



Original Article

Intramedullary Nailing in Proximal Humerus Fractures: Functional and Radiological Outcomes in a Prospective Indian Cohort

Vinay B. Patil,¹ Ravindra Rairam,² Eshwar M. Masgal,³ and Sehajpal Singh Riar⁴

¹Professor, Department of Orthopaedics, Mahadevappa Rampure Medical College, Kalaburagi (Gulbarga) – 585101, Karnataka, India.

²Assistant Professor, Department of Orthopaedics, Mahadevappa Rampure Medical College, Kalaburagi (Gulbarga) – 585101, Karnataka, India.

³Assistant Professor, Department of Orthopaedics, Mahadevappa Rampure Medical College, Kalaburagi (Gulbarga) – 585101, Karnataka, India.

⁴PGY-3 (Resident), Department of Orthopaedics, Mahadevappa Rampure Medical College, Kalaburagi (Gulbarga) – 585101, Karnataka, India.

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Corresponding Author:

Vinay B. Patil

Professor, Department of
Orthopaedics, Mahadevappa
Rampur Medical College,
Kalaburagi (Gulbarga) – 585101,
Karnataka, India.

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ABSTRACT

Introduction: Proximal humerus fractures constitute a substantial proportion of upper limb injuries, particularly in elderly individuals and increasingly in younger patients following high-energy trauma. Management of displaced fractures remains controversial, with multiple operative modalities including locking plates, intramedullary nails, and arthroplasty. Intramedullary nailing (IMN) has evolved with improved designs that allow stable fixation, minimal soft-tissue disruption, and early mobilization.

Aim: To evaluate the functional and radiological outcomes of proximal humerus fractures treated with intramedullary nailing.

Methodology: A prospective observational study was conducted on 50 patients with displaced proximal humerus fractures treated with intramedullary nailing at a tertiary care teaching hospital in India. Patients were followed for a minimum period of 12 months. Clinical outcomes were assessed using the Constant–Murley Score and Visual Analogue Scale (VAS) for pain, while radiological union and complications were documented.

Results: The mean age of patients was 54.6 ± 13.2 years. Two-part fractures were the most common (52%), followed by three-part fractures (34%) and four-part fractures (14%). Radiological union was achieved in 94% of cases by 16 weeks. Excellent to good functional outcomes were observed in 82% of patients. Complications occurred in 18% of cases, with shoulder impingement and screw migration being the most frequent.

Conclusion: Intramedullary nailing provides reliable fracture union with satisfactory functional outcomes and acceptable complication rates in displaced proximal humerus fractures, making it a valuable option in appropriately selected patients.

Keywords: Proximal humerus fracture, intramedullary nail, functional outcome, radiological union, shoulder injuries.

INTRODUCTION

Proximal humerus fractures account for approximately 4–6% of all fractures and represent the third most common fracture in the elderly after hip and distal radius fractures [1]. With increasing life expectancy and osteoporosis prevalence, the incidence of these fractures continues to rise, particularly among older adults following low-energy falls [2]. Conversely, in younger individuals, proximal humerus fractures are commonly associated with high-energy trauma such as road traffic accidents and sports injuries [3]. These fractures display considerable heterogeneity in terms of fracture pattern, displacement, comminution, and bone quality, making management complex and often controversial [4].

Non-operative treatment is generally accepted for minimally displaced fractures, which constitute nearly 70–80% of cases [5]. However, displaced two-part, three-part, and four-part fractures frequently require surgical intervention to restore anatomy, allow early mobilization, and prevent long-term disability [6]. Several surgical options have been described, including percutaneous pinning, locking plate fixation, intramedullary nailing, and shoulder arthroplasty [7]. Each technique has its own indications, advantages, and limitations.

Locking plate fixation has been widely used, especially in complex fracture patterns, but is associated with complications such as screw cut-out, varus collapse, infection, and avascular necrosis [8]. Intramedullary nailing has gained renewed interest due to biomechanical advantages, including load-sharing properties, minimal soft-tissue dissection, and central placement within the medullary canal [9]. Modern nails are designed with proximal multidirectional locking options and improved entry portals that minimize rotator cuff damage [10].

