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A Cross Sectional Study to Assess Management of External Fixation of Distal End Radius Fractures

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ABSTRACT
Preservation of the articular congruity is the principle prerequisite for successful recovery following distal radius fractures. The best method of obtaining and maintaining an accurate restoration of articular anatomy however, remains a topic of considerable controversy. External fixation as a method of treatment for distal end of radius fracture has more than 60 years of documented clinical experience. The main aim of this study is to evaluate the results obtained by treatment of distal end radius fractures by external fixation. In a prospective controlled study, 30 cases of unstable distal end radius fractures with intra-articular extension were treated with uni-planar bridging type of external fixation using the principle of ligamentotaxis and augmentation by K wires. External fixator was applied for a mean duration of 6.06 weeks and cases were followed up for an average of 36.8 weeks post operatively. Mean age of the patients was 39.03 years. 73.3% of our cases dominant hand was found to be involved which is right hand, most of fractures occurred following RTA (60%), external fixator in situ was for 5-6 weeks in 85% cases. Assessed as per De merit point system of Gartland and Werley (modified by Sarmiento 1975) for functional results at the end of 6 months of follow up. Excellent to good functional result was noted in 80%. External fixation and ligamentotaxis provides better functional and anatomical results in comminuted intra-articular and unstable extra-articular wrist injuries. The successful use of external fixator for distal end radial fractures requires careful assessment of fracture pattern, appropriate patient selecting, meticulous surgical techniques, appropriate choice of fixation, judicious augmentation with internal fixation and bone grafting, careful post-operative monitoring and aggressive early institution of rehabilitation. The final functional result of treatment of distal radius fractures not only depends on the anatomical restoration of the articular surface but also on the associated soft tissue injuries and articular damage.

INTRODUCTION

Fractures of the distal radius continue to be the most common skeletal injuries treated by the orthopedic surgeon. In fact these injuries are the most common fractures of the upper extremity and account for approximately 1/6th (16%) of all fractures seen and treated in emergency rooms[1,2,3]. Distal radius fractures crush the mechanical foundation of the man's most elegant tool, the hand. The same ligaments, retinaculae, tendons and the periosteum that envelop the fracture which are the surgical barrier for open reduction of the fracture fragments, help to achieve reduction of the fracture by ligamentotaxis[4]. In majority of cases prompt detection of articular fragments displacement, stability, and reducibility provides a rational basis of optimal management of these complex distal end radius fractures. Many fractures of the distal aspect of the radius are relatively uncomplicated and are effectively treated by closed reduction and immobilization in cast. However unstable/intra-articular fractures can jeopardize the integrity of the articular congruence and kinematics of these articulations[5].

A consensus prevails that vast majority (nearly 90%) of distal radius fractures are articular injuries resulting in disruption of both the radiocarpal and radioulnar joints[6,7]. Intra-articular fractures are inherently unstable, difficult to reduce anatomically and immobilize in closed POP support and are associated with high rate of complications[8]. Preservation of the articular congruity is the principle prerequisite for successful recovery[7]. External fixation is generally accepted as superior to plaster immobilization in young patients with intra-articular comminuted displaced distal radius fracture[9-11].

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 post-operative monitoring and aggressive early rehabilitation[12].

Objectives:

- To evaluate the duration of immobilization in external fixation and restoration of anatomy of distal end radius (radial length, palmar tilt and radial angulation)
- To study the effectiveness in allowing early motion of digits and rehabilitation
- Prevention of deformity and disability due to malunion
- Evaluation of treatment related complications

MATERIALS AND METHODS

This cross-sectional study was conducted in a Vijayanagara Institute of Medical Sciences hospital, Bellary. All the patients who are attended at the out-patient and in-patient department of Orthopaedics at VIMS, Bellary with fracture of distal end radius fulfilling the inclusion criteria during the study period of 2 year from December 2020 to November 2022 were enrolled for the study.

Calculation of Sample Size
Formula for Sample Size Calculation:

$$n = (Z1 ^2 \{P(1-P))/d^2$$ [13]

Variable Considered for Calculation of Sample Size: 76% wounds were healed at that time of fixator removal is considered here for sample size calculation.

P	Your guess of Population P (any value<1)	0.80
1-α	Confidence level set by you	0.23
Z	Z value associated with confidence	1.96
D	Absolute precision (Value less than P)	0.153
N	Minimum sample size	28

By using above formula and putting the values in it, minimum sample size came to 28, but we are planned to include total 30 cases fulfilling the eligibility criteria of our study.

