

# A Cross-Sectional Study on Functional Outcome of Comminuted Fracture Distal End Radius Managed by Joshi's External Stabilizing System Application in a Tertiary Care Hospital in Western Uttar Pradesh

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## ABSTRACT

**Introduction:** Distal radial (DR) fractures can result from any trauma to the forearm. Isolated DR fractures typically include Smith's, Colle's, Torus/Buckle, Greenstick, Die-punch, and isolated radial shaft fractures. The objective of this study was to assess the functional outcome of distal end radius (comminuted fractures) managed by Joshi's external stabilizing system application.

**Material and methods:** This study was a cross-sectional study conducted in the Department of Orthopedics, Uttar Pradesh Institute of Medical Sciences, Saifai Etawah. Patients were included in the study if they had a comminuted fracture of the distal radius.

**Results:** The mean age of patients was 38.56±13.96 years and more than half of patients were males (52.1%). 4.12±0.99 days. The total average DASH score was 17.94±15.06. There was no significant ( $p>0.05$ ) difference in DASH score between patients of  $\leq 40$  years and  $>40$  years. However, DASH score was significantly ( $p=0.008$ ) lower among male patients (11.92±6.71) compared to females (25.76±18.20). There was no significant ( $p>0.05$ ) difference in DASH score between patients of fall and road traffic accidents. There was a positive moderate significant correlation of DASH score with interval between injury and surgery in days ( $r=0.39$ ,  $p=0.006$ ). The overall complication was 37.5%. Shoulder hand syndrome was the most common complication followed by reflex sympathetic dystrophy (10.4%), deformity (8.3%) and pin tract infection (6.3%).

**Conclusion:** With no need of implant removal, better grip strength after long term follow-up are some of the advantages of JESS fixation and remains a good treatment option for distal end radius fracture.

**Keywords:** Distal Radial, Fractures, Joshi's External Stabilizing System

the result of high energy falls sustained on the playground or during sporting events. DR fractures can also present in more complicated injury patterns such as the Galeazzi fracture-dislocation, both bone fractures, radial styloid fractures, and Barton's and Chauffeur's fractures. The mechanism for these fractures is often more complex or atypical than that of isolated DR fractures.<sup>2</sup>

Over the past 20 years, more sophisticated internal techniques and external fixation techniques and devices for the treatment of displaced fractures of the distal end of the radius have been developed. The use of percutaneous pin fixation, Kapandji's intrafocal pinning external fixation devices that permit distraction and palmar translation, low profile internal fixation plates, arthroscopically assisted reduction, and bone grafting techniques including bone-graft substitutes, all have contributed to improved fracture stability and outcome.<sup>3,4</sup>

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 maneuvered, 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 stabilisation and helps in fracture healing by gradual and controlled distraction and works on the principle of ligamentotaxis.<sup>5</sup>

Pennig and Gausepohl have recommended that external fixator to be used to restore the radial anatomy if three or more cortices show comminution on the anteroposterior and lateral films in conjunction with radial shortening of

## INTRODUCTION

Distal radial (DR) fractures can result from any trauma to the forearm. Isolated DR fractures typically include Smith's, Colle's, Torus/Buckle, Greenstick, Die-punch, and isolated radial shaft fractures.<sup>1</sup> These fractures most frequently occur as a result of fall on the outstretched hand (FOOSH) injuries. DR fractures in the elderly are often the result of low-energy falls from a standing or seated position. They are often comminuted and intra-articular fractures that often fall outside of traditional eponymous classification. In children and adolescents, isolated DR fractures are more frequently

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more than 5 mm and/or intra-articular involvement in the radiocarpal or distal radioulnar joint<sup>6</sup>.

