



FUNCTIONAL AND RADIOLOGICAL OUTCOMES OF INTRA-ARTICULAR LOWER END RADIUS FRACTURES MANAGED WITH JOSHI'S EXTERNAL STABILIZATION SYSTEM (JESS).

Orthopaedics

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ABSTRACT

Background: Intra-articular lower end fractures are among the commonest fracture of upper extremities. As these fractures profoundly impair wrist mobility, a prompt and accurate intervention is crucial for restoring optimal biomechanics. Operative management is the preferred alternative for fractures that cannot be realigned by closed manipulation. Surgical interventions for these fractures compromise of percutaneous pinning, external fixation and open reduction with internal fixation. External fixation, a typically minimally invasive procedure, not only stabilizes the fracture but also aid in maintaining anatomically structure through the process of healing. The aim of the present was to determine to determine functional and radiological outcomes of intra-articular lower end radius fractures managed by Joshi's External Stabilization System (JESS) JESS. **Methods:** Patients presenting with intra-articular lower end radius fracture belonging to the group 18 to 55 years were selected for the study. A detailed clinical examination including neurovascular assessment of each patient was performed. Radiographs of antero-posterior and lateral wrist and routine laboratory investigations were advised for all these patients. These patients then underwent JESS fixation either under general or regional anesthesia. Radiological and functional assessment of these patients was done. **Results:** A total of 118 cases were included in the study. These included 83 (70.3%) male and 35 (29.7%) female patients. Left-sided fractures (n=73, 61.9%) were more common than right-sided fractures (n=45, 38.1%). A total of 98 (83.1%) patients presented with closed fractures whereas 20 (16.4%) patients had compound fractures. The most common mode of injury was road traffic accident (RTA) (n=88, 74.6%). There was significant improvement in radiological parameters post-operatively. Sequential assessments of range of motion conducted at different interval of time showed progressive functional recovery. At 180 day post-operatively, a total of 44 (37.3%) patients achieved excellent PRWE functional score. A total of 3 (2.5%) patients experienced post-operative complications. **Conclusion:** As implementation of Joshi's External Stabilization System (JESS) provides a successful stability and is associated with favorable clinical outcomes, it can be recommended as an efficient and reliable management strategy for intra-articular lower end radius fractures.

KEYWORDS

Intra-articular Lower End Fractures, Joshi's External Stabilization System, Radiological Parameters, Clinical Outcomes

INTRODUCTION.

Fractures rank among most frequent presentation in casualty and emergency departments and constitute a significant portion of acute care burden across the world. Intra-articular lower end fractures are among the commonest fracture of upper extremities and contribute to approximately 1/6th of the fractures encountered in casualty and emergency services.¹

These fractures present a bimodal age pattern, featuring a characteristic primary peak in young adults and a secondary peak in older adults. While a simple incidence of fall on outstretched hand can lead to these fractures in elderly population, younger adults generally require high-energy impacts like sport injuries or motorcycle accidents to cause such fractures.^{1,2} The incidence of intra-articular lower end radius fractures increasing globally especially among the younger population.^{1,2}

As intra-articular lower end radius fractures profoundly impair wrist mobility, a prompt and accurate intervention is crucial for restoring optimal biomechanics. Since its initial description in 1814 by Sir Abraham Colles, a pioneer Irish Orthopedic Surgeon, the management strategies of these fractures have significantly evolved.^{3, 4} Controversies persist over optimal management of these fractures as it is driven by both intrinsic and extrinsic factors.

Operative management is the preferred alternative for fractures that cannot be realigned by closed manipulation. Surgical interventions for these fractures compromise of percutaneous pinning, external fixation and open reduction with internal fixation.⁵

External fixation, a typically minimally invasive procedure, not only stabilizes the fracture but also aid in maintaining anatomically structure through the process of healing. It has an added potential advantage as there is no direct manipulation of the fracture site. External fixation, a skeletal immobilization technique, involves the insertion of pins percutaneously into bones, followed by fixation to an external construct of connecting rods, which results in a rigid and robust stabilizing framework.⁶

Joshi's External Stabilization System (JESS), a specialized external fixator was developed by Dr. Brij Bhushan Joshi a legendary pioneer in hand surgery from Mumbai.⁷ (Based leveraging ligamentotaxis, the JESS exerts longitudinal distraction traction to realign naturally and

reduce fractured bone fragments. The present study was conducted at a tertiary care hospital of western Maharashtra with an aim to determine to determine functional and radiological outcomes of intra-articular lower end radius fractures managed by JESS.

Material and Methods.