Statistical Analysis: Data is collected by using a structure proforma. Data entered in MS excel sheet and analysed by using SPSS 24.0 version.

Qualitative Data is Expressed in Terms of Proportions: Quantitative data is expressed in terms of Mean and Standard deviation. Association between two qualitative variables is seen by using Chi square/Fischer's exact test Comparison of mean and SD between two groups is done by using unpaired t test to assess whether the mean difference between groups is significant or not. Descriptive statistics of each variable is presented in terms of Mean, standard deviation, standard error of mean. A $p<0.05$ is considered as statistically significant whereas a p value <0.001 will be considered as highly significant.

Assessment of fractures of distal end radius was done with reference to skin condition (closed/open fracture), peripheral circulation, neurologic examination especially median nerve, flexor and extensor tendon function, distal radioulnar joint stability, compartment syndrome and associated injuries.

Radiographs of Injured Wrist taken Included:

- Antero Posterior view
- Lateral view

Fig 1: Preop x-rays

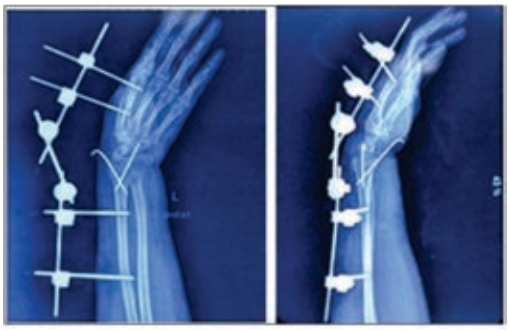

Fig 2: Post op x-rays

Fig 3: 6 months follow-up

Fig 4: Preop x-rays

Radiographic Parameters Noted were:

- Radial inclination in PA view
- Radial length in PA view
- Palmar tilt in lateral view
- Articular step off/displacement

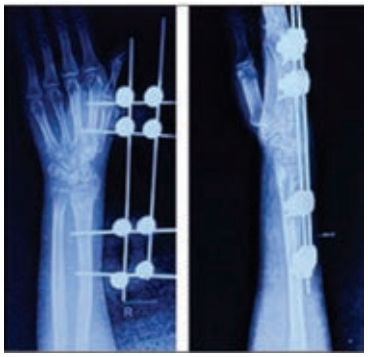

Fig 5: Post op x-rays

Fig 6: 6 months follow-up

Fractures were classified according to Frykman classification. Instability was recognized based upon initial displacement. >20 dorsal angulation, marked dorsal metaphyseal comminution, radial shortening >10mm.Secondary instability is said to be present when closed reduction and cast immobilization fails to maintain initial reduction and is found if residual dorsal angulation >100, residual radial shortening >5mm, >2mm step-off or displacement of articular fragments, intra articular fractures, loss of radial inclination >20, metaphyseal comminution of >50% diameter of radius, associated ulnar fracture, significant osteoporosis.

RESULTS AND DISCUSSIONS

Majority of our patients were in the age group of 21-40 years. Youngest person was 22 years old and oldest was 60years. Mean age was 39.03 years. Out of 30 patients, 18 (60%) were males and 12 (40%) were females. Out of 30 patients, 73.3% of our cases dominant hand was found to be involved which is right hand. Most of our cases occurred following RTA (60%), only to followed by fractures due to fall on out stretched hand (23.3%), fall from height (16.6%).Out of 30 patients, 6 of the cases (20%) had associated skeletal injuries.

Duration of External Fixation: Duration of the external fixator in situ was for 5-6 weeks in 85% and in 15% of cases external fixator was left in place for 7-8 weeks. Mean duration of external fixator application was 6.17 weeks.

Table 1: Distribution of patients according to age and sex wise

Age group in years	Number of cases	Percentage
20-40	16	53.3
41-50	8	26.6
51-60	6	20
Sex		
Male	18	60
Female	12	40
Total	30	100

Table 2: Distribution of patients according to side of involvement

Side	Number of cases	Percentage
Dominant (Right)	22	73.4
Non dominant (Left)	8	26.6
Total	30	100

Table 3: Distribution of patients according to mode of injuries

Mode of injury	Number of cases	Percentage
Road traffic Accident	18	60
Fall from height	7	23.3
Fall on outstretched hand	5	16.6
Total	30	100

