

Abstract for Thesis on Functional Outcome in Fracture in Lower End Radius in Patients Treated with Joshi External Stabilizing System (JESS FIXATOR)

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Abstract: ***Introduction:** Fractures of the distal end radius are a common upper extremity fracture. Intra-articular distal end radius fractures are recognized as very complex injuries with a variable prognosis. The aim of the study was to assess the functional outcome of patients treated with Joshi's external stabilizing system (JESS) for displaced intra-articular distal end radius fractures. **Materials and Methods:** A total of 25 patients with distal end radius fracture were treated with JESS from July 2020 to June 2022. The patients were followed up at 2, 6 weeks, 6 months, 1 year after the surgery. The assessment of pain, range of motion, grip strength, and satisfaction were assessed at 6 months, follow-up and scored according to Green and O'Brien scoring system modified by Conney. **Results:** The excellent to good results were found in 84% of cases. We observed that patients with age less than 50 years had greater prognosis as compared with patients with more than 50 years of age. Final outcome was also found better in males as compared with females at 6 months and 1 year postoperatively. **Conclusion:** JESS is an effective treatment technique for intra-articular distal end radius fractures in our community. On long-term follow-up of the patients treated with JESS for intra-articular distal end radius fractures, the functional and radiological outcomes were good with low complication rate.*

Keywords: Joshi's external stabilization system; Green and O'Brien scoring system modified by Conney; distal end radius fractures

1. Introduction

Fractures of the distal radius account for approximately (20%) of all fractures seen and treated in emergency rooms^{1, 2, 3}. The female sex is the most affected due to the presence of greater osteoporosis. Fracture of distal radius show bimodal age distribution. Below 40 years of age, it has an incidence of 368 per 100,000 and above 40 years the incidence is 1,150 per 100,000 inhabitants. FDERs are caused by high-energy trauma in the young patient and low-energy trauma in the elderly caused by axial compression of the limb with the wrist in 40-90° extension. In 1814 it was redefined by Irish surgeon and anatomist **SIR ABRAHAM COLLES** in his paper "**On the fracture of carpal extremity of radius**"

Colles fracture is specifically defined as metaphyseal injury of corticocancellous junction (within 2-3 cm of articular surface) of distal radius with characteristic dorsal tilt, dorsal shift, radial tilt, radial shift, supination and impaction

Smith fracture also referred to as reverse Colles which have palmar tilt of dorsal fragment. Barton fracture is displaced intraarticular coronal plane fracture subluxation of dorsal lip of distal radius with displacement of carpus with fragment. Reverse Barton occur in wrist in palmar flexion and involve volar lip. Chauffers fracture involve intraarticular fracture of radial styloid of variable size.

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}. About 50% of the metaphyseal fractures have intra-articular extension to radiocarpal or distal radioulnar joint⁵. Intra-articular fractures are inherently unstable, difficult to reduce

anatomically and immobilize in closed POP support and are associated with high rate of complications⁸.

The 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 ligamentotaxis⁴. 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/or kinematics of these articulations⁵. With the changing mode of injury, fracture of the distal end radius occurring in younger patients, increasing functional demands of the patients, better understanding of the fracture pattern, advances in biomechanics of the wrist and availability of treatment oriented classification system, it seems we have to look beyond the conventional teaching that they all do well ultimately. Distal radius fractures especially the high energy fractures are often associated with poor results and high complication rates⁵. Preservation of the articular congruity is the principle prerequisite for successful recovery⁷. The best method of obtaining and maintaining an accurate restoration of articular anatomy however, remains a topic of considerable controversy⁷.

2. Aims and Objectives

The aim of present prospective study is to assess **functional outcome in fracture of the lower end of radius in patients**

treated with Joshi's external stabilizer system" (JESS FIXATOR).

Material and Methods: This is a prospective study including patients attending the out patient and in patient department of orthopedics at government medical college kota with fracture of distal end radius fulfilling inclusion criteria during study period from July 2020 to December 2022.

Inclusion Criteria:

- 1) Unstable intra - articular distal end radius fractures
- 2) Extension into radiocarpal / radioulnar joints or with ulnar fractures
- 3) Unstable extra - articular fractures with significant metaphyseal comminution and failure to maintain reduction after initial attempt at closed reduction and cast application
- 4) Open fractures of distal end radius to facilitate wound care.
- 5) Bilateral distal end radius fractures.

