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## Management of comminuted intra-articular fractures of distal radius by external fixator using principle of ligamentotaxis: A prospective study

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### Abstract

Management of fracture distal end of radius is still a challenge for Orthopaedic surgeon and pose therapeutic problem in terms of reduction of fracture, maintenance of reduction till the fracture unites, mobility of the joint after fracture union. Failure in the management may cause permanent disability<sup>1</sup>. The efficacy of ligamentotaxis in neutralizing detrimental compression forces, which are likely to cause displacement of unstable fracture with radial shortening, is a significant and increasingly appealing advance in the management of distal radius fracture. The aim of our study is to evaluate the functional outcome of comminuted intra-articular distal radius fractures in 30 patients treated by External fixator using principle of Ligamentotaxis. Demerit score system modified after Gartland Werley (1951) was used to assess the functional outcome. As per scoring system 14 patients had excellent results, 12 patients had good results and 3 patients had fair results and poor result in 1 patient. Based on our study we found ligamentotaxis is a good surgical option in the management of comminuted intra-articular distal end radius fractures.

**Keywords:** Distal end radius fracture, ligamentotaxis, external fixation

### Introduction

Fractures of distal end radius are the most common fractures of the upper extremity and account for approximately 1/6th of all fractures seen and treated in emergency rooms<sup>[2]</sup>. It occurs in middle aged and elderly women commonly. It also occurs in young men with high velocity injury though less in number. Osteoporosis and tendency to fall on outstretched hand constitute the major risk factors<sup>[3]</sup>. About 50% of metaphyseal fracture of the distal aspect of the radius also has involvement of the radiocarpal and/or distal radioulnar joint<sup>[4]</sup>. Treatment of displaced fractures of the distal end of the radius has changed over the course of time. In the past, closed reduction with immobilization in a plaster cast was considered the treatment of choice. However, fractures that are either unstable and/or involve the articular surfaces can jeopardize the integrity of the articular congruence and/or the kinematics of these articulations. The fracture pattern, the degree of displacement, the stability of the fracture, and the age and physical demands of the patient determine the best treatment option.

Over the past many years, more sophisticated internal and external fixation techniques and devices like percutaneous pin fixation; external fixation devices that permit distraction and palmar translation; low-profile internal fixation plates and implants; arthroscopically assisted reduction; and bone-grafting techniques, including bone-graft substitutes have been used for the treatment of displaced fractures of the distal end of the radius<sup>[5]</sup>. They all have contributed to improved fracture stability and outcome. However, the best method of obtaining and maintaining an accurate restoration of articular anatomy however, remains a topic of considerable controversy.

External skeletal fixation has been popular for the treatment of displaced, unstable fractures of the distal part of the radius because it combines a minimally invasive procedure with reduction by ligamentotaxis<sup>[6]</sup>.

Through prolonged distraction by the fixator, tension is provided by the capsuloligamentous structures across fracture site which help in bone healing, to achieve radial length, volar tilt and radial angulation to near normal and also allows freedom of elbow hand motion so that all the activities of daily living can be performed without any impediment.

### Materials and Methods

This is a prospective study consisting of 30 patients with comminuted intra-articular distal radius fractures treated by External fixator using principle of Ligamentotaxis conducted at MVJ Medical College & Research Hospital, Bengaluru from October 2019 to September 2021. Patients were evaluated for clinical & functional outcome for minimum at 6 weeks interval to minimum of 6 months. The Scoring system used was Demerit score system modified after Gartland Werley (1951).

### Inclusion criteria

- Patients with comminuted intra-articular distal radius fractures.
- Patients above 20 years of age.
- Patients who are willing to participate in this study.
- Open fractures of distal end radius to facilitate wound care.

### Exclusion criteria

- Patients with polytrauma.
- Cases with associated fractures with other bones in wrist, hand or forearm.
- Neurovascular injuries.
- Nonunion.
- Patients with pathological fractures.
- Fractures more than 2 weeks old.
- Unstable extra-articular fractures with significant metaphyseal comminution and failure to maintain reduction after initial attempt at closed reduction and cast application.

### Operative technique

Patients above the age of 20 yrs presenting with comminuted intra-articular distal radius fractures were admitted to our hospital. A thorough history was elicited from the patient/attenders with regards of the nature of the injury (mechanical fall or due to any other causes). The affected upper limb was immobilized with POP or splints. Consent for surgery was taken. All preoperative work up were carried out. X-rays of the wrist (Antero-posterior & Lateral views) +/- scaphoid view were taken and CT wrist was taken if required. All other injuries were investigated and managed appropriately. After Anaesthetic fitness patient was posted for surgery.

