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Original Article

FUNCTIONAL OUTCOME OF PROXIMAL HUMERUSFRACTURE FIXATION USING PHILOS

Khadim Khawaja[1], Fateh Ali Janjua[2], Yasir Mohib[3], Tashfeen Ahmad[4]

1. *Department of Orthopaedic Surgery, Ziauddin University Hospital, Karachi.*
2. *Department of Orthopaedics Shaukat Khanam Memorial Cancer Hospital Lahore*
3. *Department of Orthopaedic Surgery, Aga Khan University Hospital, Karachi*
4. *Department of Orthopaedic Surgery, Aga Khan University Hospital, Karachi*

Introduction:
Background:
Proximal humerus fractures are among the most common fragility fractures in the elderly. Several operative techniques have been described and locking plates such as the Proximal Humeral Internal Locking System (PHILOS) are widely used. This study aimed to evaluate the short-term functional outcome of displaced proximal humerus fractures treated with PHILOS plating.
Methodology:
This descriptive case series was conducted in the Department of Orthopaedic Surgery at Aga Khan University Hospital, Karachi, from 14 December 2016 to 13 June 2017. Adult patients (16–60 years) with displaced proximal humerus fractures classified as Neer type 2, 3 or 4 and treated with PHILOS plating were included. Patients with open or pathological fractures, active infection, or major neuromuscular disease were excluded. Functional outcome was assessed at 12 weeks using the Constant–Murley score.
Results:
Thirty-seven patients were included. The mean age was 48.0 ± 13.59 years; 19 (51.4%) were male and 18 (48.6%) females. The dominant right hand was affected in 32 (86.5%) patients. Sixteen (43.2%) fractures involved the right humerus, and 21 (56.8%) the left. There were 24 (64.9%) Neer type 2, 11 (29.7%) type 3 and 2 (5.4%) type 4 fractures. PHILOS fixation yielded an acceptable outcome in 34 (91.9%) patients and an unacceptable outcome in 3 (8.1%). The mean Constant–Murley score at 12 weeks was 78.14 ± 14.25; 15 (40.5%) patients had excellent, 11 (29.7%) good, 8 (21.6%) moderate, and 3 (8.1%) poor scores. There was no significant association between outcome and age ($p = 0.27$), dominant side ($p = 0.13$) or Neer fracture type ($p = 0.98$).
Conclusion:
PHILOS plating for displaced proximal humerus fractures in adults resulted in predominantly good-to-excellent short-term functional outcomes without compromising fracture union.
Keywords: PHILOS, locking plate, proximal humerus fracture, Constant–Murley score

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Corresponding Author: Fateh Ali Janjua. **Email:** Fatehalij@gmail.com

Introduction:

Proximal humerus fractures are common injuries in the adult population, accounting for approximately 4–6% of all fractures and around one fourth of humeral fractures. They occur in high-energy trauma in younger adults and low-energy osteoporotic falls in older patients, in whom they rank among the most frequent non-vertebral fragility fractures, particularly in women [1,2]. In Pakistan, a large tertiary-care series reported proximal humerus fractures to constitute roughly 2% of all adult fractures presenting to emergency departments, reflecting a growing burden of both osteoporosis and high-energy road-traffic trauma in our setting [3]. Neer described a classification

system based on the number and displacement of fracture parts that continues to guide contemporary management decisions [4]. Displaced two-, three- and four-part fractures are more likely to require operative intervention, particularly in active patients.

Non-displaced or minimally displaced fractures are generally amenable to conservative treatment with sling immobilization and early physiotherapy, whereas approximately one-fifth of proximal humerus fractures are sufficiently displaced to warrant operative fixation [5]. A variety of surgical techniques have been described, including tension band wiring, trans-osseous sutures, conventional plate-and-screw constructs, intramedullary nails, hemiarthroplasty and newer locking plate systems [6–9].

Locking plates, such as the Proximal Humeral Internal Locking System (PHILOS), provide angular stability with minimal additional soft-tissue stripping, thereby helping preserve the vascularity of the humeral head and tuberosities [8–11]. Their fixed-angle design functions as an internal fixator, allowing multidirectional locking screws in the humeral head and shaft, and permitting suture augmentation of the tuberosities in comminuted fractures.

