

Evaluations of the Treatment of Volar Barton Fracture of the Distal Radius by Buttress Plate

Rahman MM¹, Habib HA², Taleb MA³, Jaman MH⁴

Article info

Received : 05-08-2024
Accepted : 12-09-2024
No. of Table : 04
No. of figure : 00
No. of references : 22

Cite the Article:

Rahman MM, Hasan-Al-Habib, Taleb MA, Jaman MH. Evaluations of the Treatment of Volar Barton Fracture of the Distal Radius by Buttress Plate. Pabna Med. Col. J. 2024;3(2): 51-56.

Keywords: Volar Barton Fracture, Distal Radius Fracture, Buttress Plate Fixation and Functional Outcome.

Abstract:

Background: Distal radius fractures are common, with volar Barton fractures posing a unique challenge due to their intra-articular nature and instability. These injuries often result from high-energy trauma and involve dislocation of the radiocarpal joint. Conservative treatment frequently yields poor outcomes, prompting a shift toward surgical management. Volar buttress plating via open reduction and internal fixation (ORIF) has emerged as the preferred approach, offering stable fixation, early mobilization, and favorable functional recovery. Anatomically contoured low-profile plates enhance outcomes by minimizing soft tissue complications. Despite some risks, such as tendon irritation, clinical results have generally been positive when appropriate surgical protocols are followed.

Aim of the study: This study aims to evaluate the treatment outcomes of volar Barton fractures of the distal radius managed with volar buttress plates.

Methods: This prospective observational study was conducted over 12 months, from July'23 to June'24 at the Department of Orthopaedics of Pabna Medical College, Bangladesh to evaluate outcomes of volar Barton fractures treated with open reduction and internal fixation using a volar buttress plate. Thirty (30) adult patients with closed, radiologically confirmed Volar Barton fractures were included. The surgery involved a standard volar (Henry's) approach with fixation using locking or non-locking screws. Postoperative care included early mobilization and radiographic follow-up at 2, 6, and 12 weeks postoperatively. Outcomes were assessed radiologically and functionally using the Mayo Wrist Score. Data were analyzed descriptively using SPSS version 26.0 without inferential statistics.

Results: In this study of 30 patients with volar Barton fractures treated using buttress plate fixation, most were males (70%) aged 30–50 years (53.33%), with the right hand predominantly affected (93.33%). The primary cause was falls on an outstretched hand (56.67%). Radiographic union occurred within 6–12 weeks in 70% of cases, and final alignment was maintained in 90% of cases. Functional assessment using the Mayo Wrist Score showed excellent to good outcomes in 86.67% of patients. Complications were minimal, including superficial infection (3.33%), tendon irritation (3.33%), and implant prominence (6.67%). No cases of deep infection, implant failure, or reduction loss were reported.

Conclusion: Volar buttress plate fixation is an effective treatment for volar Barton fractures, promoting early union, stable anatomical reduction, and good functional recovery with minimal complications. Optimal outcomes depend on selecting the appropriate patients, performing surgery promptly, and employing precise surgical techniques.

1. Dr. Md. Masud Ur Rahman, Associate Professor (Orthopaedics), Pabna Medical College, Pabna
2. Dr. Hasan-Al-Habib, Junior consultant (Orthopaedic), Pabna Medical College Hospital, Pabna
3. Dr. Md. Abu Taleb, Junior Consultant (Orthopaedics), 250 bed General Hospital, Pabna
4. Dr. Md Hasanusjaman, Resident Surgeon, 250 bedded general hospital, Pabna

Address of Correspondence: Dr. Md. Masud Ur Rahman, Associate Professor (Orthopaedics), Pabna Medical College, Pabna.
E-mail: dr.masudk47@gmail.com, Cell Phone- +8801711786789

Introduction:

Fractures of the distal radius are among the most frequently encountered injuries in orthopaedic practice, comprising approximately one-sixth of all fractures treated in emergency departments¹. Among these, intra-articular fractures such as volar Barton fractures represent a particularly challenging subset due to their instability and propensity to disrupt wrist mechanics. A volar Barton fracture is characterized by a fracture of the volar rim of the distal radius with dislocation or subluxation of the radiocarpal joint, typically resulting from high-energy trauma or a fall on an outstretched hand^{2,3}. Because this fracture pattern compromises the volar lip of the distal radius – a critical buttress for carpal stability effective management is crucial to restore articular congruity, prevent post-traumatic arthritis, and preserve wrist function. Historically, closed reduction and casting were considered the standard treatment for managing distal radius fractures; however, in cases of volar Barton fractures, conservative treatment often results in unsatisfactory outcomes due to the intra-articular nature and instability of the fragment⁴. Malunion, persistent subluxation, and impaired range of motion are frequently reported complications when such injuries are not stabilized adequately. As a result, surgical intervention is now widely recommended for these fractures, especially when radiocarpal instability, displacement, or comminution is present⁵.

