



EVALUATION OF FUNCTIONAL RECOVERY FOLLOWING EARLY MOBILIZATION IN DISTAL RADIUS FRACTURES TREATED WITH VOLAR PLATING

¹Tinku Singh, ²Sanjeev Joshi, ³Pawan Dubey

¹*Assistant Professor, Department of Orthopedics, Government Medical College, Budaun, Uttar Pradesh

²Assistant Professor, Department of Orthopedics, Rama Medical College, Hapur, Uttar Pradesh

³Assistant Professor, Department of Orthopedics, Saraswathi Medical College, Hapur, Uttar Pradesh

***Corresponding Author:** Dr. Tinku Singh

*Assistant Professor, Department of Orthopedics, Government Medical College, Budaun, Uttar Pradesh. Mail Id- TNKU60@GMAIL.COM

Abstract

Background: Distal radius fractures are frequently treated with volar locking plate fixation, which provides stable internal fixation and permits early postoperative mobilization. However, evidence regarding its impact on functional recovery remains evolving. **Objectives:** To evaluate functional recovery following early mobilization in patients with distal radius fractures treated with volar plating. **Materials and Methods:** A prospective observational study was conducted on 40 patients with distal radius fractures managed with volar locking plate fixation. Early mobilization was initiated postoperatively. Functional outcomes were assessed using wrist range of motion, grip strength, visual analogue scale (VAS) for pain, and PRWE/DASH scores at 2 weeks, 6 weeks, 3 months, and 6 months. **Results:** Mean PRWE/DASH scores showed a significant improvement from early follow-up to six months ($p < 0.05$). Wrist flexion–extension arc and forearm rotation improved progressively, achieving near-functional ranges by six months. Mean grip strength increased to more than 80% of the contralateral side, while mean VAS pain scores decreased significantly over time. **Conclusion:** Early mobilization after volar locking plate fixation of distal radius fractures results in significant early functional improvement and pain reduction without increasing complication rates, supporting its routine use in postoperative rehabilitation.

Keywords: *Functional Recovery, Early Mobilization, Distal Radius Fractures, Volar Plating*

Introduction

Distal radius fractures (DRFs) are among the most common fractures encountered in orthopedic practice, accounting for nearly one-fifth of all fractures presenting to emergency departments.¹ These injuries show a bimodal distribution, occurring in younger individuals following high-energy trauma and in elderly populations as a result of low-energy falls related to osteoporosis. Impaired wrist function following these fractures can substantially limit daily activities, reduce work productivity, and adversely affect quality of life, highlighting the importance of optimal management strategies.

The goals of treatment for distal radius fractures include restoration of anatomical alignment, achievement of stable fixation, pain relief, and early return of wrist function.² While conservative

management remains appropriate for stable fracture patterns, unstable and displaced fractures often require surgical intervention to obtain satisfactory functional outcomes. Volar locking plate (VLP) fixation has become the preferred surgical modality for many such fractures due to its biomechanical stability, ability to maintain reduction, and lower risk of extensor tendon complications compared to dorsal plating.³ The fixed-angle construct of VLPs provides secure fixation even in osteoporotic bone, theoretically allowing early postoperative wrist mobilization.⁴ Postoperative rehabilitation plays a critical role in determining functional outcomes following distal radius fracture fixation. Traditionally, immobilization for several weeks was advocated to protect the fixation and facilitate fracture healing. However, prolonged immobilization is associated with complications such as joint stiffness, muscle atrophy, tendon adhesions, reduced grip strength, and delayed functional recovery.⁵ These concerns have led to increasing interest in early mobilization protocols that initiate controlled wrist motion soon after surgery.

Early mobilization following VLP fixation is based on the premise that stable internal fixation can tolerate physiological stresses during gentle wrist movement without compromising fracture healing. Several clinical studies have demonstrated that early mobilization results in faster recovery of wrist range of motion, improved grip strength, and better patient-reported functional outcomes in the early postoperative period.^{6,7}

Evidence from systematic reviews and meta-analyses further supports the benefits of early mobilization after volar locking plate fixation. Early motion has been associated with improved short-term outcomes in terms of pain relief, range of motion, grip strength, and functional scores such as DASH and PRWE, without increasing the risk of loss of reduction or implant failure.^{8,9} However, these benefits tend to diminish at longer follow-up, with comparable outcomes reported at one year postoperatively, leading to continued debate regarding the optimal rehabilitation protocol.

