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Original Research Article

PHILOS PLATE FIXATION FOR PROXIMAL HUMERUS FRACTURES: PROSPECTIVE EVALUATION OF CLINICAL AND RADIOLOGICAL OUTCOMES

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ABSTRACT

Background: Proximal humerus fractures are common injuries, particularly among adults, often resulting from high-energy trauma in younger individuals or low-energy falls in the elderly. Optimal management remains debated, but locking compression plates, such as PHILOS (Proximal Humerus Internal Locking System), have emerged as reliable fixation methods. This study evaluated the clinical and functional outcomes of proximal humerus fractures treated with PHILOS plating.

Materials and Methods: A prospective study was conducted on 46 patients with proximal humerus fractures managed surgically using PHILOS plating. Sociodemographic details, mode of injury, fracture type (Neer's classification), and intraoperative variables were recorded. Postoperative assessment included immobilization type, complications, pain scores, muscle strength, and functional outcome. Descriptive analysis was performed, and results were compared with existing literature.

Results: The majority of patients were aged 31–50 years (69.6%), with a slight female predominance (52.1%). Road traffic accidents were the most common cause (67.4%). Two-part fractures (67.4%) predominated, followed by three-part (23.9%) and four-part fractures (8.7%). Postoperatively, most patients were immobilized in an arm pouch (82.6%). Early complications included wound gaping (6.5%) and skin necrosis (4.3%), while late complications included stiffness (15.2%) and infection (6.5%). Functional outcomes were good in 60.8%, fair in 39.1%, and poor in 2.1%. Pain relief and near-normal muscle strength were achieved in over 90% of patients.

Conclusion: PHILOS plating offers stable fixation, facilitates early mobilization, and achieves satisfactory pain and functional outcomes in proximal humerus fractures, particularly in two- and three-part fractures. It is associated with manageable complications and remains a reliable surgical option.

Keywords: Proximal humerus fractures, PHILOS plate, Functional outcome, Neer's classification.

INTRODUCTION

Fractures of the proximal humerus represent one of the most common injuries encountered in orthopaedic practice, accounting for approximately 4–5% of all fractures and ranking third in frequency after hip and distal radius fractures.[1] The incidence has been steadily increasing due to an aging population, osteoporosis, and rising rates of high-energy trauma, particularly road traffic accidents (RTAs), in younger age groups.[2] These fractures are clinically significant as they involve the shoulder joint, a highly mobile articulation essential for upper limb function, and can result in substantial pain, disability, and loss of independence if inadequately treated.

The epidemiology of proximal humerus fractures (PHFs) demonstrates two distinct patterns. In elderly patients, they typically occur following low-energy mechanisms such as domestic falls, with women being disproportionately affected due to postmenopausal osteoporosis.[3] Conversely, in younger adults, PHFs are often the consequence of high-energy trauma, including RTAs, sports injuries, and occupational accidents.[4] Such injuries in younger patients are frequently associated with complex fracture patterns, displacement, and soft tissue involvement, which complicate management and compromise outcomes if not properly addressed.

Classification systems play an important role in guiding treatment decisions. Neer's classification, which subdivides PHFs into two-, three-, and four-part patterns based on displacement of key anatomic segments, remains widely used.[5] However, its moderate inter- and intra-observer reliability presents challenges in clinical application and interstudy comparisons. Despite these limitations, the classification remains clinically relevant, particularly for determining vascular risk to the humeral head fragment and the potential need for surgical intervention.

Management strategies for PHFs range from conservative treatment with immobilization to surgical fixation or arthroplasty. While non-operative treatment is often suitable for minimally displaced fractures in elderly, low-demand patients, displaced and unstable fractures in younger or active individuals generally require surgical stabilization.[6] Over the years, various surgical techniques have been employed, including percutaneous pinning, intramedullary nailing, hemiarthroplasty, and open reduction with internal fixation (ORIF) using plates and screws. Each method carries distinct advantages and limitations, with no universal consensus on the optimal strategy.

The advent of locking plate technology, particularly the Proximal Humerus Internal Locking System (PHILOS), has significantly transformed the surgical management of PHFs. Designed to provide angular stability and maintain fixation even in osteoporotic bone, PHILOS plates allow stable fixation of multi-fragmentary fractures while preserving vascularity.[7] The fixed-angle construct minimizes risks of varus collapse, screw loosening, and fixation failure, thereby facilitating early mobilization and functional recovery.[8] Numerous studies have reported satisfactory outcomes with PHILOS plating in both simple and complex fractures, though complications such as screw penetration, impingement, infection, and malunion remain concerns.[9,10]

Given these factors, it is imperative to evaluate the functional outcomes, complications, and radiological results of PHILOS plating across diverse patient populations and injury mechanisms. The present prospective study was conducted to assess the clinical and functional results of PHILOS plating in 46 patients with proximal humerus fractures, emphasizing demographic trends, fracture patterns, postoperative protocols, and outcomes in comparison with existing literature.