Among various surgical techniques available, volar buttress plating using open reduction and internal fixation (ORIF) has gained prominence as the preferred modality for volar Barton fractures. The technique involves placing a contoured volar plate to buttress the volar fragment and prevent its displacement under axial loading. This method not only ensures stable fixation of the fracture but also facilitates early mobilization and functional recovery⁶. Moreover, advances in implant design, particularly the introduction of anatomically contoured low-profile locking plates, have minimized soft tissue complications and improved fixation even in osteoporotic bone⁷. Numerous studies have highlighted the biomechanical and clinical superiority of volar plate fixation over other modalities, such as dorsal plating, percutaneous pinning, or external fixation in managing volar Barton fractures. Jupiter et al. and Ruch et al. demonstrated that volar plating provides superior mechanical support to the volar cortex and minimizes

the risk of tendon irritation compared to dorsal approaches^{8,9}.

The volar approach also offers direct visualization of the fracture site, allowing for precise anatomical reduction, which is crucial for intra-articular injuries. Clinical outcomes following volar buttress plating have generally been favorable. Reports have indicated high union rates, improved wrist strength, satisfactory range of motion, and minimal complications such as infection or implant-related issues when surgery is performed early and appropriately^{10,11}. However, some complications remain a concern, including flexor tendon irritation or rupture, plate prominence, and loss of reduction in cases with comminution. Consequently, the choice of implant, surgical technique, and post-operative rehabilitation protocols significantly influence outcomes¹².

While the literature affirms the utility of volar buttress plating in achieving stable fixation, there remains a need for further evaluation of its efficacy in diverse populations and clinical settings, especially in resource-limited environments where implant availability and surgical expertise may vary. Additionally, long-term studies assessing functional and radiographic outcomes can provide deeper insights into the role of this approach in preventing post-traumatic arthritis and ensuring patient satisfaction. This study aims to evaluate the treatment outcomes of volar Barton fractures of the distal radius managed with volar buttress plates.

Materials and Methods:

This was a prospective observational study conducted to evaluate the clinical, radiological, and functional outcomes of volar Barton fractures of the distal radius treated with open reduction and internal fixation using a buttress plate. The study was conducted at the Department of Orthopaedics, Pabna Medical College, a tertiary care centre in Bangladesh, over 12 months, from July 2023 to June 2024. A total of 30 patients diagnosed with volar Barton fractures and treated surgically with buttress plates were included.

Inclusion Criteria

- Patients aged 18 years or older with radiologically confirmed volar Barton's fracture of the distal radius.
- Closed fractures.
- Fractures are treated with a volar buttress plate within two weeks of injury.

Exclusion Criteria

- Open fractures.
- Associated neurovascular injury or multiple fractures of the same limb.
- Pathological fractures.
- Patients unfit for surgery or lost to follow-up.

Data Collection Procedure

After obtaining ethical clearance from the institutional review board and informed written consent from each patient, detailed demographic and clinical data were collected using a structured data collection sheet. The preoperative evaluation included a clinical examination and standard anteroposterior and lateral radiographs of the wrist.

Surgical Procedure

All patients underwent open reduction and internal fixation (ORIF) using a volar buttress plate under regional or general anesthesia. A standard volar (Henry's) approach was used to access the fracture site. Fracture fragments were reduced under direct visualization and stabilized with the buttress plate using locking or non-locking screws as appropriate. Intraoperative fluoroscopy was used to confirm reduction and hardware placement. Wound closure was done in layers, and a sterile dressing was applied.

Postoperative Management

- Gradual mobilization exercises followed a short period of immobilization (up to 2 weeks).
- Radiographic assessments were performed at 2, 6, and 12 weeks to monitor union and alignment.
- Patients were followed up clinically and radiologically for at least 12 weeks postoperatively.

