

## Original Research Article

# Results of open reduction and fixed angle locked volar plate fixation for fracture lower end of radius

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### ABSTRACT

**Background:** The fracture of lower end radius is the most common fracture of upper extremity encountered in practice. Intra-articular fractures of distal radius present a challenging task to the operating surgeon. Open reduction and internal fixation using volar fixed-angle plates has shown to be a valid treatment option for unstable, dorsally displaced distal radial fractures. The present study was undertaken to evaluate the functional outcome of unstable distal radius fractures treated with fixed angle volar locking plate.

**Methods:** The current study aimed at using fixed angle volar locking plate to treat unstable distal radius fractures. A total of 25 patients records were studied comprising of 19 males and 6 females with a mean of 44.5 years and followed up for a maximum of 1.5 year. Fractures were classified using the AO classification. The interpretation of functional outcome was done according to Mayo Wrist Score.

**Results:** At final functional assessment, according to the Mayo wrist score, the scores of 6 patients were excellent, 10 patients good, 8 patients satisfactory and 1 patient poor. No non-union was reported in any patients. 3 patients developed minor complications in the form of superficial infection, hypertrophic scar and reflex sympathetic dystrophy and 1 patient developed major complication in the form of deep infection.

**Conclusions:** Primary volar plate fixation of unstable distal radius fracture provides a stable construct that helps in early mobilization, better functional outcome and minimizes chances of complications and thereby is the treatment of choice for fracture distal end of radius.

**Keywords:** Distal radius fracture, Internal fixation, Fixed angle, Volar locking plate, Intra articular fracture

### INTRODUCTION

The fracture of lower end radius is the most common fracture of upper extremity encountered in practice and constitutes 17% of all the fractures and 75% of all forearm fractures. Most of them occur following low-energy trauma, such as falls from the individual's own height, and they have been correlated with losses of bone density (osteoporosis).<sup>1,2</sup> In young patients, on the other

hand, they are associated with high-energy trauma, such as in road traffic accidents, sports accidents and falls from a height.

Intra-articular fractures of the distal radius present a challenging task to the operating surgeon as compared with unstable extra-articular fractures.<sup>3</sup> Apart from being more difficult to reduce and stabilize with internal fixation, these injuries frequently result in malunion,

which may result in a less satisfactory long-term functional outcome, if not anatomically reduced.<sup>4,5</sup> In the past, these fractures were managed with external fixation or a combination of limited open reduction, Kirschner wire (K-wire) augmentation, and bone grafting.<sup>6</sup>

However, with the recent development of specifically designed locking implants for the distal radius, fragment-specific fixation has emerged as an option.<sup>7</sup> Open reduction and internal fixation using volar fixed-angle plates has also shown to be a valid treatment option for unstable, dorsally displaced distal radial fractures.<sup>8,9</sup>

Intra-articular and extra-articular malalignment can lead to various complications such as posttraumatic osteoarthritis, decreased grip strength and endurance, as well as limited motion, and carpal instability.<sup>10</sup>

Biomechanical studies have shown that fractures fixed using locked plates have greater stability than either dorsal or volar non-locked plates. Volar plates have the advantage of causing lower incidence of complications relating to the extensor tendons, compared with dorsal plates.<sup>11,12</sup>

Open reduction and internal fixation using an interlocking plate system is a valid treatment of displaced extra-articular and intra-articular distal radius fractures in adults.<sup>13-15</sup> The goals of treatment are to achieve anatomic fracture union, facilitate early range of motion, and avoid complications.

Recently, the volar locked plate osteosynthesis is considered as the "gold standard" in treatment of unstable distal radius fractures.

With conventional plates and screws, stability is achieved by compression of the plate to a bone by bicortical screws. With fixed angle locking plates, the locking screws support subchondral bone and resist axial forces. Compression of locking compression plate to bone is unnecessary and preserves periosteal blood supply.<sup>16</sup>

Based on this background the current study was undertaken with the objective to evaluate the functional and radiological results of treating intra-articular and extra-articular distal radius fractures with a volar locking plate.

