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Original Article

Short-Term Comparative Analysis of External Fixation Versus Volar Locking Compression Plate Fixation in Managing Distal Radius Fractures: A Prospective Observational Study

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Abstract

Introduction: Distal radius fractures are among the most common upper extremity injuries, accounting for a significant proportion of emergency orthopedic consultations. The optimal surgical approach for unstable fractures remains debated. External fixation (EF) and volar locking compression plate (VLCP) fixation are widely employed techniques, each with specific biomechanical and clinical advantages. This study aims to compare the short-term functional and radiological outcomes of two common surgical treatments – EF and VLCP fixation – for unstable distal radius fractures. Despite their high prevalence and multiple treatment options, debate continues about the best approach, especially regarding anatomical restoration, early mobilization, complication rates, and overall functional recovery. The goal is to offer evidence-based guidance to orthopedic surgeons in choosing the most effective treatment for adult patients with these fractures.

Materials and Methods: This prospective observational study took place at a tertiary care center in eastern India from September 2018 to April 2020. It included 30 patients aged 10–60 years with distal radius fractures (Fernandez type I–III, AO type B/C). Patients were assigned to two groups: One received EF, the other VLCP. Outcomes assessed included radiological parameters, union rates, complications, and functional scores using the Gartland and Werley system.

Results: Both groups achieved successful union. The VLCP group showed significantly better anatomical alignment and quicker return to function, while the EF group experienced more minor issues like pin site infections. Functional results favored the VLCP group, with more patients achieving excellent and good scores.

Conclusion: VLCP fixation provides improved anatomical reduction, allows earlier mobilization, and results in better short-term functional outcomes compared to EF for unstable distal radius fractures.

Key words: AO classification, Distal radius fracture, External fixation, Functional outcome, Volar locking plate

INTRODUCTION

Distal radius fractures are among the most frequently encountered orthopedic injuries, constituting nearly 14% of all extremity fractures and around 17% of fracture cases presenting to emergency departments.[1] These injuries are especially prevalent in the elderly due to osteoporotic bone and in younger individuals as a result of high-energy trauma. Given demographic shifts, such as increased life expectancy and a more active aging population, the incidence of such fractures is expected to rise further.[2]

Over time, the approach to managing distal radius fractures has seen a notable evolution – from early conservative treatments, such as closed reduction and casting to the

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development of surgical techniques, such as external fixation (EF) and volar plate osteosynthesis. The earliest descriptions of distal radius fractures date back to the 18th and 19th centuries, notably by Fernandez, highlighting the long-standing clinical attention this injury has received.[3]

Despite advancements in surgical instrumentation and imaging, the optimal method for managing unstable distal radius fractures remains a subject of ongoing debate. Fractures in this region can vary significantly, from simple extra-articular breaks to complex intra-articular patterns, demanding individualized treatment strategies. The primary therapeutic goals remain the same: Restore anatomical alignment, ensure stable fixation, and facilitate early mobilization to enhance functional recovery.[4]

Two common operative techniques used in the management of unstable distal radius fractures are EF and volar locking compression plate (VLCP) fixation. EF is minimally invasive and utilizes ligamentotaxis to maintain reduction, whereas VLCP enables direct anatomical realignment and early range of motion through rigid internal stabilization.[5] Each technique presents distinct advantages and limitations regarding fracture healing, radiographic outcomes, complication risks, and recovery timelines.

This study aims to compare the short-term outcomes of EF and VLCP fixation in the treatment of distal radius fractures. By analyzing both functional and radiological results, the objective is to generate clinical insights that support evidence-based decision-making in the operative management of these fractures.

MATERIALS AND METHODS

Study Design and Setting

A prospective observational study was conducted in the Department of Orthopaedics at IPGMER and SSKM Hospital, Kolkata – an advanced tertiary care institution in Eastern India. The study duration spanned from September 2018 to April 2020.

Study Population

Thirty patients diagnosed with distal radius fractures were enrolled, all aged between 10 and 60 years. The classification of fractures was carried out using the Fernandez (types I–III) and AO/OTA (types B and C) systems.

Inclusion Criteria

- Age between 10 and 60 years
- Closed fractures <3 weeks old
- Fractures classified as Fernandez types I, II, and III
- AO types B and C.

Exclusion Criteria

- Open fractures
- Fernandez types IV and V
- AO type A fractures
- Polytrauma or life-threatening injuries
- Fractures older than 3 weeks
- Patients under 10 or over 60 years of age.

Sampling and Group Allocation

A non-randomized consecutive sampling method was used. Patients were categorized into two treatment groups:

- Group A: Treated with EF
- Group B: Treated with VLCP fixation.