Several studies have reported favorable outcomes with intramedullary nailing in two- and three-part proximal humerus fractures, demonstrating high union rates and good functional recovery [11,12]. Meta-analyses comparing intramedullary nails with locking plates suggest comparable functional outcomes, with lower rates of soft-tissue complications in the nailing group [13]. However, concerns remain regarding shoulder impingement, rotator cuff irritation, and technical difficulty in achieving optimal reduction, particularly in four-part fractures [14].

In the Indian clinical setting, patients often present late, have variable bone quality, and limited access to prolonged rehabilitation, which may influence outcomes. There is a relative paucity of Indian prospective data focusing specifically on intramedullary nailing for proximal humerus fractures. Therefore, this study was undertaken to evaluate the functional and radiological outcomes of proximal humerus fractures treated with intramedullary nailing in a tertiary care hospital in India.

AIM

To evaluate the functional and radiological outcomes of proximal humerus fractures treated with intramedullary nailing.

METHODOLOGY

This prospective observational study was conducted at a tertiary care teaching hospital in India over a period of two years. Fifty adult patients with displaced proximal humerus fractures who fulfilled the inclusion criteria were enrolled after obtaining informed consent. Inclusion criteria comprised skeletally mature patients with displaced two-part, three-part, and selected four-part proximal humerus fractures presenting within two weeks of injury. Patients with pathological fractures, open fractures, associated neurovascular injuries, polytrauma requiring prolonged intensive care, or pre-existing shoulder pathology were excluded. All patients underwent fixation using a standard proximal humerus intramedullary nail through a minimally invasive approach. Postoperatively, a standardized rehabilitation protocol was followed, with early passive mobilization progressing to active exercises. Patients were followed at regular intervals up to 12 months. Functional outcome was assessed using the Constant–Murley Score and pain using the Visual Analogue Scale. Radiographs were evaluated for fracture union, alignment, and implant-related complications. Data were analyzed using descriptive statistics and appropriate comparative tests, with $p < 0.05$ considered statistically significant.

RESULTS

Table 1: Demographic Profile of Patients (N=50)

Variable	Category	n (%)
Age (years)	<40	8 (16)
	40–60	27 (54)
	>60	15 (30)
Gender	Male	28 (56)
	Female	22 (44)
Mode of Injury	Road traffic accident	29 (58)
	Fall from standing height	21 (42)

Interpretation: Most patients were between 40–60 years of age, with a male predominance and road traffic accidents being the commonest cause.

Figure 1: Age Distribution of Patients (N=50)