## METHODS

This retrospective study was carried out at Integral Institute of Medical Sciences And Research, Lucknow from September 2013 till August 2016. A total of 25 patients records were analyzed in this study with fracture of lower end of radius.

Records of patients aged over 18 years (male and female) with unstable, comminuted or intra articular fractures of distal end radius were included in this study.

Records of patients aged below 18 years and compound fractures associated with vascular injuries were excluded from the study.

The fractures were classified using AO classification. On admission, all patients were investigated for skin condition, deformity, and any other associated injuries. X-rays, antero-posterior and lateral radiographs of the involved wrist was done along with ipsilateral elbow.

After getting surgical clearance, patients were posted for operation. The duration from the date of injury to date of operation ranged from 2-10 days (average 3.3 days). The operations were performed under brachial block in all the cases. All cases were treated with a volar locking compression plate using an extended flexor carpi radialis approach.

**Table 1: Mayo wrist score.**

	Points
<b>Section 1: pain intensity</b>	
No pain	25
Mild occasional	20
Moderate, tolerable	15
Severe to intolerable	0
<b>Section 2: functional status</b>	
Return to regular employment	25
Restricted employment	20
Able to work, but unemployed	15
Unable to work because of pain	0
<b>Section 3: range of motion (% of normal side)</b>	
100	25
75-99	15
50-74	10
25-49	5
0-24	0
<b>Section 4: grip strength (% of normal)</b>	
100	25
75-99	15
50-74	10
25-49	5
0-24	0

Patients were followed up at 6, 12 and 18 months and were evaluated using the Mayo wrist scoring system (Table 1) which takes into consideration the intensity of pain (maximum of 25 points), functional status (maximum of 25 points), percentage of range of motion of operated side as compared to normal side (maximum of 25 points), and percentage of grip strength of operated side as compared to normal side (maximum of 25 points), at the final follow up with the maximum total score being 100 points.

Patients with Mayo wrist score between 91-100 points were labelled as having excellent outcome, 81-90 points

as good outcome, 61-80 points as satisfactory outcome and less than 61 points as poor outcome.

The statistical analysis of the data was done using SPSS software version 17.0.

**RESULTS**

This retrospective study was carried out at Integral Institute of Medical Sciences and Research, Lucknow from September 2013 till August 2016. A total of 25 patients records were included in this study with fracture of lower end of radius.

The age of the patients varied from 31 to 70 years, with a mean age of 44.5 years. The majority patients (36%) were in the age group of 41-50 years.

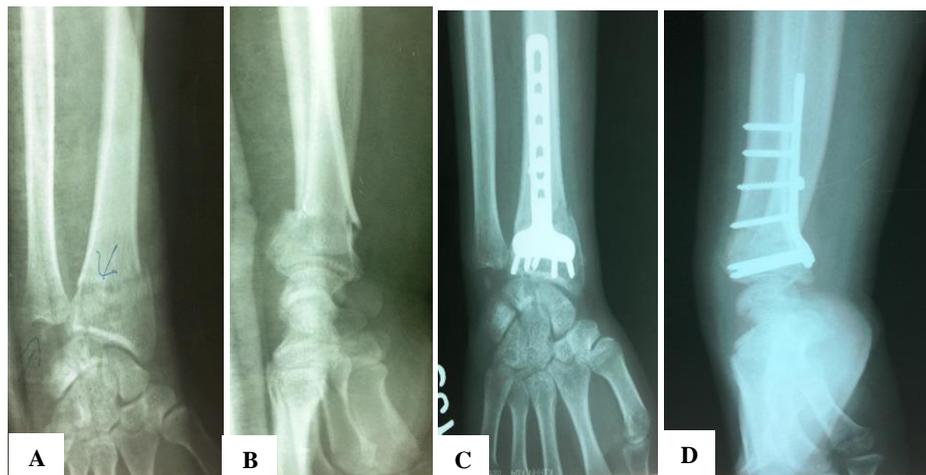
There was a male predominance in this study with male to female ratio of 3.16:1.

Right side of the extremity was more commonly involved than the left side. Right side was involved in 56% (n=14) and left side in 44% (n=11).

