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Prospective Study of Outcome of Radius Volar Barton Fracture Treated with Volar Buttress Plate at GMERS Hospital Dharpur

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ABSTRACT

Background: Volar Barton fractures are unstable partial intra-articular distal-radius fractures involving the volar rim and radiocarpal joint. Stable anatomical fixation is required to restore articular congruity and facilitate early wrist mobilisation.

Methods: This prospective observational study included 22 patients with closed AO type B3 volar Barton fractures treated with open reduction and internal fixation using a 3.5-mm volar buttress plate. Functional outcome was assessed at 6 months using the Disabilities of the Arm, Shoulder and Hand (DASH) score. Radiological outcome was assessed using Sarmiento's modification of Lindström's criteria. Fracture union, wrist motion, and postoperative complications were documented.

Results: The mean patient age was 34.5 years. Eighteen patients were male, and road-traffic accidents were the most common mechanism of injury. All fractures united, with a mean union time of 12 weeks. Excellent or good functional outcomes were achieved in 21 patients (95%), while excellent or good radiological outcomes were observed in 19 patients (86%). Wrist stiffness was the most common complication, occurring in 3 patients (14%).

Conclusion: Volar buttress plate fixation provided stable fracture fixation, predictable union, and predominantly excellent-to-good functional and radiological outcomes in closed volar Barton fractures. Accurate reduction, appropriate plate and screw placement, and early rehabilitation remain essential for optimal results.

Keywords: Volar Barton Fracture, Distal Radius Fracture, Volar Buttress Plate, Volar Locking Plate, Dash Score, Internal Fixation.

INTRODUCTION

Volar Barton fractures are intra-articular distal-radius fractures involving the volar marginal fragment, usually with radiocarpal subluxation or displacement. The volar rim has an important role in maintaining radiocarpal stability. Inadequate reduction

may result in loss of alignment, restricted wrist movement, persistent pain, and post-traumatic arthritis [1,2].

The objectives of treatment are restoration of articular congruity, stable fixation of the volar fragment, maintenance of radial alignment, and early mobilisation.



Although closed reduction, cast immobilisation, percutaneous fixation, and external fixation have been used, unstable intra-articular fractures may lose reduction with these techniques [3–5]. Open reduction and internal fixation using a volar plate allows direct visualisation of the fracture, restoration of the volar buttress, and early postoperative rehabilitation [2,6,7].

This study evaluated the functional and radiological outcomes of patients with volar Barton fractures treated with volar buttress plate fixation at a tertiary-care teaching hospital.

Aim: To evaluate the functional and radiological outcomes of volar locking-plate fixation in patients with unstable intra-articular distal-radius fractures.

Objectives:

1. To assess functional outcomes using an appropriate validated scoring system at final follow-up.
2. To evaluate radiological restoration and maintenance of distal-radius alignment.
3. To document postoperative complications, including tendon-related complications, infection, implant failure, and loss of reduction.

MATERIALS AND METHODS

Study Design and Setting

This prospective observational study was conducted in the Department of Orthopaedics, GMERS Medical College and Hospital, Dharpur, Patan, Gujarat, from January 2024 to June 2025. Ethical approval was obtained before enrolment, and written informed consent was obtained from all participants.

Participants

Patients aged 18–60 years with closed AO type B3 volar Barton fractures were included. Patients with dorsal Barton fractures, extra-articular distal-radius fractures, open fractures, age below 18

years or above 60 years, and those unwilling to participate were excluded.

A total of 22 patients were enrolled and followed for 6 months.

Surgical Technique

All patients underwent preoperative clinical and radiological assessment with standard anteroposterior and lateral wrist radiographs. Open reduction and internal fixation were performed through a modified Henry volar approach. A 3.5-mm site-specific volar buttress plate or locking compression plate was applied after reduction of the volar fragment. Intraoperative fluoroscopy was used to confirm fracture reduction, implant position, and appropriate screw length.

Postoperatively, the wrist was supported in a below-elbow slab during the initial healing period. Patients were reviewed at approximately 2 weeks, 1 month, 3 months, and 6 months. Active wrist mobilisation and supervised rehabilitation were initiated according to fracture stability and soft-tissue recovery.

