



Original Article

Functional Outcomes of Proximal Humerus Fractures Treated with Philos Plating” – A Prospective Study

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ABSTRACT

Background: Proximal humerus fractures are common in adults and often pose challenges in achieving stable fixation and early functional recovery. PHILOS (Proximal Humerus Internal Locking System) plating offers angular stability and allows early mobilisation.

Objective: To evaluate the functional and radiological outcomes of extra-articular proximal humerus fractures treated with PHILOS plating.

Methods: A prospective cross-sectional observational study was conducted from June 2024 to December 2025 at Shri B. M. Patil Medical College, Vijayapura, Karnataka, India. Twenty-six patients with Neer type II and III proximal humerus fractures were treated with PHILOS plating. Pre- and post-operative evaluations included clinical examination, radiography, and functional assessment using the Neer scoring system. Pain was assessed with the Visual Analogue Scale (VAS), and range of motion was recorded over six months.

Results: The mean age of patients was 47.42 ± 13.98 years, with a female predominance (53.8%). The mean surgery duration was 101.73 ± 12.65 minutes, and no intraoperative complications were reported. At six months, mean forward flexion and abduction were 152.5° and 148.85° , respectively. Radiological union occurred at a mean of 13.12 ± 2.67 weeks. Post-operative complications were minimal (11.5%). Excellent or satisfactory Neer scores were observed in 88.5% of patients. Fracture complexity significantly influenced functional outcomes ($p = 0.001$), while age and injury mechanism showed no significant effect.

Conclusion: PHILOS plating provides stable fixation, early mobilization, and satisfactory functional and radiological outcomes in extra-articular proximal humerus fractures. Fracture pattern influences recovery, while age and mechanism of injury do not.

Keywords: Proximal humerus fracture, PHILOS plate, ORIF, Neer score, functional outcome, angular stability.

INTRODUCTION

Proximal humerus fractures account for approximately 5–6% of all fractures and are the third most common fractures in the elderly, after hip and distal radius fractures [1]. The incidence increases with age due to osteoporosis and is slightly higher in females due to decreased bone density [2,3]. These fractures present a wide spectrum, from minimally displaced fractures to complex, multi-part fractures involving the articular surface [4].

The Neer classification system is widely used to categorise proximal humerus fractures based on displacement and fragment number, aiding in surgical decision-making [5]. Two-part and three-part fractures are commonly seen in

middle-aged adults, while four-part fractures and fracture-dislocations are more frequent in elderly osteoporotic patients [6].

Treatment of displaced proximal humerus fractures is controversial. While non-operative management is reserved for minimally displaced fractures, displaced and comminuted fractures often require surgical fixation to restore anatomy, stability, and shoulder function [7,8]. Various surgical options exist, including percutaneous pinning, intramedullary nailing, tension band wiring, and locked plate fixation [9].

The Proximal Humerus Internal Locking System (PHILOS) plate provides angular stable fixation and allows early mobilization, which is critical in preventing stiffness and improving functional outcomes, especially in osteoporotic bone [10,11]. However, complications such as screw cut-out, varus collapse, avascular necrosis, and subacromial impingement can occur, particularly in complex fractures [12,13].

Previous studies have reported that PHILOS plating yields satisfactory outcomes in two- and three-part fractures, with union rates ranging from 90–95% and good to excellent functional outcomes in the majority of patients [14–16]. Functional recovery depends on fracture type, bone quality, surgical technique, and adherence to rehabilitation protocols [17,18].

Given the paucity of prospective Indian studies evaluating functional outcomes following PHILOS plating, this study aims to assess pain, range of motion, radiological union, complications, and overall functional outcomes in patients with displaced extra-articular proximal humerus fractures treated with PHILOS plates.

MATERIALS AND METHODS

Study Design and Setting

This study was a **prospective cross-sectional observational study** conducted in the Department of Orthopaedics at B.L.D.E. (Deemed to be University), Shri B. M. Patil Medical College, Hospital and Research Centre, Vijayapura, Karnataka, India.

Study Duration

The study was carried out from **June 2024 to December 2025**.

Sample Size Estimation

The sample size was calculated using the formula for a single proportion:

$$n = \frac{Z^2 \times p \times (1 - p)}{d^2}$$

Where:

- $Z = 1.96$ (95% confidence interval)
- $p = 0.017$ (estimated failure rate from previous literature)
- $d = 0.05$ (margin of error)

The calculated sample size was **26 patients**. Eligible patients were enrolled using **consecutive sampling** after obtaining informed written consent.

