Section: Orthopaedics

Original Research Article

COMPARISON OF FUNCTIONAL OUTCOME OF JOSHI'S EXTERNAL STABILIZATION SYSTEM VERSUS VOLAR LOCKING COMPRESSION PLATE IN UNSTABLE DISTAL END RADIUS FRACTURES: A SHORT-TERM PROSPECTIVE STUDY

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Received *: 26/02/2025*
Received in revised form *: 12/05/2025*
Accepted *: 31/05/2025*

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DOI: 10.70034/ijmedph.2025.2.315

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (2); 1760-1763

ABSTRACT

Background: This study aims to evaluate and compare the short-term functional outcomes of unstable distal end radius fractures treated using Joshi's external stabilization system (JESS) and volar locking compression plate (LCP).
Materials and Methods: A prospective study was carried out involving 20 patients aged 20 to 60 years with closed, unstable distal radius fractures. They were randomly allocated into two treatment groups (10 patients each). Clinical follow-up and outcome assessment were performed over a 9-month period.
Results: At the 9-month follow-up, functional outcomes assessed using the Modified Mayo Wrist Score showed a distribution of excellent to poor results in both groups, with the LCP group exhibiting a higher proportion of good outcomes.
Conclusion: Volar plating allows for quicker recovery of wrist function in the early postoperative period. However, the long-term outcomes between the two methods are comparable. This suggests that while volar plating may be beneficial for patients needing a quicker return to activity, JESS remains a viable option.
Keywords: distal radius fracture, external fixation, volar plating, Joshi's stabilization system, wrist injury, orthopaedic trauma.

INTRODUCTION

Distal radius fractures are among the most frequently encountered injuries in orthopedic practice, constituting roughly 16% of all fractures presenting to emergency departments and accounting for approximately 74.5% of all forearm fractures.[1] These injuries typically occur as a result of a fall on an outstretched hand and can affect a wide demographic, ranging from young adults involved in high-energy trauma to elderly individuals with osteoporotic bones sustaining low-energy falls. Since Colles first described this injury in 1814,[2] considerable progress has been made in understanding the pathoanatomy, classification, and management of distal radius fractures. This extensive research has culminated in the development of multiple treatment strategies aimed at restoring the anatomy and function of the wrist while minimizing complications.

Conventional management options have historically included closed reduction with cast immobilization, also known as pin and plaster, which is still employed in certain cases with minimal displacement. However, this technique often struggles to maintain reduction, particularly in unstable fracture patterns, leading to malunion and functional deficits. To

address these challenges, a variety of surgical modalities have been introduced. These include percutaneous pinning, which provides temporary stabilization while allowing early mobilization; intramedullary fixation techniques, which offer biomechanical stability with minimal soft-tissue disruption,[3,4] and external fixation systems, both bridging and non-bridging, that can maintain fracture reduction through ligamentotaxis while facilitating some degree of wrist movement.[5] More recently, injectable bone substitutes have emerged as an adjunct to enhance bone healing, particularly in osteoporotic fractures where metaphyseal voids are common.[6]

Internal fixation using volar locking compression plates (LCPs) has gained popularity due to its ability to provide stable fixation even in comminuted and osteoporotic bone, and to permit early wrist mobilization.[7] Despite these advancements, the orthopedic community continues to debate the relative merits of these techniques, and no definitive consensus has been reached regarding the superiority of one method over another.[8] This ongoing debate is particularly relevant when comparing external fixation methods, such as the Joshi's External Stabilization System (JESS), with volar LCP plating, especially in complex intra-articular distal radius fractures where functional outcomes, complication rates, and patient satisfaction must be weighed carefully.

Therefore, this study aims to directly evaluate and compare the outcomes of JESS external fixation and volar LCP fixation in the management of intra-articular distal radius fractures. By assessing parameters such as functional recovery, radiological alignment, complication profiles, and overall patient satisfaction, this study seeks to contribute meaningful evidence to guide treatment decisions for this common and challenging orthopedic injury.

