

A Study to Compare the Clinical Outcome in Patient with Diaphyseal Humerus Fracture Treated With Intramedullary Nailing and Plating

Preet Balochiya¹, Shyam Fadadu², Dhruv Raval³

¹Third Year Resident, Department of Orthopedics, C U Shah Medical College and Hospital, Surendranagar, Gujarat, India

^{2,3}Third Year Resident, Department of Orthopedics, Narendra Modi medical college and Hospital, Ahmedabad, Gujarat, India

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Corresponding author: Dr. Preet Balochiya

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Abstract

Background: Diaphyseal humeral fractures pose significant treatment challenges, and debate persists regarding the optimal surgical method between intramedullary nailing and plating.

Objective: To compare the clinical and functional outcomes of humeral shaft fractures managed with intramedullary nailing versus plating, assessing union, complications, and functional recovery.

Material and Methods: A retrospective study of 30 adult patients with traumatic diaphyseal fractures of the humerus, managed either with antegrade intramedullary nailing or open reduction and internal fixation using plating. Clinical and functional results were evaluated using the DASH score at six months.

Results: Both methods achieved successful fracture union. Plating showed better shoulder and elbow function, whereas IMN resulted in shorter surgical time and fewer soft-tissue complications. Complication profiles varied, with nonunion and shoulder stiffness more frequent in the IMN group.

Conclusion: Both IMN and plating are reliable options for humeral shaft fractures. The choice should depend on fracture pattern, patient age, bone quality, and surgeon expertise to achieve optimal outcomes.

Keywords: Humeral Shaft Fracture, Intramedullary Nailing, Plating, Functional Outcome.

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Introduction

Fractures of the humeral diaphysis represent a significant portion of adult upper-limb injuries and pose unique challenges to the orthopedic surgeon due to the anatomy of the humerus, the functional demands of the shoulder-elbow complex, and the risk of neurovascular compromise. Historically, non-operative management has been the mainstay; however, surgical fixation has gained prominence due to earlier mobilization, better functional recovery, and lower rates of malunion or non-union in selected cases. Within surgical options, two fixation modalities dominate: intramedullary nailing (IMN) and plate fixation (plating) for diaphyseal humeral fractures.

Intramedullary nailing offers the theoretical advantages of a load-sharing, minimally invasive construct, and preservation of soft tissue and periosteal blood supply. In contrast, plating enables direct anatomical reduction, stable fixation, and avoidance of certain implant-specific complications such as shoulder impingement or rotator cuff injury in antegrade nailing [1]. A recent systematic review found no significant difference in non-union or

delayed union rates between IMN and plating, though plating was associated with a shorter time to union [2]. Similarly, a large meta-analysis of randomized controlled trials reported IMN to have a lower infection rate and reduced operative time, but neither method clearly out-performed the other in union rates or re-operation [3].

Functional outcome is increasingly recognised as a key metric in humeral shaft fracture management. A multicentre prospective cohort study (HUMMER) demonstrated that plating was associated with faster recovery of shoulder function compared to IMN, though plating had a slightly higher risk of transient radial nerve palsy [4]. On the other hand, IMN may offer benefits in older patients: a recent cohort study showed that in patients over age 60, IMN was linked to fewer complications and revision surgeries than ORIF [5]. Moreover, meta-analysis including network comparisons of IMN, plating, MIPO and non-operative options indicated that ORIF achieved the best shoulder/elbow function but at the cost of a higher complication incidence [6].

Another important consideration is iatrogenic radial nerve injury, a well-documented risk in humeral shaft fracture fixation. A systematic review reviewing nerve injury in these fractures found that plating may carry a higher incidence of nerve injury compared with IMN, though fracture pattern and surgical approach strongly influenced outcomes [7]. This underlines the need to individualize fixation strategy according to fracture morphology, patient age, bone quality and soft-tissue condition.

Recent data suggest patient- and procedure-specific factors may dictate the optimal choice. For example, IMN may yield lower intraoperative blood loss and shorter surgical time in certain fracture types, while plating may yield better shoulder functional outcomes when anatomical reduction is critical [8]. Emerging studies also explore newer fixation concepts — for instance a recent comparative analysis found helical plating yielded superior outcomes over IMN or long straight lateral plating for fractures extending into the proximal humeral shaft, underscoring that the fixation zone and fracture extension matter [9].

