

## Original Research Article

# Comparison of clinic-radiological and functional outcome of intra articular distal end radius fractures managed by volar locking plate versus external fixation

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### ABSTRACT

**Background:** Distal end radius (DER) fractures are most common fractures in upper limb. Intra articular fractures can be managed either by open reduction and internal fixation by volar locking plate or can be managed by closed reduction and external fixator application or by percutaneous pinning. The purpose of our study was to compare the functional outcome of volar locking plate with that of external fixation.

**Methods:** A prospective cohort study was conducted between June 2019 to June 2020 in Government Medical College, Jammu on 46 patients with intra articular distal end radius fractures. Of which 26 were managed by volar locking plate and 20 were managed by external fixator. The results of both groups were compared on the basis of radiological parameter and range of motion achieved post operatively. The functional outcome was evaluated using DASH score and Gartland–Werley scale.

**Results:** Final range of motion, grip strength were better in patients managed with volar locking plate (VLP) as compared to those who were managed with external fixator (EF). Radiographically, volar tilt, radial height were all better in VLP group than EF.

**Conclusions:** We concluded that VLP is superior method to maintain reduction till the union occurs and prevents the fracture collapse in intra articular distal end radius fractures as compared with external fixator. Thus, giving better functional and radiological outcome than the external fixator.

**Keywords:** Intra articular DER fractures, ORIF with VLP, CR and external fixation, DASH score, Gartland–Werley scale

### INTRODUCTION

Distal radius fracture is the most common fracture of upper extremity with average incidence of 17.5% of fractures per year.<sup>1</sup> and has a bimodal distribution in children and the elderly.<sup>2</sup> Nonsurgical management remains main line of management; however, there are a variety of treatment options available for fractures too unstable for non-operative management.<sup>3-5</sup> These include external fixation, percutaneous pinning, and internal fixation. The primary

goal of treatment of these fractures is restoration of wrist function.<sup>6</sup> During the past 10 years, volar locking plate (VLP) has gained the most popularity in the treatment of distal radius fractures, due to its superior biomechanical property.<sup>7,8</sup> By contrast, external fixation (EF) is not so extensively used, but was preferred by a fair number of surgeons due to its easy application, improved reduction by ligamentotaxis, no need of secondary procedure, and the acceptable results. However, the higher complication rate should be a concern, including pintract infection, loss

of reduction, the radial sensory nerve injury, and complex regional pain syndrome.<sup>9-11</sup>

## METHODS

This study was performed in the Department of Orthopaedics, Government Medical College Jammu. All the patients satisfying inclusion criteria who were managed either by volar locking plate or by external fixator from June 2019 to June 2020 were included in the study. A written and informed consent was taken from all the patients for their inclusion in the study. Operative procedure as well as complications of the surgery and anaesthesia were explained well before hand to all the patients in detail in language well understood by them. The collected data of all the patients included in the study design was analyzed using EpiInfo Version 3.0 and Statistical package for social sciences (SPSS).

### Study design

This study was an observational prospective study.

### Inclusion criteria

Age more than 20 and less than 70 years. Radiological findings confirming intra articular fracture of distal end radius, Frykman and AO classification. Patients who are medically fit and willing for surgery. Intra-articular fractures extending less than 5 cm from joint line. Closed fractures.

### Exclusion criteria

Age less than 20 and more than 70 years. Undisplaced fracture. All open fractures. Neglected fractures more than 4 weeks. History of previous wrist pathology or malunited distal radius fracture.



**Figure 1: Pre (a) and post-operative (b) x-rays of distal end radius fracture managed by volar locking plate.**

A total of 49 patients were included for study out of which 3 were lost to follow up. Remaining 46 patients (n=46)

were followed up regularly and their data was analysed in detail.

After receiving patient in ER, Patient's limb was splinted and appropriate analgesia given. Following which appropriate radiographs (AP and lateral) of the involved limb were taken (Figure 1a). Computed tomographic (CT) scan was done in all cases to know the intra-articular extension of fracture line. All baseline blood investigation, electrocardiograph (ECG) and chest X-rays were done. The time to surgery was decided by the soft tissue condition and patient fitness. All patients received Injection Cefuroxime 1.5 g IV preoperatively as routine prophylaxis.

### Procedure

All procedures were performed under general or regional anaesthesia (supraclavicular or interscalene block). Patient was positioned supine on the radiolucent table with side arm-board. Image intensifier was positioned under the arm-board so as to visualise the distal radius, distal ulna and the articular surface in AP and lateral views.

### Volar locking plate (VLP)

The standard modified Henry's volar approach was undertaken to fix the fragments of the distal radius. In cases where the radial column fragment was initially approached, the plane between the radial artery and the flexor carpi radialis was used. For the intermediate column fragment under the lunate facet, plane between the flexor carpi radialis tendon and the median nerve was used. The distal and lateral borders of pronator quadratus were erased and retracted ulnarward. Locking compression plates with 2.4 mm were used. Bone grafting was not done in any of the cases in spite of the higher degree of comminution in high number of patients as all of them had good bone in the volar intermediate column. The reduction of distal radius was confirmed with the image intensifier during the fixation and ensured before closure of the surgical site. Drain was used in all of our Volar LCP internally fixed patients.