The present prospective observation study was conducted in the Department of Orthopedics of a tertiary care hospital of western Maharashtra for a period of three years. The study included patients presenting with intra-articular lower end radius fracture. For the purpose of study, patients belonging to the group 18 to 55 years were selected. Patients with un-displaced fractures of the distal end of radius, fractures with volar displacements and bilateral fractures of the distal radius were excluded. The patients were explained about the study procedure and written informed consent was obtained from each participant of the study.

A detailed clinical examination including neurovascular assessment of each patient was performed. Radiographs of antero-posterior and lateral wrist and routine laboratory investigations were advised for all these patients. Each patient was initially managed with below-elbow slab and prescribed analgesics for pain relief.

These patients then underwent JESS fixation either under general or regional anesthesia. After manual reduction and alignment of the wrist, Schanz pins of 3.5 mm and 2.5 mm were inserted into the radius and 2nd metacarpal respectively through percutaneous stab incisions. The JESS frame was then applied and the adequacy of the reduction was verified and optimized by using image intensifier. Multi-fragmentary fractures were fixed by using K-wire augmentation.

Post-operative management consisted of application of sterile dressings and a below-elbow slab, broad-spectrum antibacterial therapy and the preservation of finger mobility. Immediate X-rays were performed post-operatively and patient began with active mobilization of finger, thumb and elbow. Patient was discharged on post-operative day 3 with instruction for twice weekly follow-up. The slab was removed after 28 days. Upon successful union, the fixator was removed at 6 weeks. Physiotherapy of full wrist and forearm was commenced after removal of fixator. Patients underwent follow-up assessments at interval of 3 and 6 months to evaluate long-term stability and monitor for complications.

Radiological assessment of these patients was done for measurement of residual dorsal angulation, radial shortening, and loss of radial inclination. These parameters were graded as per Sarmiento's modification of Lind Strom.⁸ Post-operatively follow x-rays were performed after six weeks to evaluate fracture collapse, displacement or progressive consolidation. Criteria for complete healing included clinical resolution (absence of tenderness/pain) along with radiological confirmation indicated by disappearance of the fracture line. The functional outcome of the patient was assessed using 'Patient Rated Hand / Wrist Evaluation (PRWE)' scoring system. Patients underwent regular follow up at 15-, 30-, 45-, 90- and 180- day interval on the basis on of PRWE system score and radiological outcomes.

RESULTS.

A total of 118 cases were included in the study. These included 83 (70.3%) male and 35 (29.7%) female patients. The mean age of the patients was 38.4 ± 14.8 years and it ranged between 23 to 53 years. The age and gender wise distribution of patients is shown in Table 1. Most of male patients belonged to the 21-40 age group, whereas most of the female patients were older than 50 years.

Table 1. Age and gender wise distribution of patients with intra-articular lower end radius fractures.

Age group in years	Male (%)	Female (%)	Total
21-30	25 (30.1)	6 (17.1)	31 (26.3)
31-40	24 (28.9)	7 (20)	31 (26.3)
41-50	16 (19.3)	6 (17.1)	22 (18.6)
>50	18 (21.7)	16 (45.7)	34 (28.8)
Total	83	35	118

Left-sided fractures (n=73, 61.9%) were more common than right-sided fractures (n=45, 38.1%). A total of 98 (83.1%) patients presented with closed fractures whereas 20 (16.4%) patients had compound fractures.

Table 2 outlines the distribution of fracture according to the Frykman classification. Type III fracture (32.2%) was the most prevalent followed by type VI (24.6%) and type II (20.3%).

Table 2. Patient distribution as per the Frykman fracture classification.

Type of fracture	Frequency (%)
III	24 (20.3)
IV	12 (10.2)
V	15 (12.7)
VI	29 (24.6)
VII	38 (32.2)
Total	118

The most common mode of injury was road traffic accident (RTA) (n=88, 74.6%) followed by fall from height (FFH) (n=16, 13.6%) and fall on outstretched hand (FOOH) (n=14, 11.8%). Fracture from RTA was more common in young males whereas fracture from simple FOOH was more common in females belonging to age group > 40 years. Patients had a mean hospital stay of 7.4 ± 2.2 days and a mean time from injury to surgery of 4.6 ± 1.6 days. Initial Vs post-operative radiological parameters of patients with intra-articular lower end radius fractures are shown in Table 3. There was significant improvement in radiological parameters post-operatively.

Table 3. Initial Vs post-operative radiological parameters of patients with intra-articular lower end radius fractures.