Outcome Measures

The outcome measures in this study were divided into radiological, functional, and postoperative assessments. Radiological outcomes focused on the time to union, determined by the presence of trabecular continuity across the fracture site, and the final alignment, which was classified as maintained, mildly malaligned, or grossly malunited based on postoperative radiographs. Functional outcomes were evaluated using the Mayo Wrist Score, which allocates a total of 100 points across four domains: pain, functional status, range of motion, and grip strength, each contributing 25 points. Based on the total score,

outcomes were categorized as excellent (90–100), good (80–89), fair (65–79), or poor (<65). Lastly, postoperative complications included superficial or deep infections, tendon irritation, implant prominence or failure, loss of reduction, and the need for implant removal.

Statistical Analysis

Data were entered and analyzed using **SPSS version 26.0**. Descriptive statistics were used, Categorical variables were expressed as frequencies and percentages, Continuous variables were expressed as means $\pm$ standard deviation (SD). In addition, no inferential statistics were applied due to the observational nature and small sample size of the study.

Results:

The present study evaluated 30 cases of volar Barton fractures treated with buttress plate fixation. As shown in Table 1, the majority of patients (53.33%) were in the 30–50 years age group, while 26.67% were under 30 years old, and 20% were above 50 years old. Males were predominantly affected (70%) compared to females (30%). The right hand was more commonly involved (93.33%). Falls on an outstretched hand were the leading mechanism of injury (56.67%), followed by road traffic accidents (36.67%). Most patients underwent surgery within 3 days of the injury (66.67%), with fewer cases occurring between 3 and 7 days (30%) or beyond 7 days (3.33%). Radiological outcomes are summarized in Table 2, where 70% of cases achieved radiographic union within 6–12 weeks, 23.33% within 6 weeks, and only 6.67% required over 12 weeks. Final alignment was maintained in 90% of cases, with mild malalignment in 10%, and no cases showed gross malunion. Functional outcomes, assessed using the Mayo Wrist Score (Table 3), indicated that 40% of patients had excellent results, 46.67% had good outcomes, and 13.33% had fair outcomes; notably, no patient had a poor outcome. As detailed in Table 4, postoperative complications were minimal. Superficial infection and tendon irritation were each reported in one case (3.33%), implant prominence in two cases (6.67%), and three patients (10%) required implant removal. There were no incidences of deep infection, loss of reduction, or implant failure, indicating a favorable safety profile of buttress plating in managing volar Barton fractures.

Table I*Demographic and Injury-Related Characteristics of Patients with Volar Barton Fracture (n = 30)*

Variables	Frequency (n)	Percentage (%)
Age Group (Years)		
<30	8	26.67
30–50	16	53.33
>50	6	20.00
Sex		
Male	21	70.00
Female	9	30.00
Hand Dominance		
Right	28	93.33
Left	2	6.67
Mechanism of Injury		
Fall on Outstretched Hand	17	56.67
Road Traffic Accident	11	36.67
Others (e.g., Assault)	2	6.67
Time from Injury to Surgery		
<3 days	20	66.67
3–7 days	9	30.00
>7 days	1	3.33

Table II*Radiological Outcomes Following Buttress Plate Fixation (n = 30)*

Variable	Frequency (n)	Percentage (%)
Radiographic Union Time		
<6 weeks	7	23.33
6–12 weeks	21	70.00
>12 weeks	2	6.67
Final Radiographic Alignment		
Maintained	27	90.00
Mild Malalignment	3	10.00
Gross Malunion	0	0.00

Table III*Functional Outcomes Based on Mayo Wrist Score (n = 30)*

Functional Outcome	Frequency (n)	Percentage (%)
Excellent	12	40.00
Good	14	46.67
Fair	4	13.33
Poor	0	0.00

Table IV*Postoperative Complications Observed Among the Study Population (n = 30)*

Complication Type	Frequency (n)	Percentage (%)
Superficial Infection	1	3.33
Deep Infection / Osteomyelitis	0	0.00
Tendon Irritation	1	3.33
Implant Prominence	2	6.67
Loss of Reduction	0	0.00
Implant Failure	0	0.00
Need for Implant Removal	3	10.00

Discussion:

