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SURGICAL MANAGEMENT OF PHILOS PLATE FIXATION IN DISPLACED PROXIMAL HUMERUS FRACTURES: A PROSPECTIVE STUDY

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ABSTRACT **Background:** Displaced proximal humerus fractures require treatment that restores anatomy while permitting early shoulder rehabilitation. Aim: To evaluate union, functional outcome and complications after open reduction and internal fixation with a PHILOS plate. **Materials and Methods:** This prospective observational study included 30 adults with closed displaced proximal humerus fractures treated from April 2024 to March 2026. Union, range of motion, complications and DASH grade were assessed to one year. **Results:** Road traffic accident was the commonest mechanism (70%). Two-part fractures predominated (63.33%). Radiological union was seen in 90% at three months and 100% by six months. Final outcomes were excellent in 50%, good in 33.33%, fair in 13.33% and poor in 3.33%. Fracture pattern was significantly associated with outcome ($p = 0.031$). **Conclusion:** PHILOS plating produced reliable union and satisfactory function in selected displaced proximal humerus fractures when reduction, medial support and rehabilitation were optimized.

KEYWORDS : Proximal Humerus Fracture; PHILOS Plate; Locking Plate; DASH Score

INTRODUCTION

Proximal humerus fractures are clinically important injuries because shoulder function depends on coordinated articular congruity, tuberosity position, rotator cuff balance and painless motion. Although many minimally displaced fractures can be treated conservatively, displaced and unstable patterns may heal with malunion, stiffness and functional limitation if alignment is not maintained. The management decision must therefore balance fracture morphology, age, bone quality, functional demand and the ability to participate in rehabilitation (Rangan et al., 2015; Spross et al., 2019).

The Proximal Humeral Internal Locking Osteosynthesis System (PHILOS) plate provides a fixed-angle construct with multiple divergent and convergent screws in the humeral head. This design is useful in cancellous and osteoporotic bone and helps maintain reduction until union. However, good outcomes depend not only on implant choice, but also on accurate reduction, restoration of inferomedial calcar support, correct plate height, secure tuberosity fixation and early physiotherapy (Gardner et al., 2007; Sudkamp et al., 2009).

The present study was designed to convert the institutional prospective dissertation data into an original research article evaluating the functional and radiological results of PHILOS plating in displaced proximal humerus fractures.

Aim and Objectives

The aim was to evaluate the functional outcome and complications following open reduction and internal fixation of displaced proximal humerus fractures using the PHILOS plate. The objectives were to study demographic profile and mechanism of injury, assess radiological union, assess functional outcome using the DASH score and document complications.

Materials and Methods

This was a prospective observational study conducted in the Department of Orthopaedics, Santhiram Medical College and General Hospital, Nandyal. The study included 30 adult patients treated between April 2024 and March 2026.

Inclusion Criteria

- Patients aged 18 years or above
- Closed displaced proximal humerus fractures
- Patients who were medically fit for surgery and willing for follow-up .

Exclusion Criteria

Undisplaced fractures, open fractures, pathological fractures, fractures with vascular injury requiring repair, polytrauma precluding early surgery and patients unfit for anaesthesia.

Surgical Technique

All patients underwent clinical assessment, neurovascular examination and radiological evaluation with shoulder anteroposterior and axillary views; computed tomography was used for complex fractures when required. Fractures were classified according to Neer classification. Surgery was performed under general anaesthesia or brachial block in the beach-chair position through a deltopectoral approach. Reduction focused on restoring head-shaft alignment, tuberosity position and medial support. A pre-contoured PHILOS plate was placed lateral to the bicipital groove and 8mm distal to the apex of greater tuberosity to avoid impingement. Multiple locking screws were inserted into the humeral head under fluoroscopic control, and calcar screw support was used whenever feasible.

Postoperatively, the limb was supported in an arm sling, and protected passive shoulder motion was started as pain allowed. Active-assisted and active movements were advanced according to pain and radiological stability. Strengthening was delayed until clinical and radiological evidence of union. Follow-up was performed at 6 weeks, 3 months, 6 months and 1 year. Clinical union, radiological union, pain, range of motion and complications were recorded. Functional outcome was graded using the DASH score, with lower scores indicating better function. Data were summarized using descriptive statistics. For contingency tables with small expected cell counts, Fisher-Freeman-Halton exact test was used. A p value less than 0.05 was considered statistically significant. Ethics committee approval and written informed consent were obtained.

RESULTS

The study included 30 patients. Patients older than 60 years formed the largest age group (33.33%). Males constituted 53.33% and females 46.67%. Road traffic accident was the commonest mode of injury (70%), followed by falls (30%). Left-sided fractures were slightly more frequent (53.33%). Most patients presented within one day of injury (70%).

