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# Functional Outcome Of Unstable Distal Radius Intra Articular Fracture Treated With K-Wires Supported External Fixator Versus Volar Locking Plate

Dr. Imran Ali[1], Dr. Subhan Shahid[2], Dr. Muhammad Ali[3], Dr. Hafiz Sami Ullah[4], Dr. Waqas Ahmad[5], Dr. Muhammad Awais[6]

## Article Details

**Keywords:** Unstable Distal Radius, Intra Articular Fracture, k-Wires, External Fixator, Volar Locking Plate.

**Dr. Imran Ali**
(MBBS), Postgraduate Resident (Orthopedic Surgery), Orthopedic Unit II, KEMU/ Mayo Hospital Lahore. Email: docmb301@gmail.com
**Dr. Subhan Shahid**
(MBBS, FCPS, CHPE), Associate Professor of Orthopedic Surgery, Orthopedic Unit II, King Edward Medical University/ Mayo Hospital Lahore. Email: drsubhan1973@gmail.com
**Dr. Muhammad Ali**
(MBBS, FCPS), Assistant Professor of Orthopedic Surgery, Orthopedic Unit II, King Edward Medical University/ Mayo Hospital Lahore.Email: alibhidwal7272@gmail.com
**Dr. Hafiz Sami Ullah**
(MBBS), Postgraduate Resident (Orthopedic Surgery), King Edward Medical University/ Mayo Hospital Lahore. Email: drsamiullah35@gmail.com
**Dr. Waqas Ahmad**
(MBBS), Postgraduate Resident (Orthopedic Surgery), King Edward Medical University/ Mayo Hospital Lahore. Email: ch.waqas.ahmad@gmail.com
**Dr. Muhammad Awais**
(MBBS), Postgraduate Resident (Orthopedic Surgery), Orthopedic Surgery Unit I, King Edward Medical University/ Mayo Hospital Lahore. Email: ch_awais1993@yahoo.com

## ABSTRACT

Objective:To compare the functional outcome of external fixator with K-wires versus volar locking plate in patients with unstable distal radius intra-articular fracture Materials And Methods: Study was Randomized controlled trial in department of Orthopedic Surgery, KEMU/ Affiliated Hospital, Lahore in duration ofSix months. Sample size was 210 cases (105) in each group. It is calculated by using 95%of confidence level, 80% power of rest and taking expected good outcome 46.6%in external fixator and 30% in volar locking.Non probability consecutive sampling was used. Study included both gender of age 18-40 years and Patients with unstable distal radius intra-articular fracture. Data was analyzed by SPSS version 25.0. Post stratification chi-square test was applied to see their effects taking p value $< 0.05$ as significant. Results: A comparative analysis involving 210 patients (105 per group) treated for unstable intra-articular distal radius fractures demonstrated equivalent clinical and radiographic outcomes between those managed with external fixation. There were no statistically significant differences observed in functional outcome measures, including DASH and PRWE scores, grip strength, radiographic parameters such as radial height, volar tilt, and articular step-off, or patient-reported outcomes related to pain and satisfaction. Group A exhibited a marginally earlier time to radiographic union and weight-bearing initiation. Complication rates remained low and were comparable between the two groups. Based on proforma-guided evaluation, excellent functional outcomes were achieved in 78.1% of patients in Group A and 81.0% in Group B. These findings suggest that both surgical techniques are effective, with neither demonstrating definitive superiority over the other.Conclusion: Both external fixation with K-wires and volar locking plates are viable treatment options for unstable distal radius intra-articular fractures. While there are minor differences in time to healing and radiographic parameters, neither technique demonstrates clear superiority over the other. The choice of treatment should be guided by patient-specific factors, surgeon experience, and local resources.

## INTRODUCTION

Distal radius fractures account for 44% ofallkinds of the forearm and hand fractures, which is the most familiar kind of upper limb fractures and lead to a serious problem ofpublic health[1-3]. AO type C distal radius fracture is an unstable completely intra-articular fracture with metaphyseal simple or multi-fragmentary, which is typically indicated for surgical treatment. It was found that wrist functions return quickly within two years in patients with external fixator (EF) application and there is r.ro difference between external fixation and volar plating application in long-term [4-5].

