International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Website: https://ijmpr.in/

Research Article

Functional Outcome of Volar Barton Fractures Treated with Volar Plating: A Retrospective Study of 34 Cases

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Received: 18-01-2026
Accepted: 28-02-2026
Published: 12-03-2026

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ABSTRACT

Background: Volar Barton fractures are unstable intra-articular fractures of the distal radius and often require operative stabilization to restore alignment and permit early mobilization. This study evaluated the functional outcome of volar Barton fractures treated with volar plating.

Methods: This retrospective, non-controlled study included 34 patients with volar Barton fractures treated with volar plate and screw fixation at a tertiary care centre between 9 November 2020 and 5 February 2021. Demographic profile, mode of injury, timing of surgery, radiological parameters, fracture union, complications, and functional outcome were assessed during follow-up.

Results: The largest proportion of patients was in the 51-60 year age group (15/34, 44.11%). There were 28 males and 6 females. Fall on an outstretched hand was the commonest mode of injury (24/34, 70.59%), and Frykman type III was the most frequent fracture pattern (22/34, 64.71%). Seventeen patients (50.00%) underwent surgery within 6 hours of injury. All fractures were closed. Radial shortening greater than 6 mm was noted in 2 patients (5.88%). Radiological union was seen in 30 patients (88.23%) by 6 weeks, and all fractures united subsequently. No postoperative infection was observed. Excellent to good functional outcome was achieved in 90% of patients. Eleven patients (32.35%) returned to their pre-injury occupation or lifestyle within 6 months, and 16 patients (47.06%) returned within 12 months. Post-traumatic arthritis developed in 7 patients (20.59%).

Conclusion: Volar plating provided stable fixation, maintained reduction until union, and produced satisfactory functional outcome with a low complication rate in patients with volar Barton fractures.

Keywords*: Volar Barton fracture, Distal radius fracture, Volar plating, Functional outcome, Open reduction internal fixation.*

INTRODUCTION

Fractures of the distal radius are among the most common injuries treated by orthopaedic surgeons. They show a wide spectrum of patterns, from simple extra-articular fractures to complex intra-articular injuries. The final outcome depends not only on fracture union, but also on restoration of joint congruity, radial length, volar tilt, and early recovery of wrist function [1,3].

Volar Barton fracture is an intra-articular shearing fracture of the volar rim of the distal radius. It is usually associated with displacement of the radiocarpal joint and instability. Because of its intra-articular nature, loss of reduction can lead to pain, stiffness, deformity, reduced grip strength, and post-traumatic arthritis. For this reason, precise reduction and stable fixation are important in order to obtain a good functional result [1,5].

The management of distal radius fractures has evolved over time. Traditional methods such as plaster immobilization and closed reduction were widely practiced and remain useful in selected fractures [4,6,7]. External fixation has also been used for unstable and intra-articular distal radius fractures, especially where ligamentotaxis can help restore alignment

[2]. However, in fractures with volar marginal instability, these methods may not reliably maintain reduction, particularly when there is a displaced intra-articular fragment [1,5].

Open reduction and internal fixation has therefore gained an important role in the treatment of unstable distal radius fractures. Volar plating offers the advantages of direct fracture visualization, restoration of the articular surface, stable fixation, and early mobilization of the wrist [5,8]. It is especially useful in volar Barton fractures, where the displaced volar fragment must be buttressed to prevent carpal subluxation and recurrence of deformity [1,3].

Although volar plating is widely used, evaluation of its clinical and radiological outcome remains important. The present study was undertaken to assess the outcome of volar plating in volar Barton fractures treated operatively at a tertiary care centre.

METHODS

This retrospective, all-inclusive, non-controlled, non-randomized, non-blinded study was conducted at a tertiary care centre affiliated with a medical college. The study included 34 patients with volar Barton fractures of the distal radius who were treated operatively with volar locking plate fixation between 9 November 2020 and 5 February 2021. Institutional approval was obtained prior to conducting the study.

Patient selection

All patients diagnosed with closed volar Barton fractures of the distal radius who underwent operative fixation with a volar locking plate during the study period were included in the study. Patients with pathological fractures, open fractures, and associated injuries that could affect functional assessment of the wrist were excluded.