### External fixation

Closed reduction and external fixation was done for those with skin conditions not permitting for open reduction. In cases which had a displaced radial styloid or fragments too small for other means of fixation, was fixed with Kirschner wires augmented with external fixator.

Continuous slight traction was performed to achieve and maintain the reduction under fluoroscopic guidance. Then, the external fixator (Stryker Trauma Corporation, Swiss) was directly fixed on the radius and the second or third metacarpal bone, with 4-mm Schanz pins and 3-mm pins applied respectively. For fractures that were unsatisfactorily reduced or with the significant articular surface collapse or significant displacement of the larger

fragment, a small incision was made at the volar side of the distal radius and the periosteum elevator was introduced to elevate the collapsed fragments. After confirmation of the reduction under the fluoroscopic control, additional K wires were inserted for auxiliary fixation, if needed. All ulnar styloid fractures were not treated specially.



**Figure 2: Pre (a) and Post-operative (b) x-rays of distal end radius fracture managed with external fixator and K-wires.**

Postoperatively, early motion of the finger, elbow, and shoulder was started on the first postoperative day. At the 12th day, sutures were removed. At the 28th day, auxiliary K-wires were removed; active and passive wrist rehabilitation begun and gradually strengthened.

#### **Follow-up and postoperative evaluation**

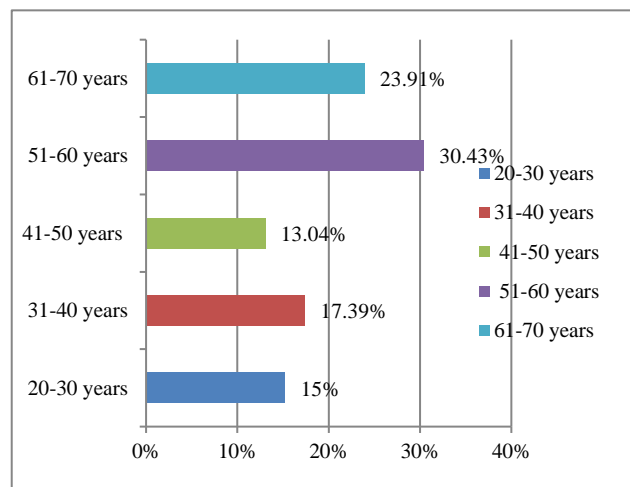
The minimum follow-up period was 12 months. The objective functional outcomes were wrist motion range and grip strength. A goniometer was used to measure the wrist flexion, extension, supination, and pronation; a Jamar dynamometer (Jamar, Preston, USA) was used to measure the grip strength. All of these measurements were assessed in comparison with the contralateral uninjured wrist, using percentage as the indicator. The patient-reported DASH score system<sup>12</sup> and the physician-based Gartland–Werley scale were used to indicate the overall functional outcome.<sup>13</sup> DASH questionnaire was used to evaluate patients' ability to perform the daily activities, with a score range from 0, representing no disability, to 100 points representing maximum disability (the higher the score, the more severe the disability). Gartland–Werley scale is a validated physician-based scoring system, which combines residual deformity, subjective findings, the ROM, the postoperative complications, and poor finger function. The scale ranges from 0 to 52 points, with a higher score representing poorer outcome.

Standard AP and lateral radiographs were used to measure volar tilt, radial inclination, radial length, ulnar variance, and articular step-off. The Jupiter criteria were used to judge the presence of arthritic changes on the final radiographs.<sup>14</sup> At each visit (post operative 2 weeks, 6

weeks, 3 months, 6 months, and 12 months), any potential complication was evaluated and documented, either from patients' self-reports or surgeons' check-up, including infection, plate/screw loosening, neuropathy or nerve injury, tendon-related issues, loss of reduction, chronic regional pain syndrome, malunion, non-union, re-fracture, and others.

## **RESULTS**

This study included 46 patients (n=46) with intra articular distal end radius fracture out of which 25 were male (54.34%) and 21 were female (45.65%). 26 patients (14 male and 12 female) were managed by VLP and 20 patients (11 male and 9 female) were managed by external fixator. Most common age group was 50- 60 years with mean age being 54 years. Age distribution of patients is depicted in Figure 3. Mode of injury was fall from standing height (23 patients), RTA (20 patients), and other causes like sports injury, industrial equipment injury, fall of heavy object accounting for remaining 3 patients. Right limb was involved in 24 patients while 22 patients had injury to their left limb with no case of bilateral limb injury. Out of 26 patients fixed with VLP 14 had injury to right limb and 12 had injury to left limb and in external fixator group 11 had injury to right side and 9 had injury to left side.



**Figure 3: Distribution of patients according to age.**

Mean duration of surgery in case of VLP was 74.6 minutes while it was 56.8 minutes in case of external fixator application. Mean time taken for clinical union was 7.6 weeks for VLP while it was 6.9 weeks for external fixator. Mean grip strength was 95 % for VLP and 92% for external fixator group when compared with the contralateral side non injured wrist. Range of motion at wrist for both groups at 6 weeks, 3 months, 6 months and 12 months is compared in table 1 and found to be better in patients managed by volar locking plate.

