

Original article

Clinical Outcomes of Intra-Articular Distal Radius Fractures Treated with Volar Locking Plate Fixation

Zeyad Buahlaika 

Department of Orthopedics, Faculty of Medicine, Omar Al-Mukhtar University.

zeyad.buahlaika@omu.edu.ly

Abstract

Distal radius fractures are extremely common, accounting for one-sixth of all fractures seen in the emergency department. Intra-articular fractures present a greater challenge due to joint involvement. These fractures occur more commonly in women than in men, increase in frequency with advancing age, and result from low-energy falls more often than from high-energy trauma. The work aims to evaluate the predictors of clinical and radiological outcomes of intra-articular distal radius fractures treated by open reduction and internal fixation using a volar locking plate. A total of 20 patients were included in this study, conducted between August 2024 and August 2025 at the Orthopedic Department, Omar Al-Mukhtar University. Patients aged between 40 and 65 years with intra-articular distal radius fractures were managed surgically using a volar locking plate. The majority of patients demonstrated good to excellent functional outcomes, with significant improvement in Mayo scores over a one-year follow-up period. Range of motion and grip strength improved with early return to activities of daily living. The majority of injuries were caused by falls, while a smaller proportion resulted from road traffic accidents. Among the 20 patients included in the study, the left distal radius was more commonly affected (55%) compared to the right side (45%). The study population consisted of 13 females (65%) and 7 males (35%), with a mean age of 50.35 years. The average time to fracture healing was 2.4 months, with most fractures healing within two months. Patients were followed up for a period of 6-12 months. Fixation of the distal radius fractures with a volar locked plate is very important for a good functional outcome and restoring the anatomical function of the joint. Radiographic alignment (including articular congruity) is a key determinant of outcome. Early motion and stable fixation help regain function and minimize stiffness.

Keywords. Distal Radius, Intra-Articular Fracture, Volar Locking Plate Fixation.

Introduction

Distal radius fractures are among the most frequent injuries encountered in the emergency department, representing approximately one-sixth of all fractures. These fractures are more prevalent in women than in men, and their incidence increases with age. They typically result from low-energy falls rather than high-energy trauma (1–3). Anatomically, the distal radius articular surface is inclined radially at 22°–23° in the frontal plane, while the joint surface slopes toward the palm between 4° and 22°, with an average palmar tilt of 10°–12° (4–7). Clinically, distal radius fractures are traditionally categorized as Colles, Smith, or Barton fractures. Since the 1960s, multiple classification systems have been proposed to better capture the diversity and complexity of distal radius fracture patterns (8–10). Among these, Jupiter and Fernandez developed a system that incorporates the mechanism of injury, offering practical utility in clinical decision-making (11). Standard evaluation of distal radius fractures involves plain radiography in anteroposterior (AP) and lateral views, with computed tomography (CT) or fluoroscopic imaging used as needed for detailed assessment. Tilting the lateral view 20°–25° from distal to proximal enhances visualization of the articular surface (12). Treatment options vary depending on fracture type and patient factors and include immobilization with above- or below-elbow casts, percutaneous pinning with casting, external fixation with or without pins, open reduction with plate fixation, and autologous bone grafting. Many fractures can be initially managed with closed reduction using ligamentotaxis, which relies on intact ligaments to restore anatomical alignment (13). The use of volar locking plates allows direct reduction of fracture fragments, provides stable fixation, and enables early postoperative mobilization, which facilitates faster recovery of wrist motion and a quicker return to daily activities and work (14–16). This study was conducted to evaluate the outcome of intra-articular distal radius fractures.

Patients and methods

A total of 20 patients were included in this study, all of whom were treated with open reduction and internal fixation of an intra-articular fracture of the distal radius using a volar locking plate. The study was conducted over a one-year period from August 2024 to August 2025, in the orthopaedic department at Omar Al-Mukhtar University. Most of the injuries were caused by falls, compared to a smaller proportion resulting from traffic accidents. The patients' ages ranged from 40 to 65 years. Informed consent was obtained from all participants in this prospective study.

Eligibility criteria

Patients aged 40 to 65 years presenting with intra-articular distal radius fractures were included in this study. All cases were managed with volar locking plate fixation as the primary treatment modality. To ensure

consistency and minimize confounding factors, specific exclusion criteria were applied. Patients with open fractures were excluded, as were those with associated neurovascular injuries. This selection allowed for a focused evaluation of outcomes in a relatively homogeneous patient population, highlighting the effectiveness of volar locking plate fixation in managing intra-articular distal radius fractures within the defined age group.