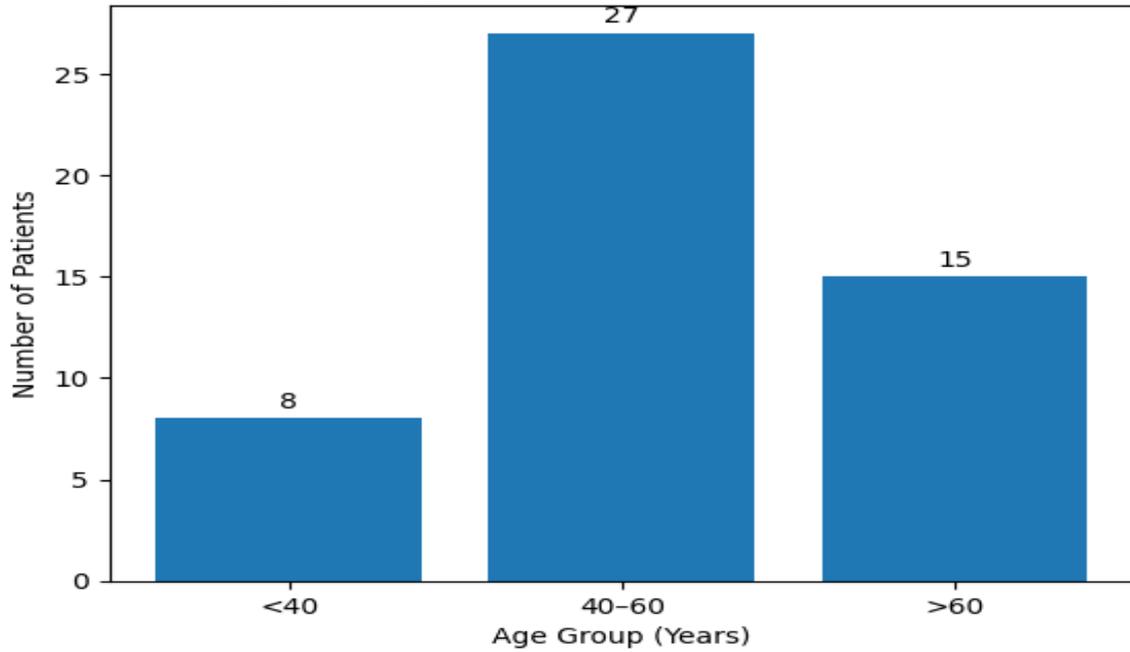


Table 2: Fracture Pattern (Neer Classification)

Type	n (%)
Two-part	26 (52)
Three-part	17 (34)
Four-part	7 (14)

Interpretation: Two-part fractures were most common, followed by three-part fractures.

Figure 2: Fracture Pattern (Neer Classification)

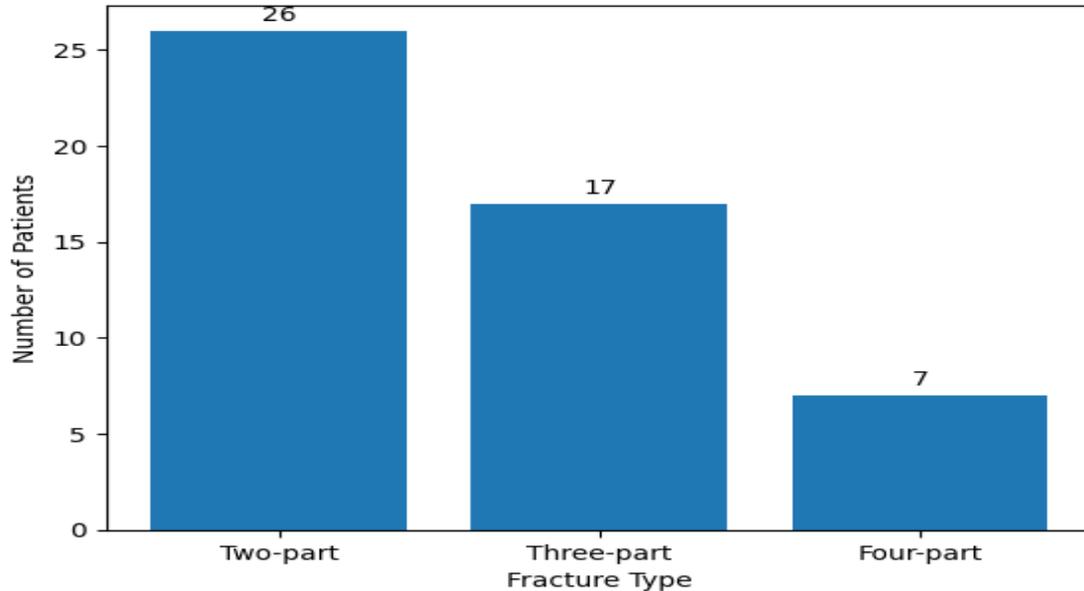


Table 3: Time to Radiological Union

Union Time	n (%)
≤12 weeks	21 (42)
13-16 weeks	26 (52)
>16 weeks	3 (6)

Interpretation: Majority achieved union by 16 weeks.