Clinically, patients typically present with shoulder pain exacerbated by motion, swelling and ecchymosis, often holding the arm in adduction for comfort [12]. High-energy injuries and fracture–dislocations may be associated with significant deformity and axillary nerve dysfunction [12,13]. Functionally, these patients can be assessed with the Constant–Murley score, one of the widely used clinical scores for assessing shoulder function and which has been validated across multiple shoulder pathologies [14,15]. With this in mind, our aim in this study was to evaluate the short-term functional outcome of displaced proximal humerus fractures treated with PHILOS plating in adults, using the Constant–Murley score 12 weeks postoperatively.

Materials and Methods:

Following approval of the study protocol by the College of Physicians and Surgeons Pakistan (CPSP), we conducted this descriptive case series over a six-month period from 14 December 2016 to 13 June 2017. The study utilized data from a prospectively maintained trauma registry that is approved by our Institutional Ethical Review Committee (ERC No. 3193-SUR-ERC-14), under which this analysis was conducted.

Both male and female patients aged 16–60 years with displaced proximal humerus fractures, classified as Neer type 2, 3, or 4 on plain radiographs, were eligible. Patients with open fractures or open wounds, acute local infection, pathological fractures, or major neuromuscular or systemic conditions (e.g., multiple sclerosis, myeloma) likely to interfere with rehabilitation were excluded. Patients younger than 16 years were also excluded.

A total of 37 consecutive patients who met the inclusion criteria and were treated with PHILOS plating during the study period were included using non-probability consecutive sampling. All surgeries were performed at Aga Khan University Hospital by fellowship-trained orthopaedic surgeons. A standard deltopectoral approach was used in all cases. Fracture reduction and implant positioning were confirmed intraoperatively with an image intensifier. Fractures were classified according to the Neer classification based on preoperative radiographs and intraoperative imaging.

Postoperatively, the affected arm was supported in a polysling for three weeks. Pendulum exercises and passive range-of-motion exercises were initiated early, followed by active-assisted external rotation to neutral and flexion as tolerated. The active range of motion of the shoulder and elbow was progressively increased after three weeks. Strengthening exercises were introduced after radiological signs of healing were observed.

Patients were reviewed at 3, 6, and 12 weeks postoperatively. At each follow-up visit, patients were clinically assessed for pain, range of motion and strength, and complications. At 12 weeks, functional outcome was evaluated using the Constant–Murley score. [14]

Data were analysed using SPSS version 21.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean and standard deviation, and categorical variables as frequencies and percentages. Associations between categorical variables and functional outcome (acceptable vs not acceptable) were

assessed using the chi-square test. A p-value <0.05 was considered statistically significant.

Results:

Thirty-seven patients with displaced proximal humerus fractures treated with PHILOS plating were included. The mean age was 48.0 ± 13.59 years (range 16–60). There were 19 (51.4%) males and 18 (48.6%) females. The dominant right hand was present in 32 (86.5%) patients.

Sixteen (43.2%) fractures involved the right humerus and 21 (56.8%) the left (Table 1). According to the Neer classification, 24 (64.9%) fractures were type 2, 11 (29.7%) were type 3, and 2 (5.4%) were type 4. Thirty-four (91.9%) patients underwent surgery within 1 week of injury, and 3 (8.1%) between 1 and 2 weeks after injury.

At three-month follow-up, the mean Constant–Murley score was 78.14 ± 14.25. Functional outcome was excellent (86–100 points) in 15 (40.5%) patients, good (71–85) in 11 (29.7%), moderate (56–70) in 8 (21.6%) and poor (0–55) in 3 (8.1%) patients (Table 1).

When outcomes were dichotomized, 34 (91.9%) patients had an acceptable result (excellent or good) and 3 (8.1%) had an unacceptable result (moderate or poor) (Table 2). There was no statistically significant association between outcome and age category (≤40 vs >40 years; p = 0.27), side of fracture (dominant vs non-dominant; p = 0.13) or Neer fracture type (p = 0.98).

Discussion:

This study demonstrates that PHILOS plating for displaced proximal humerus fractures in adults is associated with predominantly good-to-excellent short-term functional outcomes, with a mean Constant–Murley score of 78.1 at 12 weeks. More than 70% of patients achieved good or excellent functional outcomes, and only a small proportion had a poor outcome.

