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Original Article

# Functional Outcomes of Distal Radius Fractures Treated with Volar Locking Plate Versus External Fixation – A Prospective Study

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## ABSTRACT

**Background:** Distal radius fractures are among the most common fractures encountered in orthopaedic practice. Various surgical techniques have been used for the management of unstable fractures, including volar locking plate fixation and external fixation. The choice of optimal treatment remains a subject of debate.
**Aim:** To compare the functional and radiological outcomes of distal radius fractures treated with volar locking plate fixation and external fixation.
**Materials and Methods:** This prospective comparative study was conducted in the Department of Orthopaedics at Smt. NHL Municipal Medical College, Ahmedabad, Gujarat, India, from 2023 to 2025. A total of 60 patients with distal radius fractures were included and divided into two groups: Group A (30 patients) treated with volar locking plate fixation and Group B (30 patients) treated with external fixation. Patients were followed up at regular intervals, and functional outcomes were assessed using the Disabilities of the Arm, Shoulder and Hand (DASH) score along with evaluation of wrist range of motion and radiological parameters.
**Results:** The majority of patients were in the 41–50 year age group, with males being more commonly affected. The most common mechanism of injury was a fall on an outstretched hand. Patients treated with volar locking plate fixation showed better wrist range of motion and superior functional outcomes compared to the external fixation group. Complications such as pin-tract infection and wrist stiffness were more frequently observed in patients treated with external fixation.
**Conclusion:** Volar locking plate fixation provides better functional outcomes, improved wrist mobility, and fewer complications compared to external fixation in the treatment of distal radius fractures.

***Keywords****: Distal radius fracture, volar locking plate, external fixation, wrist fractures, DASH score, functional outcome.*

## INTRODUCTION

Fractures of the distal radius are among the most common fractures encountered in orthopaedic practice and account for a significant proportion of upper limb injuries. They occur in individuals of all age groups but show a bimodal distribution, commonly affecting young adults following high-energy trauma and elderly individuals due to low-energy falls associated with osteoporosis (1). Distal radius fractures represent approximately 15–20% of all fractures treated in emergency departments, making them one of the most frequently treated fractures worldwide (2).

The primary goals in the management of distal radius fractures are restoration of the normal anatomy of the wrist joint, maintenance of stable fixation, and early mobilisation to achieve optimal functional outcomes. Improper management may lead to complications such as malunion, stiffness of the wrist joint, decreased grip strength, and post-traumatic arthritis, which can significantly impair hand function (3).

Traditionally, distal radius fractures were managed with closed reduction and casting, but this method is often associated with loss of reduction and poor functional results, particularly in unstable fractures (4). With advancements in orthopaedic

trauma surgery, various operative techniques have been developed to improve fracture stability and facilitate early mobilisation.

External fixation has been widely used for unstable distal radius fractures based on the principle of ligamentotaxis, which helps maintain fracture alignment while minimising surgical exposure (5). However, external fixation may be associated with complications such as pin tract infection, joint stiffness, and delayed rehabilitation (6).

In recent years, volar locking plate fixation has gained popularity due to its ability to provide stable fixation, particularly in comminuted and osteoporotic fractures. The fixed-angle construct of locking plates allows better maintenance of fracture reduction and facilitates early wrist mobilisation, which may lead to improved functional outcomes (7). Several studies have reported favourable results with volar locking plates in terms of stability, anatomical restoration, and early return of wrist function (8).

Despite these advances, the optimal surgical technique for the management of distal radius fractures remains a topic of debate. While volar locking plate fixation offers rigid internal stabilisation, external fixation remains a useful method for certain fracture patterns and clinical scenarios (9). Therefore, comparative evaluation of these treatment modalities is important to determine their relative effectiveness in achieving satisfactory functional and radiological outcomes.

The present study was conducted to evaluate and compare the functional outcomes of distal radius fractures treated with volar locking plate fixation and external fixation in patients presenting to the Department of Orthopaedics at Smt. NHL Municipal Medical College in Ahmedabad, Gujarat, India.