Radiological parameters	Initial (pre-operative) (Mean± SD)	Post-operative (Mean± SD)	Paired T-test, P value
Radial height/length (mm)	9.21 ± 1.8	11 ± 0.9	0.03*
Radial inclination(°)	12.8 ± 2.4	19.8 ± 1.2	<0.0001*
Loss of palmar tilt (°)	11.8 ± 1.8	0.75 ± 2.8	<0.0001*

Sequential assessments of range of motion conducted at different interval of time showed progressive functional recovery (Table 4).

Table 4. Post-operative sequential assessment of range of motion at different intervals.

Range of motion	45 day (Mean± SD)	90 day (Mean± SD)	180 day (Mean± SD)
Dorsi flexion	38.8 ± 12.8	49.6 ± 11.9	70.4 ± 12.4

Palmar flexion	35.6 ± 14.4	58.9 ± 11.2	70.4 ± 14.7
Radial deviation	11.8 ± 1.8	15.7 ± 2.8	17.1 ± 1.2
Ulnar deviation	9.4 ± 3.4	12.8 ± 4.4	16.9 ± 2.8
Supination	34.6 ± 8.4	52.6 ± 7.2	79.0 ± 6.8
Pronation	35.6 ± 11.4	50.4 ± 12.6	68.9 ± 10.5

Post-operative PRWE functional scores at different interval of time are shown in table 5. At 180 day post-operatively, a total of 44 (37.3%) patients achieved excellent PRWE functional score whereas a good PRWE score was observed in 61.6% patients (n=72).

Table 5. Post-operative PRWE functional scores at different interval of time.

Clinical outcome	45 day N (%)	90 day N (%)	180 day N (%)
Excellent	37 (31.4)	42 (35.6)	44 (37.3)
Good	68 (57.6)	70 (59.3)	72 (61.1)
Fair	11 (9.3)	4 (3.4)	1 (0.8)
Poor	2 (1.7)	2 (1.7)	1 (0.8)
Total	118	118	118

In this study, out of the total cohort who underwent JESS fixation, a total of 3 (2.5%) patients experienced post-operative complications including pin tract infection in 2 patients and malunion in 1 patient.

DISCUSSION.

The optimal management of intra-articular lower end radius fractures remains a persistent challenge and highly debated subject among orthopedic surgeons. Management of these fractures aims restoration of grip strength and range of motion, and mitigation of the risk of long-term degenerative changes of the wrist joint.⁹

Management strategies for distal end fractures are diverse and include both surgical and non-surgical interventions. They are depended on factors like fracture stability, displacement and need of patients.¹⁰

Studies have demonstrated appreciable clinical efficacy of external fixators for management of these fractures.⁶ The present analyzed functional and radiological outcomes in a total of 180 patients with intra-articular lower end radius fractures managed JESS. The mean age of the patients was 38.4 ± 14.8 years, with majority (>52.6%) aged between 21-40 years. Similar observation was noted in other studies. In consistent to findings of other researchers male fractures were common in males (30.7%) as compared to female patients (29.7%).

In recent years, the incidence of intra-articular lower end radius fractures has increased in young men, primarily driven by high energy trauma from road traffic accidents.¹¹ Similar finding was noted in this study where RTA was the predominant cause of trauma in young males. Fracture from simple FOOH was more common in females belonging to age group > 40 years. This observation is in consistent to other studies. The incidence of fracture from FOOH in older females is steadily increasing in females belonging to peri-menopausal age group.¹²

It is observed that Left-sided fractures (61.9%) were more common than right-sided fractures (38.1%). Studies have documented that left-sided distal radial fractures are common than right sided ones.¹³ A total of 98 (83.1%) patients presented with closed fractures whereas 20 (16.4%) patients had compound fractures. Predominance of closed fractures was also noted in the study of Harshawardhan et al (2025) and Maruthi et al (2015).^{14,15}

In this study, three radiological parameters like radial height/length, radial inclination and loss of palmar tilt were used to assess the degree of displacement and impaction. These parameters were evaluated both pre- and post-operative. It was noted that there was significant improvement in radiological parameters post-operatively.

Upon sequential assessments of range of motion conducted at different interval of time, it was observed that there was progressive functional recovery. On follow up of affected limb post-operative 180 day, dorsi flexion, palmar flexion, radial deviation, ulnar deviation, supination and pronation were 70.4 ± 12.4 , 70.4 ± 14.7 , 17.1 ± 1.2 , 16.9 ± 2.8 , 79.0 ± 6.8 , 68.9 ± 10.5 respectively. Similar findings were observed in studies conducted by other researchers.^{14,15}

When post-operative PRWE functional scores at different interval of time, it was noted that at 180 day post-operatively, 37.3% of patients achieved excellent PRWE functional score whereas a good PRWE

score was observed in 61.6% of patients. Poor score was noted in 1 (0.8%). Researchers like Khajotia et al (2017)¹⁶ and Harshawardhan et al (2025)¹⁷ reported similar findings where PRWE functional score was noted to be excellent and good in majority of patients treated with JESS.