MATERIALS AND METHODS

This prospective interventional study was conducted in the Department of Orthopaedics, MNR Medical College and Hospital, Sangareddy, from January 2024 to June 2025. Forty-six patients aged 18-50 years with clinically and radiologically confirmed proximal humerus fractures (closed, ≤3 weeks old) who consented to participate were included. Exclusion criteria were fractures associated with humeral shaft, acute infection, pathological fractures, neurovascular injury requiring repair, open fractures, polytrauma precluding rehabilitation, severe cognitive impairment, and refusal to participate. Ethical approval and written informed consent were obtained.

Preoperative Evaluation

Following initial resuscitation, a detailed history and clinical examination were performed, including distal neurovascular assessment. Baseline investigations (hematology, biochemistry, chest radiograph, ECG) and radiographs (AP, lateral, axillary) were obtained, with CT scans reserved for complex fracture patterns. Fractures were classified according to Neer's system. Anaesthetic fitness was ensured, and prophylactic intravenous antibiotics were administered 30 minutes before surgery.

Surgical Technique

Under supraclavicular and interscalene block, patients were positioned supine with a sandbag under the scapula. Using a deltopectoral approach, fracture reduction was achieved and a PHILOS plate positioned ≥8 mm distal to the greater tuberosity and lateral to the biceps tendon. Locking screws were inserted into the humeral head and shaft under fluoroscopic guidance to confirm position, fixation stability, and absence of impingement. No bone grafting was required. Wounds were closed over a suction drain, which was removed on postoperative day two; sutures were removed on day 10–12.

Postoperative Care and Follow-up:

Antibiotics were continued for 48–72 hours. Passive elbow motion was started within 24–48 hours, with ice packs used for swelling control when necessary. Serial radiographs were taken immediately postoperatively and every 3–4 weeks to assess reduction quality, fracture union, and detect implant-related complications.

Functional outcome was assessed using Neer's scoring system, and radiological evaluation included fracture alignment, articular congruity, plate position, and implant integrity.

Rehabilitation Protocol:

- Phase I (0–3 weeks): Arm sling/immobilizer; pendulum exercises from week one; gentle passive forward flexion and rotations from week three.

- Phase II (4–6 weeks): Active range of motion and resistive exercises.
- Phase III (after 3 months): Advanced stretching/strengthening; light lifting permitted.

Continuous variables were summarized as mean ± SD (or median [IQR] if non-normal); categorical variables as counts (%). Normality was assessed with the Shapiro–Wilk test and Q-Q plots. Two-sided α=0.05 was used for significance, with 95% confidence intervals (CIs) reported for all effect estimates.

RESULTS

Table 1: Sociodemographic profile of study participants (n=46)

Demographic parameter	Frequency	Percentage
Age (In years)		
Below 20	04	8.69%
21-30	10	21.73%
31-40	14	30.43%
41-50	18	39.13%
Gender		
Male	22	47.82%
Female	24	52.17%
Occupation		
Professional	05	10.86
Skilled worker	11	23.91%
Labourer	16	34.78%
Housewives	04	8.69%
Unemployed	08	17.39%
Mode of Injury		
Road traffic accidents	31	67.39%
Assault	03	6.52%
Fall from height	12	26.08%

Table 2: Fracture details of the study participants

Demographic parameter	Frequency	Percentage
Laterality of injury		
Unilateral right	28	60.86%
Unilateral left	17	36.95%
Bilateral	01	2.17%
Duration of injury		
Up to 5 days	42	91.30%
6-10 days	03	6.52%
11-15 days	01	2.17%
History of previous treatment		
Splinting	02	4.34%
Reduction with splinting	02	4.34%
POP	01	2.17%
Massage	01	2.17%
No treatment	40	86.95%
Type of fractures		
Open fractures	01	2.17%
Closed fractures	45	97.82%
Neer's system fracture type		
Two part	31	67.39%
Three part	11	23.91%
Four part	04	8.70%