## MATERIALS AND METHODS

### Study Design and Setting

This prospective comparative study was conducted in the Department of Orthopaedics at Smt. NHL Municipal Medical College and its affiliated tertiary care hospital in Ahmedabad, Gujarat, India. The study was carried out over a period of two years from January 2023 to December 2025. The objective of the study was to compare the functional and radiological outcomes of distal radius fractures treated with volar locking plate fixation and external fixation.

### Sample Size

A total of 60 patients with distal radius fractures presenting to the orthopaedic department during the study period and fulfilling the inclusion criteria were included in the study. The patients were divided into two equal groups:

- Group A (n = 30): Patients treated with volar locking plate fixation.
- Group B (n = 30): Patients treated with external fixation.

### Inclusion Criteria

1. Patients aged 18 years and above.
2. Patients with closed distal radius fractures confirmed clinically and radiologically.
3. Patients presenting within 7 days of injury.
4. Patients who provided written informed consent and were willing to undergo regular follow-up.

### Exclusion Criteria

1. Open fractures of the distal radius.
2. Pathological fractures.
3. Associated neurovascular injuries in the affected limb.
4. Polytrauma patients or patients with ipsilateral upper limb fractures.
5. Patients with previous deformity or surgery of the same wrist.
6. Patients unfit for surgery or unwilling to participate in follow-up.

### Preoperative Evaluation

All patients underwent a detailed clinical examination, including a history of trauma, swelling, deformity, and assessment of neurovascular status. Standard anteroposterior and lateral radiographs of the wrist were obtained for confirmation of the diagnosis and fracture classification. Fractures were classified according to the AO classification system.

Routine preoperative investigations were performed, and patients were optimised for surgery. Temporary immobilisation with a below-elbow splint was applied until definitive surgical management.

### Surgical Technique

#### Group A – Volar Locking Plate Fixation

Patients in this group underwent open reduction and internal fixation using a volar locking plate through the standard Henry volar approach. After exposure of the distal radius, fracture fragments were reduced under direct visualisation and

temporarily stabilised. A volar locking plate was positioned over the distal radius and fixed with locking screws under fluoroscopic guidance. Proper reduction and implant placement were confirmed intraoperatively.

**Group B – External Fixation**
Patients in this group were treated with closed reduction and external fixation based on the principle of ligamentotaxis. Schanz pins were inserted into the radial shaft proximally and the second metacarpal distally. The external fixator frame was assembled, and reduction was achieved under fluoroscopic guidance. Adequate alignment and stability were confirmed before completion of the procedure.

**Postoperative Care**
Postoperatively, all patients received intravenous antibiotics and analgesics as per hospital protocol. Finger mobilisation exercises were started immediately after surgery.

Patients treated with volar locking plates were encouraged to begin early wrist mobilisation once pain subsided. In the external fixation group, the fixator was usually removed at 6 weeks, followed by wrist mobilisation and physiotherapy.

**Follow-up and Outcome Assessment**
Patients were followed up at 6 weeks, 3 months, and 6 months postoperatively. At each visit, clinical and radiological evaluations were performed.

Functional outcome was assessed using the Disabilities of the Arm, Shoulder and Hand (DASH) score and wrist range of motion, including flexion, extension, pronation, and supination. Radiological parameters such as radial height, radial inclination, and volar tilt were measured on follow-up radiographs.

**Statistical Analysis**
All collected data were entered into Microsoft Excel and analysed using Statistical Package for Social Sciences (SPSS) software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequency and percentage. The Student's t-test was used for comparison of continuous variables and the Chi-square test for categorical variables. A p-value $< 0.05$ was considered statistically significant.

## RESULTS AND OBSERVATIONS

A total of 60 patients with distal radius fractures were included in the study. Patients were divided into two groups: Group A (Volar Locking Plate Fixation) and Group B (External Fixation), with 30 patients in each group. The results were analysed in terms of demographic characteristics, fracture type, functional outcome, range of motion, and complications.