In addition to timing, the quality and structure of rehabilitation are increasingly recognized as important determinants of recovery. Supervised physiotherapy, hand therapy, and manual therapy techniques have been shown to enhance functional outcomes and pain control following volar plating of distal radius fractures, particularly in elderly patients and those with complex fracture patterns.¹⁰

Materials and Methods

Study Setting & Design

A prospective, observational study was conducted in the department of orthopaedics of a tertiary care teaching hospital in North India where study subjects meeting the inclusion criteria were recruited from the orthopedic outpatient and inpatient facility to evaluate functional recovery following early mobilization with distal radius fractures treated surgically with volar locking plate fixation. The study was carried out over a period of 12 months from November 2024 to October 2025 including patient recruitment, surgical intervention, postoperative rehabilitation, and follow-up assessment.

Study Population & Sample Size

A total of 40 patients meeting the inclusion criteria, diagnosed with distal radius fractures requiring operative fixation with a volar locking plate were included in the study based on convenient sampling method.

Inclusion & Exclusion Criteria

Patients aged 18 years and above diagnosed with closed distal radius fractures (intra-articular or extra-articular) with unstable or displaced fractures requiring surgical fixation treated with volar locking plate osteosynthesis and able to comply with postoperative rehabilitation and follow-up protocol were included in the study. However patients with open fractures of the distal radius or associated fractures of the same upper limb (e.g., carpal bones, ulna shaft) or polytrauma patients

or previous fracture or surgery involving the affected wrist and/or neurological disorders affecting the upper limb were excluded from the study.

Preoperative Evaluation

All patients underwent a detailed clinical assessment, including:

- Demographic data (age, sex, dominant hand)
- Mode of injury
- Side of involvement
- Fracture classification based on AO/OTA classification
- Preoperative radiological evaluation using standard wrist radiographs (posteroanterior and lateral views)

Baseline functional assessment was recorded when feasible.

Surgical Technique

All patients were operated on under regional or general anesthesia using a standard volar approach (Henry's approach). Fracture reduction was achieved under fluoroscopic guidance, and internal fixation was performed using a precontoured volar locking plate. Care was taken to restore:

- Radial height
- Radial inclination
- Volar tilt
- Articular congruity

Wound closure was performed in layers, and a sterile dressing was applied. A short-term volar splint was used postoperatively for comfort.

Postoperative Rehabilitation Protocol

Patients were initiated on an early mobilization protocol, which included:

- Finger, elbow, and shoulder range of motion exercises from postoperative day one
- Controlled wrist range of motion exercises (flexion, extension, pronation, and supination) initiated within the first postoperative week, depending on pain tolerance
- Gradual progression to strengthening exercises after radiological evidence of fracture healing
- Supervised physiotherapy along with a structured home exercise program

Outcome Measures

Functional recovery was assessed using the following parameters:

Primary Outcome Measures

- Patient-Rated Wrist Evaluation (PRWE) score
- Disabilities of the Arm, Shoulder and Hand (DASH) / QuickDASH score

Secondary Outcome Measures

- Wrist range of motion (flexion, extension, radial deviation, ulnar deviation, pronation, and supination) measured using a goniometer
- Grip strength measured using a hand dynamometer
- Pain assessment using the Visual Analog Scale (VAS)
- Radiological assessment for fracture union and maintenance of reduction
- Complications such as infection, tendon irritation, implant failure, or loss of reduction

Follow-Up Schedule

Patients were followed up at: *2 weeks, 6 weeks, 3 months and 6 months*

At each follow-up visit, clinical examination, functional scoring, and radiographic evaluation were performed as per protocol.

