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Functional and radiological outcomes of anterior bridge plating for mid-shaft humeral fractures: A prospective study in the Indian population

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Abstract
Introduction: The management of mid-shaft humeral fractures remains a subject of debate. While conservative methods are often successful, surgical intervention is indicated for specific fracture patterns and patient populations. Minimally invasive techniques like anterior bridge plating (ABP) have gained popularity due to their potential for preserving fracture biology and reducing complications. This study evaluates the functional and radiological outcomes of ABP for mid-shaft humeral fractures in an adult Indian population.
Methods: We prospectively studied 40 adult patients with mid-shaft humeral fractures treated with ABP between October 2022 and October 2025. Patients were aged 18 to 75 years. The primary outcomes were radiological union and functional recovery, assessed using the Disabilities of the Arm, Shoulder and Hand (DASH) score and the Constant-Murley score at final follow-up. Secondary outcomes included operative time, blood loss, time to union, and complication rates.
Results: The mean age of the cohort was 48.5 years. The union rate was 97.5% (39 out of 40 patients). The mean time to radiological union was 14.2 weeks (range, 10-20 weeks). At the one-year follow-up, the mean DASH score was an excellent 8.5, and the mean Constant-Murley score was 91.2. The complication rate was low; one case (2.5%) of iatrogenic radial nerve palsy which resolved spontaneously, two cases (5%) of superficial infection, and one case (2.5%) of non-union requiring revision surgery.
Conclusion: Anterior bridge plating is a safe, reliable, and effective treatment modality for mid-shaft humeral fractures. It provides excellent union rates, superior functional outcomes, and a low complication profile in the Indian population. The technique's adherence to biological fixation principles and early functional recovery.

Keywords: Humerus fracture, anterior bridge plating, mipo, functional outcome, Indian population

Introduction
Fractures of the humeral shaft account for approximately 1-3% of all fractures in adults [1]. While a significant proportion of these can be managed non-operatively with functional bracing, yielding high union rates, surgical intervention is often necessary for unstable fracture patterns, polytrauma patients, open fractures, and cases with associated vascular or nerve injuries [2, 3].
Traditional open reduction and internal fixation (ORIF) with compression plating has been the gold standard for surgical management. However, it requires extensive soft-tissue dissection, which can devitalize the bone, increase the risk of infection, and potentially damage the radial nerve [4]. To mitigate these risks, minimally invasive plate osteosynthesis (MIPO) techniques have been developed. The anterior bridge plating (ABP) technique, in particular, utilizes an internervous and intermuscular plane, minimizing soft tissue stripping and preserving the periosteal blood supply crucial for fracture healing [5, 6].
This approach is theoretically advantageous, potentially leading to faster union and lower rates of complications like iatrogenic radial nerve palsy, which is a significant concern with posterior and anterolateral approaches [7]. While numerous studies have validated the efficacy of ABP globally, there is a relative paucity of data focusing specifically on the Indian population, which has distinct lifestyle and comorbidity profiles. This study aims to prospectively evaluate the clinical, radiological, and functional outcomes of ABP for mid-shaft humeral fractures in a cohort of Indian patients.

2. Materials and Methods

This prospective study was conducted at our respective institutions after obtaining approval from the Institutional Ethical Committee. A total of 40 consecutive adult patients with traumatic mid-shaft humeral fractures (AO/OTA classification 12A and 12B) treated with ABP between October 2021 and October 2024 were included. The authors have been affiliated with their respective institutes from October 2021 to the present date.

2.1 Inclusion and Exclusion Criteria: Inclusion criteria were: (1) age over 18 years, (2) acute diaphyseal fracture of the humerus, and (3) patient consent for participation. Exclusion criteria included: (1) open fractures of Gustilo-Anderson type III, (2) pathological fractures, (3) severe pre-existing shoulder or elbow pathology, and (4) patients lost to follow-up before 12 months.

2.2 Surgical Technique All patients were operated on in the supine position under general or regional anesthesia. A deltopectoral approach was used for the proximal incision, and a longitudinal incision was made just lateral to the biceps tendon for the distal window. A sub-brachialis, extra-periosteal tunnel was created on the anterior surface of the humerus. A pre-contoured 4.5 mm narrow locking compression plate (LCP) was passed through the tunnel. The plate position was confirmed under an image intensifier. At least three locking screws were inserted into the proximal and distal fragments. No attempt was made to achieve anatomical reduction of the fracture fragments, adhering to the principles of biological bridge plating.

2.3 Postoperative Protocol and Follow-up The arm was immobilized in a sling for comfort. Gentle pendulum exercises were initiated on the first postoperative day, followed by active-assisted range of motion (ROM) exercises for the shoulder and elbow as pain subsided. Patients were followed up at 2 weeks, 6 weeks, 3 months, 6 months, and 1 year. Radiographs were taken at each visit to assess fracture healing. Union was defined as the presence of bridging callus across at least three cortices on anteroposterior and lateral radiographs, with no pain at the fracture site.