Preoperative Assessment

All participants underwent a complete clinical evaluation and relevant laboratory investigations. Standard radiographs (anteroposterior, lateral, and oblique views) were obtained to assess fracture type. Surgical clearance was taken after medical evaluation, and informed consent was secured from all patients.

Surgical Techniques

EF

Performed under general or regional anesthesia. Schanz pins were inserted into the distal radius and second metacarpal. Reduction was achieved under fluoroscopy, and a uniplanar fixator was applied.

Volar locking plate fixation

An open reduction was carried out through a volar approach. The fracture was temporarily stabilized with K-wires and definitively fixed using a contoured locking plate system under fluoroscopic guidance.

Post-operative Protocol

All patients received intravenous antibiotics for 48 h post-operatively. Active finger movements were initiated early. Sutures were removed between 12 and 14 days. Follow-up radiographs were obtained at 6 and 12 weeks post-operatively.

Outcome Measures

- Radiographic parameters: Radial inclination, volar tilt, and radial height
- Functional assessment: Gartland and Werley scoring system
- Complications: Infection, joint stiffness, implant-related issues.

Statistical Analysis

Data were compiled in Microsoft Excel and analyzed using SPSS software. Continuous data were evaluated using independent t-tests, while categorical variables were compared using the Chi-square or Fisher's exact test. A *P*-value of <0.05 was considered statistically significant.

RESULTS

A total of 30 patients were included in this study, with 15 patients in each group [Table 1]. All fractures united clinically and radiologically within 12 weeks. All patients were followed up for 12 months. Out of 30 cases, 19 were males while 11 were Females. Amongst them, 7 males and 8 females were in EF Group while 12 males and 3 females were in the volar locking plating (VLP) group [Figure 1].

Table 2 summarizes the number of fractures in each group of the AO/OTA fracture classification of the distal radius. In the EF group, C3 fractures were most common, followed by C2 and C1 types. In the VLP group, C1 and C2 were most common, followed by B3 and C3 types.

Radiological assessment showed a statistically significant improvement in volar tilt and radial height in the VLCP group [Table 3]. Radial inclination was also better maintained in the VLCP group, though not statistically significant.

Table 1: Distribution of mean age in two groups

Age	Group 1 (external fixation)	Group 2 (volar locking plating)	*P*-value
Mean±standard deviation	40.4±9.02	36.2±9.28	**0.219**
Median	44	36	
Range (minimum, maximum)	29 (23, 52)	30 (22, 52)	
Inter quartile range	13 (35, 48)	16 (28, 44)	

Note: *P*-value calculated using independent sample t-test; *p* value indicate intergroup comparison for statistical significance ($p < 0.05$ considered significant). The result here shows no statistically significant difference in mean age between the two groups

Table 2: Distribution of type of fracture as per AO/OTA Classification in between two groups

Surgical procedure	AO/OTA type				Total
	23-B3	23-C1	23-C2	23-C3	
External fixation	0	3	5	7	15
Volar locking plating	4	5	5	1	15
Total	4	8	10	8	30

Table 3: Radiological parameter at 12 months

Parameter	External fixation (Mean±SD)	Volar locking compression plate (Mean±SD)	*P*-value
Radial inclination (°)	17.6±3.1	19.2±2.9	0.082
Volar tilt (°)	4.8±2.6	8.9±2.1	0.003
Radial height (mm)	9.6±2.4	11.5±2.2	0.011

SD: Standard deviation

Functional Outcome (Gartland and Werley Score)

At 12 months, patients treated with VLCP fixation had a significantly better functional outcome as shown in Table 4.

Complications

Figure 2 shows that there were 2 cases of pin track infection and 1 case of wrist stiffness in the EF group, while 1 case of wound infection and 1 case of wrist stiffness in the VLP group. Overall, the EF group had more complications than the VLP group.

DISCUSSION

The present study aimed to compare short-term outcomes of two widely adopted surgical methods – EF and VLCP – in the management of distal radius fractures. Our findings demonstrated that patients treated with VLCP fixation achieved significantly better radiological alignment and functional scores at 12 months, with lower complication rates compared to those managed with EF.