MATERIALS AND METHODS

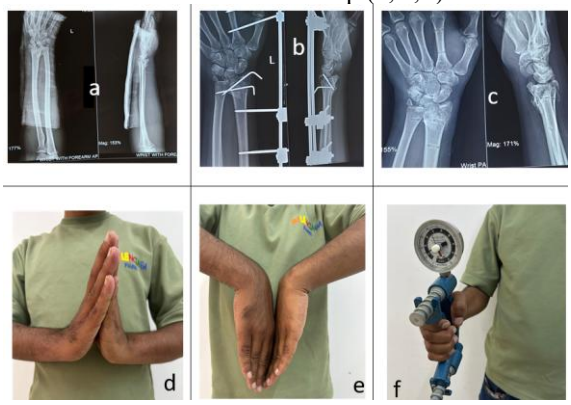
Study Design and Participants: This prospective study was conducted at a tertiary care center from July 2024 to March 2025. Its aim was to evaluate and compare the functional outcomes of two fixation methods—Joshi's External Stabilization System (JESS) and volar Locking Compression Plate (LCP)—in the treatment of complex intra-articular distal radius fractures.

A total of 20 adult patients with fresh, closed, intra-articular distal radius fractures (AO type 23C3) were included after informed consent. Patients were randomized into two groups of 10 each using a computer-generated randomization sequence. Patients with open fractures, fractures older than two weeks, prior wrist pathology, active infection, or cognitive impairments were excluded. All patients were followed up at 4 weeks, 3 months, and 9 months postoperatively to assess clinical and functional outcomes.

Assessment Criteria: The primary outcome was wrist function, assessed using the Modified Mayo Wrist Score (MMWS). This score evaluates pain, functional status, range of motion (ROM), and grip strength, with each component contributing to a total of 100 points (higher scores indicate better function). Pain was scored from 0 (severe pain) to 25 (no pain), functional status from 0 (unable to work) to 25 (regular job), ROM from 0 (<30°) to 25 (>120°), and grip strength from 0 (<24% of normal) to 25 (90%–100% of normal). The results were categorized as excellent (91–100), good (80–90), fair (65–79), or poor (<64). ROM was measured using a goniometer, and grip strength was assessed clinically. Patient-reported outcomes were collected through interviews and physical examinations by an experienced orthopedic surgeon.

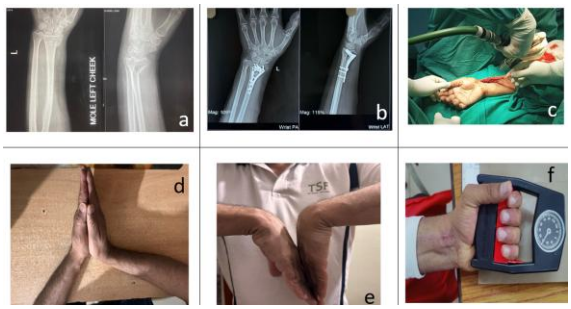
Surgical Techniques: For the JESS group, the procedure was performed under general or regional anesthesia with fluoroscopic guidance. Two Schanz pins were inserted into the distal radius and two into the second metacarpal, and traction was applied for reduction. The JESS construct was assembled to maintain alignment, and a forearm slab was applied postoperatively for initial support and immobilization (Figure 1).

Figure 1: Pre, Postoperative & after removal radiographic image of the wrist of a patient in external fixation (a, b, c). Clinical and Functional assessment picture of a patient treated with external fixation after 9 months follow-up (d, e, f).



In the volar LCP group, surgery was performed through a standard volar approach via the flexor carpi radialis (FCR) sheath. After fracture reduction and temporary K-wire fixation, a pre-contoured volar locking plate was secured with locking screws under image intensifier guidance, ensuring no dorsal cortex penetration and subchondral support of the joint surface. The surgical site was closed in layers and a sterile dressing applied (Figure 2).

Figure 2: Pre, postoperative radiographic and intra-operative image of the hand of a patient in volar plating (a, b, c). Clinical and Functional assessment picture of a patient treated with volar plating after 9 months follow-up (d, e, f).



Statistical Analysis: Data collected at the 9-month follow-up were analyzed. The JESS group had a mean MMWS of 81.2 (SD 10.4), while the LCP group had a mean of 86.5 (SD 7.8). The Shapiro-Wilk test confirmed normal distribution in both groups ($p > 0.05$). An unpaired, two-tailed Student's t-test was used to compare the groups, with a p-value <0.05 considered statistically significant.

Ethical Considerations: This study complied with the ethical standards set by the institutional and national research boards, in alignment with the Helsinki Declaration and its subsequent amendments.