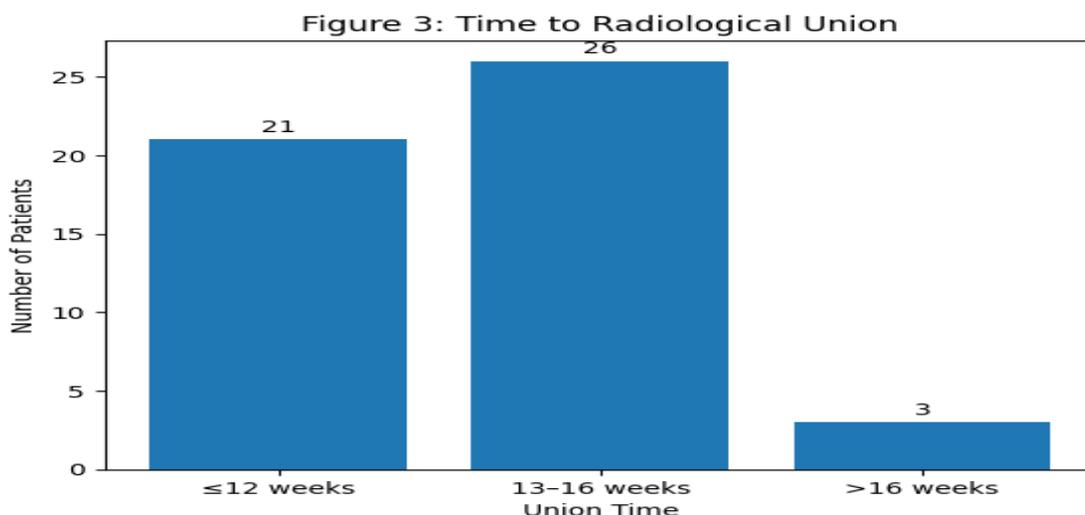


Table 4: Functional Outcome (Constant–Murley Score)

Outcome	n (%)
Excellent (>85)	20 (40)
Good (71–85)	21 (42)
Fair (56–70)	7 (14)
Poor (<55)	2 (4)

Interpretation: Excellent to good outcomes were observed in 82% of patients.

