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Anatomical evaluation of fracture of distal radius treated by external fixator cum distractor

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INTRODUCTION

Fractures of upper extremity comprise of 17% of body fractures and 75% of these are the fractures of lower end radius. Distal radius has three concave metaphyseal flare. The scaphoid and lunate fossa for articulation with the proximal carpal row. The third surface is sigmoid notch, articulates with distal ulna. As the radius and hand rotates about fixed ulna, this latter articulation has an integral role in functional anatomy of the hand and wrist. Instability of this articulation also be considered in the assessment and management of some unstable fractures of distal radius.[1] Joint disruption in high energy shearing type fractures and impacted fractures in younger individuals may prove to be the major determinant of outcome.[2] Frykman classified the distal radius fractures into: extraarticular and intraarticular fractures. Extra articular further divided on the basis of presence or absence of ulnar fracture.

Intraarticular fractures classification includes involvement of radiocarpal joint, radioulnar joint and both, along with presence or absence of fracture of ulna.[3] Keeping in mind the complexity of this fracture we applied external fixator cum distractor. The principle behind external fixation is the maintenance of reduction by continuous distraction commonly termed "Ligamentotaxis".[4] External fixation of fractures distal radius was popularized by Anderson and Neil 1944 in Seattle during world war II.[5] Though closed reduction and cast immobilization is the most favorable method of treatment, acceptable reduction can be obtained by cast but it is often difficult to safely maintain the reduction with cast immobilization. This prospective study was designed to evaluate the anatomical end result of cases in which external fixator cum distractor was used for the management of fracture of distal radius with that of closed reduction and immobilization by cast application.

MATERIAL AND METHOD

This prospective study was conducted at Department of Orthopaedics. 40 patients of fracture distal end of radius were divided in two groups-

Group A - 20 patients treated by closed reduction and external fixator cum distractor.
Group B - 20 patients treated by closed reduction and cast immobilization.

Patients subjected to-

- Standard AP and lateral radiograph of wrist with distal forearm
- Radiograph of normal wrist
- Classified according to Frykman classification
- Broad spectrum i.v antibiotics before start of surgery to group A

Surgery performed under suitable anesthesia. The first schanz screw of 2.00 mm passed through second metacarpal on the radial side, the second schanz screw of 3.5 mm passed on radial side of the radius. Once closed reduction achieved pins are connected to the stabilizing rods, the second schanz screws in second metacarpal and forearm passed and clamps were tightened by Allen keys. Pin site dressing done and radiographs were taken post operatively. Patient discharged after 1-3 days of observation. Patients were followed up clinically and radiologically regularly and evaluated for functional and anatomical outcome after 6 months.

Group B : cast removed after consolidation of the fracture site seen on radiograph and patients were evaluated at the end of 6 months.

Evaluation of anatomical results: Anatomical outcome was assessed on anteroposterior and lateral radiographs of the wrist including lower forearm (figure 1A and 1B).