Mean Gartland werley score and mean DASH score was 3.8 and 12 respectively in patients managed with volar locking plate while it was 4.7 and 16 for patients managed

with external fixator. 5 patients managed by external fixator complaint of pin tract infection and required extended course of antibiotics, 2 patients had loss of reduction and required subsequent readjustment. 2 patients complaint of injury to sensory branch of radial nerve while 3 patient had wrist stiffness which resolved upon

physiotherapy. Among the patients managed with volar locking plate 4 patients complaint of wrist stiffness, while 2 patients had superficial infection for which 2 week course of culture specific antibiotics were given and infection resolved subsequently. 1 patient had hardware symptoms and 2 patients suffered from tendonitis.

**Table 1: Comparison of wrist range of motion between patients managed by volar locking plate and external fixator.**

Wrist movements	Pat. managed via VLP				Pat. managed by External fixator			
	At 6 wk	At 3 mnth	At 6 mnth	At 12 mnth	At 6 wk	At 3 mnth	At 6 mnth	At 12 mnth
Palmer flexion	69.9	72.2	76.4	78.4	60.1	64.4	67.9	70.9
Dorsiflexion	61.2	63.4	64.5	66.5	56.4	59.5	62.8	64.2
Pronation	71.5	73.1	75.1	76.8	65.7	67.1	68.4	70.9
Supination	74.3	75.2	76.1	79.5	66.4	67.5	69.4	71.1
Ulnar deviation	18.5	19.2	21.5	23.1	17.1	18.4	19.7	20.4
Radial deviation	19.4	20.2	20.7	21.1	17.5	18.1	19.4	19.9

**Table 2: Comparison of radiographic parameters between patients managed by volar locking plate and external fixator**

Radiographic parameter	Pat. managed via VLP			Pat. managed by External fixator		
	At 3 mnth	At 6 mnth	At 12 mnth	At 3 mnth	At 6 mnth	At 12 mnth
Volar tilt	11.3	11.8	12.4	10.4	10.9	11.3
Radial Inclination	22.9	23.1	23.3	21.4	21.7	21.9
Radial length	-1.34	-1.22	-1.12	-1.31	-1.27	-1.24
Ulnar variance	12.9	12.7	12.4	12.7	12.5	12.1

**Table 3: Comparison of Mean Gartland werley score and Mean DASH score between patients managed by volar locking plate and external fixator.**

Parameter	Pat. managed via VLP	Pat. managed by External fixator
Radial carpal articular step off	0.5±0.8	1.3 +/- 0.9
Mean Gartland werley score	3.8	4.7
Mean DASH score	12	16

## DISCUSSION

In this study, we compared the EF and VLP for treatment of intra articular distal radius fractures and found that VLP is superior in maintaining joint stability and articular congruence and improving joint mobility.

During the past decade, the use of VLP has gained popularity in the treatment of unstable distal radius fractures. Volar approach allowed good exposure of

fracture fragments for easy manipulation, which is useful in reducing the compressed or impacted fragments. The fixed-angle and locking screw/ hole in VLP allowed securing the small fragments and provides better support.

In our study right side (dominant) was involved in 24 out of the 46 study cases. The relatively more predisposition could be attributed to a more- protective and early defense mechanism when fall on the right side or using right hand.

Zamzuri et al in their short term study comparing external fixation versus internal fixation for closed unstable intra-articular fractures of distal radius reported that the anatomical results were better in the internal fixation group compared to the external fixation group. The radial height, volar tilt and radial inclination were well maintained. However, the functional results at six months and one year showed no differences between these two types of fixation. The complication rate was higher in external fixation group.<sup>15</sup>

Abramo et al in their study comparing ORIF with plating to closed reduction external fixator, found that internal fixation gives better results as compared to external fixator in terms of early mobilisation, better grip strength and better subjective evaluation.<sup>16</sup>

Schmelzer et al in their study comparing the effectiveness of locking and non-locking palmar plating and external fixation for unstable distal radius fractures in the elderly concluded that the locking palmar plate fixation method demonstrated significantly better radiological and functional results in comparison to external fixation and the non-locking palmar plating methods. The subjective assessment of plate fixation proved to be better than that of external fixation. Complications and reoperations were fewer for both plate fixation groups.<sup>17</sup>

In comparison of functional outcome, the range of movements are nearly same as in study of Jupiter et al.<sup>18</sup>

Limitations of study were small number of patients and duration of follow up. A larger group of patients with even longer follow up would be more conclusive.

## CONCLUSION

From the results achieved in our study we can conclude that the VLP is better as compared to external fixator in case of intra articular distal end radius fracture. The range of motion achieved is more in VLP as compared to external fixator. Also the incidence of wrist stiffness is more in external fixator group. However, external fixator also gives satisfactory results as seen from good DASH scores and can be considered in patients in whom VLP could not be done.

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