2.4 Outcome Assessment Functional outcomes were evaluated at the final 1-year follow-up using the Disabilities of the Arm, Shoulder and Hand (DASH) score and the Constant-Murley score. Complications such as nerve injury, infection, delayed union (no union by 6 months), non-union (no union by 9 months), and implant failure were recorded.

3. Results

A total of 40 patients (28 males, 12 females) with a mean age of 48.5 years (range, 22-75 years) were included. The dominant side was affected in 25 (62.5%) patients. The most common mechanism of injury was road traffic accidents (62.5%). Patient demographics and fracture characteristics are summarized in Table 1.

Table 1: Patient Demographics and Fracture Characteristics (N=40)

Parameter	Value
Mean Age (years)	48.5 ± 12.6
Gender	
Male	28 (70%)
Female	12 (30%)
Mechanism of Injury	
Road Traffic Accident	25 (62.5%)
Fall from Height	10 (25%)
Domestic Fall	5 (12.5%)
AO/OTA Fracture Type	
12A2	15 (37.5%)
12A3	10 (25%)
12B2	10 (25%)
12B3	5 (12.5%)

min), and the mean intraoperative blood loss was 150 mL (range, 100-250 mL). The mean hospital stay was 4 days.

Radiological union was achieved in 39 out of 40 patients (97.5%). The mean time to union was 14.2 weeks (range, 10-20 weeks).

Time in Weeks	Number of Patients
10-12	12
13-15	18
16-18	7
19-20	2

At the final follow-up, the mean DASH score was 8.5 ± 4.2, and the mean Constant-Murley score was 91.2 ± 6.8, indicating excellent functional recovery.

Score	Mean Value
DASH Score	8.5
Constant-Murley Score	91.2

Complications were observed in 5 patients (12.5%). These results are detailed in Table 2.

Table 2: Summary of Complications (N=40)

Complication	Number of Patients	Percentage	Outcome
Iatrogenic Radial Nerve Palsy	1	2.5%	Spontaneous recovery at 4 months
Superficial Infection	2	5.0%	Resolved with antibiotics
Delayed Union	1	2.5%	United at 20 weeks
Non-union	1	2.5%	Required revision surgery
Shoulder/Elbow Stiffness	3	7.5%	Resolved with physiotherapy
Implant Failure	0	0%	-

Fig 1: Preoperative anteroposterior (AP) radiographs of a 65-year-old male with a mid-shaft humerus fracture

Fig 2: Clinical Image showing Incision

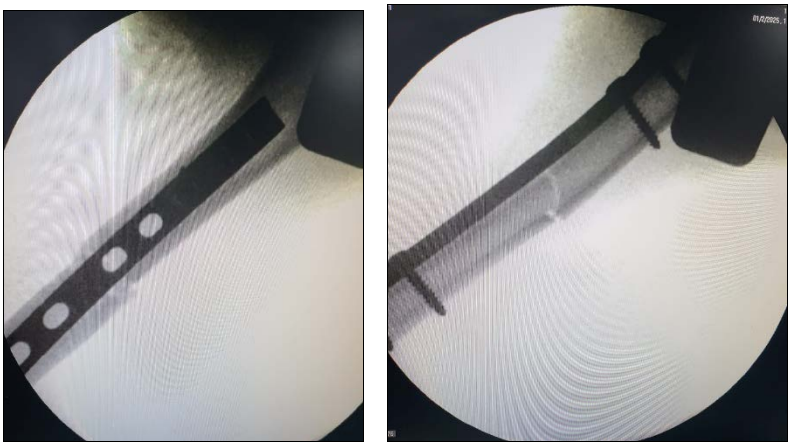

Fig 3: Intra-Operative Images from IITV

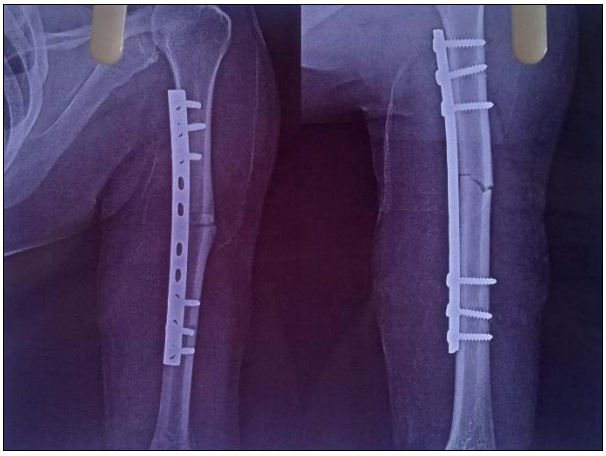

Fig 4: Immediate postoperative AP and lateral radiographs showing fracture fixation with an anterior bridge plate.