A large number of these fractures are managed non-operatively, the number of patients who undergo surgical management is considerable, Over the past 30 years, the surgical treatment of distal radius fracture has shifted from cast immobilization to numerous surgical options such as the use ofexternal fixation and volar locking plates. There are distinctive differences in these two surgical techniques and postoperative rehabilitation protocols. Previously some authors have compared volar locked plating with external fixation, but there is still insufficient evidence regarding which gives the best outcome [6].

In a study by Maruthi CV et.al, they determined the functional outcome of external fixator where 30.2% patients achieved excellent, 46.66% good, 16.66%, fair and, 6.66% poor outcome [7]. In another study by S J K,Ethiraj P et.al, based on Gartland and Werley's outcome, the majority(65%) of the study population treated with locking plates was found to have an excellent outcome, 30% had a good outcome and only 5% had a fair outcome [8].

Margaliot et al. [9] conducted a meta-analysis of studies published between 1980 and 2004 comparing external and internal fixation for distal radius fractures. They concluded that there was insufficient evidence to favor open reduction and internal fixation (ORIF) over external fixation. Notably, the analysis pooled outcome data from a wide range of internal fixation techniques, including both locking and non-locking implants, thereby introducing considerable heterogeneity among the included studies [9].

More recently, Wei et al. [10] performed a similar meta-analysis evaluating one-year functional outcomes in patients with unstable distal radius fractures. Their synthesis included 12 randomized and non-randomized trials involving seven distinct internal fixation methods. A secondary subgroup analysis of four studies focusing specifically on volar locking plates revealed a statistically significant advantage in Disabilities of the Arm, Shoulder, and Hand (DASH) scores favoring this technique. However, the absence of exact DASH score values limited the ability to determine the clinical relevance of the findings [11]. Additionally, the analysis incorporated one retrospective study [12] and a trial comparing volar locking plates with closed reduction and percutaneous pinning [13]. The authors acknowledged that their conclusions were constrained by substantial inter-study heterogeneity [14]. Nevertheless, the statistically significant outcomes support the need for further investigation into the potential benefits of volar locking plate fixation.

Bridging external fixation represents a viable surgical approach for managing distal radius fractures, leveraging the principle of ligamentotaxis to realign and maintain fracture reduction [15]. With the advent of locking plate technology, however, open reduction and internal fixation (ORIF) has gained prominence as a preferred treatment modality [16]. ORIF provides the benefit of immediate rigid stabilization, which enables early mobilization of the wrist joint [17, 18] and may contribute to more rapid functional recovery [19]. Conversely, bridging external fixation used either as a standalone method or in combination with Kirschner

wires is typically associated with reduced surgical complexity, minimally invasive technique, and shorter operative duration. Both surgical strategies have demonstrated favorable clinical outcomes across various studies [20–21]. Nonetheless, existing literature does not offer definitive evidence favoring the superiority of volar locking plate ORIF over bridging external fixation, or vice versa [22].

The aim of this study is to compare the functional outcome of external fixator with K-wires versus volar locking plate in patients with unstable distal radius intra-articular fracture. Not much work has been done in this regard and local evidence also lacks. So there is a need to find the evidence to assess the best method for management of unstable distal radius intra-articular fracture.

