

To compare the functional and radiological outcome between external fixation and volar plating for the treatment of intraarticular distal end radius fractures



Atul Kumar Saroj¹, Ashutosh Verma², Mohd. Baqar Abbas³, Upendra Kumar Patel⁴, Virendra Kumar⁵

^{1,2}Senior Resident, ^{4,5}Junior Resident, Department of Orthopaedics, K. G. Medical University, Lucknow, ³Assistant Professor, Department of Orthopaedics, J. N. Medical College, Aligarh, Uttar Pradesh, India

Submission: 03-02-2023

Revision: 03-06-2023

Publication: 01-07-2023

ABSTRACT

Background: Fracture of distal radius may be stable that is extra-articular, non-comminuted without distal radio ulnar joint disruption or unstable that is intra-articular, comminuted displaced with distal radio ulnar joint disruption. Complications of unstable fractures are shortening due to bone loss or due to resorption of the cancellous bone from metaphysis, resistant deformity, residual pain, late collapse, radio carpal arthritis and gross functional impairment. **Aims and Objective:** The purpose of this study to compare the relative efficacy of external fixation versus plating with regard to functional and radiological outcome. **Materials and Methods:** Total of 60 patients having intraarticular distal end radius fracture were included in this study and was equally divided into two groups, one group treated by external fixator other group with volar locking compression plate with or without augmentation by k-wire. Follow-up was done after 2 weeks, 4 weeks, 6 weeks and 3, 6 and 12 months. The radiological evaluation was performed with Sarmiento's Modification of Lindstrom's Criteria. With the Modified Mayo Wrist Score, the patient's functional outcomes were assessed and both groups were compared. **Results:** In this study we found that volar plate group had good to excellent outcome in 73% cases and 07% with fair outcome however with external fixator group found good to excellent in 50% cases and poor in 17% cases. **Conclusion:** In our study, we showed that the use of an external fixator and a volar locking plate for the treatment of intraarticular distal radial fractures were reliable. The relative simplicity of use, low surgical exposure, and decreased surgical trauma are benefits of external fixation. Despite these volar locking plates augmented with or without k wire had a good to excellent results in terms of early rehabilitation and less complications related to wrist joint. External fixator with ligamentotaxis provide significant good results in comminuted intraarticular distal end radius fracture.

Key words: Distal End Radius, External Fixator, Fracture Volar Locking Compression Plate

INTRODUCTION

Fracture distal end radius (DER) is one of the common fractures encountered in orthopedic departments and accounts for almost 20% of all fractures treated in emergencies.¹ Apart from the high incidence, most of the DER fractures especially extraarticular are treated non-surgically by closed reduction and pop cast application. It has a bimodal age distribution in children

and the elderly,² However, in patients with unstable fracture patterns, conservative therapy fails to maintain reduction, emphasizing the need for further fixation.³⁻⁵ Unstable fracture of the DER mostly results due to high energy trauma, with inadequate fixation may results in complications such as loss of reduction, irritation of a tendon, nerve injury, malunion, pain syndrome, and post-traumatic arthritis When treating distal radius fractures with conservative treatments, it is necessary to pay close

Access this article online

Website:

<http://nepjol.info/index.php/AJMS>

DOI: 10.3126/ajms.v14i7.52056

E-ISSN: 2091-0576

P-ISSN: 2467-9100

Copyright (c) 2023 Asian Journal of Medical Sciences



This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

Address for Correspondence:

Dr. Atul Kumar Saroj, Senior Resident, Department of Orthopaedics, K. G. Medical University, Lucknow, Uttar Pradesh, India.

Mobile: +91-844510485. **E-mail:** atul.saroj19@gmail.com

attention to reduction and post-reduction complications, frequent follow-up is necessary, and shift to surgical treatment when necessary.⁶

The main requirement for a successful recovery is the preservation of articular congruity. In young patients with intra-articular comminuted displaced distal radius fractures, external fixation is often regarded as superior to plaster immobilization. For unstable intra-articular fractures to be successfully treated with external fixation, careful evaluation of the fracture pattern, careful patient selection, meticulous surgical technique, appropriate selection of fixation devices, judicious use of internal fixation and bone grafting, careful post-operative monitoring, and aggressive early rehabilitation are required.⁷ Open reduction internal fixation of fracture DER with locking compression plate by volar approach can give significant good results. The main advantage is maintaining the articular surface of the wrist joint which results in early rehabilitation.