The post-operative complications in this study were minimal. Out of the total cohort who underwent JESS fixation, a total of 2 patients developed pin tract infection and malunion was noted in 1 patient. Results of the present study are accordance to other studies in term of outcome but complications were less. This study also highlights the importance of physiotherapy in rehabilitation of these patients. Physiotherapy boosts blood supply, reduces swelling and prevents joint stiffness.^{17,18}

CONCLUSION.

The findings of present study demonstrate that as implementation of Joshi's External Stabilization System (JESS) provides a successful stability and is associated with favorable clinical outcomes, it can be recommended as an efficient and reliable management strategy for intra-articular lower end radius fractures.

Conflict of interest: Nil.

REFERENCES

1. Michael G, George K, Canjirathinkal MA, Ratna P, Francis J. Functional Outcome of Joshi's External Stabilization System Fixation in Distal Radius Fractures. *Cureus*. 2022;14(4):e24215.
2. Dr. Saurabh Parkhi, Dr. DK Dubey, Dr. G Bhuvanesh and Dr. N Adhishwar Kumaran. Functional outcomes of jess fixator application in fractures of distal end radius: A prospective study. *Int. J. Orthop. Sci.* 2024; 10(1):202-207.
3. Gurnani S, Phalak MO, Gupta A. The Life and Contributions of Dr. Abraham Colles: A Pioneer in Orthopaedics. *Cureus*. 2024; 16(10):e71331.
4. Gawali SR, Hardikar SM, Prakash S, Nadkarni S. Management of intra-articular fractures of distal end radius in adults. *Int J Res Orthop* 2016; 2:220-8.
5. Michael G, George K, Canjirathinkal MA, Ratna P, Francis J. Functional Outcome of Joshi's External Stabilization System Fixation in Distal Radius Fractures. *Cureus*. 2022;14(4):e24215.
6. Fragomen AT, Rozbruch SR. The mechanics of external fixation. *HSS J*. 2007; 3(1):13-29.
7. Prabhoo R. A legend forever – Dr. Brij Bhushan Joshi. *Indian J Orthop*. 2009; 43(3):312.
8. Criteria Sarmiento A, Pratt G.W., Berry N.C., Sinclair W.F. Colle's fractures: functional bracing in supination. *J. Bone surg.* 1975; 57A: 311-317.
9. Ali T, Ashraf IU, Qazi SATN, Beigh IA. Distal radius fractures: a prospective study of the clinical and radiological outcomes in surgically managed patients. *Int J Res Orthop* 2022;8:559-64.
10. Challani A, Agrawal A, Kadam R, Jain V, Shah A, Pandey S. Assessment of radiological evidence of collapse of distal end radius fracture after treating with cast, percutaneous k-wire fixation and external fixator. *Int J Res Orthop* 2018;4:367-70.
11. Ali T, Ashraf IU, Qazi SATN, Beigh IA. Distal radius fractures: a prospective study of the clinical and radiological outcomes in surgically managed patients. *Int J Res Orthop* 2022;8:559-64.
12. Koo OT, Tan DM, Chong AK. Distal radius fractures: an epidemiological review. *Orthop Surg*. 2013 Aug;5(3):209-13.
13. Giddins G, Giddins M. Which is more common; right or left distal radial fractures? *Journal of Hand Surgery (European Volume)*. 2026;51(2):160-164.
14. Dr. Hemeshwar Harshawardhan DHH, Dr. S.K. Bhaskar DSB, Dr. Pooran Mal Mandolia DPMM, Dr. Umesh Samra DUS, Dr. Sumer Singh DSS. Functional and Radiological Outcome of Unstable Distal End Radius Fracture Treated with JESS. *International Journal of Medical and Pharmaceutical Research*. 2025;6(5):355-360.
15. Maruthi CV and Shivanna. Management of fracture of distal end radius by external fixator using the principle of ligamentotaxis a prospective study. *Indian Journal of Orthopaedics Surgery* 2015; 2(1):19-26.
16. Khajotia BL, Singh B, Sharan S, Kumar K.. Functional & Radiological Outcome of the Volar Locking Plate Fixation for Fracture of the Distal End Radius. *JMSCR*. 2017;5(6):22983-22989.
17. 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(1):49-54.
18. Wakefield A B, Mc Queen MM. The role of physiotherapy and clinical predictors of outcome after fracture of the distal end radius. *J Bone Joint surg* 2000;82 B: 972-976.