The present study evaluated the clinical, radiological, and functional outcomes of 30 cases of volar Barton fractures treated using a volar buttress plate. The results demonstrate that this method offers satisfactory stability, early union, and favorable functional recovery with minimal postoperative complications. These findings support the existing body of evidence suggesting that volar plating is a reliable method for managing intra-articular distal radius fractures, particularly those of the volar Barton type. Volar Barton fractures represent a specific category of distal radius fractures that involve the volar rim and articular surface, often resulting from high-energy trauma or falls on an outstretched hand with wrist hyperextension¹³. In the current study, the predominant mechanism of injury was a fall on an outstretched hand (56.67%), which is consistent with the literature^{14,15}. Road traffic accidents contributed to 36.67% of cases, reflecting the rising incidence of high-velocity trauma in urbanizing regions like

Bangladesh. The demographic profile showed that the majority of patients were between 30 and 50 years old (53.33%), with a male predominance (70%). This finding aligns with those of Mehara et al.¹⁶ and Omokawa et al.¹⁷, who reported similar age distributions and a male predominance. These trends may be attributed to greater exposure to physical labor and risk-prone environments among men in this age group. Timely surgical intervention was another critical aspect evaluated. In this study, 66.67% of patients underwent surgery within 3 days of injury. Early surgical fixation is crucial in intra-articular fractures to restore the articular congruity and prevent post-traumatic arthritis. Studies by Orbay and Fernandez⁵ have highlighted the importance of early stabilization in achieving optimal outcomes.

Radiological union was achieved in most cases within 6–12 weeks (70%), while only two patients required more than 12 weeks. This pattern of healing is consistent with observations by Kapoor et al.¹⁸, who reported an average union time of 10 weeks in similar patient cohorts. Furthermore, 90% of patients maintained their final radiographic alignment, and none developed a gross malunion. Such results reflect the biomechanical superiority of volar buttress plates in maintaining alignment under compressive forces. The locking plate system, in particular, offers angular stability and is effective even in osteoporotic bones, making it preferable over external fixation or dorsal plating in such fracture types¹⁹.

Functionally, outcomes were excellent or good in 86.67% of patients, according to the Mayo Wrist Score. These results are comparable to those reported by Wong et al.²⁰ and Drobetz & Kutscha-Lissberg⁶, who also achieved excellent to good results in more than 80% of patients treated with volar plates. The few patients with fair outcomes may be linked to late presentation, delayed surgery, or associated soft-tissue damage. Postoperative complications in this study were minimal. There were no cases of deep infection, loss of reduction, or implant failure. Only one case of superficial infection and tendon irritation was recorded (3.33%), while two patients experienced implant prominence. Total three patients (10%) required implant removal due to discomfort or cosmetic concerns. These findings indicate a low complication profile, aligning with those reported by Arora et al.²¹, who observed similar rates of soft-tissue irritation and implant-related discomfort. Importantly,

no tendon ruptures or catastrophic failures were noted, which reinforces the safety of the volar approach, as it avoids significant dorsal soft-tissue manipulation. Moreover, the volar buttress plate supports early wrist mobilization, which is critical for functional recovery. This approach aligns with the principles of fracture management that prioritize early rehabilitation without compromising fracture stability²².

Limitations of the study:

This study had several limitations. The small sample size of 30 patients may limit the generalizability of the findings to the broader population. Additionally, the follow-up period was relatively short, restricting the assessment of long-term complications such as post-traumatic arthritis or implant-related issues. Functional outcomes were evaluated using the Mayo Wrist Score only, which may not capture all aspects of wrist function. Lastly, the absence of a control group or comparison with alternative fixation methods limits the ability to draw definitive conclusions about the superiority of the treatment.

Conclusion and Recommendation:

In conclusion, the present study demonstrates that volar buttress plate fixation is a highly effective method for managing volar Barton fractures of the distal radius. It ensures early union, maintains anatomical reduction, allows for prompt wrist mobilisation, and leads to favourable functional outcomes with minimal complications. However, it is essential to emphasise the importance of proper patient selection, timely surgical intervention, and meticulous operative techniques to optimise results. Further large-scale prospective studies with long-term follow-up are warranted to reinforce these findings and assess outcomes such as the incidence of post-traumatic arthritis and long-term wrist function.

Funding: No funding sources

Conflict of interest: None declared

References:

1. Chung KC, Shauver MJ, Birkmeyer JD. Trends in the United States in the treatment of distal radial fractures in the elderly. *JBJS*. 2009 Aug 1;91(8):1868-73.
2. Medoff RJ. Essential radiographic evaluation for distal radius fractures. *Hand clinics*. 2005 Aug 1;21(3):279-88.