Study Population

Inclusion Criteria

- Patients aged more than 18 years
- Extra-articular proximal humerus fractures (Neer type II and III)
- Comminuted proximal humerus fractures

Exclusion Criteria

- Intra-articular proximal humerus fractures
- Polytrauma patients
- Open/compound fractures
- Active infection at the surgical site
- Patients with severe medical comorbidities precluding surgery
- Patients unwilling to provide consent or comply with follow-up

Data Collection Procedure

The study was initiated after obtaining approval from the Institutional Ethics Committee. All procedures adhered to the principles of the Declaration of Helsinki and Good Clinical Practice guidelines. Data were collected prospectively using a structured proforma.

Pre-operative Evaluation

All patients underwent detailed clinical and radiological assessment. A thorough history was obtained, including mechanism of injury, duration since injury, hand dominance, occupation, functional demands, and relevant medical history such as osteoporosis or chronic steroid use.

Clinical examination included assessment of general condition, vital signs, and local examination of the affected shoulder for deformity, swelling, tenderness, and range of motion. Neurovascular status was assessed, particularly axillary nerve function and distal circulation.

Radiological evaluation included anteroposterior, lateral, and axillary or scapular Y views of the shoulder. Fractures were classified according to the Neer classification system.

Routine pre-operative investigations included complete blood count, renal function tests, blood sugar, ECG, chest radiograph, and viral markers (HIV, HBsAg, HCV). Pre-anaesthetic evaluation was performed prior to surgery.

Surgical Procedure

All patients underwent **open reduction and internal fixation (ORIF)** using the PHILOS (Proximal Humerus Internal Locking System) plate under aseptic precautions.

Patients were positioned supine with a bolster under the scapula. Surgery was performed using the deltopectoral approach. The cephalic vein was identified and preserved, and the deltopectoral interval was developed. Care was taken to identify and protect the axillary nerve.

Fracture fragments were exposed, hematoma evacuated, and reduction achieved using gentle manipulation. Temporary fixation was done using Kirschner wires. The PHILOS plate was positioned lateral to the bicipital groove and fixed using locking screws in the humeral head and cortical/locking screws in the shaft.

In comminuted fractures, additional fixation was achieved using non-absorbable sutures through the rotator cuff tendons. Reduction and screw placement were confirmed intraoperatively using fluoroscopy.

Wound closure was performed in layers, and the limb was immobilised using a shoulder immobiliser.

Post-operative Management

Patients were monitored postoperatively for vital stability and complications. Intravenous antibiotics were administered for 48–72 hours, followed by oral antibiotics. Analgesics were given for pain control.

Post-operative radiographs were obtained on the first or second day to assess reduction and implant position. Wound inspection and dressing were done regularly, and sutures were removed after 12–14 days.

Rehabilitation Protocol

A structured rehabilitation protocol was followed under physiotherapy supervision:

- **Phase I (0–3 weeks):** Immobilisation with early mobilisation of elbow, wrist, and hand; pendulum exercises initiated
- **Phase II (3–6 weeks):** Passive and assisted active shoulder movements
- **Phase III (6–12 weeks):** Active range of motion and gradual strengthening exercises
- **Phase IV (>12 weeks):** Functional rehabilitation and return to daily activities

Follow-up and Outcome Assessment

Patients were followed up at **2 weeks, 6 weeks, 3 months, and 6 months.**

Clinical assessment included pain (Visual Analogue Scale), range of motion, and functional status. Radiological evaluation was performed to assess fracture union, implant position, and complications.

Functional outcome was assessed using the **Neer scoring system**. Fracture union was defined as bridging callus formation across at least three cortices with painless shoulder movement.

Data Management

All data were recorded in a structured proforma and maintained with confidentiality using unique patient identifiers.

Statistical Analysis

Data were analysed using **Microsoft Excel and SPSS version 20.**

- Continuous variables were expressed as mean \pm standard deviation or median (interquartile range)

- Categorical variables were expressed as frequencies and percentages
- Independent t-test or Mann–Whitney U test was used for comparison of continuous variables
- Chi-square or Fisher’s exact test was used for categorical variables
- Paired t-test or Wilcoxon signed-rank test was used for within-group comparisons
- ANOVA or Kruskal–Wallis test was used for multiple group comparisons

A **p-value < 0.05** was considered statistically significant.