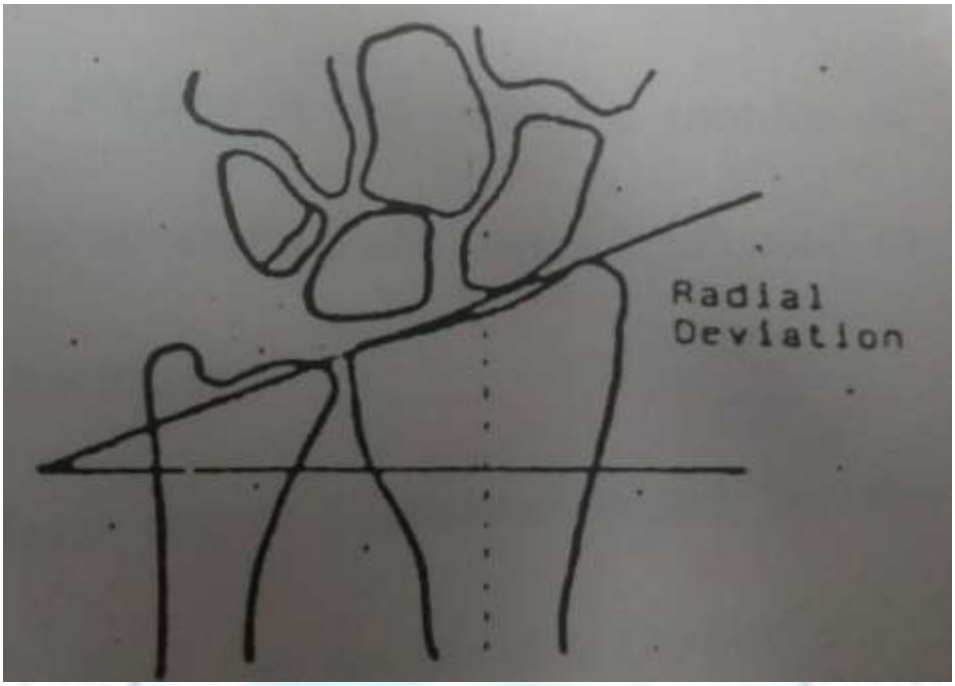

Figure 1A: Schematic presentation of radial deviation

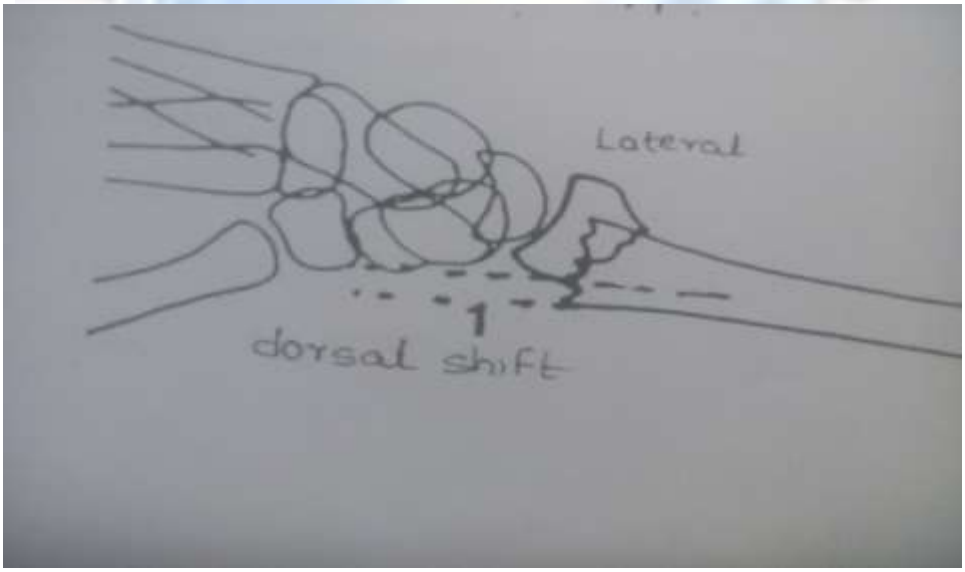

Figure 1B: Schematic presentation of dorsal shift

a) Lateral radiograph-

- Dorsal angle: angel between long axis of bone and the articular surface indicated by line joining the volar and dorsal margin of the surface.
- Dorsal shift: increase in distance from long axis to the most dorsal point of the distal end of the bone.

b) Anteroposterior radiograph-

- Radial angle: angle between a line perpendicular to the long axis and the articular surface indicated by a line joining the radial and ulnar margin of that surface.
- Radial length: distance that the radial styloid process distal to ulnar part of wrist joint.
- Radial shift: increase in distance between the long axis and most radial part of the styloid process.
- Deviation to these angles after 6 months were compared to immediate post reduction results.

Anatomical evaluation was based on a system devised by Stewart et al (1984)[6] and grading was done accordingly (table I)

Table I- Adopted form Stewart et al (1984)

Final dorsal angle (degrees)	Loss of radial length (mm)	Loss of radial angle (degrees)	Score for each measurement
Neutral	Less than 3	0-4	0
1-10	3-6	5-9	1
11-14	7-11	10-14	2
Above 15	12 and more	15 and more	3

Grading according to score: Excellent 0, Good 1-3, Fair 4-6, Poor 7-12

Complications were in the **point range 0 to 5** depending of the severity of arthritic change and association of pain. Arthritic change minimum 1, minimum with pain 3, moderate 2, moderate with pain 4, severe 3, severe with pain 5. Nerve complications (median) given 1 to 3 and poor finger function due to cast 1 to 2. End result point ranges from 0 to 2- excellent, 3 to 8- good, 9 to 20- fair and 21 and above- poor

Observations

Age of the patients in the present series varied from 20-60 years and overall average 43.7 years. In our study it was found that fall on outstretched hand was the most common mode of the trauma in 52.5%. Left side preponderance was observed in 22 patients i.e 55% (figure 2).