RESULTS

The mean age of patients in the JESS group was 42 years, while in the volar LCP group it was 38 years. Both groups had a predominance of male patients. Right-sided injuries were more frequent in both groups, reflecting the higher incidence of injuries on the dominant side. The most common cause of injury in both groups was a fall on an outstretched hand, accounting for 90% of injuries in the JESS group and 88% in the volar LCP group. Road traffic accidents were the next most frequent cause of injury, particularly in younger patients.

At the final 9-month follow-up, both groups demonstrated comparable range-of-motion values for palmar flexion, dorsiflexion, pronation, supination, radial deviation, ulnar deviation, and grip strength, indicating that both treatment methods resulted in satisfactory functional recovery.

Table 1: Modified Mayo Wrist Score Outcome: The outcomes, based on the Modified Mayo Wrist Score (MMWS), are summarized below.

Modified Mayo wrist Score Outcome	JESS Fixator	Volar LCP
Excellent (90–100)	2 patients	2 patients
Good (80–89)	4 patients	6 patients
Fair (65–79)	3 patients	2 patients
Poor (<65)	1 patient	1 patient
Mean Score	81.2 ± 10.4	86.5 ± 7.8
p-value	>0.05 (NS)	-

Both groups achieved similar overall outcomes, with slightly better scores observed in the volar LCP group; however, the difference was not statistically significant ($p > 0.05$).

Table 2: Functional Scoring: Mayo wrist scores suggested slightly superior early functional results in the volar LCP group compared to the JESS group.

MAYO Wrist Score findings	JESS Fixator	Volar LCP
Mean ± SD	81.2 ± 10.4	86.5 ± 7.8
Grip Strength (% normal)	~70–80%	~80–90%
Flexion-Extension Arc	~95–105°	~105–115°

Grip strength was measured using a hand dynamometer, while the flexion-extension arc was assessed using a goniometer. These results indicate marginally better grip strength and range of motion in the volar LCP group.

Table 3: comparison of complications among the study participants. Complications were more frequent in the JESS group compared to the volar LCP group. The complications are summarized in the table below:

Complication	Volar LCP (n=10)	%	JESS Fixator (n=10)	%
Infection	0	0%	4	40%
Neuropraxia	1	10%	1	10%
No Complications	7	70%	2	20%
Stiffness	2	20%	3	30%

In the JESS group, pin tract infections were reported in 25% of patients, while pin loosening occurred in 15% of cases. Sensory neuropraxia, likely due to pin placement or soft-tissue irritation, was observed in 5% of patients. Stiffness was a common complication in both groups due to postoperative immobilization, but was effectively managed with physiotherapy.

DISCUSSION

Managing intra-articular distal radius fractures remains complex, with the primary goal being anatomical and functional restoration. Although both external fixation and plating are effective,[12–14] recent literature emphasizes the biomechanical advantages of locking plates, especially in complex or osteoporotic fractures.[15–19]

External fixation, including systems like JESS, remains a viable option due to its simplicity, lower learning curve, and minimal invasiveness.[20–24] Several comparative studies, including Egol et al,[8] have shown early advantages in motion with plating, though long-term results are often equivalent.

In this study, while LCP allowed earlier mobilization and, JESS provided comparable functional outcomes at 9 months and a faster union time. Despite minor complications like pin tract infections, the JESS technique remains an effective alternative, especially when internal fixation is not feasible.

Study	Follow-up	Main Finding
Egol et al.[8]	1 year	Early ROM better with LCP
Rozental et al.[11]	12 months	Faster recovery with LCP, but similar long-term outcomes
Kapoor et al.[19]	6–12 months	LCP superior in osteoporotic bone for maintaining reduction
Cooney et al.[18]	9–12 months	JESS effective, minimal complications, good outcomes
Present Study	9 months	LCP allowed earlier mobilization; JESS showed faster union and similar outcomes

This study had some limitations. It did not account for variables such as patient occupation or workers' compensation. Additionally, the small sample size and short follow-up period limited the ability to observe long-term outcomes such as post-traumatic arthritis. Some subjective variability in scoring systems also potentially influenced results. A longer-term, larger-scale randomized trial would provide more comprehensive insights.

CONCLUSION

Open reduction and volar plating provide better functional outcomes in the early postoperative period and should be considered for patients needing faster return to activity. However, JESS remains a reliable method with comparable outcomes over time. Both techniques have distinct advantages and should be selected based on patient needs and surgeon expertise.

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