*Galore International Journal of Health Sciences and Research*
*DOI: https://doi.org/10.52403/gijhsr.20211009*
*Vol.6; Issue: 4; Oct.-Dec. 2021*
*Website: www.gijhsr.com*
*Original Research Article* *P-ISSN: 2456-9321*

# Study of Functional Outcome of Comminuted Fracture Distal End Radius Managed by Joshi's External Stabilizing System Application: An Observational Study

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## ABSTRACT

**Objective:** To study the fracture lower end radius (comminuted fractures) by Joshi's external stabilizing system application.

**Methods:** This was a cross-sectional observational study conducted in the Department of Orthopaedics, DHH Koraput and Capital Hospital Bhubaneswar. The study comprised patients with comminuted fracture distal end radius in the hospital. Patients were included in the study if they had a comminuted fracture of the distal radius. This was defined as any distal radial fracture with more than 20° of dorsal angulation, metaphyseal comminution with or without intra-articular extension and more than 2 mm of positive ulnar variance. A total of 44 patients were included in the study.

**Results:** The mean age of patients was 37.41±12.63 years. More than half of patients were males (65.9%). Closed fracture was among majority of patients (86.4%). Right side injury was involved in 63.6% patients. C3 fracture classification was most common (31.8%). TILT dorsal/ventral 20-30° was in more than half of patients (65.9%). The mean TILT dorsal/ventral was 28.26±12.57°. The time interval of injury to surgery was 4-5 days in 73.7%. The mean time interval of injury to surgery was 4.24±0.56 days. DASH score 10-20 was in 63.6% patients. The mean DASH score was 18.4±13.45. Pin tract was most common complication (18.2%) followed by loosening of pin (6.8%).

**Conclusion:** JESS is an effective treatment technique for intra-articular distal end radius fractures.

***Key Words:*** Comminuted fractures, Joshi's external stabilizing, Fracture classification

## INTRODUCTION

Fractures of the distal end of radius continue to be the most common skeletal injuries treated by orthopedic surgeons. In fact, these injuries are the most common fractures of the upper extremity and account for approximately 1/6th (17%) of all fractures seen and treated in emergency rooms (Ark and Jupiter, 1993; Nagi et al, 2004).

Many fractures of the distal aspect of the radius are relatively uncomplicated and are effectively treated by closed reduction (CR) and immobilization in plaster of Paris (POP) cast. However, vast majority of fractures of the distal end of radius are articular injuries that result in disruption of either radiocarpal joint or distal radioulnar joint or both (Melone, 1993).

Intra-articular fractures are inherently unstable, are difficult to reduce anatomically and immobilize in POP cast, and are associated with high rate of complications (Knirk and Jupiter, 1986).

For an optimal result, there must be an accurate restoration of skeletal anatomy and supervised rehabilitation by a skilled physiotherapist. Preservation of the articular congruity is the principal prerequisite for successful recovery. The best method of obtaining and maintaining an accurate restoration of articular anatomy, however, remains a topic of considerable controversy (Simic and Weiland, 2003; Simic and Weiland, 2003).

Most orthopedic surgeons today would agree that a patient with a malunited fracture of the distal end of the radius who "enjoys perfect freedom in all motions, and is exempt from pain," is the exception, not the rule. The goal of a treating surgeon should then be to restore the functional anatomy by a method that does not compromise hand function.

The Joshi External Stabilising System (JESS) has been used for bone stabilisation in the Indian subcontinent for 30 years. It was initially used in hand surgery. As the construct was simple, light weight and could be easily manoeuvred it was also useful in treating contractures of the hand and wrist and interphalangeal joint due to burns and due to diseases like leprosy. It was later used in intra-articular distal radial fractures, idiopathic clubfoot, calcaneal fractures, and congenital talipes equinovarus. It assists the surgeon in obtaining fracture stabilization and helps in fracture healing by gradual and controlled distraction and works on the principle of ligamentotaxis (Prabhu, 2009).

The present study was conducted with the objective to study the fracture lower end radius (comminuted fractures) by Joshi's external stabilizing system application.

## MATERIAL AND METHODS

This was a cross-sectional observational study conducted in the Department of Orthopaedics, DHH Koraput and Capital Hospital Bhubaneswar. The study was approved by the Ethical Committee of the Institute and consent was taken from each patient before including in the study. The study comprised patients with comminuted fracture distal end radius in the hospital. Patients were included in the study if they had a comminuted fracture of the distal radius. This was defined as any distal radial fracture with more than 20° of dorsal angulation, metaphyseal comminution with or without intra-articular extension and more than 2 mm of positive ulnar variance. A total of 44 patients were included in the study.