Outcome Measures

Functional outcome was assessed at 6 months using the DASH score. Radiological outcome was assessed using Sarmiento's modification of Lindström's criteria, which evaluates deformity, residual dorsal tilt, radial shortening, and loss of radial inclination. Fracture union, wrist range of motion, grip strength, distal radioulnar joint pain, and complications were recorded.

Statistical Analysis

Data were analysed using descriptive statistics and are presented as mean, frequency, and percentage. A *p*-value of less than 0.05 was considered statistically significant where applicable.

RESULTS



Demographic and Injury Characteristics

The mean age of the patients was 34.5 years. The largest proportion of patients belonged to the 31–40-year age group. Eighteen patients were male and four were

female. Right-sided injuries were more common than left-sided injuries. Road-traffic accidents were the leading mechanism of injury, followed by falls on an outstretched hand.

Table 1. Baseline demographic and injury characteristics

Characteristic	Number of patients (n = 22)	Percentage
Age group, years		
18–20	2	10
21–30	5	23
31–40	10	45
41–50	4	18
51–60	1	4
Sex		
Male	18	82
Female	4	18
Side involved		
Right	14	64
Left	8	36
Mechanism of injury		
Road-traffic accident	14	64
Fall on an outstretched hand	7	32
Sports injury	1	4

The mean interval between admission and surgery was 3.56 days. All fractures were closed AO type B3 injuries. Surgical delay

was mainly related to soft-tissue swelling, medical optimisation, or management of associated injuries.

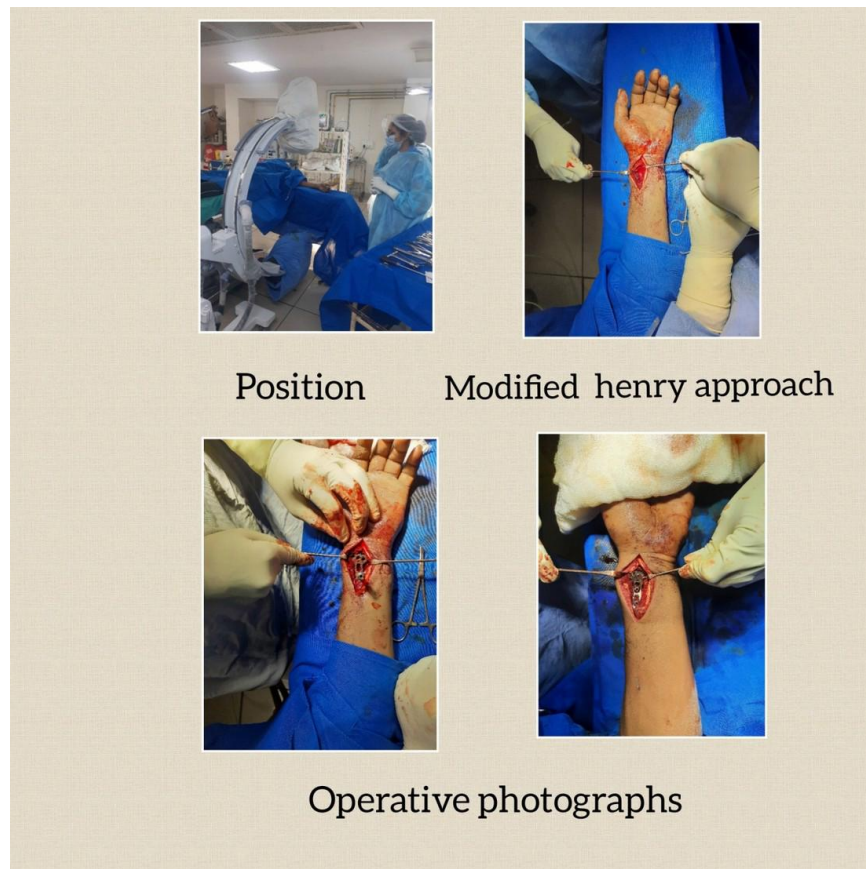


Figure 1. Intraoperative steps of volar buttress plate fixation

[Positioning, modified Henry approach, fracture reduction, and volar buttress plate fixation for a volar Barton fracture.]

Fracture Union and Wrist Motion

All 22 patients achieved fracture union. The mean time to union was 12 weeks, ranging from 8 to 16 weeks. Eighteen patients demonstrated union by 12 weeks, whereas four patients required a longer duration for radiological union.

At final follow-up, all patients achieved functional dorsiflexion, palmar flexion, pronation, and supination. Functional radial deviation was achieved in 20 patients, while functional ulnar deviation was achieved in 21 patients.