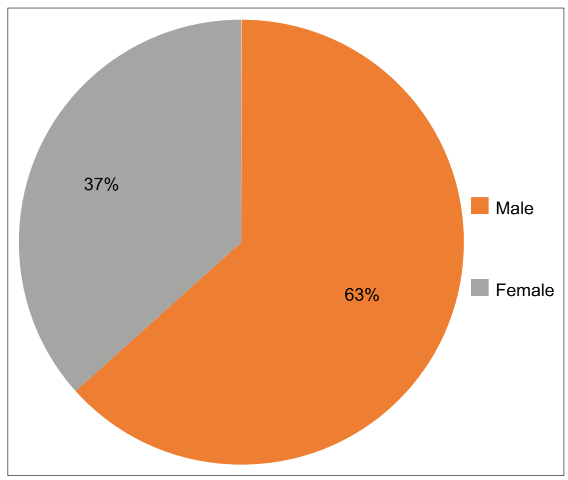

Figure 1: Pie chart showing gender distribution in study subjects

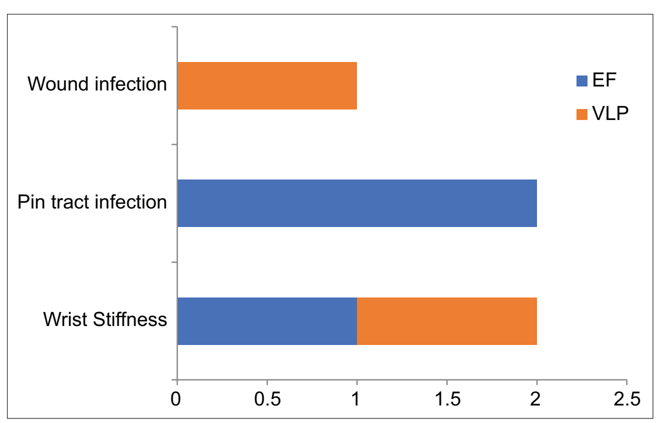

Figure 2: Bar graph showing complications in both groups

Table 4: Gartland and Werley score at 12 months

Outcome grade	External fixation (*n*=15)	Volar locking compression plate (*n*=15)	*P*-Value
Excellent (0–2)	3	7	0.044
Good (3–8)	7	6	
Fair (9–20)	5	2	
Poor (>20)	0	0	

The significant improvement in volar tilt ($P = 0.003$) and radial height ($P = 0.011$) in the VLCP group highlights the superior anatomical restoration achieved with rigid internal fixation. These findings align with previous studies by Orbay who emphasized the biomechanical advantage of VLCP in maintaining volar support and preventing collapse of the distal fragment.[6] Our study also corroborates the work of Jupiter and Ring, who noted favorable early outcomes with internal fixation in comminuted fractures.[7]

Functionally, the VLCP group exhibited a greater proportion of excellent outcomes according to the Gartland and Werley scoring system, consistent with the reports by Catalano *et al.*, who observed better wrist mobility and grip strength in internally fixed fractures.[8] The incidence of complications, such as pin tract infections and joint stiffness was higher in the EF group, echoing the concerns noted in literature regarding external fixators' soft tissue morbidity and prolonged immobilization.[9]

One of the strengths of this study is its prospective design and standardized follow-up protocol, which ensured consistent assessment of radiological and functional parameters. Furthermore, both surgical procedures were performed at a high-volume tertiary care center with adherence to standard protocols, reducing variability in technique.

However, the study is not without limitations. The sample size was relatively small ($n = 30$), which limits the statistical power and generalizability of the results. The follow-up duration was confined to the short-term period (12 months), and longer-term data would be essential to evaluate the persistence of functional benefits and the onset of complications, such as post-traumatic arthritis. Selection bias may also exist as patients were not randomized, and allocation was based on surgeon discretion.

The clinical implications of our findings suggest that VLCP should be the preferred modality for managing unstable distal radius fractures, particularly when early functional recovery is prioritized. Nonetheless, EF remains a viable alternative in select cases, such as open fractures, polytrauma, or when soft tissue conditions preclude open surgery.

Future multicenter randomized trials with larger sample sizes and extended follow-up are needed to confirm these results and establish long-term guidelines for treatment selection in distal radius fractures.

CONCLUSION

This prospective observational study compared short-term radiological and functional outcomes of EF and VLCP fixation in the treatment of distal radius fractures. Based on the data collected, it is evident that VLCP provides superior anatomical restoration, particularly in terms of volar tilt and radial height, as well as better early functional recovery when assessed using the Gartland and Werley scoring system. These outcomes were statistically significant and clinically relevant, supporting the use of VLCP as a preferred surgical method in suitable patients.

While EF remains a viable option – particularly in patients with soft tissue compromise or complex trauma – it's relatively higher complication rates, such as pin tract infections and joint stiffness, underscore its limitations in routine use for isolated distal radius fractures.

The findings of this study fulfill the stated objective of comparing EF and VLCP in terms of measurable radiological and functional parameters. However, the conclusions are limited by the small sample size, short follow-up period, and non-randomized allocation. Further large-scale randomized controlled trials with extended follow-up are necessary to confirm the durability of these short-term benefits and inform long-term treatment protocols.

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