Preoperative assessment

All patients underwent detailed clinical evaluation at the time of presentation. Standard radiographs of the wrist, including anteroposterior and lateral views, were obtained to assess the fracture pattern and displacement. Based on clinical and radiological findings, the decision for operative fixation with volar plating was made.

Surgical technique

All procedures were performed under appropriate anaesthesia using a standard volar approach to the distal radius. After exposure of the fracture site, open reduction was performed to restore the articular surface and anatomical alignment of the distal radius. Internal fixation was then achieved using a volar locking plate. Fluoroscopic guidance was used intraoperatively to confirm satisfactory reduction and implant positioning.

Postoperative management

Postoperatively, the wrist was immobilized for a short period followed by gradual mobilization. Patients were encouraged to begin wrist and finger movements as tolerated to prevent stiffness. Follow-up visits were scheduled at regular intervals for clinical and radiological evaluation.

Outcome assessment

Patients were followed for a minimum period of six months. Clinical assessment included evaluation of pain, swelling, range of motion of the wrist, and grip strength. Functional outcome was assessed using a standardized functional scoring system. Radiological evaluation was performed using follow-up radiographs to assess fracture union and maintenance of reduction.

Statistical analysis

Data collected from clinical records and follow-up evaluations were compiled and analyzed using descriptive statistical methods. Continuous variables were expressed as means where applicable, and categorical variables were presented as frequencies and percentages.

Patient and injury characteristics

A total of 34 patients with volar Barton fractures of the distal radius who underwent operative fixation with volar plating during the study period were included in the study. Demographic and injury-related variables, including age distribution, sex, mechanism of injury, and fracture classification, were analyzed. Most patients were male, and fall on an outstretched hand was the most common mode of injury, followed by road traffic accidents. The distribution of these variables is shown in Table 1.

Table 1. Baseline demographic and injury characteristics (n = 34)

Variable	Number of Patients	Percentage (%)
Age group (years)		
51–60	15	44.11
Other age groups	19	55.89
Sex		

Male	28	82.35
Female	6	17.65
Mechanism of injury		
Fall on outstretched hand	24	70.59
Road traffic accidents	10	29.41
Frykman classification		
Type III	22	64.71
Other types	12	35.29

Operative details

Operative variables and early postoperative findings were analyzed for all patients. The interval between injury and surgery, radiological alignment parameters, fracture union, and early complications were assessed. Half of the patients underwent surgery within the first six hours of injury. Most fractures achieved union within six weeks, and no cases of postoperative infection were observed. The operative details and early postoperative outcomes are summarized in Table 2.

Table 2. Operative details and early postoperative outcome (n = 34)

Variable	Number of Patients	Percentage (%)
Time from injury to surgery		
Operated within 6 hours	17	50.00
Operated after 6 hours	17	50.00
Fracture characteristics		
Closed fractures	34	100
Radiological parameter		
Radial shortening > 6 mm	2	5.88
Radial shortening ≤ 6 mm	32	94.12
Fracture union		
Union within 6 weeks	30	88.23
Union after 6 weeks	4	11.77
Early complications		
Infection	0	0

Radiological outcome and fracture union

Radiological evaluation was performed using serial anteroposterior and lateral wrist radiographs during follow-up to assess fracture alignment, maintenance of reduction, and union. Most fractures showed satisfactory restoration of anatomical alignment following volar plate fixation. Only two patients (5.88%) demonstrated radial shortening of more than 6 mm, while the remaining patients maintained acceptable radiological parameters.

Fracture union was achieved within six weeks in 30 patients (88.23%), while the remaining patients showed union at a later follow-up. No cases of loss of reduction were observed during the follow-up period.

Representative preoperative and postoperative radiographs demonstrating the fracture configuration and fixation with a volar locking plate are shown in **Figure 1** and **Figure 2**.

Figure1-Preoperative anteroposterior and lateral radiographs of the wrist showing a volar Barton fracture of the distal radius.