Table 4: Distribution of patients by associated injuries

Associated injuries	Number of cases	Percentage
Distal humerus fracture	1	16.7
Tibia shaft fracture	2	33.3
Ttibial plataue	1	16.7
Femur fracture	1	16.7
Metatarsal fracture	1	16.6
Total	6	100

Table 5: Average range of movement achieved after 6 months

Movements	Average movement
Dorsi flexion	62.5°
Palmar flexion	54.6°
Radial deviation	16.5°
Ulnar deviation	25.5°
Supination	75.2°
Pronation	71°

Table 6: Distribution of patients by associated complications

Complications	No. of cases	Percentage
Residual pain	7	35
Dorsal angulation	4	20
Pin loosening	2	10
Restricted wrist movements	4	20
Finger stiffness	2	10
Sudek's dystrophy	1	5
Total	20	100

Table 7: Distribution of patient by functional results

Functional results	Number	Percentage
Excellent	8	26.6
Good	16	53.3
Fair	5	16.6
Poor	1	3.3
Total	30	100

Follow Up: Most of our cases were followed up for a minimum period of 6 months. Average duration of follow up was 36.8 weeks. At the end of follow up the average range of movement achieved was 62.5° dorsi flexion, 54.60 palmar flexion, 16.5° radial deviation, 25.5° vulnar deviation, 75.2° supination and 71° pronation. Our of 20 cases who have got post-operative complications, 7 cases of residual wrist pain which was mild to moderate and was treated by analgesics alone. Restricted wrist movements and finger stiffness was present in cases of metaphysical communition.

One case had mild Sudeck's dystrophy which responded to aggressive physiotherapy. Results were assessed as per De merit point system of Gartland and Werley (modified by Sarmiento 1975)[14] for functional results at the end of 6 months of follow up. 26.6% have excellent results and only 1 patients had poor results.

Patients ranged from 22-60 years and the mean age was 39.03years. Study by Leung *et al*.[15] and Gunaki *et al*.[16] had mean age group of 34.8 and 35.6 respectively, whereas Aggarwal *et al*.[17] has 45 mean age group. The incidence of fractures in our study was more common in males 18/30 (60%) which can be attributed to the risk of injury due to occupational and ambulant life led by them, another reason for high incidence of cases in males may be due to high susceptibility to injury and easy accessibility to health facilities. High incidence of fractures in males was also seen in studies of Leung *et al*.[15], Yamamoto *et al*.[18], Nagi ON *et al*.[2]. In our study it was noted that dominant hand was more commonly involved (73.3%). This may be attributed to tendency of stretching the dominant hand as a reflex while RTA/fall so as to avoid injury to face and head.

In 60% of cases, the mode of injury was RTA, 23.3% of cases were due to fall from height, 16.6% of cases were due to fall over out stretched hand. In Gunaki *et al*.[16] study 60% of cases were due to road traffic accident. In our study associated skeletal injuries were present in 20% of cases. In that of Gunaki *et al*.[16] study more common associated injuries were head injury (2), tibia-fibula fractures (3). In our study 3 (10%) of fractures were open fractures, the incidence of open fracture is comparable to that observed in Jain BK et al. study (18.1%)[19]. This aspect is important in our study as it has bearing on planning for secondary procedure like split thickness skin grafting and final outcome of treatment. There was poor outcome in cases with open fractures with associated tendon injuries.

In complications, the lower incidence of pin related complications (pin tract infection 0 cases, pin loosening 2 cases) can be explained probably due to limited open technique of external fixator application as advocated by Seitz *et al*.[20]. One case of osteomyelitis of radius with ring sequestrum at pin site was seen in case of open fracture. Residual wrist pain was seen in 8 patients most of which was mild and reproduced on exertion but it was not disabling as far as activities of daily living was concerned. Restricted wrist joint movements were seen in 4 patients and finger stiffness in 3 patients, this can be due to open fracture and non-adherence of patient strict vigorous rehabilitation program. Our study showed functional status with excellent and good results accounting to 79.9%, whereas Gunaki *et al*.[16], Nagi ON *et al*.[2] showed 86% and 74.4% respectively.

CONCLUSION

This series concludes that in younger age group [<50], ligamentotaxis by external fixation consistently results in a favorable outcome in the management of

intra-articular distal end of radius fractures. External fixaton is the effective method in treating the unstable intra- articular fractures of the distal end of radius. It is important to have a tight purchase of the pin in the bone with minimal damage to surrounding tissue. External fixation was maintained for 6 weeks till the bony union is complete. For an optimal result, good anatomical reduction is necessary.

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