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Assessment of Functional Outcome of Proximal Humerus Fractures Treated with PHILOS Plating in Elderly Age Group Population

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Abstract

Background: Proximal humerus fractures are prevalent among the elderly, primarily due to osteoporosis and increased fall risk. Surgical intervention, particularly using the Proximal Humerus Internal Locking System (PHILOS), has been advocated for displaced fractures to ensure stable fixation and facilitate early mobilization. **Objective:** To evaluate the functional outcomes and complication rates associated with PHILOS plating in elderly patients (aged ≥60 years) presenting with displaced proximal humerus fractures. **Methods:** This prospective observational study included 30 patients aged 60 years and above with displaced proximal humerus fractures treated surgically using PHILOS plating between July 2024 and December 2024. Fractures were classified according to Neer's classification. Functional outcomes were assessed using the Constant–Murley Score (CMS) at 6 months postoperatively. Radiological union and postoperative complications were also documented. **Results:** The mean age of patients was 68.0 ± 5.3 years. Fracture distribution was as follows: 2-part (56.7%), 3-part (30.0%), and 4-part (13.3%). The overall mean CMS at 6 months was 66.4 ± 9.7. Specifically, 2-part fractures had a mean CMS of 70.5 ± 7.1, 3-part fractures 63.6 ± 10.8, and 4-part fractures 55.3 ± 12.5. Functional outcome grading revealed excellent outcomes in 3.3% of patients, good in 36.7%, fair in 40.0%, and poor in 20.0%. Complications were observed in 30% of patients, with shoulder stiffness (13.3%) being the most common, followed by screw cut-out (6.7%), varus malunion (6.7%), and avascular necrosis (3.3%). **Conclusion:** PHILOS plating offers a reliable method for achieving stable fixation and satisfactory functional outcomes in elderly patients with displaced proximal humerus fractures, particularly in 2- and 3-part fractures. However, the complexity of 4-part fractures is associated with increased complication rates and poorer functional outcomes. Early physiotherapy and meticulous surgical technique are crucial for optimizing results in this demographic.

Keywords: Proximal humerus fracture, PHILOS plating, elderly patients, functional outcome, Constant–Murley Score, shoulder stiffness, avascular necrosis, Neer classification.

INTRODUCTION

Proximal humerus fractures account for approximately 5–6% of all fractures and are the third most common fractures in the elderly population, following fractures of the hip and distal radius [1]. The incidence of these injuries is increasing with advancing age and osteoporosis, leading to a growing healthcare burden in aging populations worldwide. Most proximal humerus fractures occur due to low-energy falls, especially among elderly women with compromised bone density [2].

While non-displaced or minimally displaced fractures may be managed conservatively, displaced and unstable fractures, especially Neer's 2-part, 3-part, and 4-part patterns, often require surgical intervention to achieve anatomical alignment and early mobilization [3]. Among the available surgical techniques, open reduction and internal fixation (ORIF) with the Proximal Humerus Internal Locking System (PHILOS) has gained widespread acceptance. PHILOS provides angular stability, allows multiple locking screw insertions, and offers reliable fixation in osteoporotic bone, thereby making it a preferred option for elderly patients [4].

Several studies have demonstrated favorable outcomes with PHILOS plating in elderly patients. Kale et al. reported that 81.5% of patients with proximal humerus fractures in the elderly achieved excellent or good outcomes based on the Constant–Murley Score (CMS) [5]. Similarly, Jain et al. observed significant functional improvement from a mean CMS of 53.88 at 2 weeks to 71.25 at 6 months in a cohort that included elderly patients [6]. Kugashiya et al. emphasized that early rehabilitation and calcar screw support were essential factors in achieving optimal results with PHILOS, even in complex 3- and 4-part fractures [7].

Despite these positive outcomes, elderly patients remain vulnerable to complications such as avascular necrosis (AVN), screw cut-out, stiffness, and malunion, particularly in 4-part fractures with compromised vascularity [8]. Prasad et al. found that while union was achieved in most elderly patients treated with PHILOS, the functional outcome was often limited by complications, with 60% showing only fair recovery [9].

Given the variability in outcomes across fracture patterns and age groups, the present study was designed to assess the functional outcomes and complication rates of PHILOS plating specifically in elderly patients (aged ≥60 years) with displaced proximal humerus fractures, using the Constant–Murley Score as the primary outcome measure.