### Methods

JESS consists of the application of a total of 4 Kirschner wires in which 2 was placed in radius (2.5 mm), and 2 was placed in 2nd and 3rd metacarpals (2 mm) together connected by 2□2 mm clamps and inter connected rods after pre-stressed two Kirschner wires by conversing it together. Pre-stressing the wires reduces the chances of wires pulling out from the bone. Now both units are connected with 4 mm connecting rods after applying the distractor. The frame was made more stable by applying another 4 mm rod and connected with 4□4 mm clamps. The distractor was removed once all clamps were made tighten and thus converting it into the static frame. In osteoporotic bone, was used two 3.5 mm Schanz pins in radius and 2.5 mm Schanz pins in 2nd metacarpal connected by connecting rods (JESS). If there was any wound, swab for culture sensitivity was sent, thorough debridement was done and the wound was properly cleaned. Then the fracture was stabilized by JESS. The patients were followed up at 2 weeks, 3 weeks, between 6 and 8 weeks, 6 months, 1 year and 5 years after the surgery. The assessment of pain, range of motion, grip strength and activity were assessed at 6th months, 1 year and 5 years follow-up and scored according to Green and O'Brien scoring system. Acceptable reduction was achieved and confirmed in the image intensifier. If articular reduction was not be found satisfactory, then the depressed fragment was elevated though Kirschner

wire percutaneously. The Guidelines for acceptable closed reduction was taken: (i) Radial inclination: ≥ 15°; (ii) Radial length: ≤ 5 mm shortening; (iii) Radial tilt : ≤ 15°dorsal or 20° volar tilt and (iv) Articular incongruity: ≤ 2 mm of step-off.

Post -operative X- ray was taken. The patient was given IV antibiotics for 1 day and oral for 5 days. Active finger, elbow, and shoulder mobilization was started the 1st post operative day. Patient was discharged on the same day or on the 2nd day, and pin tract care was explained to the patient.

### Statistical evaluation

The results are presented in frequencies, percentages and mean±SD. All the analysis was carried out on SPSS 16.0 version (Chicago, Inc., USA).

## RESULTS

**Table-1: Baseline characteristics of patients**

| Baseline characteristics | No. (n=44) |
|---|---|
| Age in years, Mean±SD | 37.41±12.63 |
| Gender, no. (%) | |
| Male | 29 (65.9) |
| Female | 15 (34.1) |
| Close/open | |
| Close | 38 (86.4) |
| Open | 6 (13.6) |
| Side involved | |
| Left | 16 (36.4) |
| Right | 28 (63.6) |
| Fracture classification | |
| B2 | 6 (13.6) |
| B3 | 4 (9.1) |
| C1 | 12 (27.3) |
| C2 | 8 (18.2) |
| C3 | 14 (31.8) |
| TILT dorsal/ventral | |
| 20-30º | 29 (65.9) |
| >30º | 15 (34.1) |
| Mean±SD | 28.26±12.57º |
| Time interval (injury to surgery) | |
| 4-5 days | 32 (73.7) |
| 6-7 days | 12 (27.3) |
| Mean±SD | 4.24±0.56 |

**Table-2: Distribution of patients as per DASH score**

| DASH score | No. (n=44) | % |
|---|---|---|
| 10-20 | 28 | 63.6 |
| >20 | 14 | 31.8 |
| Mean±SD | 18.14±13.45 | |

**Table-3: Distribution of patients as per complications**

| Complications | No. (n=25) | % |
|---|---|---|
| Loosening of pin | 3 | 6.8 |
| Pin tract | 8 | 18.2 |
| None | 33 | 75.0 |

The mean age of patients was 37.41±12.63 years. More than half of patients were males (65.9%). Closed fracture was among majority of patients (86.4%). Right side injury was involved in 63.6% patients. C3 fracture classification was most common (31.8%). TILT dorsal/ventral 20-30º was in more than half of patients (65.9%). The mean TILT dorsal/ventral was 28.26±12.57º. The time interval of injury to surgery was 4-5 days in 73.7%. The mean time interval of injury to surgery was 4.24±0.56 days (Table-1).

DASH score 10-20 was in 63.6% patients. The mean DASH score was 18.4±13.45 (Table-2).

Pin tract was most common complication (18.2%) followed by loosening of pin (6.8%) (Table-3).