This selection allowed for a focused evaluation of outcomes in a relatively homogeneous patient population, highlighting the effectiveness of volar locking plate fixation in managing intra-articular distal radius fractures within the defined age group. All patients underwent open reduction and internal fixation of distal radius fractures using the modified Henry's volar approach. This technique involves working in the plane between the flexor carpi radialis (FCR) tendon and the radial artery, with the FCR tendon retracted ulnarly to expose the pronator quadratus, which covers the distal radius. Fractures were stabilized using a 3.5 mm volar locking compression plate. The volar locked compression plate may be applied to either the proximal or distal fragment first, depending on fracture characteristics and surgeon preference. Proximal-first fixation: Plate aligned with radial shaft; an initial screw placed through the oblong slot allows fine axial adjustments before distal screws. Distal-first fixation: Plate secured to the distal fragment first, then levered onto the shaft. The plate's anatomical contour corrects volar tilt. Once the plate is seated, sequential screws are inserted proximally and distally to achieve stable fixation. The construct restores radial alignment and tilt through the plate's design. Final plate positioning, screw length, and fracture reduction are confirmed intraoperatively using fluoroscopy. Surgery was performed 1–2 weeks after the injury, depending on the patient and soft tissue condition. Postoperatively, patients were instructed to perform gentle active finger movements with limb elevation for the first three days. Intravenous antibiotics were administered for three days, followed by oral antibiotics until suture removal. All participants were discharged on the second postoperative day.



Figure 2. Preoperative X-ray of a distal radius fracture

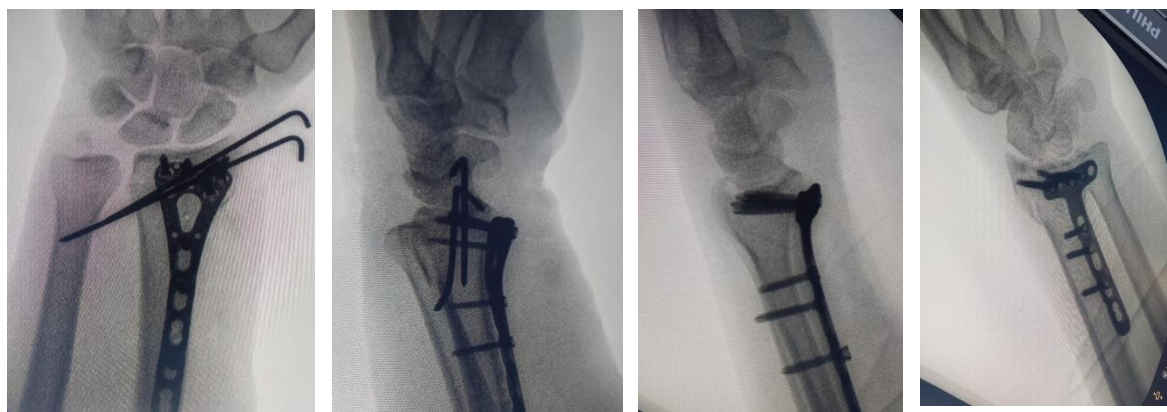


Figure 3 Anteroposterior (AP) and lateral radiographs showing fixation of the distal radius fracture using a 3.5 mm volar locking plate.

All patients were prospectively followed up with clinical and radiological evaluations over a period of 6 months to 1 year.

Results

Functional outcome scores showed good to excellent results in most patients. A total of 20 patients participated in this study, comprising 13 females (65%) and 7 males (35%). The mean age of the participants

was 50.35 years, with an age range of 40 to 65 years. Regarding occupational status, 70% of the patients were not employed (Table 1):

Table 1. Distribution of the studied cases according to Demographic data (n = 20)

Variables	No. (%)
Gender	
Male	7 (35.0%)
Female	13 (65.0%)
Age (years)	
Min. – Max.	40.0 – 65.0
Mean ± SD.	50.35 ± 10.55
Median (IQR)	54.50 (45.0 – 58.0)
Occupation	
Not worker	14 (70.0%)
Worker	6 (30.0%)

IQR: Interquartile range. SD: Standard deviation

The left side was more commonly affected, accounting for (55%) of cases, compared to (45%) on the right side. The most frequent mechanism of injury was a fall on an outstretched hand, responsible for 65% of fractures, while road traffic accidents accounted for (25%) of cases. Postoperative pain assessment revealed that the majority of patients experienced no pain, while a smaller proportion reported mild or moderate pain (Table 2).