Therefore, the objective of this prospective study was to assess the radiological, clinical, and functional results of two groups of patients treated for displaced distal radius fractures with either bridging external fixation or volar locked plating.

Aims and objectives

To assess the radiological, clinical, and functional results of two groups of patients treated for displaced distal radius fractures with either bridging external fixation or volar locked plating.

MATERIALS AND METHODS

This is a prospective study comprises of two groups each having 30 patients of both sex ranges between the age group of 20–70 years presented with unstable intraarticular fracture DER in our institute after due clearance from the institutional ethics committee.

Patients were admitted underwent evaluations that included a detail history. Comprehensive clinical examination and necessary investigations. After that these were classified as per the Arbeitsgemeinschaft für Osteosynthesefragen/ Association of the Study of Internal Fixation (AO) classification system. Further patients were selected on the basis of inclusion criteria having Age group 20–70 years, Intraarticular fractures distal radius AO type B and C, <3 weeks duration, unilateral and patients fit for surgery and anesthesia. Exclusion criteria includes patients <20 and >70 years, bilateral injury, more than 3 weeks duration, patients with comorbidities not fit for surgery and anesthesia, patient not giving consent and patient with pathological fractures.

Patient group of open reduction internal fixation was done using Modified Henry Approach with or without supplemented radio-ulnar k wire fixation if needed (Figures 1 and 2).

Patients group for external fixator was reduced close under C-arm guidance, after satisfactory reduction external fixator applied supplemented with or without k wire if needed (Figures 3 and 4).

All of the participating cases underwent follow-up examinations every 2 weeks, 4 weeks, 6 weeks and 3, 6, and 12 months. The radiological evaluation was performed with Sarmiento's Modification of Lindstrom's Criteria (Table 1).

Once every 4 weeks, radiographs were evaluated to check for fracture union and evaluate fracture alignment. Bony union was determined clinically by pain-free normal activities and radiologically by bridging trabeculae across



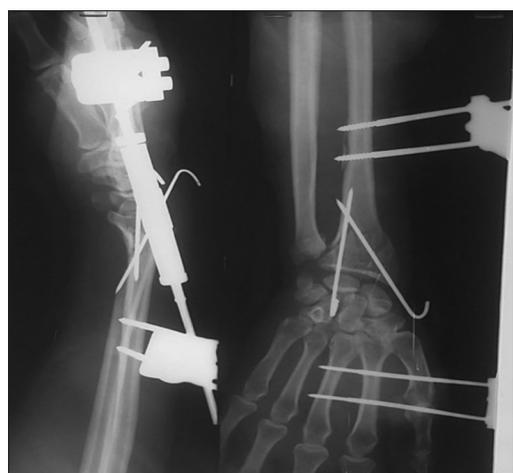
Figure 1: Pre-operative X-ray of fracture distal end radius



Figure 2: Post-operative X-ray of volar plate done by modified Henry approach

Table 1: Sarmiento's modification of Lindstrom's criteria

Outcomes	Residual deformity	Loss of palmer tilt (°)	Radial shortening (mm)	Loss of radial deviation (°)
Excellent	Insignificant	0	<3	5
Good	Slight	1–10	3–6	5–9
Fair	Moderate	11–14	7–11	10–14
Poor	Severe	At least 15	At least 12	>14

**Figure 3:** Pre-operative X-ray showing fracture distal end radius in both AP and lateral view**Figure 4:** Post-operative X-ray showing fracture fixation by application k-wire and wrist distractor

the fracture site and disappearance of the fracture line in both the anteroposterior and lateral views.

With the Modified Mayo Wrist Score, the patients' functional outcomes were assessed. Scores vary from 0 to 100, with 100 indicating better wrist functioning and 0 indicating worse wrist functioning.

RESULTS

This study consists of 60 interarticular fractures of the distal end of the radius in 60 cases. In 30 cases, external

fixator was applied and in another 30 cases, volar plating was done. The fracture was found more common in the 5th and 6th decades. Patients from age 20 years to 70 years were included in this study and the mean age was 45 years. The average was 45 years. Out of 60 cases, 36 cases (60%) were female and 26 cases (40%) were male. This shows female predominance due to fragile bone common in post-menopausal osteoporotic individuals. The right side was involved in 32 cases (53.3%) with predominance and the left side, it involved in 28 (46.7%) out of 60 case studies. In this study, road traffic accidents were the predominant mode of injury. Neurovascular status was intact in all the patients under study.