Exclusion Criteria:

- 1) Poor general health of the patient.
- 2) Associated hemorrhagic shock, injuries to head, chest, and abdomen requiring active management.
- 3) Cases of age >80yrs and <18yrs.
- 4) Cases with neurovascular deficit due to associated fracture at site proximal to the wrist.
- 5) Patient also having other fracture in the affected extremity

Radiographs of injured wrist taken will include Anterior - Posterior view and Lateral view.

Radiographic parameters will be noted:

- a) Radial inclination in AP view
- b) Radial length in AP view
- c) Palmar tilt in lateral view
- d) Dorsal tilt in lateral view
- e) Radial shortening
- f) Articular step off / displacement

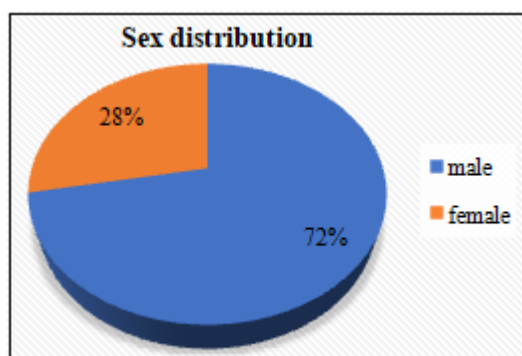
Routine invtigation were done for all patients included in surgery. JESS was done under regional\general aesthesia. The patients were followed up at 2, 6 weeks, 6 months, 1 year after the surgery. The assessment of pain, range of motion, grip strength, and satisfaction were assessed at 6 months, follow - up and scored according to Green and O'brien scoring system modified by Conney



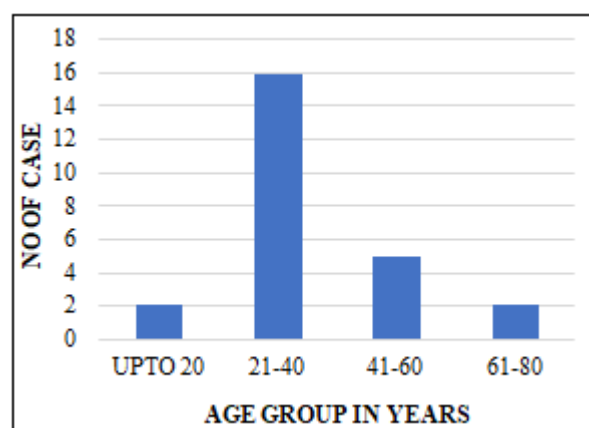
Figure 1: Intraoperative image showing application of JESS fixator

3. Observation

A total of 25 cases of distal end radius fractures attending department of orthopedics in GMC KOTA during study period FROM JULY 2020 TO DECEMBER 2022 were managed by JESS FIXATOR. Majority of patients in present series were in age group of 21 - 40 years. Youngest person was 19 yrs old and oldest was 64 yrs. Mean age was 39.24 years. Out of 25 patients 18 (72%) were male and 7 (28%) were female in the present study. In 64 % of case dominant hand was found to be involved in present case series, 2 of our cases had bilateral distal end radius fractures of which only one side was treated by external fixator. At the end of follow up of 6 month it was noted that the average loss in radial length was 3.21mm, the average radial angle obtained was 17.65° and average palmer tilt was 1.52° in our cases. at the end of follow up the average range of movement achieved was 57.39° dorsiflexion, 48.26° palmer flexion, 17° radial deviation, 23° ulnar deviation, 72.8° supination and 69° pronation.



Graph 1: Sex Distribution



Graph 2: Age Distribution

Complications

In our study we noticed 8 case of residual wrist pain which was mild to moderate and was treated by analgesic alone. Pin tract infection was seen in 2 patients which respond very well to antibiotic therapy. restricted wrist movements and finger stiffness was present in case of open fractures and in patient who were not compliant for physiotherapy. One case had mild sudeck's dystrophy which responded to aggressive physiotherapy.