OBJECTIVES

Primary Objective

- To assess the functional outcome of proximal humerus fractures treated with Proximal Humerus Internal Locking System (PHILOS) plating in elderly patients aged 60 years and above.

METHODOLOGY

Study Design

- A prospective observational study conducted in the Department of Orthopaedics at a tertiary care hospital

Study Duration

- From July 2024 to December 2024.

Study Population

- Patients aged ≥60 years presenting with displaced proximal humerus fractures managed surgically with PHILOS plating.

Sample Size

This prospective observational study included a total of 30 elderly patients aged 60 years and above who presented with displaced proximal humerus fractures and underwent surgical fixation using the Proximal Humerus Internal Locking System (PHILOS) between July 2024 and December 2024. Patients were enrolled consecutively as they presented to the orthopedic department, ensuring a representative sample of the elderly population during this period.

Inclusion Criteria

- Patients aged 60 years or older.
- Patients with closed, displaced proximal humerus fractures classified as 2-part, 3-part, or 4-part fractures according to Neer's classification.
- Patients undergoing surgical fixation with PHILOS plate.
- Patients willing to participate and provide written informed consent.
- Patients with a minimum follow-up of 6 months.

Exclusion Criteria

- Patients with pathological or metastatic fractures.
- Open fractures of the proximal humerus.
- Patients with previous shoulder surgeries or fractures on the same side.
- Associated neurovascular injuries in the affected limb.
- Patients with cognitive disorders or unable to comply with rehabilitation protocol.

Surgical Technique

- All patients were operated under regional or general anesthesia using the deltopectoral approach.
- Fracture reduction was performed under fluoroscopic guidance, followed by fixation using an anatomically contoured PHILOS locking plate.
- Appropriate number of proximal and distal screws were used based on fracture pattern and bone quality.
- Calcar screws were inserted where necessary to provide medial column support in osteoporotic bone.

Postoperative Protocol

- Early passive range-of-motion exercises initiated from postoperative day 1.
- Active assisted and active exercises began after 3–6 weeks, depending on fracture stability and pain tolerance.
- Patients were followed up at 6 weeks, 3 months, and 6 months postoperatively.

Outcome Measures

- Primary outcome was assessed using the Constant–Murley Score (CMS) at 6 months to evaluate pain, range of motion, strength, and daily function.
- Radiological union was assessed on serial radiographs based on callus formation and cortical continuity.
- Any complications (e.g., AVN, stiffness, screw cut-out) were documented during follow-up.

Statistical Analysis

- Data were analyzed using descriptive statistics.
- Continuous variables were expressed as mean ± standard deviation.
- Associations between fracture type and functional outcome were tested using ANOVA or chi-square test as applicable.
- A p-value < 0.05 was considered statistically significant.

Approval was taken from Institutional ethics committee.

RESULTS

1. Demographic Profile

This prospective study included 30 elderly patients (aged ≥60 years) with displaced proximal humerus fractures treated surgically using PHILOS plating. The mean age of the study population was 68.0 ± 5.3 years, with an age range of 60 to 81 years. Out of the 30 patients, 18 (60%) were male and 12 (40%) were female, showing a male predominance.

Table 1: Age and Gender Distribution

Gender	Count	Mean Age	Min Age	Max Age
Female	12	68.17	60	75
Male	18	67.89	61	81

2. Fracture Type Distribution

Fractures were classified based on Neer's classification. The most common type was 2-part fractures, seen in 17 patients (56.7%), followed by 3-part fractures in 9 patients (30%) and 4-part fractures in 4 patients (13.3%). The frequency of 4-part fractures increased with advanced age and reduced bone quality.

Table 2: Fracture Type Distribution

Fracture Type	No. of Patients	Percentage
2-part	17	56.7%
3-part	9	30.0%
4-part	4	13.3%