3. Khan SM, Saxena NK, Singhania SK, Gudhe M, Nikose S, Arora M, Singh PK. Volar plating in distal end radius fractures and its clinical and radiological outcome as compared to other methods of treatment. *Journal of Orthopaedics and Spine*. 2016 Jan 1;4(1):40-4.
4. Arora R, Lutz M, Deml C, Krappinger D, Haug L, Gabl M. A prospective randomized trial comparing nonoperative treatment with volar locking plate fixation for displaced and unstable distal radial fractures in patients sixty-five years of age and older. *Jbjs*. 2011 Dec 7;93(23):2146-53.
5. Orbay JL, Fernandez DL. Volar fixation for dorsally displaced fractures of the distal radius: a preliminary report. *The Journal of hand surgery*. 2002 Mar 1;27(2):205-15.
6. Drobetz H, Kutscha-Lissberg E. Osteosynthesis of distal radial fractures with a volar locking screw plate system. *International orthopaedics*. 2003 Feb;27:1-6.
7. Musgrave DS, Idler RS. Volar fixation of dorsally displaced distal radius fractures using the 2.4-mm locking compression plates. *The Journal of hand surgery*. 2005 Jul 1;30(4):743-9.
8. Ruch DS, Ginn TA, Yang CC, Smith BP, Rushing J, Hanel DP. Use of a distraction plate for distal radial fractures with metaphyseal and diaphyseal comminution. *JBJS*. 2005 May 1;87(5):945-54.
9. Jupiter JB, Lipton H. The operative treatment of intraarticular fractures of the distal radius. *Clinical Orthopaedics and Related Research®*. 1993 Jul 1;292:48-61.
10. Kundu ZS, Sangwan SS, Guliani G, Siwach RC, Kamboj P, Singh R. Thompson's quadricepsplasty for stiff knee. *Indian Journal of Orthopaedics*. 2007 Oct;41(4):390.
11. Leung F, Tu YK, Chew WY, Chow SP. Comparison of external and percutaneous pin fixation with plate fixation for intra-articular distal radial fractures: a randomized study. *JBJS*. 2008 Jan 1;90(1):16-22.
12. Soong M, van Leerdam R, Guitton TG, Got C, Katarincic J, Ring D. Fracture of the distal radius: risk factors for complications after locked volar plate fixation. *The Journal of hand surgery*. 2011 Jan 1;36(1):3-9.
13. Jupiter JB. Fractures of the distal end of the radius. *JBJS*. 1991 Mar 1;73(3):461-9.
14. Colles A. On the fracture of the carpal extremity of the radius. *The New England Journal of Medicine, Surgery and Collateral Branches of Science*. 1814 Oct 1;3(4):368-72.
15. Court-Brown CM, Caesar B. Epidemiology of adult fractures: a review. *Injury*. 2006 Aug 1;37(8):691-7.
16. Mehara AK, Rastogi S, Bhan S, Dave PK. Classification and treatment of volar Barton fractures. *Injury*. 1993 Jan 1;24(1):55-9.
17. Omokawa S, Abe Y, Imatani J, Moritomo H, Suzuki D, Onishi T. Treatment of intra-articular distal radius fractures. *Hand Clinics*. 2017 Aug 1;33(3):529-43.
18. Kapoor H, Agarwal A, 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 Mar 1;31(2):75-9.
19. Ring D, Prommersberger K, Jupiter JB. Combined dorsal and volar plate fixation of complex fractures of the distal part of the radius. *JBJS*. 2004 Aug 1;86(8):1646-52.
20. Wong KK, Chan KW, Kwok TK, Mak KH. Volar fixation of dorsally displaced distal radial fracture using locking compression plate. *Journal of Orthopaedic Surgery*. 2005 Aug;13(2):153-7.
21. Arora R, Lutz M, Hennerbichler A, Krappinger D, Espen D, Gabl M. Complications following internal fixation of unstable distal radius fracture with a palmar locking-plate. *Journal of orthopaedic trauma*. 2007 May 1;21(5):316-22.
22. Fernandez DL, Jupiter JB. Fractures of the distal radius: a practical approach to management. *Springer Science & Business Media*; 2002 Jun 15.