The most common mode of injury was road traffic accident in this study involving 17 patients (68%) while slip and fall on outstretched hand was documented in remaining 8 patients (32%).

According to AO classification of fracture of lower end of radius, the most common fracture type was 23A2 which was seen in 7 patients (28%) followed by type 23C1 in 6 patients (24%), type 23A3, 23B3 and 23C2 in 3 patients each (12%), type 23B2 in 2 patients (8%) and type 23C3 in 1 patient (4%). None of the patients had type 23A1 or type 23B1 fractures in this study. (Table 2)

At the final follow up, 7 patients with type 23A2 fracture had a mean Mayo wrist score of 93.5 and 6 out of these 7 patients had an excellent outcome while 1 patient had Good outcome. 6 patients with type 23C1 had a mean Mayo wrist score of 87.5 and all these 6 patients had a good outcome. 3 patients with type 23A3 fracture had a mean Mayo Wrist Score of 86.6 and all these 3 patients had a good outcome. 1 patient with type 23C3 fracture had Mayo wrist score of 55 and a poor outcome. 8 patients with remaining fracture types of 23B2, 23B3 and 23C2 had satisfactory outcome with mean Mayo wrist score being 69.3 (Table 2).



**Figure 1: (A, B) Preoperative X-ray; (C, D) postoperative X-ray.**

**Table 2: Results at final follow up.**

AO classification	No. of patients	Mean Mayo wrist score
23 A1	0	-
23A2	7	93.5 (95,95,95,95,95,85)
23A3	3	86.6 (85,85,90)
23B1	0	-
23B2	2	67.5 (65,70)
23B3	3	70 (65,70,75)
23C1	6	87.5 (90,90,90,85,85,85)
23C2	3	70 (65,70,75)
23C3	1	55 (55)



**Figure 2 (A-E): Range of motion of wrist joint at final follow up.**



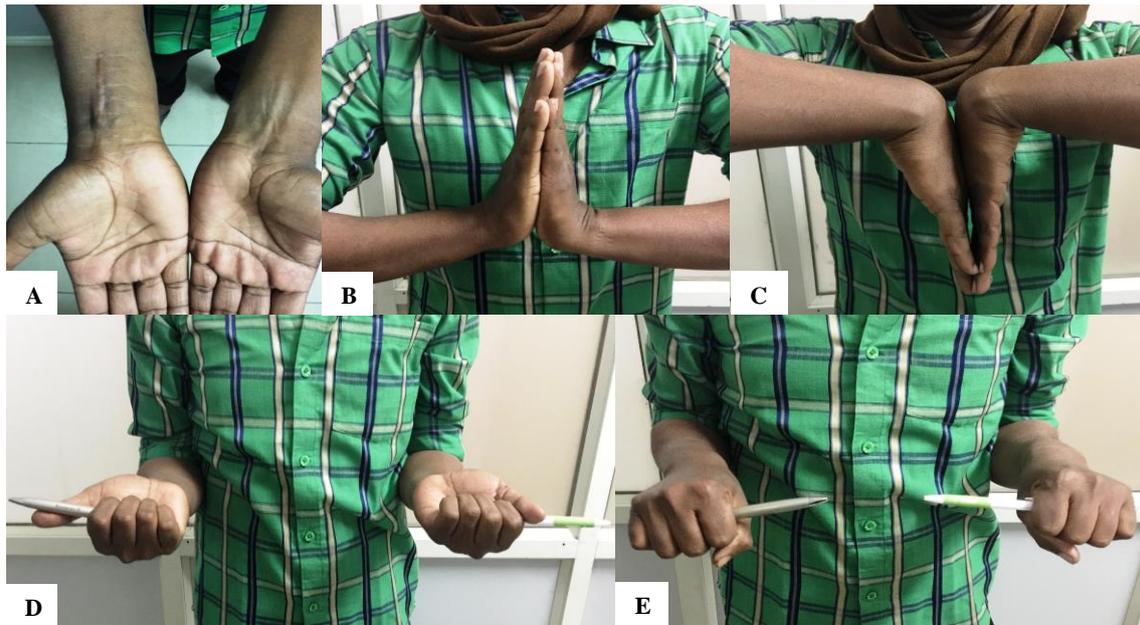
**Figure 3: (A, B) Preoperative X-ray; (C, D) postoperative X-ray.**