Table 3: Post-operative profile of cases undergone humerus PHILOS plate

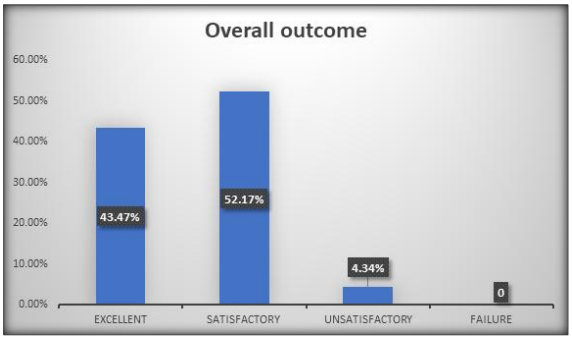
Demographic parameter	Frequency	Percentage
Post-operative immobilisation		
Arm pouch	38	82.60%
Post op POP	-	-
Shoulder immobilizer	08	17.40%
Post-operative early complication		
Wound gaping	03	6.52%
Skin necrosis	02	4.34%
Post-op late complication		
Infection	03	6.52%
Joint stiffness	07	15.21%
Malunion	01	2.17%
Heterotrophic ossification	02	4.34%

Most patients (82.60%) were immobilized with an arm pouch, while the remaining (17.40%) required a shoulder immobilizer. Early complications included wound gaping (6.52%) and skin necrosis (4.34%). Late complications observed were joint stiffness in 15.21% of cases, infection in 6.52%, malunion in 2.17%, and heterotrophic ossification in 4.34% (Table 3).

Pain assessment revealed that 65.21% reported no pain, while 23.91% experienced only slight, occasional discomfort without limitation. A small proportion reported mild (8.69%) or moderate (2.17%) pain, whereas no cases had marked or disabling pain. Functional outcomes were rated as good in 60.86% of patients, fair in 39.13%, and poor in only one case (2.17%). Muscle strength recovery was satisfactory in most cases, with 91.30% regaining normal strength, while a few had minor residual weakness (Table 4). The majority of patients achieved favourable results with good functional outcome and normal muscle strength, accompanied by minimal pain in most cases. Only a minority experienced complications or suboptimal recovery, indicating the overall effectiveness of the surgical intervention in restoring function (Table 5).

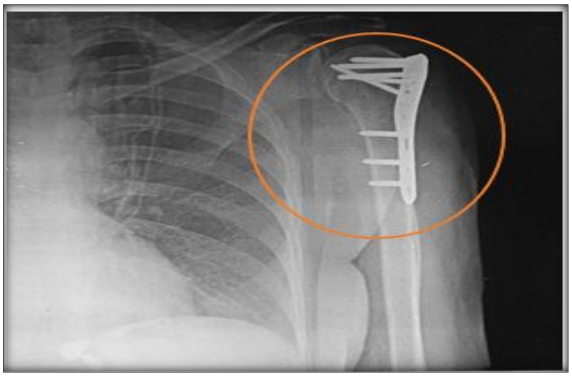
Table 4: Details of post-operative pain and functional outcome

Category	Frequency (%)
Pain scale	
No pain	30 (65.21%)
Slight, occasional, no compromise in activity	11 (23.91%)
Mild, no effect on ordinary activity	04 (8.69%)
Moderate, tolerable, makes concessions	01 (2.17%)
Marked, serious limitations	-
Totally disabled	-
Functional outcome	
Good	28 (60.86%)
Fair	18 (39.13%)
Poor	01 (2.17%)
Traces	-
Zero	-
Muscle strength	
Normal	42 (91.30%)
Against slight resistance	03 (6.52%)
Against gravity	01 (2.17%)
With the elimination of gravity	-
Flicker	-
Paralysis	-



Graph 1: Overall outcome of present study

A: Preoperative



B: Immediate post-op

B: Immediate post-op

Figure 1: Radiographs showing the status of proximal humerus fractures managed with PHIOLOS plate

DISCUSSION

This prospective cohort of 46 patients treated with PHILOS plating for proximal humerus fractures (PHFs) demonstrated a relatively young age distribution, with the peak incidence in the 41-50 years of age, and a slight female predominance. Road traffic accidents (RTAs) were identified as the leading cause of injury (Table 1). In contrast, Launonen et al. reported that most PHFs in Western populations occur in elderly women, predominantly in the seventh and eighth decades, and are usually the result of low-energy falls.[1] However, Kumar V et al. described a younger demographic with a higher proportion of high-energy trauma, particularly RTAs, which is consistent with the present study.[2]

Radiographically, two-part fractures constituted the majority of our cases, followed by three- and four-part fractures (Table 2). This distribution aligns with the Neer classification, although it is recognized that the system has only moderate inter- and intra-observer reliability, which can affect comparisons across studies. A modified Neer's system that assesses displacement relative to the humeral head fragment has been shown to improve reliability and better predict vascular risk to the humeral head.[3] Despite these limitations, the predominance of two-part fractures in our study is similar to that reported in several operative series and meta-analyses of PHILOS fixation, where simpler patterns are more frequently managed with plating.[4,5]

In our series, 82.6% of patients were immobilized in an arm pouch postoperatively, while 17.4% required a shoulder immobilizer, and none were treated with a postoperative POP slab. Early mobilization is a recognized advantage of stable internal fixation with locking plates, as it helps minimize postoperative stiffness. Functional results in our cohort were favorable, with 60.9% of patients achieving a "good" outcome, 39.1% a "fair" outcome, and only one patient (2.2%) a "poor" result. Pain relief was also significant, with 65.2% reporting no pain and 91.3% regaining normal muscle strength at follow-up.