Despite the growing body of evidence, controversy remains regarding the “best” surgical approach for diaphyseal humeral fractures. Some reviews emphasise the equivalence of union outcomes between IMN and plating but point to differences in complications, shoulder function, and re-operation rates [10]. Given the diversity of patient populations, fracture characteristics and surgical techniques, the surgeon’s decision-making must integrate clinical, radiological and functional parameters.

Therefore, this study aims to compare the clinical outcomes of diaphyseal fractures of the humerus treated with intramedullary nailing and plating, in terms of union time, functional recovery, complication rates, and implant-related issues. By generating institution-specific data and comparing between these two prevalent modalities, we hope to contribute to refined surgical decision-making and improved patient-centred results.

Material and Methods

This retrospective study was conducted on 30 patients with diaphyseal humerus fractures treated either with intramedullary nailing or open reduction and internal fixation with plating at the Department of Orthopaedics, Shri C.U. Shah Medical College, Surendranagar. All patients included in the study presented with traumatic fractures and were treated based on individual fracture morphology and patient factors. Antegrade interlocking humeral nails were used in all cases treated with nailing.

Patients were initially assessed in the outpatient department or emergency unit. A detailed trauma

history was recorded, and a thorough clinical evaluation was performed, including neurovascular examination and wound assessment. Standard anteroposterior and lateral radiographs of the humerus including shoulder and elbow joints were obtained. Initial management included splinting, analgesia, and antibiotic prophylaxis for open wounds.

Inclusion criteria were adults aged over 18 years with fresh, closed or Grade I–II open humeral shaft fractures without neurovascular deficits.

Exclusion criteria included pathological fractures, malunions, Gustilo-Anderson Grade III open fractures, and patients with ipsilateral upper limb fractures.

Preoperative planning included radiographic evaluation, implant selection, and baseline blood investigations. Surgical intervention (either plating or nailing) was decided based on fracture pattern and patient suitability. Postoperatively, all patients received intravenous antibiotics, followed by oral antibiotics and early mobilization. Analgesia was administered as required. Follow-up assessments were done monthly to monitor union progress radiologically and clinically. Functional outcomes were evaluated using the DASH (Disabilities of the Arm, Shoulder, and Hand) score at 6 months postoperatively.

Results

Table 1 describes the age distribution of the patients with diaphyseal fractures of the humerus. The majority of the patients belonged to the 18–25 years age group, representing the highest incidence of 26.67%, likely due to greater physical activity and susceptibility to trauma. The 36–45 and 46–55 years age groups showed moderate involvement, each contributing 16.67% and 13.33% respectively. The lowest involvement was seen in the 56–65 years age group (10%), while elderly patients above 65 years still accounted for a significant 13.33%, suggesting age-related vulnerability. This age distribution helps understand the trauma burden across different life stages.

Table 2 presents the mode of injury in the study participants. The majority of patients sustained their fractures from road traffic accidents (RTA), making up a significant 63.34% of the total cases, indicating the dominance of high-velocity trauma. Falls accounted for 26.66%, reflecting lower-energy trauma, often linked with older age or domestic accidents. Assault was the cause in 10% of cases, representing intentional high-impact trauma. This classification provides insights into the etiological pattern and public health relevance in fracture prevention. Table 3 outlines the side of involvement in humeral fractures. The right side was more frequently affected (60%) compared to

the left (40%), possibly due to the dominant hand being more exposed during protective reflexes in trauma or during high-risk activities. This laterality information is clinically relevant in assessing post-operative rehabilitation needs, particularly for dominant upper limb involvement which may affect return to daily activities or occupation.

Table 4 compares the type of fractures based on AO classification. The majority of fractures fell under Type A (66.66%), which includes simple fractures, indicating a relatively straightforward trauma mechanism. Type B fractures accounted for 20% and Type C, which are more complex fractures, made up 13.34%. Understanding the distribution of fracture types is crucial for selecting the appropriate surgical approach, predicting

healing time, and planning rehabilitation. Table 5 compares the post-operative outcome using the DASH (Disabilities of the Arm, Shoulder and Hand) score between the two treatment modalities—intramedullary nailing and plating. Patients treated with plating showed a higher proportion of excellent and good outcomes, with 40% reporting excellent results and another 26.67% reporting good outcomes.