## DISCUSSION

The main objective of treatment of fracture lower end of radius is to re-establish the anatomic integrity and function. In unstable intra-articular fractures, re-establishment of intra-articular integrity of the wrist and maintaining the radial height are often not possible with closed methods. In such cases, where an open positioning

is required, various surgical methods and fixation materials can be used.

In our study, distal radial fractures were most common between 41-50 years with a mean of 44.5 years. The mean age in our study is comparable to studies done by Kilic et al, Chung et al and Anakwe et al where the mean age were 45 years, 48.9 years and 48 years respectively.<sup>17-19</sup>



**Figure 4 (A-E): Range of motion of wrist joint at final follow up.**

Our study had a male to female ratio of 3.16:1 which is comparable to study done by Kilic et al which had the male to female ratio of 1.25:1.<sup>17</sup>

Increased incidence in males is probably due to their involvement in outdoor activities, riding vehicles and heavy manual labour.

The right side was involved in 56% patients (n=14) in our study which is comparable to studies done by Chung et al and Arora et al where right side was involved in 57.5% and 61.4% cases respectively.<sup>18,20</sup>

In our study 68% of the patients had road traffic accident and 32% had a fall on the out stretched hand which is comparable with other studies done by Anakwe et al where 66.6% cases had road traffic accident as the mode of injury.<sup>19</sup>

Chung et al and Arora et al reported fall on the outstretched hand as the most common mode of injury.<sup>18,20</sup>

Based on AO classification, we had 7 (28%) 23A2 type fractures, 3 (12%) 23A3, 2 (8%) 23B2, 3 (12%) 23B3, 6 (24%) 23C1, 3 (12%) 23C2 and 1 (4%) 23C3 fractures which is comparable with other studies done by Arora et al where 34.2% cases are type 23A2, 26.3% cases are 23C2 type, 21% cases are 23C1 type and 14% cases are 23A3 type.<sup>20</sup>

Kilic et al reported maximum number of cases of 23C2 type of fractures.<sup>17</sup> Chung et al reported maximum number of cases of 23C1 and 23A3 type of fractures.<sup>18</sup> Anakwe et al reported maximum number of cases of 23C3 and 23C2 type of fractures.<sup>19</sup>

According to Mayo wrist scoring system our study at final functional outcome had 6 patients excellent, 10 patients good, 8 patients satisfactory and 1 patient poor results.

## CONCLUSION

The present study was undertaken to assess the functional outcome of operative management of distal radial fractures in adults by a volar locking compression plate and the following conclusions were drawn. Distal radial fractures are more common in the 4rd to 6th decades. Male preponderance is due to their involvement in heavy manual labour, outdoor activities and riding vehicles. Most of the fractures in the younger individuals is due to motor vehicle accidents or high energy trauma which are usually intra-articular and displaced. The fractures occurring in the older individuals are usually due to trivial fall on outstretched hand causing extra articular fracture in the osteoporotic bone. The mode of injury is either a road traffic accident or fall on the outstretched hand. Distal radial fractures which occur due to road traffic accidents (high energy trauma) are mostly intra-articular, displaced and AO type B2, B3, C1 and C3. Locked plates that are widely used provide successful results especially for the treatment of intraarticular unstable fractures of distal radius. This method, which is effective in anatomic realignment, allows early joint motion, owing to its fixation strength. Volar approach provides both access with minimal surgical trauma on distal radius and fixation with a better adaptation to surrounding tissues. In the subjects of our study, a successful anatomic alignment was acquired with volar approach, regardless of the direction of fracture angulation. Primary volar plate fixation of unstable distal radius fracture provides a stable construct that helps in

early mobilization, thereby better functional outcomes and minimizes chances of complications and thereby is the treatment of choice for fracture distal end of radius.

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