Table 2. Distribution of the studied cases according to side, mechanism of injury, and pain (n = 20)

Variables	No. (%)
Side	
RT	9 (45.0%)
Lt	11 (55.0%)
Mechanism of injury	
Fall down	13 (65.0%)
Direct trauma	2 (10.0%)
RTA	5 (25.0%)
Pain	
No pain	14 (70.0%)
Mild	5 (25.0%)
Moderate	1 (5.0%)

The mean time required for fracture healing was 2.4 months, with most fractures healing within two months. The follow-up period for all patients ranged up to 5 months, allowing for assessment of clinical and radiological outcomes. Summary statistics in the format Median (IQR) for three groups or variables: First group: Median = 2.50, IQR = 2.0–2.50 → The values are clustered tightly, with the upper quartile equal to the median, suggesting many observations at the top end. Second group: Median = 4.0, IQR = 3.50–6.0 → Wider spread, showing more variability in the data. Third group: Median = 6.0, IQR = 6.0–6.0 → No variability at all; all values are 6 (Table 3).

Table 3. Distribution of the studied cases according to time of healing, follow-up, and return to work (n = 20)

Variables	Min. – Max.	Mean ± SD.	Median (IQR)
Time of healing (month)	2.0 – 3.0	2.40 ± 0.35	2.50 (2.0 – 2.50)
Follow up (month)	3.0 – 6.0	4.55 ± 1.28	4.0 (3.50 – 6.0)
Return to work (month)	4.0 – 12.0	6.35 ± 2.08	6.0 (6.0 – 6.0)

IQR: Interquartile range. SD: Standard deviation

Assessment of postoperative wrist function revealed that 14 patients (70%) achieved a normal range of motion. Similarly, evaluation of grip strength demonstrated excellent to good outcomes in 70% of patients, indicating satisfactory functional recovery following volar plate fixation (Table 4).

Table 4. Distribution of the studied cases according to power of grip, range of motion, and complication (n = 20)

Variables	No. (%)
Power of grip	
Poor	1 (5.0%)
Fair	1 (5.0%)
Good	4 (20.0%)
Excellent	14 (70.0%)
Range of motion	
Normal	14 (70.0%)
Mild	5 (25.0%)
Moderate	1 (5.0%)
Complication	
No	19 (95.0%)
Infection diabetic	1 (5.0%)

Discussion

These fractures occur more commonly in women than in men, increase in frequency with advancing age, and result from low-energy falls more often than from high-energy trauma. The age of patients in this study ranged from 40 to 65 years, with a mean age of 50.35 ± 10.55 years. This finding is consistent with other studies that reported a mean age between 42 and 48 years (17–20). Seventy percent of the patients included in this study were non-workers (70.0%), and females constituted the majority of cases (65%). This is in agreement with similar studies that reported a higher proportion of female patients (21–22). In the present study, the left side was more commonly involved compared to the right side (45%). In contrast, other studies have reported right-sided predominance in approximately one-third of cases (23).

The most common mechanism of injury was a fall on an outstretched hand (65%), followed by road traffic accidents (25%). Similarly, other studies have identified road traffic accidents as the most common cause, followed by falls (17–19). This study aimed to evaluate the predictors of clinical and radiological outcomes of intra-articular distal radius fractures.

All fractures in this study were managed using Henry's volar approach to the distal radius and fixed with a 3.5 mm volar locking plate. Volar plate fixation with fixed-angle locking screws for the operative treatment of unstable intra-articular distal radius fractures has generally demonstrated acceptable outcomes in terms of both functional and radiographic parameters. However, the correlation between functional outcomes and radiographic appearance following distal radius fractures remains controversial, as several studies have reported no significant association between the two (18,19). Multiple studies have shown that volar plating facilitates early mobilization, which is essential in preventing joint stiffness and enhancing functional recovery. Furthermore, intra-articular fractures that are anatomically reduced and adequately stabilized tend to yield better clinical outcomes and a reduced risk of post-traumatic arthritis." Delayed wound healing and mild wrist stiffness were observed in one patient with diabetes mellitus.

Conclusion

Volar locking plate fixation for distal radius fractures provides stable fixation, facilitates early rehabilitation, and results in favorable clinical and functional outcomes. It is especially effective in unstable and osteoporotic fractures when meticulous surgical technique is applied.

Conflict of interest. Nil

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