Ethical Considerations

The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants. Confidentiality of patient data was strictly maintained, and the study did not interfere with standard patient care.

RESULTS AND OBSERVATIONS

The Orthopaedics department at Shri B. M. Patil Medical College, Hospital & Research Centre, Vijayapura, conducted this study from March 2024 to December 2025 to evaluate PHILOS-plated proximal humerus fractures' post-operative functional results.

DEMOGRAPHIC CHARACTERISTICS

Table 1: Age and Gender Distribution (N = 26)

Variable	Category	Frequency	Percentage (%)
Age Distribution	20–40 years	7	26.9%
	41–60 years	14	53.8%
	61–80 years	5	19.2%
	Total	26	100.0%
Mean Age (SD)	—	—	47.42 ± 13.98 years
Gender Distribution	Female	14	53.8%
	Male	12	46.2%
	Total	26	100.0%

Demographic analysis shows that the majority of patients (53.8%) belonged to the 41–60 years age group, followed by 26.9% in the 20–40 years group and 19.2% in the 61–80 years group. The mean age of the study population was 47.42 ± 13.98 years.

In terms of gender distribution, females constituted a slight majority (53.8%), while males accounted for 46.2% of the study population

CLINICAL CHARACTERISTICS

Table 2: Clinical Profile of Patients (N = 26)

Variable	Category	Frequency	Percentage (%)
Side of Injury	Left	8	30.8%
	Right	18	69.2%
	Total	26	100.0%
Mode of Injury	Fall	11	42.3%
	Road Traffic Accident (RTA)	15	57.7%
	Total	26	100.0%
Neer Classification	2-part	12	46.2%
	3-part	14	53.8%
	Total	26	100.0%

The clinical profile of patients showed that the right side was more commonly affected (69.2%) compared to the left side (30.8%). Regarding the mechanism of injury, road traffic accidents were the predominant cause (57.7%), followed by falls (42.3%).

Based on fracture classification, three-part fractures (53.8%) were slightly more frequent than two-part fractures (46.2%), indicating a higher proportion of relatively complex fracture patterns in the study population.

SURGICAL CHARACTERISTICS AND PAIN ASSESSMENT

Table 3: Surgical Parameters and Pain Score Progression (N = 26)

Variable	Category / Time Point	Mean / Frequency	SD / Percentage (%)
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Intraoperative Parameters	Surgery Duration (minutes)	101.73	12.645
Intraoperative Complications	None	26	100.0%
	Present	0	0%
VAS Pain Score	Postoperative Day 1	7.31	1.225
	Week 2	5.46	1.392
	Month 1	3.73	1.373
	Month 3	2.73	1.373
	Month 6	1.81	1.297

The mean duration of surgery was 101.73 ± 12.645 minutes, reflecting a consistent operative time across cases. No intraoperative complications were reported, indicating a high level of surgical safety in all patients.

Pain assessment using the Visual Analogue Scale (VAS) demonstrated a progressive reduction in pain over time. The mean pain score decreased from 7.31 on postoperative day 1 to 5.46 at 2 weeks, 3.73 at 1 month, 2.73 at 3 months, and 1.81 at 6 months, indicating effective pain control and gradual recovery following surgical intervention.

FUNCTIONAL, RADIOLOGICAL OUTCOMES AND COMPLICATIONS

Table 4: Outcomes at 6 Months Follow-up (N = 26)

Variable	Parameter / Category	Mean / Frequency	SD / Percentage (%)
Range of Motion (degrees)	Forward Flexion	152.50	15.764
	Abduction	148.85	16.632
	External Rotation	50.58	9.932
	Internal Rotation	78.46	9.030
	Extension	37.50	5.701
Radiological Outcome	Union Time (weeks)	13.12	2.673
Post-operative Complications	None	23	88.5%
	Stiffness	2	7.7%
	Varus Collapse	1	3.8%
	Total	26	100.0%

At 6 months follow-up, patients demonstrated good functional recovery, with a mean forward flexion of 152.50° and abduction of 148.85° , indicating near-normal shoulder mobility. External and internal rotation, as well as extension, also showed satisfactory improvement. Radiological assessment revealed that fracture union occurred at a mean duration of 13.12 ± 2.673 weeks, suggesting timely healing in most cases.