Comparable findings have been reported in the literature. Gnanesh V et al., in a study of 25 patients treated with PHILOS, found that four-part fractures were most common. They reported satisfactory functional outcomes overall, though complications such as screw perforation were observed, particularly among patients with comorbidities like diabetes and rheumatoid arthritis.[6] Similarly, Jain A et al. evaluated 59 patients, where Neer's type 2 and 3 fractures accounted for 37.3% each, while type 4 accounted for 25.4%. Functional outcomes were rated as very good in 20.3%, good in 37.3%, fair in 27.1%, and poor in 15.3% of cases.[7]

Sathavu PP et al. studied 20 patients with Neer's two-, three-, and four-part fractures, as well as fracture-dislocations, managed with PHILOS plating. The most common cause of injury was self-fall, followed by RTAs. Using the Constant-Murley score for follow-up, they reported excellent results in 7 cases, good in 10, moderate in 2, and poor in 1 case. The mean Constant-Murley score was 81.26 at final follow-up, with better outcomes in two- and three-part fractures compared to four-part fractures.[8]

Gurnani S et al. compared PHILOS plating with Neer's hemiarthroplasty in 20 patients. They found that the PHILOS group had significantly greater improvements in range of motion across flexion, extension, abduction, internal and external rotation, and had a Constant-Murley score that was 8.7 points higher than the hemiarthroplasty group. They concluded that PHILOS plating is a suitable option even for three- and four-part fractures in patients older than 55 years.[9]

Agrawal U et al. reviewed 33 cases of PHFs treated with PHILOS and found that three-part fractures were most common (54.54%), followed by four-part (27.27%) and two-part fractures (18.18%). RTAs were the leading mechanism of injury (54.54%). Functional outcomes assessed with Neer's score ranged from 48 to 96, with an average of 82.96 ± 12.73. Excellent results were seen in 39% of patients, satisfactory in 27%, unsatisfactory in 21%, and failure in 12.1%. Complications were minimal, with stiffness (9.09%), varus malunion (6.06%), and superficial infection (3.03%) being the most common, all of which were managed successfully.[10]

Vijayvargiya M et al. analyzed 26 cases managed with late PHILOS fixation and reported 8 good, 10 moderate, 6 excellent, and 2 poor outcomes at final follow-up using the Constant score. Mean union time was 12.3 weeks (range: 9–15 weeks). Complications occurred in 15.4% of cases, including two varus malunions, one wound infection, and one screw cut-out requiring screw removal.[11] In a larger study, Kugashiya M et al. evaluated 50 patients and found significantly higher Constant-Murley scores in two-part fractures (72.4 ± 10.8) compared with three-part (60.8 ± 8.1) and four-part fractures (59.3 ± 5.3), with the differences being statistically significant ($p = 0.0003$).[12] Kumar GN et al. assessed 51 patients treated with PHILOS plating and reported excellent outcomes in 25 cases, good in 13, fair in 6, and poor in 5. Complications included varus malunion (4 cases), subacromial impingement (1 case), deep infection (1 case), intraarticular screw penetration (1 case), and fixation failure (1 case).[13]

Taken together, these studies highlight that PHILOS plating offers good to excellent functional outcomes in a majority of patients, particularly in two- and three-part fractures, though complication rates tend to increase with fracture complexity. The present study's results are in line with these findings, with a predominance of favourable outcomes, minimal pain, and preserved muscle strength, and with complication rates comparable to those reported in the literature.

CONCLUSION

This study demonstrates that PHILOS plating is an effective method for managing proximal humerus fractures, particularly in younger and middle-aged patients sustaining high-energy injuries such as RTAs. Most patients achieved good to excellent functional recovery, with significant pain relief and restoration of muscle strength. Complications were minimal and manageable, with joint stiffness being the most frequent. Outcomes were most favourable in two- and three-part fractures, while complex four-part fractures posed greater challenges. Overall, PHILOS plating provides stable fixation, facilitates early mobilization, and yields satisfactory clinical outcomes, supporting its role as a reliable option in modern fracture management.

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