and ulnar deviation and Gartland and Werley score. Mean age of patients was 46.8 years with male: female ratio 6:4. Mean radial height was 11.2mm, mean radial inclination was 21.8 degree and mean radial (palmar) tilt was 10 degrees. Average Gartland and Werley score was 3.6. Average dorsiflexion was 71 degrees, palmar flexion was 68 degrees, mean radial deviation was 16 degrees and mean ulnar deviation was 29 degrees. Mean pronation was 72 degrees and mean supination was 75 degrees. It was concluded that volar plating has good outcome for intraarticular distal end fractures of radius with minimal complications. So, it should be considered as the first line of management for intraarticular distal end radius fracture.*

Keywords: Intraarticular, Distal end Radius, Volar Plate, Gartland and Werley Score.

I. INTRODUCTION

Distal end radius fractures are the most common fractures of the upper extremity accounts for approximately 16-20% of all skeletal fractures world wide.[1-2] In younger patients, most common cause is road traffic accident while in elderly patients, most common cause is fall on outstretched hand. Around 50% of these fractures are intra-articular.

Distal end radius fractures was first described by the Irish surgeon and anatomist Abraham Colles in 1814.[3] His description was based on clinical examination alone. It was low energy, extraarticular, dorsally displaced fracture. It is popularly known as Colles fracture while low energy extraarticular volarly displaced fracture is Smiths fracture. Barton'fracture is intraarticular volar or dorsal lip of radiocarpal joint. Chauffer'sfracture is radial styloid fracture. There are many radiological classifications like Fernandez classification based on the mechanism of injury, Frykman classification[4] based on joint involvement (radiocarpal/radioulnar and/or ulnar styloid fracture) and Melone's classification based on the displacement of intra-articular fragments and AO.

For a long time, casting and immobilization was the preferred treatment, but casting had various problems like median nerve neuropraxia, long duration of immobilization in extreme deviation i.e. palmar flexion and ulnar deviation. External fixation has also been tried but both casting and external fixators were not able to maintain reduction, especially in comminuted and intra-articular radius fracture. Moreover, external fixators had additional problems of pin tract infections, loosening leading to loss of reduction, wrist stiffness and complex regional pain syndrome.[5]

In 1970s, the AO group designed plates specifically for the treatment of distal radius fractures. There are two types of plates for fractures of the distal radius: (a) Conventional plates and (b) fixed angle locking compression plates.[6]

Open reduction and internal fixation provides good restoration of articular congruency ensures maintenance of reduction and also allows early motion. Improper reduction or residual intra-articular incongruity leads to secondary arthritis and poor functional outcome in the long term.[7,8] So, in this study 30 patients of intra-articular distal end radius fractures operated with open reduction and internal fixation with fixed angle locking compression plate were studied to assess radiological and functional outcomes.

II. METHODOLOGY

This study was carried out in the department of Orthopaedics, ESI-PGIMSR Model hospital, Basaidarapur, New Delhi.

This study was conducted on 30 patients of intra-articular distal end radius fractures involving radiocarpal joint operated with open reduction and internal fixation with the volar plate with the minimum follow up of 6 months to to assess radiological and functional outcomes. Patients >16 years with injury less than three weeks old and closed fractures were included in this study. The extra-articular fractures, skeletally immature patients, pathological fractures and patients who refuse to give consent were excluded from this study.

After taking informed consent, all patients underwent detailed clinical and radiological examination along with all routine investigations. The initial radiographic evaluation includes anteroposterior (AP), lateral and oblique radiographs of the wrist.

After doing pre-anaesthetic checkup, surgery was performed under regional anesthesia. All patients receive antibiotic prophylaxis. The part was prepped and draped. Tourniquet was inflated about 50-100 mmhg above the systolic blood pressure after exsanguinating the limb. Patient's forearm was placed supine. Henry approach was utilized. Approximately 6-7 cm incision was given on radial aspect o flexor carpi radialis tendon. Subcutaneous tissue was cut in line of skin incision. Palmar cutaneous branch of median nerve was protected. Flexor carpi radialis tendon was incised on its radial border and tendon was retracted ulnary. Flexor pollicis longus tendon was also retracted ulnary. Pronator quadratus was subperiosteally elevated from the underlying radius by making an L-shaped incision over its insertion distally and radially. Hematoma and soft tissues underlying between the fracture fragments were removed. Reduction was achieved by hyperextending the wrist and then turning it into flexion. Plate was placed and the central hole was drilled and an initial screw was placed. Reduction and plate

placement were checked under c-arm. Remaining screws were applied under fluoroscopic guidance making sure that they do not enter the joint space. The wound was irrigated and pronator quadratus was stitched with vicryl 3.0 sutures. The skin was closed with silk or nylon sutures.