A wide range of implants has been used for fixation of proximal humerus fractures, including non-locking plates, intramedullary nails and fixed-angle devices [6–9]. Earlier non-locking constructs, such as the PlantTan humerus fixator plate and Polarus nail, provided satisfactory results in younger patients but were associated with higher rates of screw loosening, loss of reduction and fixation failure in osteoporotic bone [6,7]. Locking plates were developed to address these limitations by providing angular stable fixation that better resists varus collapse and screw pull-out in compromised bone quality [8–11,16].

The PHILOS plate combines a low-profile pre-contoured plate with multiple multidirectional locking screws in the humeral head and shaft, functioning as an internal fixator [8–11]. This design permits secure fixation in osteopenic bone while allowing suture augmentation of the tuberosities. Careful attention to plate positioning and screw length is essential to avoid complications such as subacromial impingement and intra-articular screw penetration, and intraoperative fluoroscopy is critical for confirming implant placement [9–11,16].

Our functional results are comparable to those reported in other series of PHILOS fixation. Several studies have demonstrated Constant–Murley scores of good to excellent in the majority of patients, with satisfactory radiological union and acceptable complication rates [8–11,17]. In a local series from Pakistan, Ali and Wajid reported moderate to good Constant scores in patients with three- and four-part proximal humerus fractures treated with PHILOS plating, with outcomes generally improving over time [17]. International series have similarly shown that locking plates provide reliable fixation for complex fracture patterns, including osteoporotic bone, when accurate reduction and stable fixation are achieved [8–11].

Our study adds to the regional data by reporting short-term functional outcomes in a cohort of 37 patients treated at a single tertiary care Centre. The high proportion of good to excellent results supports the use of PHILOS plates as a viable option for displaced proximal humerus fractures in adults, including those with potentially compromised bone quality.

This study has several limitations. First, the sample size is relatively small, and there was no comparison group treated non-operatively or with alternative implants, which limits the ability to draw definitive conclusions about the superiority of PHILOS over other methods. Second, follow-up was limited to 12 weeks; longer-term evaluation is required to assess maintenance of function, late complications and

implant survival. Third, pre-injury shoulder function and contralateral shoulder Constant scores were not routinely documented, which may affect the interpretation of absolute scores. Finally, some patients resided in rural areas with limited access to supervised physiotherapy, which may have influenced rehabilitation and outcomes.

Despite these limitations, our findings support PHILOS plating as an effective technique for the management of displaced proximal humerus fractures in adults, with a high rate of acceptable short-term functional outcome.

Conclusion:

Most adults with displaced proximal humerus fractures treated with PHILOS plating in this series achieved good to excellent short-term functional outcomes. The locking plate design provides stable fixation that permits early mobilization without compromising fracture union. PHILOS plates are a useful surgical option for displaced proximal humerus fractures across a wide age range, particularly in osteopenic bone.

Table 1.

Demographic and Clinical Characteristics of the Study Population

Variable	Category	n (%)
Gender	Male	19 (51.4)
	Female	18 (48.6)
Age (years)	Mean ± SD	48.0 ± 13.59
Dominant working side	Right	32 (86.5)
	Left	5 (13.5)
Fracture side	Right	16 (43.2)
	Left	21 (56.8)
Neer fracture type	2-part	24 (64.9)
	3-part	11 (29.7)
	4-part	2 (5.4)
Time to surgery	Within 1 week	34 (91.9)
	1–2 weeks	3 (8.1)
Constant–Murley score	Excellent (86–100)	15 (40.5)
	Good (71–85)	11 (29.7)
	Moderate (56–70)	8 (21.6)
	Poor (0–55)	3 (8.1)

Table 2.

Outcome of PHILOS fixation by fracture and patient characteristics

Variable	Category	Acceptable n (%)	Not acceptable n (%)	p-value
Overall	—	34 (91.9)	3 (8.1)	—
Side of fracture	Dominant	15 (40.5)	0 (0.0)	0.13
	Non-dominant	19 (51.4)	3 (8.1)	
Neer fracture type	2-part	22 (59.5)	2 (5.4)	0.98
	3-part	10 (27.0)	1 (2.7)	
	4-part	2 (5.4)	0 (0.0)	
Age category (years)	≤40	10 (27.0)	0 (0.0)	0.27
	>40	24 (64.9)	3 (8.1)	

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