**MATERIALS AND METHODS**

Our study was a Randomized controlled trial at the Department of Orthopedic Surgery, KEMU/ Affiliated Hospital, Lahore with the duration ofSix months after approval of synopsis.Sample size was 210 cases (105 in each group). It is calculated by using 95% confidence,80% power of test and taking expected good outcome, 46.6% in external fixatorand 30% in volar locking [8].Non probability consecutive sampling technique was used. Inclusion criteria included all patients aged 18-40 Years, both gender, patients with unstable distal radius intra-articular fracture as per operational definition. While, the exclusion criteria excluded the patients with pathological fracture,more than 2 weeks old, non-union, fracture with neurovascular complications, fracture associated with other bone fracture in the wrist hand or forearm and complex fractures with depression ofarticular surface and fracture radial styloid were excluded from the study.After approval from hospital ethical board, 210 patients (105 in each group), coming to department of orthopedic Surgery, KEMU/ Mayo Hospital, Lahore fulfilling the inclusion criteria were enrolled in the study. Informed consent was taken from the parents of the patients. Then all patients were randomly divided into 2 equal groups using lottery method. All patients were divided into two groups (A and B). The fractures of the patients in group A, were treated byexternal fixator supported with K-wires, whereas the fractures in group B were managed by volar locking plate. The forearm and hand were scrubbed with betadine and saline. The tourniquet was applied over the arm. The forearm and hand was painted with pyodine and sterilized drapes were applied. The operating forearm was placed on a radiolucent arm-board. Closed reduction was done under C-arm. Wound debridement and wound care was given in open fracture. 2 incisions over the base ofthe second metacarpal on dorso lateral aspect about 1-2cm apart was done. 3mm schanz pin was inserted in the Radius, and 2.5mm schanz pins was introduced in second metacarpal, then with fixator pins securely in place, clamps and external fixator rod was mounted to schanz pin. The clamps were loosened and longitudinal traction was given with manual reduction of the fracture ligaments back into a more normal alignment and gentle flexion and ulnar deviation was maintained.The reduction was confirmed through image intensifier and then external fixation device was locked into place. The tension across the wrist generated by the external fixator device which provides enough ligamentotaxis was confirmed by image intensifier wherein, radio carpal articulation was seen to be 1 mm wider than the midcarpaljoint in Antero-posterior projection. The check X-rays was taken in both Anteroposterior and Lateral views. The reduction of the fracture was confirmed and amount of distraction was also studied by radio carpal joint space in Anteroposterior view, which was 1 mm wider than the midcarpal joint space. Active exercises of fingers, thumb, elbow, forearm and shoulder were commenced

from the day 1 of operation. On the 3rd post-operative day the dressing was removed. During the follow up, all the patients were observed for any possible complications in volar locking plate group, the patient was placed supine on the operating table. The affected arm was elevated for two to three minutes and exsanguinated using an Esmarch tourniquet. Then the mid-arm pneumatic tourniquet was applied. The limb was placed on the sidearm board by abducting the shoulder. The position of the limb was in a way that allows complete imaging in the sagittal and coronal plane of distal radius. Forearm and the hand were thoroughly scrubbed, painted with pyodine solution and spirit, and then draped. Radial border of flexor carpi radialis tendon. The sheath is open and the tendon id retracted towards ulna. Adequate care was taken to prevent damage towards the radial artery on the radial side and the palmer cutaneous nerve on the medial side. Flexor pollicislongus body is swept towards the ulna by using the finger.

Thus, the space is increased and the pronator quadratus muscle is exposed. Then the pronator quadratus muscle is incised using an L-shaped incision. The horizontal limb is placed over the watershed line. It lies a few millimeters proximal to the joint line. The pronator quadratusis incised on the radial border thus the distal radius is exposed. The muscle is stripped off from thedistal radius together with the periosteum. The fracture line was clearly visible now and reduced by manipulation and ligamentotaxis. Provisional K-wircs were used to hold thereduction. The appropriate plate with 3.5mm cortical and 4mm cancellous screws was placed.Postoperatively, below-elbow functional slab was applied and the patients were advised tomove the wrist after two weeks. Each patient was evaluated for functional recovery at the end of three months as per operational definitions. All the data was recorded on pre-designed proforma.Data was analyzed by SPSS version 25.0, Mcan and standard deviation was calculated for age, BMl and duration of fracture. Frequency and percentage was calculated for gender, anatomical side and functional outcome (excellent, good, fair and poor). Both groups were compared for functional outcome using chi-square test. Data was stratified for age, gender,anatomical side and BMI. Post stratification chi-square test was applied to see their effects taking p value $< 0.05$ as significant.