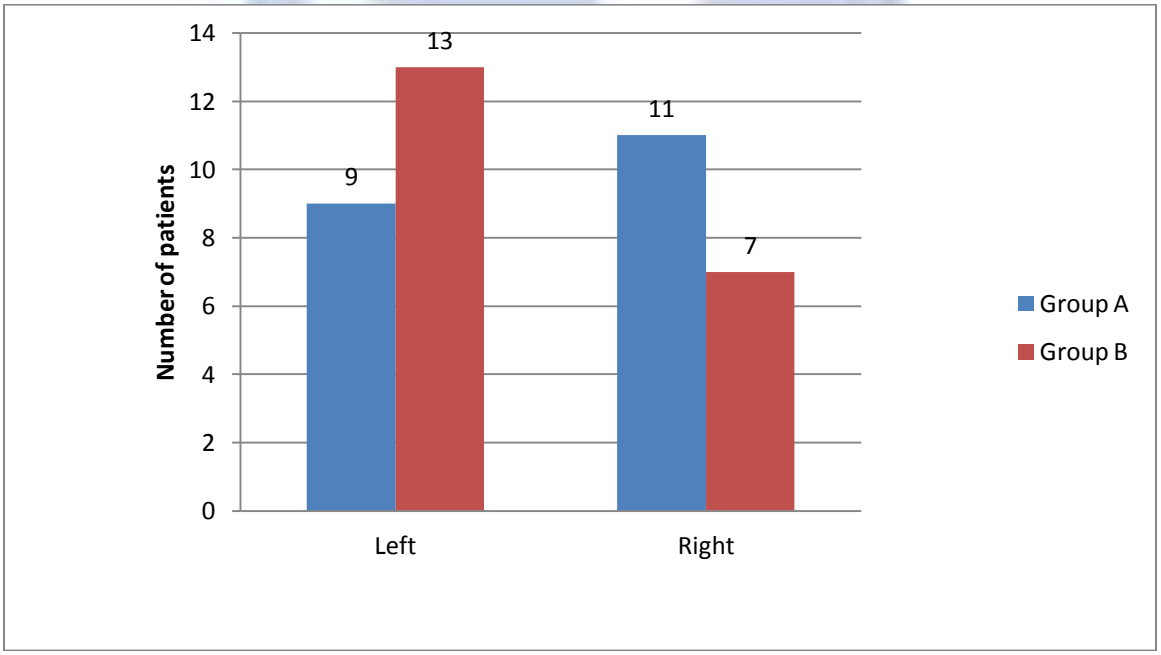

Figure 2- Side preponderance

According to Frykman classification it was observed that maximum patients belonged to type VII and type VIII in both groups (table II).

Table II- Frykman' classification

Type	Group A	Group B
Type I	0	1
Type II	0	0
Type III	4	3
Type IV	3	4
Type V	0	0
Type VI	1	1
Type VII	6	6
Type VIII	6	5
Total	20	20

Fracture of ulnar styloid was found in 45% patients in group A and 55% patients in group B. 65% patients in external fixator group had articular incongruity. Regarding radiological study of normal wrist : normal dorsal angle was -6° to -18° in our series. Average dorsal angle in group A was 11.6° and in group B was 12.3°(table III).

Table III- Dorsal angle

Range in degrees	Group A Normal wrist	Post op	Dorsal angle after fracture union	Group B Normal wrist	Post op	Dorsal angle after fracture union
-20°--16°	5	--	--	3	--	--
-15°to -11°	6	2	2	12	--	--
-10° to -6°	8	1	1	5	6	--
-5° to o	1	12	10	0	11	6
1°to 5°	--	1	2	--	2	8
6° to 10°	--	4	5	--	1	6
Total	20	20	20	20	20	20

Average dorsal angle was 11.95°. Normal radial length was ranging from 16 mm. Average in group A was 12.35 mm, average in group B was 12.72 mm and average radial length was 12.5 mm (table IV).