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

## MATERIAL AND METHODS

This study was a cross-sectional study conducted in the Department of Orthopedics, Uttar Pradesh Institute of Medical Sciences, Saifai Etawah. The study was approved by the Ethical Committee of the Institute and consent was taken from each participant/attendant before including in the study. 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. Patients with an open fracture type-II or III were excluded from 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 made 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 and 6 months. 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 through Kirschner wire percutaneously. The Guidelines for acceptable closed reduction was taken: i. Radial inclination:  $\geq 15^\circ$ , ii. Radial length:  $\leq 5$  mm shortening, iii. Radial tilt :  $\leq 15^\circ$  dorsal or  $20^\circ$  volar tilt, iv. Articular incongruity:  $\leq 2$  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 ANALYSIS

The results are presented in frequencies, percentages and mean±SD. The Mann-Whitney U test was used for comparisons. The Spearman correlation coefficient was calculated. The p-value<0.05 was considered significant. All the analysis was carried out on SPSS 16.0 version (Chicago, Inc., USA).

## RESULTS

The mean age of patients was 38.56±13.96 years and more than half of patients were males (52.1%). The right side injury was in 54.2% patients. Road traffic accidents mode of trauma was among more than half of patients (64.6%). C2 classification was most common (22.9%). The mean operative time was 38.5±8.36 minutes. The mean interval between injury and surgery was 4.12±0.99 days (Table-1).

The total average DASH score was 17.94±15.06. There was no significant (p>0.05) difference in DASH score between patients of  $\leq 40$  years and  $>40$  years. However, DASH score was significantly (p=0.008) lower among male patients (11.92±6.71) compared to females (25.76±18.20) (Table-2). There was no significant (p>0.05) difference in DASH

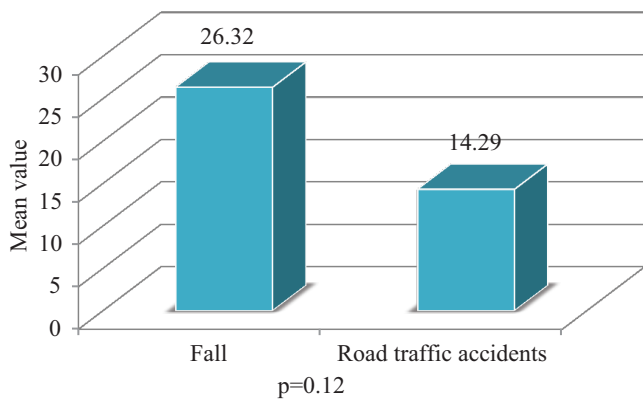
Characteristics	(n=48)
Age in years, mean±SD	38.56±13.96
Gender, no. (%)	
Male	25 (52.1)
Female	23 (47.9)
Side involved, no. (%)	
Left	22 (45.8)
Right	26 (54.2)
Mode of trauma, no. (%)	
Fall	17 (35.4)
Road traffic accidents	31 (64.6)
Fracture classification	
B1	4 (8.3)
B2	8 (16.7)
B3	7 (14.6)
C1	9 (18.8)
C2	11 (22.9)
C3	9 (18.8)
Operative time in minutes	38.5±8.36
Interval between injury and surgery in days	4.12±0.99

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

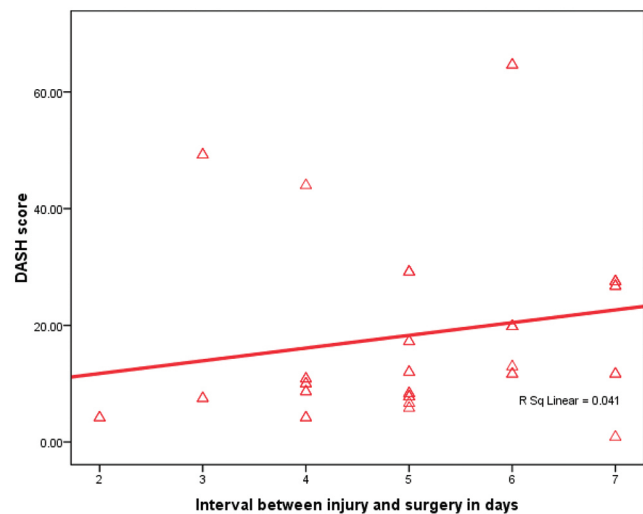
Age and Gender	DASH score (Mean±SD)	p-value <sup>1</sup>
Age in years		
$\leq 40$	14.29±9.78	0.12
$>40$	26.32±19.69	
Gender		
Male	11.92±6.71	0.008*
Female	25.76±18.20	
Total score	17.94±15.06	