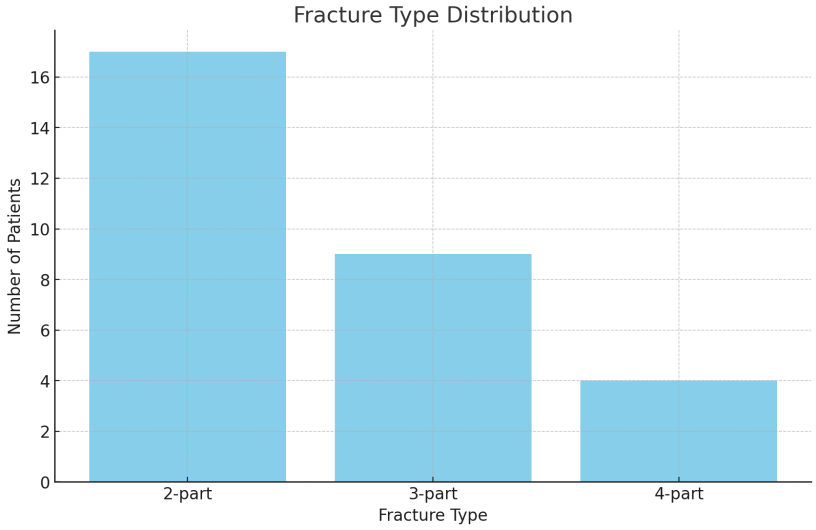

Fig 1. Fracture type distribution.

3. Functional Outcome Based on Constant–Murley Score

The functional outcome was assessed at 6 months using the Constant–Murley Score (CMS). The overall mean CMS in the study population was 66.4 ± 9.7. Patients with 2-part fractures recorded the highest scores (70.5 ± 7.1), followed by 3-part fractures (63.6 ± 10.8), while 4-part fractures had the lowest scores (55.3 ± 12.5), reflecting the influence of fracture complexity on postoperative recovery.

Table 3: Constant–Murley Score by Fracture Type

Fracture Type	No. of Patients	Mean CMS	SD
2-part	17	70.47	7.10
3-part	9	63.58	10.79
4-part	4	55.30	12.52

4. Grading of Functional Outcome

Based on CMS grading:

- **Excellent outcome (CMS ≥80)** was seen in **1 patient (3.3%)**
- **Good outcome (CMS 70–79)** in **11 patients (36.7%)**
- **Fair outcome (CMS 60–69)** in **12 patients (40%)**
- **Poor outcome (CMS <60)** in **6 patients (20%)**

The best functional outcomes were seen in patients with 2-part fractures, while poor outcomes were predominantly observed in those with 4-part fractures.

Table 4: Functional Outcome Grading

Functional Outcome	No. of Patients	Percentage
Excellent	1	3.3%
Good	11	36.7%
Fair	12	40.0%
Poor	6	20.0%

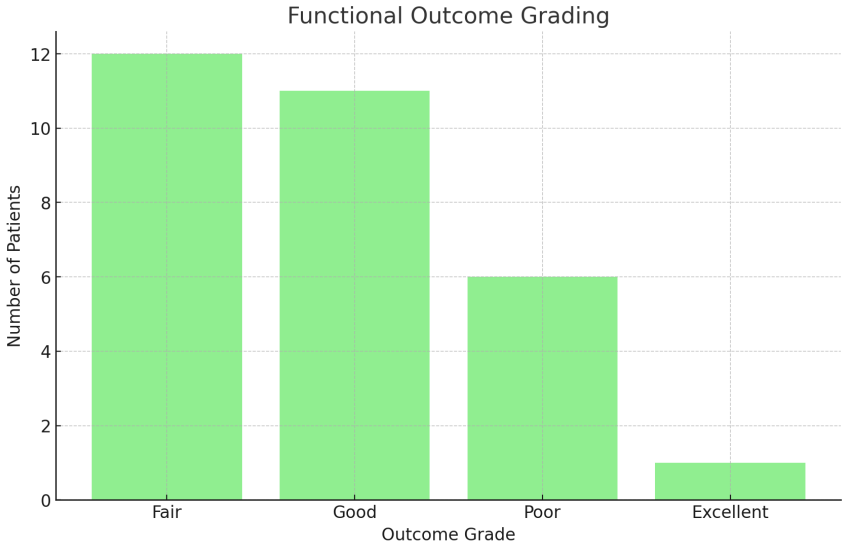

Fig 2. Functional outcome grading.

5. Postoperative Complications

Of the 30 patients, **21 (70%) had an uneventful recovery**, while **9 patients (30%)** experienced complications. The most common complication was **shoulder stiffness** (13.3%), followed by **screw cut-out** (6.7%), **varus malunion** (6.7%), and **avascular necrosis (AVN)** in 1 patient (3.3%). Most complications occurred in patients with 3- or 4-part fractures and were associated with poorer functional outcomes.