## DISCUSSION

Different surgical strategies are available for treating unstable intra-articular distal radius fractures, including external fixator, open reduction, and internal fixation with locking or non-locking palmar plates. External fixator is versatile in managing both intra- and extraarticular fractures with acceptable functional results. 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 (Agee, 1993; Kumar et al, 2011).

This study was conducted to study the fracture lower end radius (comminuted fractures) by Joshi's external stabilizing system application. A total of 44 patients were included in the study.

This study found that the mean age of patients was 37.41±12.63 years. More than half of patients were males (65.9%). Garg et al (2017) found that the mean age of patients was 36.07 ± 13.93 years. Shukla et al (2019) found that out of 170 patients, 105 (61.8%) were females and 65 (38.2%) were males. Closed fracture was among majority of patients (86.4%) in the present study.

Saha et al (2016) found that out of 75 patients, 20 patients had the open fracture.

This study observed that right side was involved among more than half of patients (63.6%). Similar to the present study, Shukla et al (2019) found that the right hand was injured in 98 (57.7%) patients. Jati et al (2017) also reported that right side was predominantly affected (60.3%). This study showed that C3 fracture classification was most common (31.8%). In the study by Shukla et al (2019), as per the AO classification, out of 170 patients, 41 patients had type B1, 35 type B2, 37 type B3, 29 type C1, 17 type C2, and 11 type C3. Pawar and Ibrahim (2017) found that among 15 patients, 9 males and 6 females, 6 had C1, 6 had C2, and 3 had C3. Jati et al (2017) found that most common fracture type was AO type C1. The time interval of injury to surgery was 4-5 days in 73.7%. The mean time interval of injury to surgery was 4.24±0.56 days in this study. Garg et al (2017) found lower interval between injury and surgery than this study in which the mean interval between injury and surgery was 3.2 days. Shukla et al (2019) found lower mean interval between injury and surgery than this study in which the mean interval between injury and surgery was 1.8 days.

The current study revealed that DASH score 10-20 was in 63.6% patients. The mean DASH score was 18.4±13.45. Dash et al (2017) found that at 6th post-operative month, the average quick DASH score (QD) was 12.9. Egol et al (2008) in 280 patients, found an improved range of movement early after volar plating, but after 1 year, the range of movement between the groups was similar, as were the results for grip strength and DASH scores at all-time points. External bridging fixation is modality of treatment long before when plating came in scenario [and is still preferred by many surgeons as a familiar technique as it requires minimal exposure and is less time consuming with low learning curve (Payandeh and McKee, 2007; Kulshrestha et al, 2011).

This study observed that Pin tract was most common complication (18.2%) followed by loosening of pin (6.8%). Garg et al (2017) found that 8.92% developed pin tract infection which was managed successfully by antibiotic treatment. Dash et al (2017) found that out of 35 cases, 2 cases of delayed wound healing &1 case of pin tract infection with ex-fix application was observed. Bobade et al (2019) reported that in JESS group, 4% of cases had pin tract infection, 2% had pin loosening, and 2% had neuropraxia of sensory branch of radial nerve. About 8% of patients had malunion after removal of JESS. About 10% of patients had finger and wrist stiffness in both JESS and volar LCP due to prolonged immobilization and inadequate physiotherapy, which was treated by regular exercises and these patients had fair result at 1 year follow-up.

Bradway et al (1989) using similar methods reported a 25% incidence of joint incongruity and an 18% infection rate. Others consider that it has a high incidence of complications, most of which are related either to pin problems or inadequate reduction (Szabo and Weber, 1988). Prolong immobilization of the wrist in an external fixator leads to decreased blood supply to the bone and soft tissues and causes periarticular fibrosis. This can be minimized by dynamization of the frame after 3 weeks postoperatively.

One of the limitations of this study was small sample size. Another limitation was that there was no follow-up in this study. The studies with larger sample size and long duration as well as long follow-up period required to have more robust findings.

## CONCLUSION

JESS is an effective treatment technique for intra-articular distal end radius fractures.

**Acknowledgement:** None
**Conflict of Interest:** None
**Source of Funding:** None

**Ethical Approval:** Approved

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How to cite this article: Kanhei Ram Mahapatro, Sahukar SK, Das SK et.al. Study of functional outcome of comminuted fracture distal end radius managed by Joshi's external stabilizing system application: An observational study. *Gal Int J Health Sci Res*. 2021; 6(4): 60-64. *DOI: https://doi.org/10.52403/gijhsr.20211009*

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