Statistical Analysis

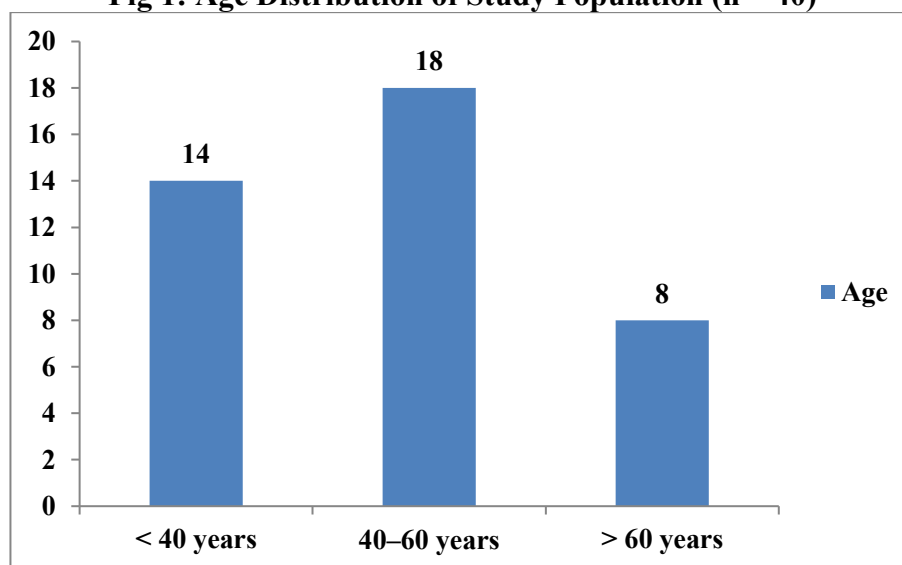
Data were entered into Microsoft Excel and analyzed using SPSS software version 21. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were expressed as frequencies and percentages. A p-value of <0.05 was considered statistically significant.

Results

Study Population

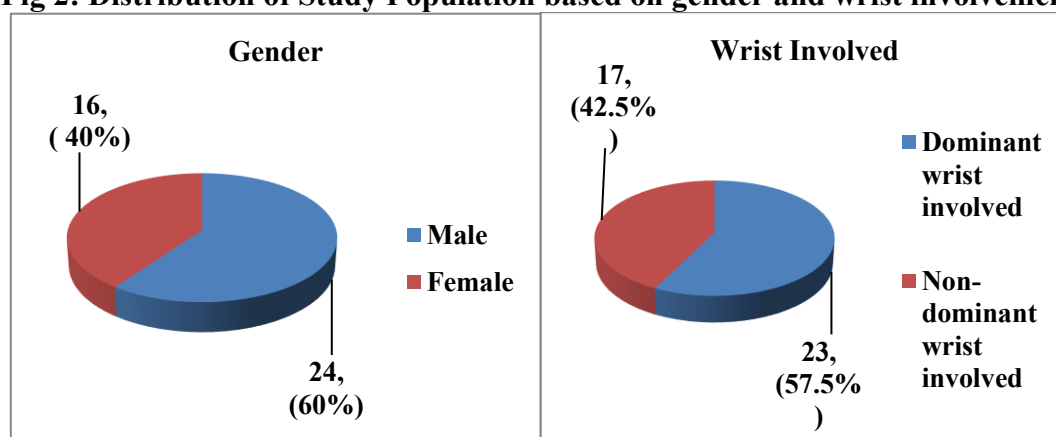
A total of 40 patients with distal radius fractures treated with volar locking plate fixation and managed using an early mobilization protocol were included in the study. All patients completed the minimum follow-up period of 6 months and were available for final analysis.

Fig 1: Age Distribution of Study Population (n = 40)