Table 1. Baseline Characteristics and Fracture Profile

Variable	Finding	Number (%)
Age >60 years	Largest age group	10 (33.33)
Sex	Male	16 (53.33)
Sex	Female	14 (46.67)
Mechanism	Road traffic accident	21 (70.00)
Mechanism	Fall	9 (30.00)
Side	Right	14 (46.67)
Side	Left	16 (53.33)
Neer type	2-part fracture	19 (63.33)
Neer type	3-part fracture	9 (30.00)
Neer type	4-part fracture	2 (6.67)

Clinical and radiological union progressed steadily during follow-up. Radiological union was present in 2 patients at 6 weeks, 27 patients at 3 months and all patients by 6 months. By final follow-up, clinical and radiological union were present in all cases, while pain at the fracture site persisted in only one patient.

Table 2. Union and Pain at Follow-up

Follow-up	Clinical union	Radiological union	Pain at fracture site
6 weeks	0 (0%)	2 (6.67%)	30 (100%)
3 months	27 (90%)	27 (90%)	5 (16.67%)
6 months	30 (100%)	30 (100%)	3 (10%)
1 year	30 (100%)	30 (100%)	1 (3.33%)

Shoulder movements improved progressively. At one year, mean flexion was 148.7 degrees, mean abduction was 143.3 degrees, mean external rotation was 62.7 degrees and mean internal rotation was 67 degrees.

Table 3. Mean Shoulder Range of Motion During Follow-up

Movement	6 weeks	3 months	6 months	1 year
Flexion	89.33 +/- 15.29	98.00 +/- 15.40	110.00 +/- 12.86	148.70 +/- 17.20
Abduction	98.30 +/- 15.30	105.33 +/- 15.69	115.60 +/- 16.70	143.30 +/- 17.50
External rotation	38.00 +/- 8.86	48.33 +/- 9.12	57.30 +/- 8.20	62.70 +/- 5.60
Internal rotation	42.00 +/- 12.14	51.30 +/- 9.30	60.60 +/- 12.80	67.00 +/- 12.80

Final functional outcome was excellent in 15 patients, good in 10, fair in 4 and poor in 1. Side of injury did not show a significant association with outcome ($p = 0.9318$). Fracture type showed a significant association with final outcome ($p = 0.031$), with simpler fracture patterns having better outcomes.

DISCUSSION

The present series demonstrates that PHILOS plate fixation can provide reliable union and satisfactory function in selected displaced proximal humerus fractures. Radiological union was achieved in 90% at 3 months and in all cases by 6 months, suggesting that the construct provided adequate stability for healing. This finding supports the role of locking plate fixation when the native humeral head is reconstructible and when the principles of reduction and medial support are respected.

The demographic pattern reflected both osteoporotic and trauma-related mechanisms. Although proximal humerus fractures are classically frequent in elderly osteoporotic patients, 70% of injuries in this series followed road traffic accidents. This may explain the slight male predominance and shows the relevance of PHILOS plating in settings where high-energy trauma contributes substantially to operative fracture burden (Court-Brown et al., 2001).

Fracture complexity influenced outcome. Two-part fractures formed the majority and produced better functional grades than three-part and four-part injuries. This is expected because increasing fragment number is associated with greater tuberosity displacement, comminution, medial instability and risk to humeral head vascularity (Hertel et al., 2004; Neer, 1970). The statistically significant association between fracture type and final outcome reinforces the importance of careful case selection and accurate preoperative classification.

Restoration of medial support is a key technical determinant after locking plate fixation. In the absence of inferomedial buttress, the head fragment may collapse into varus, producing screw cut-out, malunion and poor shoulder mechanics. The current results, with only one varus malunion and no major implant failure requiring revision, suggest that intraoperative attention to calcar support and screw placement was beneficial (Gardner et al., 2007).

The most frequent complication was shoulder stiffness. This is clinically important because stiffness can compromise function even after solid union. Early protected mobilization, pain control, patient education and supervised physiotherapy are therefore as important as the fixation itself. The progressive improvement in flexion and abduction across follow-up visits supports the value of a structured rehabilitation protocol.

This study has limitations. The sample size was small, there was no non-operative control group and follow-up was limited to one year. DASH grading was useful for functional assessment, but additional shoulder-specific scoring systems such as Constant-Murley score could provide more detailed evaluation. Larger comparative studies with longer follow-up are required to assess late complications such as avascular necrosis.

CONCLUSION

Open reduction and internal fixation with PHILOS plate achieved reliable union and satisfactory functional outcome in selected displaced proximal humerus fractures. Final outcome was excellent or good in 83.33% of patients, and union was achieved in all cases by 6 months. Fracture complexity significantly influenced functional outcome. Accurate reduction, restoration of medial support, avoidance of screw penetration and early guided rehabilitation remain essential for optimizing results.

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