This indicates that the functional results of fixing distal radius intra-articular fractures with volar plating and an external fixator differ significantly. Therefore, the null hypothesis is rejected by the above P-value of 0.05, which also shows that volar plate fixation produces better results than external fixation in terms of radiological and functional outcomes.

DISCUSSION

Fractures of the DER are one of the most frequent fractures that occur as a result of RTA and trivial trauma in elderly osteoporotic individuals. In our study, 60% of patients were injured due to road traffic accidents, and falling on the ground was the second most common cause. In our study, 60% of patients were of female gender and 40% were male. The mean age of injury was 45 years, Yu et al., in their comparative retrospective study had an average mean age of 52 years.⁸ In a study by Ludvigsen et al., the mean age of patients was 56 years. The right upper limb was predominantly (53.3%) involved in our study.⁹ Yu et al., and Ludvigsen et al., had also more involvement of the right upper limb this could be due to When someone falls on their right side or uses their right hand, there is a considerably higher propensity for protection and an early defense mechanism.^{8,9}

We have included Type B and C types of fracture DER and graded them based on their severity. Out of 60 fractures, 24 fractures (40%) were of AO type C, that is, complete intraarticular. All of our patients received the fixed angled volar locking plate, which has the most screws in the

External fixator group in intraarticular fractures					
Result	Deformity	Palmar tilt	Radial Shortening	Radial inclination	Mean (%)
Excellent	9	8	12	5	8 (26.67)
Good	9	7	7	12	9 (30)
Fair	8	10	7	10	9 (30)
Poor	4	5	4	3	4 (13.33)

Volar plating group in intraarticular fractures					
Result	Deformity	Palmar tilt	Radial shortening	Radial inclination	Mean (%)
Excellent	14	9	8	16	12 (40)
Good	9	13	12	10	11 (37)
Fair	4	5	9	4	5 (17)
Poor	3	3	1	0	2 (6)

Functional score for intra-articular fractures				
Outcomes	EXF		VLP	
	No.	%	No.	%
Excellent	7	23.00	13	43.00
Good	8	27.00	9	30.00
Fair	10	33.00	6	20.00
Poor	5	17.00	2	7.00
Total	30	100.00	30	100.00

metaphyseal region in the preferred direction of anchorage. Locking screws were found to be placed in the metaphyseal bone as close as 5 mm to the distal subchondral bone without damaging its articular surface, according to recent biomechanical and clinical investigations conducted to understand the fixation of the distal radius.¹⁰ Now, it is clear that the reefing approach involved adding extra screws to the distal metaphyseal. After an acute injury, it becomes very difficult to assess the radioulnar disruption in the casualty room by performing piano key sign.

The use of the reefing technique, which places the plate farther distally in the volar aspect so that screws in the distal metaphyseal fragment will adequately buttress the fragments and prevent the collapse of the articular comminution, resulted from improved biomechanical understandings of the ligaments of the wrist. The introduction of variable angle locking screws that have a pitch of 15–20 degrees in all directions and lock with the plate is the most recent idea among the numerous types of research on distal radius fixation. Low-energy fractures in the elderly are associated with favorable functional outcomes, although there are many complicating variables. The mean range of radiological evaluation of different studies was comparable with our study, as shown in the table. The distal radius articular surface's anatomical reduction and attaining good distal radio-ulnar congruity with early mobilisation for early rehabilitation are the main components of the treatment. Our study's 23% external fixator and 43% volar LCP rates were outstanding according to the Mayo wrist score, and they were comparable to other studies as shown in the table.

There were some complications in our study which was comparable with the other studies. Four patient had a superficial infection and one patient had a deep infection in the volar locking compression plating (VLCP) group, superficial infection was successfully treated by antibiotics while the deep infection needs wound wash and improved after that. Five patients need augmentation of distal fragment by k wire during plating and above the elbow, the pop slab was applied in them for 3 weeks. Among the patients of external fixator, eight patients had wrist stiffness, five patients had pin site infection, and six patients had malunion. Patients of subgroup VLCP were comparable with the studies like Yu et al., and Sharma et al., majority of patients had good to excellent functional scores and satisfactory movements.^{8,10} Early mobilization is made possible by primary internal fixation of the distal radius fastened with variable angle screws of the volar locking plate. This enables an earlier return to activities with a full range of motion, particularly rotation.

Limitations of the study

The limitations of our study were the small sample size and short-term follow-up. However, the results could have been more promising if a large sample and long-term follow-up were done.