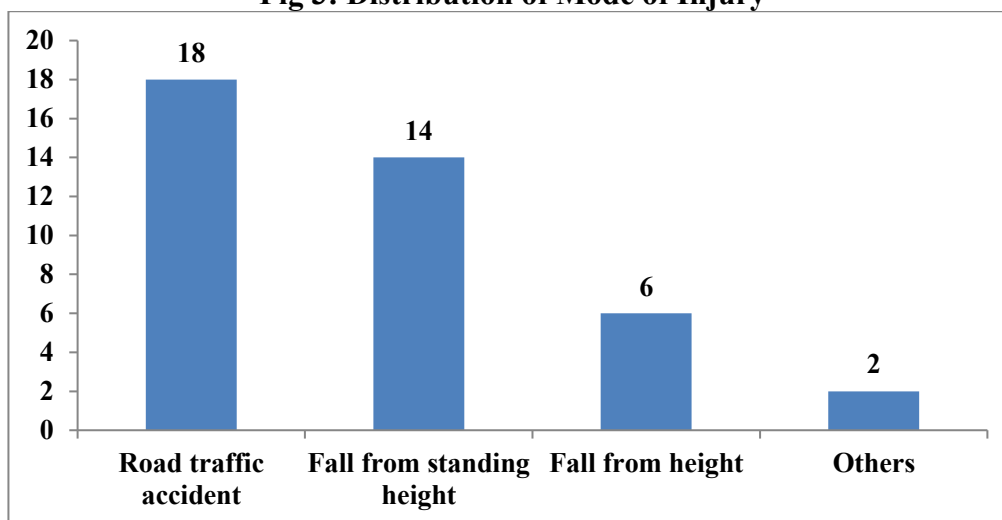
- Majority of study subjects were in the age group of 40-60 years
- Mean age of study participants was 48.6 ± 12.4 yrs

Fig 2: Distribution of Study Population based on gender and wrist involvement



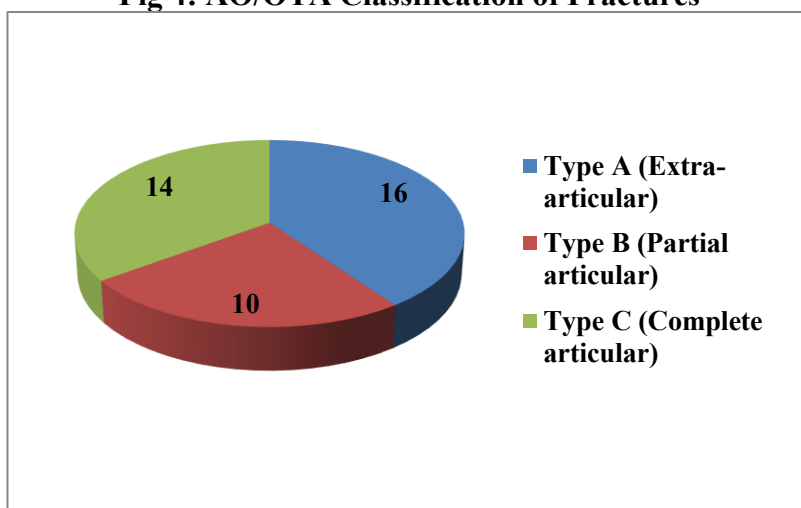
- Majority of study subjects were Males (24,60%)
- Majority of study subjects were having dominant wrist involvement of fracture radius

Fig 3: Distribution of Mode of Injury



- The most common mechanism of injury was road traffic accidents, accounting for 45% of cases, followed by fall from standing height in 35% of patients.

Fig 4: AO/OTA Classification of Fractures



- Based on the AO/OTA classification, extra-articular fractures were most common.

Functional Outcome

Table 1: Mean Patient-Rated Wrist Evaluation (PRWE) Scores at Different Follow-Up Intervals

Follow-up	Mean PRWE $\pm$ SD
2 weeks	68.4 $\pm$ 6.8
6 weeks	42.6 $\pm$ 7.1
3 months	24.8 $\pm$ 5.9
6 months	12.6 $\pm$ 4.3

($p < 0.001$)

- A progressive and statistically significant improvement in PRWE scores was observed across all follow-up intervals

Table 2: Mean DASH Scores at Follow-Up

Follow-up	Mean DASH $\pm$ SD
2 weeks	62.3 $\pm$ 7.4
6 weeks	38.7 $\pm$ 6.9
3 months	22.6 $\pm$ 5.8
6 months	14.2 $\pm$ 5.1

($p < 0.001$)

- Mean DASH scores decreased significantly over time, reflecting improvement in upper limb function.

Table 3: Wrist Range of Motion at 6 Months

Movement	Mean $\pm$ SD (degrees)
Flexion	65.2 $\pm$ 8.1
Extension	62.4 $\pm$ 7.6
Pronation	78.6 $\pm$ 5.3
Supination	76.8 $\pm$ 6.1
Radial deviation	16.4 $\pm$ 3.2
Ulnar deviation	28.7 $\pm$ 4.6

- Steady improvement in wrist ROM was observed during follow-up.