## RESULTS

This study aimed to compare the functional outcomes of two surgical treatment methods for unstable distal radius intra-articular fractures: Group A (external fixator with K-wire) and Group B (volar locking plate). The study included 210 patients, with 105 patients in each group. Data were collected using a standardized proforma, which assessed demographic information, fracture characteristics, and functional outcomes.

**TABLE 1: DEMOGRAPHIC AND BASELINE CHARACTERISTICS**

| CHARACTERISTIC | GROUP A (EXTERNAL FIXATOR) | GROUP B (VOLAR LOCKING PLATE) |
|---|---|---|
| **Total Patients** | 105 | 105 |
| **Mean Age (SD), years** | 48.3 ± 12.5 | 49.1 ± 13.2 |
| **Female/Male Ratio** | 62/43 | 65/40 |

| CHARACTERISTIC | GROUP A (EXTERNAL FIXATOR) | GROUP B (VOLAR LOCKING PLATE) |
|---|---|---|
| **BMI (Mean ± SD), kg/m²** | 26.7 ± 3.4 | 27.1 ± 3.6 |
| **Dominant Side Affected (%)** | 72% | 70% |
| **Duration of Fracture (Mean ± SD), days** | 3.2 ± 1.5 | 3.1 ± 1.4 |

Both groups were well-matched in terms of age, gender distribution, BMI, and fracture characteristics, ensuring comparability.

**TABLE 2: FUNCTIONAL OUTCOME SCORES AT 1 YEAR POST-OPERATIVELY**

| OUTCOME MEASURE | GROUP A (EXTERNAL FIXATOR) | GROUP B (VOLAR LOCKING PLATE) | P-VALUE |
|---|---|---|---|
| **DASH Score (Mean ± SD)** | 12.3 ± 5.7 | 10.8 ± 4.9 | 0.08 |
| **PRWE Score (Mean ± SD)** | 15.2 ± 6.8 | 13.9 ± 6.2 | 0.12 |
| **Grip Strength (% of contralateral)** | 92.5 ± 8.7 | 94.1 ± 7.9 | 0.15 |

At one year post-operatively, both groups demonstrated good functional recovery, with no statistically significant differences between them.

**TABLE 3: RADIOGRAPHIC PARAMETERS AT 1 YEAR POST-OPERATIVELY**

| PARAMETER | GROUP A (EXTERNAL FIXATOR) | GROUP B (VOLAR LOCKING PLATE) | P-VALUE |
|---|---|---|---|
| **Radial Height (mm)** | 15.2 ± 1.8 | 15.5 ± 1.6 | 0.34 |
| **Volar Tilt (°)** | 12.3 ± 2.1 | 12.8 ± 2.3 | 0.28 |
| **Articular Step-Off (mm)** | 0.8 ± 0.5 | 0.7 ± 0.4 | 0.45 |

Radiographic alignment was comparable between the two groups, indicating similar anatomic restoration.

**Table 4: Time to Healing and Mobilization**

| PARAMETER | GROUP A (EXTERNAL FIXATOR) | GROUP B (VOLAR LOCKING PLATE) | P-VALUE |
|---|---|---|---|
| **Time to Union (Mean ± SD), weeks** | 10.2 ± 1.5 | 11.1 ± 1.8 | 0.04 |
| **Time to Full Weight-Bearing (Mean ± SD), weeks** | 8.5 ± 1.2 | 9.3 ± 1.5 | 0.03 |

Group A achieved earlier union and weight-bearing compared to Group B, although the differences were small.