Post-operative complications were minimal, with 88.5% of patients showing no complications. A small proportion developed shoulder stiffness (7.7%), while varus collapse was observed in 3.8% of cases, indicating an overall favourable outcome profile.

FUNCTIONAL OUTCOME SCORES AND ASSOCIATION ANALYSIS

Table 5: Neer Score Grading at Final Follow-up (N = 26)

Neer Grade	Frequency	Percentage (%)
Excellent (90–100)	12	46.2%
Satisfactory (80–89)	11	42.3%
Unsatisfactory (70–79)	3	11.5%
Total	26	100.0%

Table 6: Association Between Clinical Variables and Neer Functional Outcome

Variable	Category	Excellent (n=12)	Satisfactory (n=11)	Unsatisfactory (n=3)	p-value
Age Category	20–40 years	2(28.6%)	5(71.4%)	0 (0.0%)	0.415
	41–60 years	8(57.1%)	4(28.6%)	2(14.3%)	
	61–80 years	2(40%)	2(40%)	1(20%)	
Neer Classification	2-part	10(83.3%)	2(16.7%)	0 (0.0%)	0.001*
	3-part	2(14.3%)	9(64.3%)	3(21.4%)	
Mode of Injury	Fall	4(36.4%)	4(36.4%)	3(27.3%)	0.129
	RTA	8(53.3%)	7(46.7%)	0 (0.0%)	

DISCUSSION

Proximal humerus fractures pose significant management challenges due to variable fracture patterns and patient factors. In the present study, the mean age of patients was 47.42 ± 13.98 years, with the majority (53.8%) in the 41–60 years age

group. This is consistent with Robinson et al., who reported peak incidence of surgically treated fractures in middle-aged adults [19]. Females comprised 53.8% of cases, reflecting the higher risk of osteoporosis-related fractures reported in multiple epidemiological studies [2,3,20].

The right shoulder was more commonly involved (69.2%), possibly reflecting hand dominance and the mechanism of high-energy trauma [21]. Road traffic accidents were the predominant cause (57.7%), followed by falls (42.3%), which aligns with previous reports showing high-energy trauma in younger patients and low-energy falls in elderly individuals [22].

Fracture complexity strongly influenced functional outcomes. In our study, excellent Neer scores were observed in 83.3% of two-part fractures compared to only 16.7% of three-part fractures, with a statistically significant association ($p=0.001$). This finding is corroborated by Südkamp et al. and Brunner et al., who reported higher complication rates and lower functional outcomes in three- and four-part fractures [14,23].

The mean surgery duration was 101.73 ± 12.65 minutes, and no intraoperative complications were observed, highlighting the safety of PHILOS plating in experienced hands [24]. Postoperative pain scores decreased consistently from 7.31 on day 1 to 1.81 at six months, demonstrating effective analgesia and early rehabilitation protocols [25].

Functional outcomes were satisfactory. At six months, mean forward flexion was 152.50° and abduction 148.85° , with good external and internal rotation and extension, reflecting near-normal shoulder mobility. Radiological union occurred at 13.12 ± 2.67 weeks, consistent with literature reporting union between 12–14 weeks after PHILOS plating [26,27].

Postoperative complications were minimal. Stiffness occurred in 7.7%, and varus collapse in 3.8% of patients, lower than the 10–25% reported in other series, possibly due to meticulous surgical technique and structured rehabilitation [28,29]. Age and mechanism of injury were not significantly associated with functional outcomes, while fracture type was the key determinant, underscoring the importance of preoperative fracture assessment and surgical planning [30].

Overall, PHILOS plating provides stable fixation, early mobilisation, and satisfactory functional recovery, particularly for two- and selected three-part fractures. Careful patient selection, anatomical reduction, proper screw placement, and adherence to rehabilitation protocols are essential to minimise complications and maximise functional outcomes.

CONCLUSION

PHILOS plating for extra-articular proximal humerus fractures provides reliable fixation, early pain relief, and good functional recovery. Most patients achieved good to excellent Neer scores, with minimal complications and timely fracture union. Fracture complexity significantly influenced outcomes, while age and injury mechanism did not. Overall, PHILOS plating is a safe and effective treatment for these fractures.

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