Table 2. Functional wrist motion at final follow-up

Movement parameter	Functional threshold	Patients achieving threshold	Percentage
Dorsiflexion	$\geq 45^\circ$	22	100
Palmar flexion	$\geq 30^\circ$	22	100
Pronation	$\geq 50^\circ$	22	100
Supination	$\geq 50^\circ$	22	100
Radial deviation	$\geq 15^\circ$	20	90
Ulnar deviation	$\geq 15^\circ$	21	95



Functional Outcome

At 6 months, excellent functional outcomes were achieved in 16 patients (72%), good outcomes in 5 patients (23%), and fair

outcomes in 1 patient (5%). No patient had a poor functional outcome. Overall, 21 patients (95%) achieved excellent-to-good functional results.

Table 3. Functional outcome according to DASH score

Functional result	Number of patients	Percentage
Excellent	16	72
Good	5	23
Fair	1	5
Poor	0	0
Excellent-to-good outcome	21	95

Radiological Outcome

Radiological assessment using Sarmiento's modification of Lindström's criteria showed excellent results in 11 patients (50%), good results in 8 patients (36%), and

fair results in 3 patients (14%). No patient had a poor radiological outcome. Overall, 19 patients (86%) achieved excellent-to-good radiological outcomes.

Table 4. Radiological outcome according to Sarmiento's modification of Lindström's criteria

Radiological result	Number of patients	Percentage
Excellent	11	50
Good	8	36
Fair	3	14
Poor	0	0
Excellent-to-good outcome	19	86