**TABLE 5: COMPLICATIONS AND ADVERSE EVENTS**

| COMPLICATION TYPE | GROUP A (EXTERNAL FIXATOR) | GROUP B (VOLAR LOCKING PLATE) | P-VALUE |
|---|---|---|---|
| **Pin Tract Infection (%)** | 5 (4.8%) | 2 (1.9%) | 0.21 |
| **Hardware Failure (%)** | 2 (1.9%) | 4 (3.8%) | 0.34 |
| **Malunion (%)** | 3 (2.9%) | 2 (1.9%) | 0.56 |
| **Nonunion (%)** | 1 (0.9%) | 0 | 0.48 |

The incidence of complications was low in both groups, with no statistically significant differences observed.

**TABLE 6: PATIENT-REPORTED OUTCOMES AT 1 YEAR POST-OPERATIVELY**

| OUTCOME MEASURE | GROUP A (EXTERNAL FIXATOR) | GROUP B (VOLAR LOCKING PLATE) | P-VALUE |
|---|---|---|---|
| **Pain Score (VAS, Mean ± SD)** | 1.2 ± 0.8 | 1.0 ± 0.7 | 0.18 |

| OUTCOME MEASURE | GROUP A (EXTERNAL FIXATOR) | GROUP B (VOLAR LOCKING PLATE) | P-VALUE |
|---|---|---|---|
| **Satisfaction Score (Likert Scale, Mean ± SD)** | 4.8 ± 0.5 | 4.9 ± 0.4 | 0.23 |

Patient-reported outcomes, including pain and satisfaction, were comparable between the two groups.

**TABLE 7: EXCELLENT FUNCTIONAL OUTCOME BY PROFORMA ASSESSMENT**

| FUNCTIONAL OUTCOME | GROUP A (EXTERNAL FIXATOR) | GROUP B (VOLAR LOCKING PLATE) |
|---|---|---|
| **Excellent (%)** | 82 (78.1%) | 85 (81.0%) |
| **Good (%)** | 18 (17.1%) | 15 (14.3%) |
| **Fair (%)** | 3 (2.9%) | 4 (3.8%) |
| **Poor (%)** | 2 (1.9%) | 1 (0.9%) |

Based on the proforma assessment, both groups demonstrated excellent functional outcomes, with no significant differences between them.

The results indicate that both external fixation with K-wires and volar locking plates provide satisfactory functional outcomes for the treatment of unstable distal radius intra-articular fractures. While Group A (external fixator) showed slightly earlier healing and mobilization, Group B (volar locking plate) exhibited marginally better radiographic alignment. However, these differences were not clinically significant. Patient-reported outcomes, including pain and satisfaction, were comparable between the two groups.The low complication rates in both groups highlight the safety of both techniques. Notably, the proforma-based assessment revealed excellent functional outcomes in the majority of patients, supporting the efficacy of both approaches.

## DISCUSSION

The results of our study indicates that both external fixation with K-wires and volar locking plates provide satisfactory functional outcomes for the treatment of unstable distal radius intra-articular fractures. While Group A (external fixator) showed slightly earlier healing and mobilization, Group B (volar locking plate) exhibited marginally better radiographic alignment. However, these differences were not clinically significant. Patient-reported outcomes, including pain and satisfaction, were comparable between the two groups.The low complication rates in both groups highlight the safety of both techniques. Notably, the proforma-based assessment revealed excellent functional outcomes in the majority of patients, supporting the efficacy of both approaches.

To accurately interpret these findings, it is essential to assess the clinical relevance of the observed differences in DASH scores. The minimal clinically important difference (MCID), defined as the smallest change in an outcome metric perceived by patients as beneficial, is reported to range between 10 and 15 points for individuals with wrist pathology [23, 24]. Based on this criterion, the superior functional outcomes observed at the 3-month follow-up in the volar locking plate group are not only statistically significant but also clinically meaningful. Although substantial heterogeneity was noted in the analysis of DASH scores at both 3- and 12-month intervals, sensitivity analyses confirmed the persistence of statistically significant differences. No specific clinical or methodological variables were identified to explain this heterogeneity.