Table 4: Grip Strength Recovery

Follow-up	Mean Grip Strength (% of Normal Side)
6 weeks	58.2%
3 months	72.6%
6 months	82.5%

- Grip strength progressively improved and reached 82.5% of the contralateral normal side at final follow-up.

Pain Assessment

Table 5: VAS Pain Scores During Follow-Up

Follow-up	Mean VAS $\pm$ SD
2 weeks	6.8 $\pm$ 1.0
6 weeks	4.2 $\pm$ 0.9
3 months	2.1 $\pm$ 0.7
6 months	0.8 $\pm$ 0.5

- Pain scores showed a significant decline over time.

Radiological Outcome

- Radiological union was achieved in all patients at a mean duration of 8.6 ± 1.4 weeks. No secondary displacement or implant-related complications were observed.

Table 6: Complications Observed

Complication	Number (%)
Transient wrist stiffness	3 (7.5%)
Superficial wound infection	2 (5%)

Implant failure	0
Tendon irritation/rupture	0
CRPS	0

- Minor complications were observed in 5 patients (12.5%).

Discussion

Volar locking plates have transformed the management of distal radius fractures by providing angular stability, maintaining fracture reduction, and allowing early wrist motion even in osteoporotic bone and complex fracture patterns.^{1, 3} Traditionally, prolonged immobilization was recommended to ensure fracture healing; however, this approach is associated with joint stiffness, muscle atrophy, delayed functional recovery, and reduced patient satisfaction. Early mobilization seeks to address these limitations by initiating controlled wrist movements soon after surgery while maintaining fracture stability.⁶

In the current study, patient-reported functional outcomes, as measured by PRWE and DASH scores, showed a consistent and statistically significant improvement from early follow-up to six months postoperatively. These findings are in agreement with earlier randomized controlled trials demonstrating superior short-term functional recovery in patients undergoing early mobilization compared to delayed mobilization following volar plate fixation. Quadlbauer et al. reported improved functional scores and faster recovery of wrist motion in patients who commenced early rehabilitation, without any increase in implant failure or loss of reduction.⁷ Similarly, Dennison et al. observed improved early wrist function in patients allowed early motion, although long-term outcomes were comparable between early and late mobilization groups.¹¹ This suggests that early mobilization primarily accelerates recovery rather than altering final outcomes.

Range of motion is a critical determinant of wrist function and overall upper limb performance. In this study, patients achieved progressive improvement in wrist flexion, extension, pronation, and supination, with near-functional ranges attained by six months. Early mobilization may reduce capsular tightness, tendon adhesions, and periarticular fibrosis, thereby facilitating better motion recovery.² Systematic reviews have consistently shown that early mobilization following volar locking plate fixation results in improved wrist range of motion during the first three to six months, although differences tend to diminish at longer follow-up intervals.^{8, 9}

Grip strength recovery was another important outcome evaluated in this study. Patients demonstrated gradual improvement in grip strength, reaching more than 80% of the contralateral side by six months. Grip strength is closely associated with functional independence and return to daily activities. Meta-analyses have shown that early mobilization contributes to faster recovery of grip strength by minimizing disuse muscle atrophy and encouraging early functional use of the hand.⁹ These findings further support early rehabilitation as a means of improving patient confidence and facilitating earlier return to work and routine activities.

Pain reduction was also evident across successive follow-up visits. Despite concerns that early mobilization may increase postoperative pain, patients in this study experienced a progressive decrease in VAS scores. This observation is consistent with prior literature suggesting that early controlled motion does not exacerbate pain and may reduce stiffness-related discomfort.¹²

An important concern associated with early mobilization is the potential risk of complications such as implant failure, secondary displacement, tendon irritation, or complex regional pain syndrome. Notably, no significant complications were observed in the present study. This aligns with existing evidence indicating that early mobilization is safe when fracture fixation is stable and rehabilitation protocols are appropriately supervised.^{9, 11} Studies focusing on elderly patients have similarly reported no increase in adverse events with early mobilization, although the magnitude of functional benefit may be less pronounced in this population.¹⁰