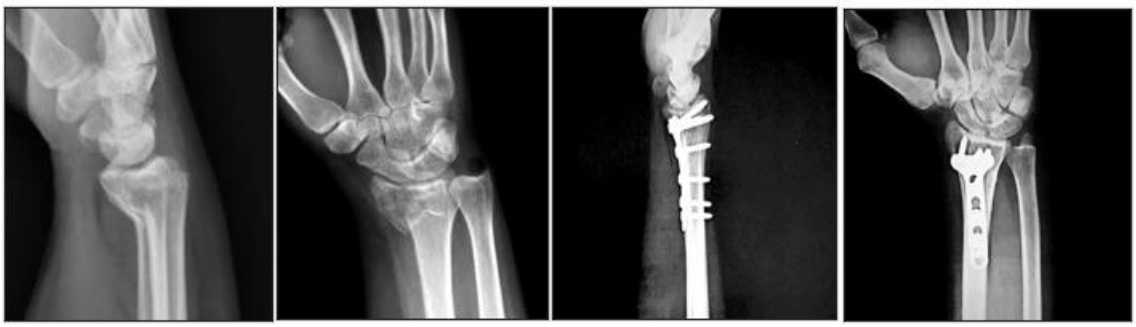
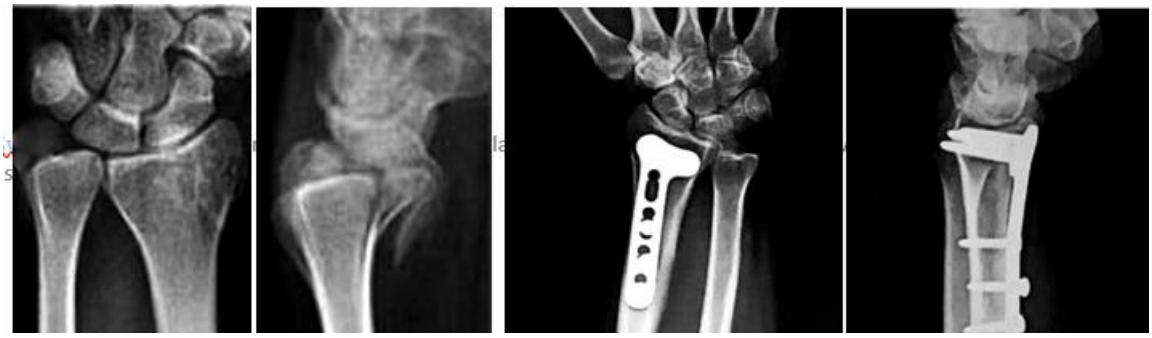


Figure 2. Postoperative anteroposterior and lateral radiographs showing fixation of the volar Barton fracture with a volar locking plate and restoration of anatomical alignment.



Functional outcome

Functional outcome was assessed at follow-up based on return to pre-injury activity and overall clinical result. Most patients achieved satisfactory functional recovery following volar plate fixation. Excellent to good functional results were observed in 90% of patients.

Return to pre-injury occupation or lifestyle was achieved in 11 patients (32.35%) within the first 6 months, while 16 patients (47.06%) returned within 12 months after surgery. Seven patients (20.59%) had not returned to their pre-injury activity by the end of the follow-up period. The timeline for return to pre-injury activity following surgery is illustrated in Figure 3.

The mode of injury also appeared to influence the final outcome. Excellent outcomes were observed in 24 patients (70.59%) who sustained injury following a fall on an outstretched hand, compared with 10 patients (29.41%) who sustained injury due to road traffic accident. At final follow-up, post-traumatic arthritis was noted in 7 patients (20.59%). The overall functional outcome is summarized in Table 4.

Table 4. Functional outcome at final follow-up (n = 34)

Variable	Number of Patients	Percentage (%)
Overall functional outcome		
Excellent to good results	31	90.00
Fair to poor results	3	10.00
Return to pre-injury activity		
Returned within 6 months	11	32.35
Returned within 12 months	16	47.06
Not returned to pre-injury activity	7	20.59
Mode of injury and outcome		
Fall on outstretched hand	24	70.59
Road traffic accident	10	29.41
Late complication		
Post-traumatic arthritis	7	20.59
No arthritis	27	79.41

Figure 3. Time to return to pre-injury activity following volar plate fixation.

DISCUSSION

Volar Barton fractures are unstable intra-articular fractures of the distal radius and are often difficult to maintain by closed methods alone. The main goals of treatment are restoration of articular congruity, maintenance of radial length and volar tilt, and early mobilization to achieve good wrist function. In the present retrospective study of 34 patients treated with volar plating, most fractures united within 6 weeks, excellent to good functional results were obtained in 90% of patients, and postoperative complications were limited.