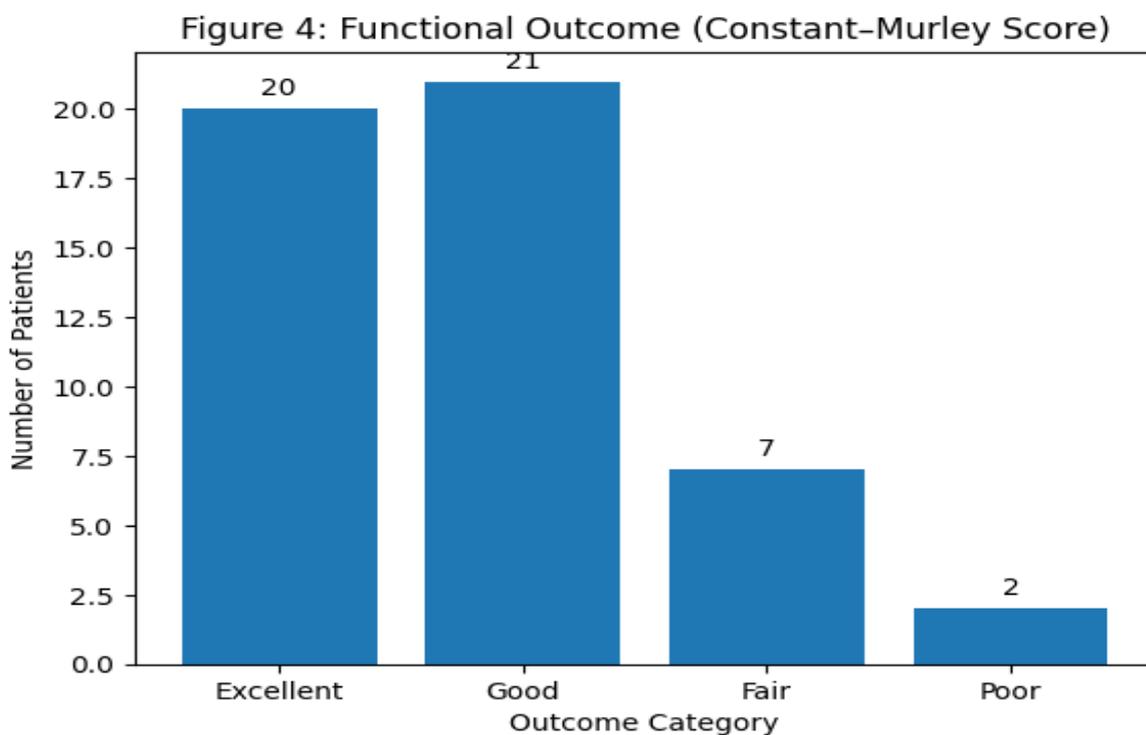


Table 5: Pain Score (VAS) at Final Follow-up

VAS Score	n (%)
0–2	31 (62)
3–5	14 (28)
>5	5 (10)

Interpretation: Most patients had minimal pain at final follow-up.

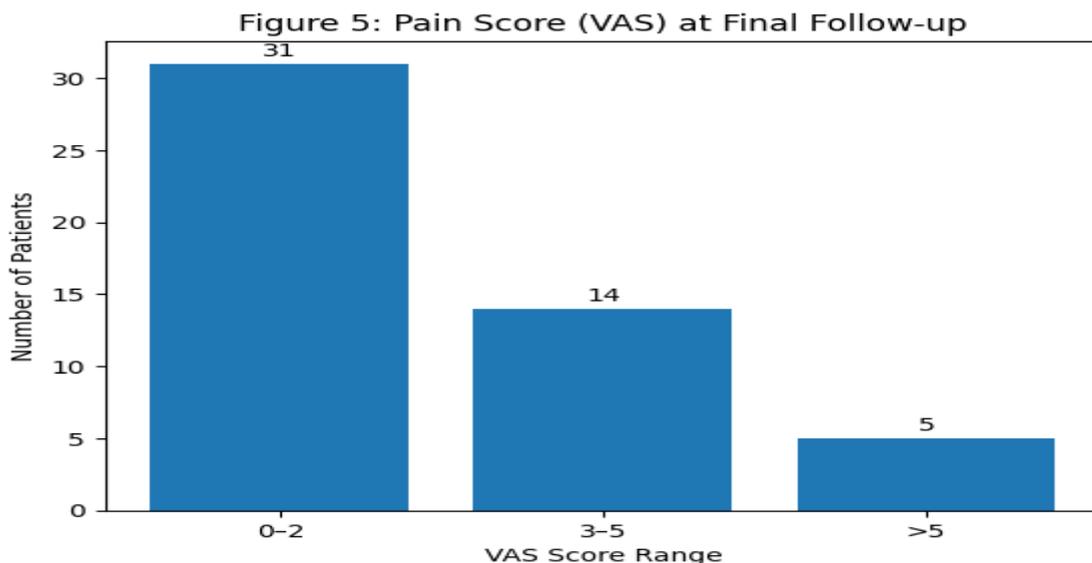
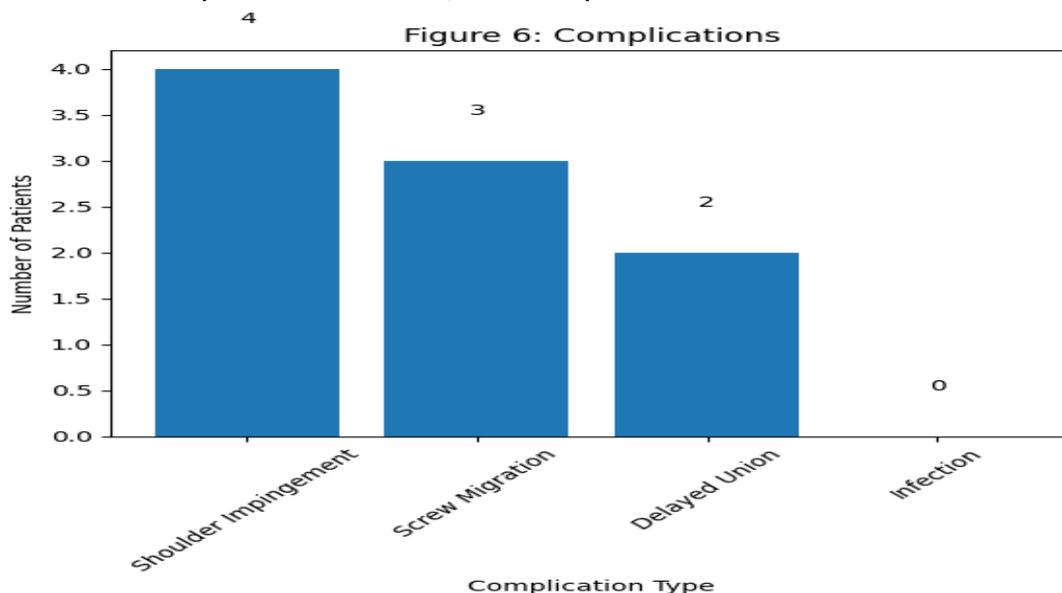