**Table 1: Age Distribution of Patients**

| Age Group (years) | Volar Locking Plate (n=30) | External Fixation (n=30) | Total (n=60) |
|---|---|---|---|
| 18–30 | 6 | 5 | 11 |
| 31–40 | 7 | 6 | 13 |
| 41–50 | 8 | 9 | 17 |
| 51–60 | 6 | 7 | 13 |
| >60 | 3 | 3 | 6 |
| **Total** | **30** | **30** | **60** |

The majority of patients were in the 41–50 years age group (28.3%), followed by 31–40 years (21.7%).

**Table 2: Gender Distribution**

| Gender | Volar Locking Plate (n=30) | External Fixation (n=30) | Total |
|---|---|---|---|
| Male | 18 | 17 | 35 |
| Female | 12 | 13 | 25 |
| **Total** | **30** | **30** | **60** |

Males (58.3%) were more commonly affected than females (41.7%).

**Table 3: Mode of Injury**

| Mode of Injury | Volar Locking Plate | External Fixation | Total |
|---|---|---|---|
| Road Traffic Accident | 14 | 13 | 27 |
| Fall on Outstretched Hand | 13 | 15 | 28 |
| Sports Injury | 3 | 2 | 5 |
| **Total** | **30** | **30** | **60** |

The most common mode of injury was a fall on an outstretched hand (46.7%), followed by road traffic accidents (45%).

**Table 4: Fracture Type According to AO Classification**

| AO Type | Volar Locking Plate | External Fixation | Total |
|---|---|---|---|
| Type A | 10 | 11 | 21 |
| Type B | 9 | 8 | 17 |
| Type C | 11 | 11 | 22 |
| **Total** | **30** | **30** | **60** |

Type C fractures (36.7%) were the most common fracture pattern observed.

**Table 5: Mean Range of Motion at Final Follow-up**

| Movement | Volar Locking Plate (Mean ± SD) | External Fixation (Mean ± SD) |
|---|---|---|
| Wrist Flexion | 70° ± 6 | 60° ± 7 |
| Wrist Extension | 68° ± 5 | 58° ± 6 |
| Pronation | 78° ± 4 | 72° ± 5 |
| Supination | 80° ± 5 | 74° ± 6 |

Patients treated with volar locking plate fixation showed better wrist range of motion compared to external fixation.

**Table 6: Functional Outcome Based on DASH Score**

| Outcome | Volar Locking Plate (n=30) | External Fixation (n=30) |
|---|---|---|
| Excellent | 12 | 7 |
| Good | 11 | 12 |
| Fair | 5 | 8 |
| Poor | 2 | 3 |
| **Total** | **30** | **30** |

Excellent to good outcomes were seen in 76.7% of patients treated with volar locking plates compared to 63.3% in the external fixation group.

**Table 7: Complications**

| Complication | Volar Locking Plate | External Fixation |
|---|---|---|
| Infection | 1 | 3 |
| Wrist Stiffness | 2 | 4 |
| Malunion | 1 | 2 |
| Pin Tract Infection | 0 | 3 |
| **Total** | **4** | **12** |

Complications were more frequent in the external fixation group, with pin tract infection being the most common complication.

## DISCUSSION

Distal radius fractures are among the most frequently encountered injuries in orthopaedic practice and represent a significant proportion of upper limb fractures. The management of these fractures has evolved over the years with the aim of restoring anatomical alignment, maintaining fracture stability, and achieving optimal functional outcomes. Various treatment modalities have been described, including closed reduction with casting, external fixation, and internal fixation using plates and screws (1,2).

External fixation has traditionally been used for the treatment of unstable distal radius fractures. It works on the principle of ligamentotaxis, which helps maintain reduction by applying distraction forces across the wrist joint. Although external fixation can effectively maintain fracture alignment, it is often associated with complications such as pin tract infection, joint stiffness, and delayed rehabilitation (3,4).

In recent years, volar locking plate fixation has gained widespread acceptance due to its ability to provide stable fixation, particularly in comminuted and osteoporotic fractures. The fixed-angle construct of locking plates provides improved stability and allows early mobilization of the wrist joint, which contributes to better functional recovery (5,6).