CONCLUSION

From this study, we conclude that the fracture of intraarticular DER treatment with variable angle volar plate with or without augmentation by a k wire provides better functional outcome and prevents the complications that happened due to prolonged immobilization and benefits in the form of early return of normal life, early range of motion, better tolerable than a messy external fixator, and no chances of pin site related problems. The radiological outcome of volar locking compression plates is also good. Despite many disadvantages, an external fixator seems to be good for the comminuted intraarticular fracture and needs early ligamentotaxis with primary fixation.

ACKNOWLEDGMENT

The authors would like thanks to teachers, junior colleagues and staffs of the department of Orthopaedic Surgery, King George Medical University, Lucknow, Uttar Pradehs.

REFERENCES

1. Pogue DJ, Vegas SF, Patterson RM, Peterson PD, Jenkins DK, Sweo TD, et al. Effects of distal radius fracture malunion on wrist joint mechanics. *J Hand Surg Am.* 1990;15(5):721-727. [https://doi.org/10.1016/0363-5023\(90\)90143-f](https://doi.org/10.1016/0363-5023(90)90143-f)
2. Vasenius J. Operative treatment of distal radius fractures. *Scand J Surg.* 2008;97(4):290-296; discussion 296-297. <https://doi.org/10.1177/145749690809700403>
3. Chung KC, Shauver MJ and Birkmeyer JD. Trends in the United States in the treatment of distal radial fractures in the elderly. *J Bone Joint Surg Am.* 2009;91(8):1868-1873. <https://doi.org/10.2106/JBJS.H.01297>
4. Mackenney PJ, McQueen MM and Elton R. Prediction of instability in distal radial fractures. *J Bone Joint Surg Am.* 2006;88(9):1944-1951. <https://doi.org/10.2106/JBJS.D.02520>
5. Orbay JL and Fernandez DL. Volar fixed-angle plate fixation for unstable distal radius fractures in the elderly patient. *J Hand Surg.* 2004;29(1):96-102. <https://doi.org/10.1016/j.jhssa.2003.09.015>
6. Seigerman D, Lutsky K, Fletcher D, Katt B, Kwok M, Mazur D, et al. Complications in the management of distal radius fractures: How do we avoid them? *Curr Rev Musculoskelet Med.* 2019;12(2):204-212. <https://doi.org/10.1007/s12178-019-09544-8>
7. Kapoor H, Agarwal A and Dhaon BK. Displaced intra-articular fractures of distal radius: A comparative evaluation of results following closed reduction, external fixation and open reduction with internal fixation. *Injury.* 2000;31(2):75-79. [https://doi.org/10.1016/s0020-1383\(99\)00207-7](https://doi.org/10.1016/s0020-1383(99)00207-7)
8. Yu X, Yu Y, Shao X, Bai Y and Zhou T. Volar locking plate versus external fixation with optional additional K-wire for treatment of AO type C2/C3 fractures: A retrospective comparative study. *J Orthop Surg Res.* 2019;14(1):271. <https://doi.org/10.1186/s13018-019-1309-4>
9. Ludvigsen T, Matre K, Gudmundsdottir RS, Krukhaug Y, Dybvik EH and Fevang JM. Surgical treatment of distal radial fractures with external fixation versus volar locking plate: A multicenter randomized controlled trial. *J Bone Joint Surg Am.* 2021;103(5):405-414. <https://doi.org/10.2106/JBJS.20.00275>
10. Meena S, Sharma P, Sambharia AK and Dawar A. Fractures of distal radius: An overview. *J Family Med Prim Care.* 2014;3(4):325-332. <https://doi.org/10.4103/2249-4863.148101>

Author's Contribution:

AKS- Prepared first draft of manuscript, data collection, data analysis, manuscript preparation and submission of article; **AV**- Concept, design, manuscript preparation, editing, and manuscript revision; **MBA**- Design of study, statistical analysis and interpretation of results; **UKP**- Editing and manuscript revision; **VK**- Review manuscript.

Work Attributed to:

King George Medical University, Lucknow, Uttar Pradesh, India.

Orcid ID:

Atul Kumar Saroj - <https://orcid.org/0000-0002-4401-9788>
Ashutosh Verma - <https://orcid.org/0000-0001-7816-9584>
Mohd. Baqar Abbas - <https://orcid.org/0000-0003-2673-2763>
Upendra Kumar Patel - <https://orcid.org/0009-0008-4597-1026>
Virendra Kumar - <https://orcid.org/0009-0002-3962-4737>

Source of Support: Nil, **Conflicts of Interest:** None declared.