<sup>1</sup>Mann-Whitney U test, \*Significant

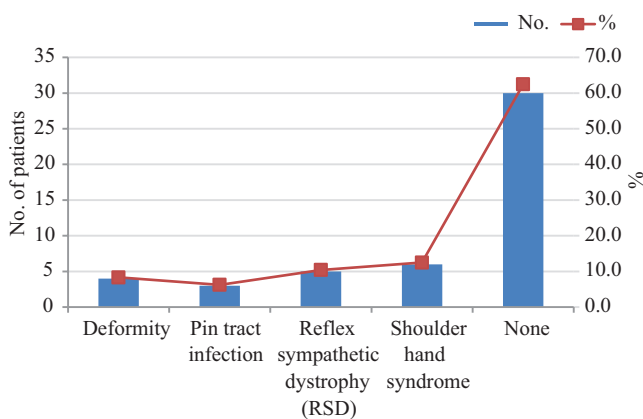
**Table-2:** Comparison of DASH score with age and gender at months



**Figure-1:** Comparison of DASH score with mode of injury at months



**Figure-2:** Scatter diagram showing correlation of DASH score with interval between injury and surgery in days ( $r=0.39$ ,  $p=0.006$ )



**Figure-3:** Distribution of complications

score between patients of fall and road traffic accidents (Fig.1).

There was positive moderate significant correlation of DASH score with interval between injury and surgery in days ( $r=0.39$ ,  $p=0.006$ ) (Fig.2).

The overall complication was 37.5%. Shoulder hand syndrome was most common complication followed by reflex sympathetic dystrophy (10.4%), deformity (8.3%) and pin tract infection (6.3%) (Fig.3).

## DISCUSSION

Different types of fractures may occur due to the anatomy of the distal radius. The successful use of external fixation requires careful assessment of fracture pattern, correct surgical techniques, supplemental fixation with K-wires, adherence to a postoperative protocol involving pin tract care, and early mobilization. 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 in external fixator treatment<sup>7</sup>.

In the current study, the mean age of patients was  $38.56 \pm 13.96$  years and more than half of patients were males (52.1%). Garg et al<sup>8</sup> found that the mean age of patients was  $36.07 \pm 13.93$  years. Similar to this study, Shukla et al<sup>7</sup> found that out of 170 patients, 105 (61.8%) were females and 65 (38.2%) were males. The right side injury was in 54.2% patients in this study. Similar to the present study, Shukla et al<sup>7</sup> found that the right hand was injured in 98 (57.7%) patients. Jati et al<sup>9</sup> also reported that right side was predominantly affected (60.3%).

This study found that road traffic accidents mode of trauma was among more than half of patients (64.6%). Bradway et al<sup>10</sup> and Catalano et al<sup>11</sup> reported fall on outstretched hand as the most common mode of injury, similar to that seen in this series. This study showed that the mean operative time was  $38.5 \pm 8.36$  minutes. The current study observed that C2 classification was most common (22.9%). In the study by Shukla et al<sup>7</sup>, 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<sup>12</sup> found that among 15 patients, 9 males and 6 females, 6 had C1, 6 had C2, and 3 had C3. Jati et al<sup>9</sup> found that most common fracture type was AO type C1.

In the present study, the mean interval between injury and surgery was  $4.12 \pm 0.99$  days. Garg et al<sup>8</sup> 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<sup>7</sup> 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 total average DASH score was  $17.94 \pm 15.06$  in this study. Dash et al<sup>13</sup> found that at 6th post-operative month, the average quick DASH score (QD) was 12.9. Egol et al<sup>14</sup> 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<sup>15,16</sup>.

In the present study, the overall complication was 37.5%. Shoulder hand syndrome was most common complication followed by reflex sympathetic dystrophy (10.4%), deformity (8.3%) and pin tract infection (6.3%). Garg et al<sup>8</sup> found that

8.92% developed pin tract infection which was managed successfully by antibiotic treatment. Swelling, inflammation, and occasional pain were observed in 4 patients (7.14%). One patient (1.78%) developed paraesthesia along radial cutaneous nerve distribution area which was resolved in 18 months. One patient (1.78%) developed undisplaced fracture shaft radius at proximal pin site after 4 months of the removal of pin due to trivial trauma. Dash et al<sup>13</sup> 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<sup>17</sup> 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.