Table IV- Radial length

Range (mm)	Group A Normal	Post op	Healed	Group B Normal	Post op	Healed
0-5	--	--	--	--	--	1
6-10	2	5	3	2	10	18
11-15	17	14	16	18	10	1
16-20	1	1	1	--	--	--
Total	20	20	20	20	20	20

Normal radial angle was 18° to 29°. Average radial angle in group A was 24.65° and in group B was 24.6°. Average radial angle was 24.62°. Anatomical end results were evaluated by criteria of Stewart et al[7] (1984) modified from Sarmiento et al[10] (1980). In group A average dorsal angle was -0.4° and in group B was -7.1°. Loss of dorsal angle in group A was 0-5° in 16 patients(80%) as compared to group B 11 patients (55%). 2 patients (10%) showed gain in dorsal angle in group A. 3 patients (15%) in group B showed more than 10°loss of dorsal angle than none to group A. The average radial length in group A was 12.56 mm at final follow up and in group B was 8.42 mm. In group A10 patients (50%) showed no change in

radial length and 9 patients (45%) showed gain in radial length was compared to group B in which 18 patients (90%) showed 1-5 mm loss of radial length. Average angle at final follow up was 22.8° in group A and 16.05° in group B. average normal radial angle was 24.62°. 7 patients showed loss of radial angle in range of 6-10° in group B as compared to none in group A in same range. According to Stewart et al criteria modified by Sarmiento results showed that 60% showed excellent and 35% showed good results in group A while 10% showed excellent and 50% showed good results in group B. 2 patients in group A showed restriction of finger movements, breakage of schanz screw (figure3).

Figure 3: Radiograph showing breakage of schnaz screw

in 1 patient, superficial pin site infection in 2 patients. Prominent ulnar styloid was seen in 5 patients of group A and in 10 patients of group B. In group B restriction of finger movements and residual pain was noticed in 5 patients. No residual deformity was observed in group A while 4 patients in group B showed residual deformity.

DISCUSSION

In our series there was male sex preponderance with average age of 43.7 years, could be because of increasing incidence of road side accidents and other higher energy trauma sustained by male patients. The results for the side preponderance were comparable to those reported by Smaill GB[7] (1965) in which he reported injury to left side in 53% cases. Most of the patients had type VI and type VIII in our series which had indirect evidence of high velocity trauma. 47.5% patients had articular incongruity. All the radiological parameters observed in our study were more or less similar to previously reported values given in western literatures by Gartland and Werley[8](1951), Sarmeinto et al[9] (1975). The reduction was better maintained in external fixator group as compared to conservative group as all parameters indicating the maintenance of reduction showed significantly less loss in external fixator group. The average loss of radial length varied from 0-4 mm with average of 2 mm in conservative group, but in external fixator group was gain of 0.5 mm. Our study corroborates with the views shared by Gartland and Werley [8](1951), Melone[10] (1953) the most altered value is dorsal tilt followed by radial angle and radial length. Regarding anatomical end results 95% patients of external fixator group showed excellent and good results as compared to conservative group (60%). No poor result was observed in external fixator group and 2 poor results were observed in conservative group. Vaughan et al (1985) reported 91% excellent and good results with external fixation of unstable fracture of distal radius.[11] Jakim et al(1991) reported excellent and good results with external fixation of fracture distal end radius.[12] Werber KD (2003) reported 96% (very good and good score) using five pins external fixator.[13] Leung showed combination of ligamentotaxis and cancellous bone grafting produces excellent clinical and radiological results.[14] Cassebaum, found bad anatomical results despite immobilization for more than 6 weeks in POP with inclusion of the elbow in comminuted fractures of the distal radius.[15] Jenkins showed external fixation allow much better anatomical result than that of cast immobilization in colles' fracture and grip strength of the fixator treated group was significantly superior to

that of the plaster treated patients after one year.[16] Complications like residual pain, restriction of finger movements, residual deformity, prominent ulnar styloid were more common in conservative group as compared to external fixator group.

CONCLUSION

The external fixator proved to be a simple, reliable and cost effective modality for treatment of distal radius fracture and maintenance of reduction. External fixator allows much better anatomical result and superior hand grip. The results as observed encouraged us to make a statement that the ligamnetotaxis by means of external fixator is a simple procedure having high percentage of excellent and good results with minimal complications appears to be better method than pop cast immobilization.

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