Under regional block anaesthesia/GA, patient was placed supine on the operating table with the operating forearm placed on a radiolucent arm-board. The forearm and hand were painted with betadine and draped. Closed reduction was done under C-arm. Wound debridement and wound care was given in compound fracture.

In our technique, 5mm incision for 4 schanz pins, 2 in the middle third of the radius on the dorso lateral aspect about 10-12cm from distal end and 2-3cm apart. Soft tissue dissection was done using a haemostat, care taken to avoid injury to radial nerve. Another 2 incisions over the base of the second metacarpal on dorso lateral aspect about 1-2 cm apart were done, 3mm schanz pins were inserted in the radius, and 2.5

mm schanz pins were introduced in second metacarpal, then with fixator pins securely in place, clamps and external fixator rod were mounted to schanz pin. The clamps were loosened and longitudinal traction was given with manual moulding of the fracture fragments back into a more normal alignment and gentle flexion and ulnar deviation was maintained.

The reduction was confirmed through C-arm and then external fixator was locked into place. The tension across the wrist generated by the external fixator device which provides enough ligamentotaxis was confirmed by image intensifier wherein, radiocarpal articulation was seen to be 1mm wider than the mid- carpal joint in A-P projection. Appropriate antibiotics and analgesics were given postoperatively.

Active exercises of fingers, thumb, elbow, forearm and shoulder were commenced from the day 1 of operation. The patient was followed up after 2 weeks, 4 weeks and 6 weeks. On demonstration of the radiological union, the external fixator was removed after 4-6 weeks and physiotherapy of the wrist and finger was commenced and exercises were taught to continue at home. Each patient was evaluated for functional recovery at the end of six weeks, three months and 6 months by clinical and radiological examination and the assessment of anatomical and functional outcome was made according to modified Gartland and Werley scoring system.

### Results

The following observations were made from data collected during study.

- Total cases: 30
- Average age: 44.6 years
- Male / Female: 16/14
- Side: Right/Left: 17/13

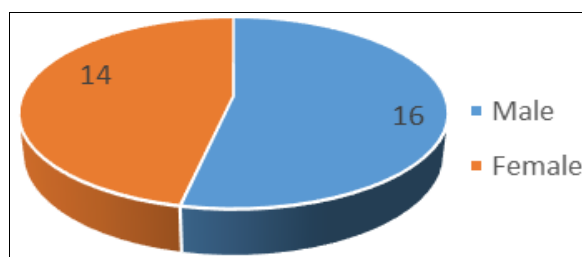


Fig 1: Sex Incidence

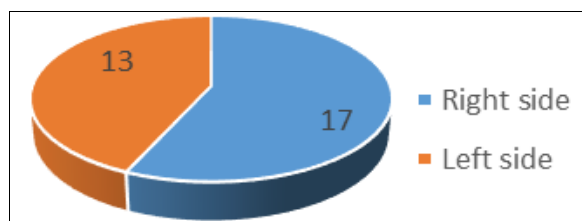


Fig 2: Side Involved

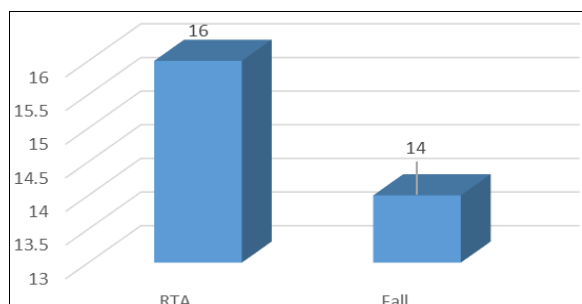
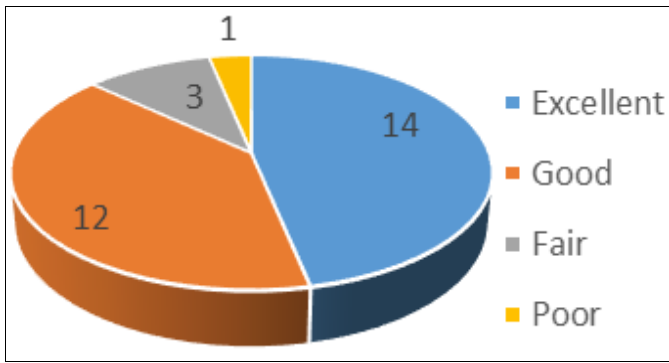


Fig 3: Mode of Injury



**Fig 4: Results**

In the present study of 30 cases with an average age of patient is 44.6 years with Male(16) to Female(14) ratio of 1.14:1; the outcome was found to be 46.66% (14) excellent, 40% (12) good, 10% (3) fair and 3.33% (1) poor according to modified Gartland and Werley scoring system.