Recent literature also highlights the importance of structured physiotherapy and hand therapy programs in optimizing outcomes following volar plate fixation. Tomruk et al. demonstrated that

early manual therapy combined with standard rehabilitation resulted in better pain control and functional outcomes compared to exercise alone.¹³

Recommendations

1. **Early Mobilization Protocol:** Early controlled wrist mobilization should be encouraged following stable volar locking plate fixation of distal radius fractures, as it facilitates faster recovery of function without increasing complication rates.
2. **Supervised Physiotherapy:** Early mobilization should be initiated under the guidance of trained physiotherapists or hand therapists to ensure safe progression of range-of-motion and strengthening exercises.
3. **Patient Education:** Patients should be adequately educated regarding postoperative exercises, activity modification, and adherence to rehabilitation schedules to improve compliance and outcomes.
4. **Use of Standardized Outcome Measures:** Validated functional scoring systems such as PRWE, DASH, and grip strength assessment should be routinely used for monitoring recovery and comparing treatment outcomes.

Limitations

1. **Small Sample Size:** The study included a limited number of patients, which may reduce the statistical power and limit generalizability of the results.
2. **Lack of Control Group:** Absence of a delayed mobilization or immobilization control group limits direct comparison between rehabilitation strategies.
3. **Short Follow-up Duration:** Follow-up was restricted to six months, which may not capture long-term functional outcomes, late complications, or implant-related issues.
4. **Heterogeneity of Fracture Patterns:** Variations in fracture types and severity could have influenced functional recovery outcomes.

Conclusion

Early mobilization after volar locking plate fixation of distal radius fractures is a safe and effective approach that enhances early functional recovery. Patients demonstrate improved wrist range of motion, grip strength, pain relief, and functional scores without an increased risk of complications. Early controlled rehabilitation facilitates faster return to daily activities and should be considered an integral component of postoperative management following stable volar plate fixation.

Conflict of Interest: None

Source of Funding: None

References

1. Nellans KW, Kowalski E, Chung KC. The epidemiology of distal radius fractures. *Hand Clin.* 2012;28(2):113–125.
2. Lichtman DM, Bindra RR, Boyer MI, et al. Treatment of distal radius fractures. *J Am Acad Orthop Surg.* 2010;18(3):180–189.
3. Orbay JL, Fernandez DL. Volar fixation for dorsally displaced fractures of the distal radius. *J Hand Surg Am.* 2002;27(2):205–215.
4. Jupiter JB, Marent-Huber M. Operative management of distal radial fractures with locking plates. *J Bone Joint Surg Am.* 2009;91(1):55–65.
5. Handoll HH, Madhok R. Conservative interventions for treating distal radial fractures in adults. *Cochrane Database Syst Rev.* 2003;(2):CD000314.
6. Souer JS, Ring D. Outcomes after early motion following volar plating of distal radius fractures. *J Hand Surg Am.* 2008;33(2):205–211.

7. Quadlbauer S, Pezzei C, Jurkowitsch J, et al. Early rehabilitation of distal radius fractures stabilized by volar locking plate. *J Hand Surg Eur Vol.* 2017;42(8):797–803.
8. Yeoh D, Tourret L. Effectiveness of early versus delayed motion in distal radius fractures treated with volar locking plates: a systematic review. *J Hand Ther.* 2020;33(2):196–207.
9. Yeoh D, Tourret L. Early mobilization after volar locking plate fixation of distal radius fractures: a meta-analysis. *J Hand Ther.* 2021;34(3):404–414.
10. Tomruk M, Gelecek N, Başçi O, Özkan MH. Effects of early manual therapy after volar plating of distal radius fractures. *Hand Surg Rehabil.* 2020;39(3):178–185.
11. Dennison DG, Elhassan B, Moran SL, Shin AY. Early versus late motion following volar plating of distal radius fractures. *Hand (N Y).* 2020;15(1):125-130.
12. Sorensen TJ, Ohrt-Nissen S, Ardensø KV, et al. Early mobilization after volar locking plate osteosynthesis of distal radial fractures in older patients. *J Hand Surg Am.* 2020;45(11):1047-1054.e1.
13. Gamo K, Baba N, Kakimoto T, Kuratsu S. Efficacy of hand therapy after volar locking plate fixation. *J Orthop Surg Res.* 2021;16(1):604.