4. Results

Results were assessed as per Green and O'Brien Scoring System modified by Cooney at 6 months and 1 year for functional results and criteria for anatomical results by Serminto (1980) at the end of 6 months of follow up

Table 1: Functional Results in Our Study

Functional Results	No. of Case	Percentage
Excellent	13	52%
Good	8	32%
Fair	2	8%
Poor	2	8%
Total	25	100%

Table 2: Average Range of Movement Achieved After 6 Month

Movements	Average Movements
Dorsiflexion	58.39 ⁰
Palmer flexion	49.26 ⁰
Radial deviation	19 ⁰
Ulnar deviation	24 ⁰
Supination	74.8 ⁰
Pronation	72 ⁰



Figure 2: 6 Months Follow Up Showing Excellent Functional Outcome



Figure 3: Preoperative, Postoperative and 6 Months Follow Up Radiograph of Patient

5. Summary and Conclusion

In the present light of advances in biomechanics of wrist, better classification methods and newer modalities of treatment, the older convention of closed reduction and cast application used as a panacea for distal end radial fractures is losing its validity. External fixation offers excellent mode of treatment for cases presenting late by gradual distraction. It allows wound observation care and coverage procedures in open fractures without compromising the reduction of fractures achieved. External fixation is an incomplete solution to many difficult articular fractures. Although ligamentotaxis can favorably affect articular surface tilting, severe fragment displacement, die punch fragment and the absence of soft tissue attachment require additional modalities of treatment. If persistent displacement of key fragments cannot be reduced with external fixation alone, consideration should be given to combining external fixation with percutaneous manipulation of key fragments and augmentation by K wires & - / bone graft or open reduction and internal fixation of displaced fragments. Anatomical voids from crushed metaphyseal bones that are evident following restoration of radial length should be filled

with bone grafting. External fixation and ligamentotaxis provides better functional and anatomical results in comminuted intra-articular and unstable extra-articular wrist injuries. It provides early mobilization and reduces edema stiffness of joints thus leading to better and early functional recovery. The incidence of complications due to redisplacement and immobilization or persistent deformity, persistent distal radioulnar joint subluxation, Sudek's dystrophy, carpal tunnel syndrome and radio carpal joint arthritis can drastically be reduced. The successful use of external fixator for distal end radial fractures requires careful assessment of fracture pattern, appropriate patient selection, 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.

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6. Discussion

Distal end radius fracture is the most common fracture we treat. Many external fixation devices are described to achieve reduction and fixation of the fragments without loss of position and acceptable functional results. The ligamentotaxis is the basic principle used by external fixation. The early mobilization of the wrist leads to normalization of blood supply, hastened functional recovery, earlier resolution of wrist swelling, and decreased joint stiffness. The dynamic external fixators have been developed to provide mobilization of the wrist while reduction and fixation are maintained. JESS fixator application in our study allowed sound fracture union with functional mobility in our study. Our study reflects a typical experience from the semi urban parts of India where different patient factors have to be considered when choosing the best available treatment. Treatment advised should be based on the best evidence, however patient preferences and cost effectiveness should be considered in choosing the final treatment. Our results shows good and/or excellent results were found in 84% of cases. In conclusion JESS is a good option in patients with displaced distal end radial fractures.

The incidence of fractures in our study was more common in males 18/25 (72%) which can be attributed to the risk of injury due to occupational and ambulant life led by them, another reason for higher incidence of case in male may be due to high susceptibility to injury and easy accessibility to health facilities. higher incidence of fracture in male was also seen in studies of leung et al (1989), jain BK et al (1998), mannur et al (2001), yamamoto et al (2003), nagi ON et al (2004)

In our study 24% of fractures were open fractures, the incidence of open fracture is to that observed in Jain BK et al study (18.1%).

The average period of immobilization in our study was shorter (6.24 weeks) as advised by Nagi ON et al compared to that of Gunaki RB et al" wherein it was 7.2weeks. We followed the method advocated by Seitz et al (1993). limited open technique to avoid pin related complication like pin tract infection, pin loosening. Eccentric drilling and fractures. The same technique was followed by Jain BK et al¹ and Gunaki RB et al