**Complications**

There were no intra operative complications observed in this study. Post-op complications which include 3 patients who developed joint stiffness, 1 patient developed pin track infection and 1 patient developed malunion. Fracture union occurred by 6 weeks in maximum number of patients (76.66%).



**Fig 5: Pre-op X-Ray**



**Fig 6: Post op X-Ray**



**Fig 7: Extension**



**Fig 8: Flexion**



**Fig 9: Pronation**



**Fig 10: Supination**

## Discussion

The efficacy of ligamentotaxis in neutralizing detrimental compression forces, which are likely to cause displacement of unstable fracture with radial shortening, is a significant and increasingly appealing advance in the management of distal radius fracture [7].

Our study is to evaluate the functional outcome of comminuted intra-articular distal radius fractures treated by External fixator using principle of Ligamentotaxis.

Average age of patients in the present study was 44.6 years. The range of age was 30-61 years. The mean age is comparable with the study of Leung *et al.* [8], Gunaki RB *et al.* [9], Jain BK *et al.* [10], Akmaz *et al.* [11] and Aggarwal *et al.* [12].

**Table 1: Mean Age**

Study group	Mean Age group (yrs)
Leung <i>et al.</i> (1989) [8]	35.6
Gunaki RB <i>et al.</i> (1998) [9]	34.8
Jain BK <i>et al.</i> (1998) [10]	37
Akmaz <i>et al.</i> (2003) [11]	39
Aggarwal <i>et al.</i> (2004) [12]	45
Our study	44.6

## Sex Incidence

The incidence of fractures in our study was more common in males (53.33%) which can be attributed to the risk of injury due to occupational and ambulant life led by them. High incidence of fractures in males was also seen in studies of Leung *et al.* (1989) [8], Jain BK *et al.* (1998) [10], Mannur *et al.* (2001) [13], Yamamoto *et al.* (2003) [14], Nagi ON *et al.* (2004) [15].

**Table 2: Sex Incidence**

Study	Males-cases (%)	Females-cases (%)	Total cases
Leung <i>et al.</i> (1989) [8]	73.6%	26.4%	72
Jain BK <i>et al.</i> (1998) [10]	63.63%	36.36%	22
Mannur <i>et al.</i> (2001) [13]	45%	55%	20
Yamamoto <i>et al.</i> (2003) [14]	54.5%	45.5%	92
Nagi ON <i>et al.</i> (2004) [15]	88.5%	11.5%	35
Our study	53.33%	46.66%	30

## Functional Outcome

In our study, the Demerit score modified after Gartland and Werley (1951) was evaluated at the follow up (minimum period of 6 months). Overall, 14 patients (46.66%) achieved excellent results, 12 patients (40%) achieved good results, 3 (10%) patients achieved fair results and 1 patient (3.33%) had a poor result. Overall, 86.66% of the patients achieved an excellent or good result, which was comparable with other studies.

**Table 3: Functional Outcome**

Study group	Excellent to Good	Fair to Poor	Total cases
Cooney WP <i>et al.</i> (1979) [16]	85%	15%	130
Leung KS <i>et al.</i> (1989) [8]	80%	20%	72
Jakim I <i>et al.</i> (1991) [17]	83%	17%	169
Gunaki RB <i>et al.</i> (1998) [9]	86.6%	14%	30
Kleina W <i>et al.</i> (2000) [18]	87%	13%	103
Mannur A <i>et al.</i> (2001) [13]	70%	30%	20
Yamamoto K <i>et al.</i> (2003) [14]	95.6%	4.4%	92
Our study	86.66%	13.33%	30

## Conclusion

In view of results obtained from similar studies ligamentotaxis is a good surgical option in the management of comminuted intra-articular distal end radius fractures.

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## Author's Contribution

Not available

## Conflict of Interest

Not available

## Financial Support

Not available

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