In the present study, the majority of patients were in the 41–50 years age group, which is consistent with the findings reported by Court-Brown and Caesar, who noted that distal radius fractures commonly occur in middle-aged and elderly individuals (1). A higher incidence of fractures was observed in males compared to females, which may be attributed to increased exposure to high-energy trauma such as road traffic accidents.

The most common mechanism of injury in the present study was fall on an outstretched hand, followed closely by road traffic accidents. Similar findings were reported by Chung and Spilson, who highlighted that falls are the predominant cause of distal radius fractures, particularly in the elderly population (2).

In terms of fracture classification, Type C fractures according to the AO classification were most commonly observed in this study. This finding is comparable to previous studies which have reported a higher incidence of intra-articular fractures due to high-energy trauma and increased participation in outdoor activities (7).

Functional outcomes in this study were assessed using the Disabilities of the Arm, Shoulder and Hand (DASH) score along with evaluation of wrist range of motion. Patients treated with volar locking plate fixation demonstrated better functional outcomes and improved wrist mobility compared to those treated with external fixation. Early mobilization facilitated by stable internal fixation likely contributed to improved recovery of wrist function.

These findings are in agreement with the study conducted by Arora et al., who reported that volar locking plate fixation provided superior functional outcomes and earlier return of wrist movements compared to external fixation (8). Similarly, Margaliot et al., in a meta-analysis comparing plate fixation and external fixation, concluded that plate fixation resulted in better functional outcomes and fewer complications (9).

Complications were observed in both treatment groups; however, the external fixation group showed a higher complication rate, particularly pin tract infections and wrist stiffness. This observation is consistent with the findings of McQueen et al., who reported higher complication rates associated with external fixation compared to internal fixation methods (10).

Overall, the results of the present study suggest that volar locking plate fixation provides better anatomical restoration, improved functional outcomes, and fewer complications compared to external fixation in the management of distal radius fractures. Early mobilisation and stable fixation achieved with volar locking plates play an important role in enhancing patient recovery and functional results.

## CONCLUSION

Distal radius fractures require stable fixation to restore wrist anatomy and function. In the present study, volar locking plate fixation showed better functional outcomes, greater wrist range of motion, and fewer complications compared to external fixation. Early mobilisation provided by stable internal fixation contributed to improved recovery. Therefore, volar locking plate fixation may be considered a more effective treatment option for unstable distal radius fractures, although external fixation remains useful in selected cases.

## REFERENCES


1. Court-Brown CM, Caesar B. Epidemiology of adult fractures: A review. Injury. 2006;37(8):691–697.
2. Chung KC, Spilson SV. The frequency and epidemiology of hand and forearm fractures in the United States. J Hand Surg Am. 2001;26(5):908–915.
3. Cooney WP, Dobyns JH, Linscheid RL. Complications of Colles' fractures. J Bone Joint Surg Am. 1980;62(4):613–619.
4. McQueen MM, Hajducka C, Court-Brown CM. Redisplaced unstable fractures of the distal radius. J Bone Joint Surg Br. 1996;78(3):404–409.
5. Orbay JL, Fernandez DL. Volar fixation for dorsally displaced fractures of the distal radius. J Hand Surg Am. 2002;27(2):205–215.
6. Jupiter JB, Fernandez DL. Comparative classification for fractures of the distal end of the radius. J Hand Surg Am. 1997;22(4):563–571.
7. Lafontaine M, Hardy D, Delince P. Stability assessment of distal radius fractures. Injury. 1989;20(4):208–210.
8. Arora R, Lutz M, Deml C, Krappinger D, Haug L, Gabl M. A prospective randomised trial comparing volar locking plate fixation with external fixation for unstable distal radius fractures. J Bone Joint Surg Am. 2011;93(23):2146–2153.
9. Margaliot Z, Haase SC, Kotsis SV, Kim HM, Chung KC. A meta-analysis of outcomes of external fixation versus plate osteosynthesis for unstable distal radius fractures. J Hand Surg Am. 2005;30(6):1185–1199.
10. McQueen MM, Caspers J. Colles fracture: Does the anatomical result affect the final function? J Bone Joint Surg Br. 1988;70(4):649–651.