One of the limitations of this study was small sample size and short duration of study period. The studies with larger sample size and long duration as well as long follow-up period required to have more robust findings.

## CONCLUSION

With no need of implant removal, better grip strength after long term follow-up are some of the advantages of JESS fixation and remains a good treatment option for distal end radius fracture.

## REFERENCES

1. Caldwell RA, Shorten PL, Morrell NT. Common Upper Extremity Fracture Eponyms: A Look Into What They Really Mean. *The Journal of hand surgery* 2018.
2. Karl JW, Olson PR, Rosenwasser MP. The Epidemiology of Upper Extremity Fractures in the United States, 2009. *Journal of orthopaedic trauma* 2015
3. Kumbaraci M, Kucuk L, Karapinar L, Kurt C, Coskunol E. Retrospective comparison of external fixation versus volar locking plate in the treatment of unstable intra-articular distal radius fractures. *Eur J Orthop Surg Traumatol* 2014;24:173-8.
4. Roh YH, Lee BK, Baek JR, Noh JH, Gong HS, Baek GH. A randomized comparison of volar plate and external fixation for intra-articular distal radius fractures. *J Hand Surg Am* 2015;40:34-41.
5. Prabhu R. A legend forever: Dr Brij Bhusan Joshi. *Indian J Orthop.* 2009;43:312.
6. Pennig D, Gausepohl T. External fixation of the wrist. *Injury* 1996; 27:1-15
7. Shukla R, Champawat VS, Jain RK. A Long-Term Study of Application of Joshi's External Stabilizing System in Displaced Intra-articular Distal End Radius Fractures. *J Wrist Surg* 2019;8:49-54.
8. Garg UK, Sharma V. P., Jain U. K. Long-term Functional Outcome in Fractures of the Lower End Radius in Young Adults Treated by Static External Fixator. *JBJS* 2017; 32 (3).
9. Jati S, Goyal D, Awasthi D. A study of correlation between radiological and functional outcome of distal radius fracture treated by various modalities.

*OrthopJMPC* 2017;23:32-35.

10. Bradway JK, Amadio PC, Cooney WP III. Open reduction and internal fixation of displaced, Comminuted intra-articular fractures of the distal end of the radius. *J Bone Joint Surg.* 1989;71-A:839-847.
11. Catalano LW III, Cole RJ, Gelberman RH, Evanoff BA, Gilula LA, Borrelli J Jr. Displaced intra-articular fractures of the distal aspect of the radius. *J Bone Joint Surg.* 1997; 79-A:1290-1302
12. Pawar M, Ibrahim M. Fractures of the distal end of humerus treated with joshi external stabilizing system. *Trauma International* 2017; 3: 8-11.
13. Dash SK, Sharma MK, Mishra S, Marandi H, Das A, Satapathy D, et al. Clinical outcomes in management of unstable distal radius fractures treated with external fixation and internal fixation: a prospective comparative study. *Int J Res Orthop* 2017;3:1004-9.
14. Egol K, Walsh M, Tejwani N, McLaurin T, Wynn C, Paksima N, et al. Bridging external fixation and supplementary kirschner-wire fixation versus volar locked plating for unstable fractures of the distal radius: A randomised, prospective trial. *J Bone Joint Surg Br* 2008;90:1214-21.
15. Payandeh JB, McKee MD. External fixation of distal radius fractures. *Orthop Clin North Am* 2007;38:187-92, 6.
16. Kulshrestha V, Roy T, Audige L. Dynamic vs static external fixation of distal radial fractures: A randomized study. *Indian J Orthop* 2011;45:527-34
17. Bobade SS, Shyoji S, Satish B, Pradeep M, Jayesh S. Comparison of Functional and Radiological Outcome of Joshi's External Stabilization System Versus Volar Locking Compression Plate in Unstable Distal End Radius Fractures: A Short-term Prospective Study. *Int J Sci Stud* 2019;7:75-78.

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