All patients were instructed to maintain strict elevation and performed range-of-motion exercises on their fingers and thumb several times per day. The suture was removed at 10-14 days. The slab was continued till 4-6 weeks.

The patients were followed up at 1month, 2 months, 3 months and 6 months. At each visit patients were assessed for clinical/functional status and radiological evaluation.

2.1 Clinical/Functional status

The range of motion was compared with the normal range of motion at wrist and Gartland and Werley score. The normal dorsiflexion-0-75 degrees; palmar flexion-0-75 degrees; Radial deviation-0-20degrees; Ulnar deviation-0-35 degrees; Pronation-0-75 degrees; supination-0-80 degrees. (Figure 1-4)

Figure 1
Dorsi-flexion measurement

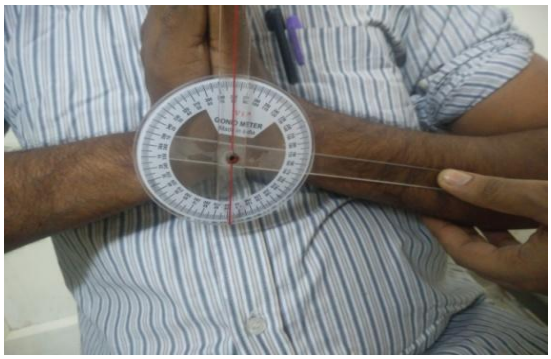

Figure 2
Palmar-flexion measurement

Figure 3
Radial Deviation

Figure 4
Ulner Deviation

2.2 Radiological evaluation

Radiographic evaluation was done on anteroposterior(AP), lateral, and oblique radiographs of the wrist. (Figure 1 & Figure 2).

Figure 1
Preoperative anteroposterior and lateral view (showing intraarticular distal end radius fracture)

Figure 2
Postoperative anteroposterior and lateral view

A. Anteroposterior (AP) view: AP view to observed followings:-

a. Radial Height is the distance between two parallel lines drawn perpendicular to the long axis of the radial shaft — one from the tip of the radial styloid and the other from the ulnar corner of the lunate fossa**.** Normal radial height is 8-18mm(av.-11mm)

b. Radial inclination is the angle between two lines—one drawn perpendicular to the long axis of the radius at the ulnar corner of the lunate fossa and the other between that point in the lunate fossa and the tip of the radial styloid. Normal radial inclination is 13-30degrees.(Av.-23°.)

B. Lateral view to observed palmar inclination (Radial or volar or sagittal tilt) is the angle between two lines—one drawn perpendicular to the long axis of the radius and the other between the dorsal and palmar lips of the distal radial articular surface. Normal radial tilt is 0-30 degrees (Av.- 12°)

III. RESULT

The present study includes 30 patients with intra-articular distal end radius fractures treated by volar plating. There was male predominance accounting for 60% (18 patients). Right side was more commonly involved (60%, 18 patients). In this study 70% patients (21 patients) had fracture after fall and 30% (9) patients had road traffic accident. (Table 1)

Table 1
Bio-demographic distribution of study population (N=30)

S. No.	Bio-clinico Variables		Number	Percentage
1	**Sex**	Male	18	60
		Female	12	40
2	**Side of Fracture**	Right	18	60
		Left	12	40
3	**Cause of Fracture**	Fall	21	70
		Road accidents	9	30

Range of motion at 6 months follow-up was measured. Average dorsi-flexion was 70 degrees (Figure 1), palmar flexion was 68 degrees (Figure 2). Mean radial deviation was 16 degrees (Figure 3) and mean ulnar deviation (Figure 4) was 29 degrees. Mean pronation was 72 degrees and mean supination was 75 degrees. Average Gartland and Werley score was 3.6. (Table 2)

Table 2
Range of Motion after 6 months (N=30)