The age range in the present series was 18 to 60 years, with the highest number of patients in the 51–60 year age group. Males predominated, with a male-to-female ratio of 5:1. This likely reflects greater exposure to outdoor work and high-risk activities. Fall on an outstretched hand was the commonest mode of injury, accounting for 70.59% of cases. A similar predominance of fall-related injury was noted by Cooney et al. in their series on distal radius fractures [9].

All patients in the present study were treated with volar plate fixation. This method provided stable fixation and maintained reduction until union in most cases. Tang et al., in a retrospective study of 33 patients with volar Barton fractures, also reported satisfactory radiological and functional results with both anatomical and locking volar plates, with fracture healing in all patients [10]. Their study further suggested that locking plates may provide better functional recovery. These findings are in agreement with the present study, in which volar plating gave acceptable radiological alignment and good functional recovery in the majority of patients.

Radiological outcome in the present series was satisfactory. Only two patients showed radial shortening of more than 6 mm, and union was achieved in all patients, with 88.23% showing union by 6 weeks. The ability of volar plating to maintain alignment has been reported in larger distal radius series as well. Chung et al. found that volar locking plates maintained anatomical reduction during follow-up and produced progressive functional recovery over time [16]. Quadlbauer et al. also reported that palmar locking plate fixation was associated with good clinical and radiological outcomes and a low complication rate at a minimum one-year follow-up [13]. These observations support the radiological findings of the present study.

Functional recovery in the present study was also encouraging. Excellent to good results were seen in 90% of patients. Return to pre-injury occupation or lifestyle occurred in 11 patients within 6 months and in a further 16 patients within 12 months. Better early recovery after volar plating has also been shown in comparative studies. Rozental et al. reported superior early functional outcomes with open reduction and internal fixation using a volar plate compared with percutaneous fixation, although the difference decreased at one year [12]. Roh et al. similarly found better early grip strength and range of motion with volar plate fixation compared with external fixation, while long-term differences were less marked [15]. These studies support the role of volar plating in enabling earlier return of function.

The relation between radiological restoration and function remains clinically important. Quadlbauer et al. observed that ulnar variance correlated with grip strength and patient-reported outcomes, although not every radiographic deviation translated into a clinically important difference [13]. In the present series, acceptable radiological alignment was preserved in most patients, and this likely contributed to the favourable functional outcome.

Complications were few in the present study. No postoperative infection was observed, although post-traumatic arthritis developed in seven patients. Cooney et al. emphasized that complications of distal radius fractures can influence long-term outcome, particularly when articular congruity is not fully restored [9]. Esenwein et al., in a large review of 665 cases of palmar plate fixation, reported that although the procedure is safe and effective, complications requiring reintervention are not uncommon and may include nerve compression, secondary displacement, tendon rupture, infection, and hardware-related problems [17]. The low complication profile in the present study may be related to careful surgical technique, stable fixation, and early postoperative mobilization.

The good results seen in the present series are likely multifactorial. Early intervention, accurate open reduction, stable fixation with a volar plate, and early mobilization appear to have contributed to maintenance of reduction and satisfactory functional recovery. These principles are consistent with the current trend toward internal fixation for unstable distal radius fractures [12,15,16].

The present study has some limitations. It is a retrospective, non-controlled study with a relatively small sample size and a limited follow-up period. Functional assessment was not based on a widely reported patient-reported outcome score such as QuickDASH or PRWE, which limits direct comparison with some recent studies [11,13,14]. Despite these limitations, the findings suggest that volar plating is an effective treatment option for volar Barton fractures, providing stable fixation, reliable union, and good functional outcome with few complications.

CONCLUSION

Volar plating is an effective method for the treatment of volar Barton fractures. It provides stable fixation, maintains anatomical reduction until union, and allows satisfactory functional recovery with a low complication rate. In the present study, most patients achieved union within 6 weeks and excellent to good functional outcome was observed in the

majority of cases. Early intervention, accurate reduction, rigid internal fixation, and early mobilization appear to be important factors contributing to a favourable outcome.

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