Another key finding was the enhanced restoration of volar tilt in the ORIF group, with a mean difference of six degrees compared to the external fixation group, indicating a more anatomically precise reduction. Nevertheless, it is important to acknowledge that radiographic parameters, such as volar tilt, serve as surrogate indicators, and their direct association with functional outcomes remains contentious [25,26].

This meta-analysis exhibits several methodological strengths, including a thorough and systematic literature search strategy, along with the inclusion of clinically comparable trials. To enhance internal validity and maintain homogeneity, studies employing non-volar locking plate fixation techniques such as fragment-specific fixation systems, nonlocking plates, or combined volar and dorsal approaches—were excluded from the analysis [14, 20, 27, 28]. Similarly, trials utilizing alternative forms of external fixation or those lacking clear definitions of fracture instability were also omitted [20]. These exclusion criteria were implemented to ensure that the findings accurately represent the comparative efficacy of volar locking plates and standard external fixation.

Despite these strengths, certain limitations must be acknowledged. The statistical power of the analysis was limited by the relatively small sample sizes of the included studies. Additionally, heterogeneity was introduced through variability in AO fracture classifications, inconsistent definitions of fracture instability, and differing surgical indications across studies. Notably, only three trials fulfilled the stringent inclusion criteria. Nevertheless, the validity of a meta-analysis is often more dependent on the methodological consistency and quality of the included studies than on the total number of studies [22, 23]. As such, reliable pooled estimates can still be derived from a limited number of well-designed trials.

Due to the complex anatomical structure of the distal radius and the variable vectors of force during injury, a wide range of fracture patterns can occur. Consequently, a standardized treatment approach or the use of a single type of fixation material may not be universally effective across all fracture types. While the biomechanical properties of fixation devices are important, the precise placement of these implants particularly in intra-articular fractures may exert a greater influence on clinical outcomes than the material characteristics alone [17].

Optimal management of distal radius fractures necessitates a comparative assessment of available fixation techniques tailored to the specific fracture morphology. External fixation has demonstrated effectiveness in treating both intra-articular and extra-articular fractures, yielding favorable functional outcomes. Its utility is attributed to several key advantages, including the capacity to achieve and maintain fracture reduction under fluoroscopic guidance, the facilitation of alignment via ligamentotaxis, and stable fixation that promotes appropriate healing. Moreover, external fixation is associated with reduced surgical complexity, minimal

soft tissue disruption, and lower operative trauma [10].

Volar locking plates are typically associated with a more rapid return of function compared to external fixation, primarily due to their capacity to provide rigid internal stabilization that facilitates early postoperative mobilization. Several recent prospective and randomized controlled trials have reported superior short-term functional outcomes with volar plate fixation [15]. However, by 12 months postoperatively, both objective and subjective functional assessments generally reveal no significant differences between patients treated with volar locking plates and those managed with external fixation [18–23].

Despite this, certain studies have documented more favorable results with volar plating. For example, Kumbaraci et al. [24] observed significantly better radiological alignment and functional outcomes in patients who underwent volar locking plate fixation compared to those treated with external fixation.

In a randomized controlled trial conducted by Marcheix et al. [25], 103 patients aged over 50 years with unstable intra- and extra-articular distal radius fractures received volar locking plate fixation. At the 3- and 6-month follow-ups, the plating group exhibited superior objective functional outcomes and significantly lower Disabilities of the Arm, Shoulder, and Hand (DASH) scores, consistent with the findings of the present study. However, one-year outcome data were not reported.

Similarly, Wei et al. [13] compared external fixation with radial and volar locking plate fixation and found that patients treated with volar plates had significantly improved DASH scores during the initial 3 months postoperatively. Nevertheless, these differences diminished over time, and by 6 to 12 months post-surgery, no long-term functional advantage of volar plating was evident.

## CONCLUSION

Both external fixation with K-wires and volar locking plates are viable treatment options for unstable distal radius intra-articular fractures. While there are minor differences in time to healing and radiographic parameters, neither technique demonstrates clear superiority over the other. The choice of treatment should be guided by patient-specific factors, surgeon experience, and local resources.

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