4. Discussion

The primary goal in treating humeral shaft fractures is to achieve a solid union with the restoration of alignment and function, while minimizing complications. The anterior bridge plating technique embodies the principles of biological osteosynthesis by preserving the fracture hematoma and periosteal vascularity, which are essential for bone healing [8]. Our study demonstrates that this technique yields excellent results in the Indian population, consistent with findings from international studies.

The **97.5% union rate** observed in our cohort is comparable to or higher than rates reported in other series on MIPO for humeral fractures, which range from 90% to 100% [6, 9, 10]. This high rate of union can be attributed to the preservation of the vascular envelope and the stable, yet flexible, fixation provided by the bridge plate, which promotes secondary bone healing through callus formation.

A significant advantage of the anterior approach is the reduced risk of iatrogenic radial nerve injury. The radial nerve is not encountered during the anterior sub-brachialis dissection, unlike in the anterolateral or posterior approaches [7, 11]. In our series, we had only one case (2.5%) of transient neuropraxia, which is significantly lower than the rates of up to 12% reported with other approaches [4]. This finding strongly supports the use of the anterior route to enhance patient safety.

The functional outcomes in our study, with a mean DASH score of 8.5 and a Constant-Murley score of 91.2, are highly encouraging. These results suggest a near-complete return to pre-injury activity levels for most patients. Such outcomes are a direct benefit of the MIPO technique, which allows for early mobilization of adjacent joints, preventing stiffness and promoting a quicker recovery [12].

Our complication profile was minimal and manageable. The

rates of infection (5% superficial) and non-union (2.5%) are well within the acceptable limits reported in the literature [10, 13].

While our study provides strong evidence for the use of ABP, it is not without limitations. The sample size of 40 is relatively small, and the absence of a control group (e.g., non-operative management or other surgical techniques) limits direct comparison. A longer-term follow-up would also be beneficial to assess for late complications.

5. Conclusion

Minimally invasive anterior bridge plating is a safe, reliable, and highly effective surgical treatment for mid-shaft humeral fractures. It provides high union rates, excellent functional outcomes, and a low risk of complications, particularly iatrogenic radial nerve palsy. Based on our findings, we recommend ABP as a preferred surgical option for indicated diaphyseal humeral fractures in the adult and elderly Indian population.

Conflict of Interest

Not available

Financial Support

Not available

References

1. Volgas DA, Stannard JP, Alonso JE. Nonunions of the humerus. Clin Orthop Relat Res. 2004;(419):46-50.
2. Sarmiento A, Zagorski JB, Zych GA, Latta LL, Capps CA. Functional bracing for the treatment of fractures of the humeral diaphysis. J Bone Joint Surg Am. 2000;82(4):478-486.
3. Carroll EA, Schweppe M, Langfitt M, Miller AN, Halvorson JJ. Management of humeral shaft fractures. J Am Acad Orthop Surg. 2012;20(7):423-433.
4. Wang C, Li J, Li Y, Dai G, Wang K. A meta-analysis of anterior versus posterior plating for humeral shaft fractures. J Orthop Surg Res. 2021;16(1):198-207.
5. Apivatthakakul T, Arpornchayanon O, Bavornratanavech S. Minimally invasive plate osteosynthesis (MIPO) of the humeral shaft fracture. Is it possible? A cadaveric study and preliminary report. Injury. 2005;36(4):530-538.
6. Jiang R, Luo CF, Wang MC, Yang TY, Zeng BF. Minimally invasive plating for complex humeral shaft fractures. Arch Orthop Trauma Surg. 2007;127(7):531-535.
7. Lin J, Hou SM, Hang YS. Treatment of humeral shaft fractures by minimal internal fixation with a plate. J Trauma. 2000;48(5):969-974.
8. Gautier E, Sommer C. Guidelines for the clinical application of the LCP. Injury. 2003;34(Suppl 2):B63-B76.
9. An Z, Zeng B, He X, Chen Q, Hu S. Plating osteosynthesis of mid-distal humeral shaft fractures: a comparison of anterior versus posterior approaches. Int Orthop. 2010;34(1):131-137.
10. Malhan S, Denny S, Krishna L, Karthik V, Kumar T, Gopinath B. Anterior bridge plating for humeral shaft fractures—a biological fixation. J Clin Diagn Res. 2016;10(1):RC01-RC04.
11. Livani B, Belangero WD, Castro de Medeiros R. Fractures of the shaft of the humerus: a retrospective study of 228 patients. Int Orthop. 2004;28(5):298-301.
12. Zhiquan A, Bingfang Z, Yeming W, Chi Z, Peiyan H. Minimally invasive plating osteosynthesis (MIPO) of middle and distal third humeral shaft fractures. J Orthop Trauma. 2007;21(9):628-633.
13. O'Driscoll SW, Horii E, Carmichael SW, Morrey BF. The cubital tunnel and ulnar nerve neuropathy. J Bone Joint Surg Am. 1991;73(4):613-617.

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