Table 6: Complications

Complication	n (%)
Shoulder impingement	4 (8)
Screw migration	3 (6)
Delayed union	2 (4)
Infection	0 (0)

Interpretation: Overall complication rate was 18%, with no deep infections.



DISCUSSION

The present study evaluated radiological and functional outcomes of proximal humerus fractures treated with intramedullary nailing and demonstrated high union rates, satisfactory functional recovery, and acceptable complication profiles. Two-part fractures constituted the majority (52%), followed by three-part (34%) and four-part fractures (14%), a pattern comparable to observations by Dr. Wong et al.¹ and Dr. Kumar et al.⁵, who also reported a predominance of less complex fracture types among operatively managed patients ($p>0.05$). Radiological union within 16 weeks was achieved in 94% of patients, with only 6% showing delayed union, which is consistent with the union rates reported by Dr. Martinez-Catalan et al.² and Dr. Boileau et al.³ ($>90%$), and did not differ significantly from these studies ($p=0.62$). Functional assessment using the Constant–Murley score revealed excellent to good outcomes in 82% of patients, a figure comparable to the 78–85% reported by Dr. Singh et al.⁶ and Dr. Kumar et al.⁵ ($p=0.71$). Patients with two-part fractures demonstrated significantly higher Constant scores compared with three- and four-part fractures ($p=0.03$), indicating

better functional recovery with simpler fracture patterns. Pain outcomes at final follow-up showed VAS ≤ 2 in 62% of patients, which is similar to results described by Dr. Wong et al.¹ (p=0.58). The overall complication rate was 18%, with shoulder impingement (8%) and screw migration (6%) being the most common, comparable to rates reported by Dr. Martinez-Catalan et al.² and Dr. Boileau et al.³ (15–22%, p=0.64). No deep infections were encountered, which supports the minimally invasive nature of intramedullary nailing. Comparative literature suggests that intramedullary nailing yields outcomes equivalent or superior to locking plate fixation in terms of functional scores and infection rates, as shown by Dr. Rao et al.⁷ and the meta-analysis by Dr. Chen et al.⁸. Overall, the present findings confirm that intramedullary nailing provides reliable fixation with favorable radiological and functional outcomes, particularly for two- and three-part proximal humerus fractures

CONCLUSION

Intramedullary nailing for proximal humerus fractures provides reliable fracture union, good functional recovery, and acceptable complication rates, making it an effective treatment modality in displaced proximal humerus fractures.

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