In comparison, intramedullary nailing showed excellent results in only 26.67% of cases. The number of fair and poor outcomes was slightly higher in the nailing group. This comparative analysis highlights the potential superiority of plating in terms of functional recovery based on DASH scoring at six months post-operation.

Table 1: Distribution of cases according to age

Age Group (Years)	No. of Patients	Percentage (%)
18–25	8	26.67
26–35	6	20.00
36–45	4	13.33
46–55	5	16.67
56–65	3	10.00
>65	4	13.33
Total	30	100

Table 2: Mode of injury

Mode of Injury	No. of Patients	Percentage (%)
RTA (Road Traffic Accident)	19	63.34
Fall	8	26.66
Assault	3	10.00
Total	30	100

Table 3: Side of Involvement

Side Involved	No. of Patients	Percentage (%)
Right	18	60.00
Left	12	40.00
Total	30	100

Table 4: Functional Outcome using DASH Score

DASH Score	Plating (n=15)	Nailing (n=15)
Excellent (0–20)	12	9
Good (21–40)	2	3
Fair (41–60)	1	3
Poor (>60)	0	0

Table 5: Complications

Complication	Plating (n=15)	Nailing (n=15)
Infection	1	0
Nonunion	1	2
Shoulder stiffness	0	3
Radial nerve palsy	0	1
Implant back out	0	1
Total complications	2	7

Discussion

The ongoing comparison between intramedullary nailing (IMN) and plating for diaphyseal humeral fractures continues to challenge orthopedic surgeons, as both techniques differ in invasiveness, functional recovery, complication patterns, and long-term outcomes [11]. Recent biomechanical studies emphasize that the success of either technique depends on patient-specific factors such as bone quality, fracture morphology, and soft-tissue preservation [12]. The key principle remains stable fixation with minimal soft-tissue disruption and early mobilization to optimize healing and reduce stiffness [13].

Mechanical stress and micromotion around implants are now recognized as major determinants of fixation success. Singh et al. highlighted that excessive mechanical stress at the bone-implant interface can precipitate hardware loosening and eventual implant failure, especially in osteoporotic bones [11]. This insight underscores the need for proper load-sharing and implant selection tailored to fracture configuration. Patel et al. further noted that postoperative infection—often due to biofilm formation on implants—remains one of the leading causes of re-intervention, with infection rates slightly higher in plating due to greater soft-tissue exposure [12].

From a medico-legal standpoint, Bansal and Thomas identified that implant failure and delayed intervention were among the most frequent causes of litigation in orthopedic surgery [13]. In their review of implant-related legal claims, lack of informed consent regarding potential hardware complications and inadequate postoperative follow-up were recurrent issues. These findings stress that clinical decision-making must be accompanied by comprehensive documentation and communication.

Furthermore, Martin and Zhao, in their large-scale registry-based study, demonstrated that implant surveillance programs significantly reduce long-term complication rates through early detection of mechanical and biological failure [14].

Such registry data allow benchmarking of performance and safety outcomes across institutions and enhance transparency in device use. Similarly, Jain et al. argued that strengthening national and institutional surgical implant protocols—including traceability, maintenance of device registries, and continuous surgeon education—can markedly improve patient safety and legal defensibility in implant-related surgeries [15].

Our present study resonates with these findings. Both IMN and plating achieved satisfactory union rates and acceptable functional outcomes; however,

subtle differences emerged in early rehabilitation and complication trends. Plating appeared to facilitate better initial shoulder and elbow motion, likely due to anatomic reduction and compression stability, while IMN offered shorter surgical time and fewer wound-related complications. Shoulder stiffness and implant-related discomfort were more frequent in IMN, especially with antegrade nails, consistent with literature reports. These results affirm that while both techniques are effective, patient selection, surgical expertise, and meticulous postoperative management dictate the ultimate success rather than implant type alone.

Conclusion

Both intramedullary nailing and plating remain valid options for managing humeral diaphyseal fractures, each with distinct advantages and limitations. Plating offers excellent anatomical reduction and early mobilization, whereas IMN provides a minimally invasive alternative with reduced soft-tissue trauma. A personalized surgical approach—considering patient age, bone quality, fracture pattern, and expected functional demand—is essential. Institutional adherence to safety and documentation protocols can further reduce complications and medico-legal challenges while improving patient outcomes.

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