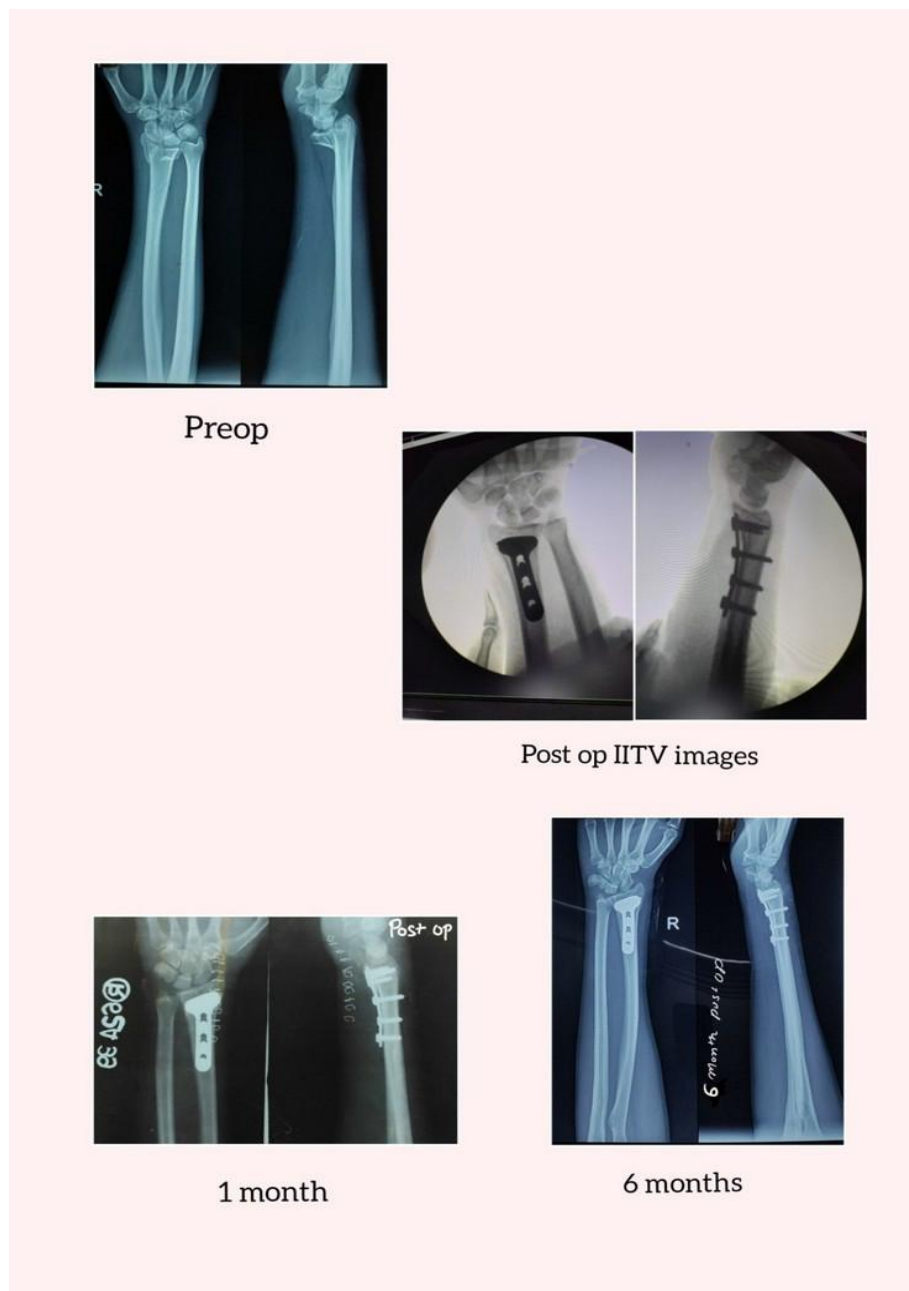


Figure 2. Serial radiographic assessment of fracture healing

[Preoperative radiographs, immediate postoperative fluoroscopic images, and radiographs obtained at 1 and 6 months after volar buttress plate fixation, demonstrating restoration of alignment and fracture union.]

Complications

Wrist stiffness was the most common postoperative complication, occurring in three patients (14%). Loss of reduction and extensor pollicis longus tendon irritation

occurred in two patients each (9%). One patient developed superficial infection. No case of complex regional pain syndrome was observed.



Table 5. Postoperative complications

Complication	Number of patients	Percentage
Wrist stiffness	3	14
Loss of reduction	2	9
EPL tendon irritation	2	9
Infection	1	5
Complex regional pain syndrome	0	0

DISCUSSION

Volar Barton fractures require stable reduction and fixation of the volar marginal fragment because this fragment is essential for radiocarpal stability. Failure to restore the volar rim can lead to recurrent displacement, wrist instability, reduced movement, and post-traumatic arthrosis [1,2].

In the present study, all fractures united, with a mean union time of 12 weeks. Excellent-to-good functional outcomes were observed in 95% of patients, and excellent-to-good radiological outcomes were observed in 86%. These findings support the role of volar buttress plate fixation in maintaining fracture reduction and enabling early functional recovery.

Previous studies have also shown favourable outcomes after volar plating of unstable intra-articular distal-radius fractures. Internal fixation provides direct fracture visualisation, stable restoration of alignment, and the possibility of early mobilisation [6–10]. Volar locking constructs may be particularly advantageous in unstable fracture patterns because they provide fixed-angle support to the distal fragment [9,10].

Wrist stiffness was the most frequent complication in this study. Loss of reduction and extensor pollicis longus tendon irritation were also observed. Tendon-related complications after volar plate fixation may occur because of inappropriate plate placement or excessive screw length. Therefore, careful plate positioning, accurate measurement of screw

length, and fluoroscopic confirmation are important intraoperative measures [11,12]. Tendon-related complications after volar plate fixation may occur because of inappropriate plate placement or excessive screw length. Therefore, careful plate positioning, accurate measurement of screw length, and fluoroscopic confirmation are important intraoperative measures [12,13]. Variable-angle volar locking plates have also demonstrated satisfactory mid-term functional and radiological outcomes in unstable distal-radius fractures [14–17]. Karthik and Ethiraj reported favourable functional and radiological outcomes in patients with volar Barton fractures treated with variable locking plates [17]. The present findings are comparable, with most patients achieving excellent or good outcomes at final follow-up.

The principal limitations of this study include the small sample size, single-centre design, absence of a comparison group, and follow-up limited to 6 months. Larger comparative studies with longer follow-up are required to assess late complications, maintenance of reduction, post-traumatic arthritis, and long-term patient-reported outcomes.

CONCLUSION

Volar buttress plate fixation is an effective treatment option for closed AO type B3 volar Barton fractures. It provides stable fixation, predictable union, restoration of functional wrist motion, and predominantly excellent-to-good functional and radiological outcomes. Meticulous fracture reduction, appropriate plate and screw



placement, and early rehabilitation are essential to minimise complications and optimise recovery.

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