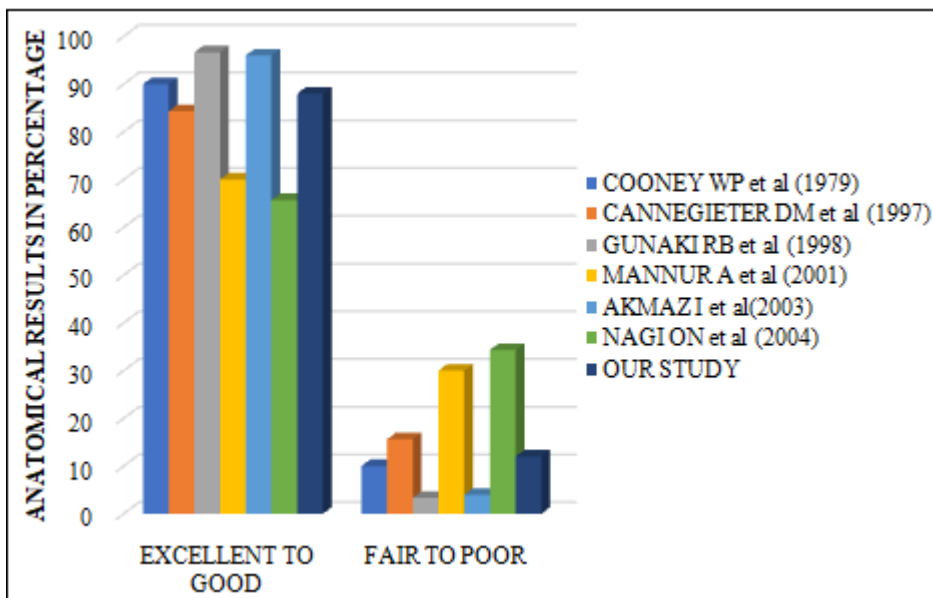
In our series average palmar tilt was 1.52° as against 2° found in that of Gunaki RB et al (1998) " series. Even small change in palmar tilt leads to radiocarpal dysfunction as suggested by Talrisnik and Watson (1987) and causes midcarpal instabilities due to change in load distribution".

Inability of achievement of palmar tilt is shortcoming of uniplanar external fixation which provides ligamentotaxis in one plane this is confirmed by cadaveric study of intra - articular fractures by Bartosh and Saldanha" This short coming is overcome by multi planar ligamentotaxis and non bridging external fixation which provides facility for palmar translocation of fracture fragments without positioning of wrist in extreme flexion Prohibitive cost factor compelled us to use simple but versatile AO type external fixation. Non bridging external fixation was not tried because of severe comminution of fractures. Average range of movements at the end of follow up in our study was compared with that of Gunaki RB et al.

Table 3: Comparison of range of movement of wrist

Movement	Our Study	Mminimum For Normal Function (Serminto 1975)	Gunaki Rb et al (1998)	Normal
Dorsiflexion	58.39 ⁰	45 ⁰	59 ⁰	70 ⁰
Palmer Flexion	49.26 ⁰	30 ⁰	52 ⁰	60 ⁰
Radial Deviation	19 ⁰	15 ⁰	18.83 ⁰	25 ⁰
Ulnar Deviation	24 ⁰	15 ⁰	23.5 ⁰	30 ⁰
Supination	74.8 ⁰	50 ⁰	75.16 ⁰	85 ⁰
Pronation	72 ⁰	50 ⁰	73.83 ⁰	85 ⁰

In our study the anatomical & functional results are comparable to the standard studies The functional result was poor in cases with open fracture and injury to tendons of wrist and hand. Our overall functional results were poor compared to anatomical results which may be due to severity of associated soft tissue injury and articular damage as suggested by Jakim et al (1991) ". Mcqueen et al (1992) " and Akmaz et al (2003) " who also reported similar results.



Graph 3: Comparison of Anatomical Results in Different Studies

Table 4: Functional results compared with other standard studies

Study Group	Excellent To Good	Fair To Poor	Total Case
COONEY WP et al (1979)	85%	15%	130
LEUNG KS et al (1989)	80%	20%	72
JAKIM I et al (1991)	83%	17%	169
CANNEGIETER DM et al (1997)	74.2%	25.8%	31
GUNAKI RB et al (1998)	86.6%	13.4%	30
JAIN BK et al (1998)	72.8%	27.2%	22
KLEINA W et al (2000)	87%	13%	103
MANNUR A et al (2001)	70%	30%	20
YAMAMOTO K et al (2003)	95.6%	4.4%	92
AKMAZI I et al (2003)	44%	56%	25
NAGI ON et al (2004)	74.28%	25.72%	35
OUR STUDY	84%	16%	25

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