S. No.	Range of Motion Variables	Degrees
1	Dorsiflexion	70
2	Palmar Flexion	68
3	Mean Radial Deviation	16
4	Mean Ulnar Deviation	29
5	Mean pronation	72
6	Mean supination	75
7	Mean Radial height	11.2 mm
8	Mean radial inclination	21.8

On postero-anterior view mean radial height was 11.2mm and mean radial inclination was 21.8 degree and on lateral view mean radial(palmar) tilt was 10 degrees. Loss of reduction was not observed in any case. (Table 2 & 3)

In this 6 months followup, there was no dehiscence of the wound, compartment syndrome, infection, carpal tunnel syndrome, rupture of tendons or non-union. (Table 3)

Table 3
Gartland and Werley score and Complications after 6 months (N=30)

S. No.	Variables	Value
1	Average Gartland and Werley score	3.6
2	Compartment Syndrome	0
3	Carpal Tunnel Syndrome	0
4	Rupture of Tendons	0
5	Non-Union	0

IV. DISCUSSION

This present study distal end radius fractures are the most frequently seen upper extremity fractures. It is also one of the most challenging types. The main objective of treatment is to re-establish anatomic integrity and function.

The present study includes 30 patients with intra-articular distal end radius fractures treated by volar plating. There was male predominance with M:F 3:2. Right side was more commonly involved. In this study 70% patients had fracture after fall and 30% patients had road traffic accident. Almost similar observations were made by other authors also regarding side of fracture involved and cause of fracture.[9-11]

Jose A et all[9] also reported male preponderance in their study of 53 distal end radius cases. They also reported that Road traffic accident was the most common mode of injury accounting for 66.04% of the distal radius fractures. Rest 33.96% of them sustained a fall resulting in distal radius fracture. They also observed that right hand was more affected (56.6% v/s 43.4%).

In this study range of motion was measured at 6 months follow-up. In range of motion, average dorsi-flexion was 70 degrees and palmar flexion was 68 degrees. Mean radial deviation was 16 degrees and

mean ulnar deviation was 29 degrees. Mean pronation was found 72 degrees and mean supination 75 degrees. Average Gartland and Werley score was observed 3.6. On postero-anterior view mean radial height was 11.2mm and mean radial inclination was 21.8 degree and on lateral view mean radial(palmar) tilt was found 10 degrees. Loss of reduction was not observed in any case. Overall range of motion at the wrist were satisfactory in this study.

Pankaj etall[10] studied 242 X-rays and reported the mean value (n = 242) of radial inclination was 23.27°± (standard deviation [SD]) 7.42° (range: 11.3–42.1°), palmer tilt 10.07° ± (SD) 5.28° (range: 1–16.9°), radial height 11.31 mm ± (SD) 4.9 mm (range: 7.1–30.4 mm), and ulnar variance 0.66 mm ± (SD) 2.46 mm (range: −2.4 to +4.1) in Indian population.

Well comparable observations to present study were made by Jose etall[9] who observed average radial inclination, radial height, palmar tilt and ulnar variance changed to 20.94±4.44 degrees, 10.03±1.20 mm, 9.51±5.23 degrees and −0.15±1.99 mm respectively after one year follow up. Average wrist range of motion at the end of 1 year of follow-up was 61.13±12.88 degrees flexion (range 35 to 85 degrees) and 50.66±18.43 degrees extension (range 35 to 90 degrees). The average forearm range of motion was 77.43±11.40 degrees supination (range 50 to 90 degrees) and 84.37±5.35 degrees pronation (range 70 to 90 degrees) at 1 year of follow-up.

In this 6 months followup, there was no evidence of the wound, compartment syndrome, infection, carpal tunnel syndrome, rupture of tendons or non-union in this study whereas Jose etall[9] observed superficial wound infection in one case out of 53 cases studied which. Zenke Y et al., the good functional outcome of distal radius fractures

The limitations of our study were lack of controls and non- uniformity of fracture pattern.

V. CONCLUSION

This present study concludes that males were more affected than female and fall on outstretched hand was the most common mechanism of injury. Ranges of motion at the wrist were satisfactory. So it can be concluded that open reduction and internal fixation with volar plating is an effective procedure to treat distal end radius fracture. However, a large group with long term follow-up is needed.

CONFLICT OF INTEREST

None declared till now.

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