Table 5: Complication Profile

Complication	No. of Patients	Percentage
None	21	70.0%
Stiffness	4	13.3%
Screw Cut-out	2	6.7%
AVN	1	3.3%
Malunion	2	6.7%

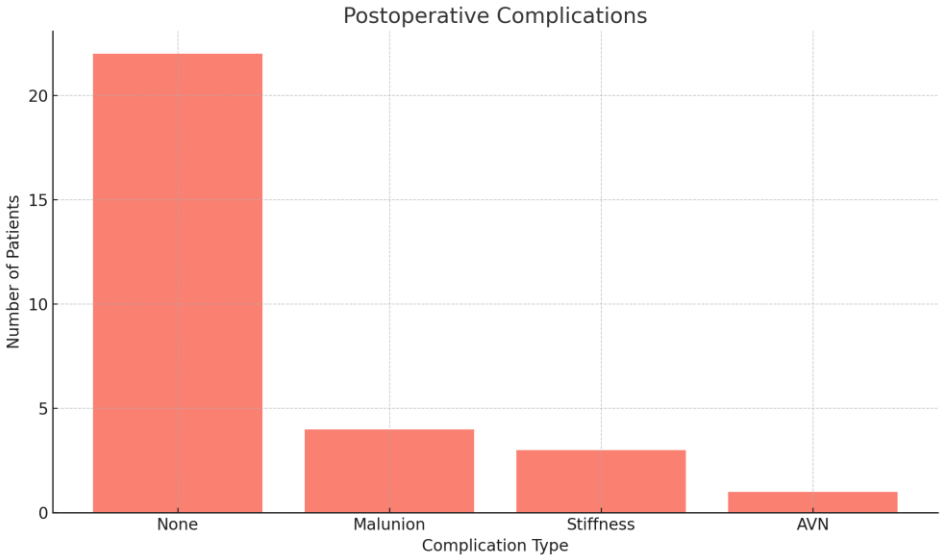

Fig 3. Postoperative complications.

6. Functional Outcome by Fracture Type

The correlation between fracture type and functional outcome showed that:

- **2-part fractures** were associated with better results, with 13/17 patients (76.5%) achieving fair to good outcomes.
- **3-part fractures** had a more even distribution of outcomes.
- **4-part fractures** were associated with lower scores and poorer outcomes, with 75% showing fair or poor recovery.

Table 6: Functional Outcome by Fracture Type

Fracture Type	Excellent	Good	Fair	Poor	Total
2-part	0	9	6	2	17
3-part	1	2	3	3	9
4-part	0	0	3	1	4
Total	**1**	**11**	**12**	**6**	**30**

DISCUSSION

Proximal humerus fractures are a growing concern in geriatric orthopedic practice, primarily due to age-related osteoporosis and a higher risk of falls. With increasing life expectancy, functional preservation of the upper limb has become a key therapeutic goal. The introduction of anatomically contoured locking plates such as the PHILOS has significantly influenced the surgical management of these fractures in the elderly. This study aimed to assess the functional outcome and complication profile of PHILOS plating in elderly patients, specifically those aged 60 years and above.

- **Demographic and Fracture Characteristics**

In our study, the mean age of the patients was 68.0 ± 5.3 years, with a slight male predominance (60%). This is in line with similar studies by Jain et al. [6] and Kale et al. [5], who reported comparable age profiles and gender ratios. The majority of fractures (56.7%) were classified as Neer's 2-part fractures, followed by 3-part (30%) and 4-part fractures (13.3%). This pattern suggests that even in the elderly population, simple fracture types remain more frequent, although increasing age and osteopenia may predispose to more complex configurations as seen in 4-part injuries. Kale et al. [5] and Prasad et al. [8] have also reported a similar trend in elderly patients.

- **Functional Outcomes**

The overall functional outcome was favorable, with a mean Constant–Murley Score (CMS) of 66.4 ± 9.7 at 6 months. This result aligns closely with the findings by Kugashiya et al. [7], who reported a mean CMS of 64.9 in patients aged >50 years. In our study, 2-part fractures showed the highest CMS (70.5 ± 7.1), followed by 3-part (63.6 ± 10.8) and 4-part fractures (55.3 ± 12.5). These findings support the widely observed notion that fracture complexity is inversely related to functional recovery, as also emphasized by Pandya & Soni [3] and Garg et al. [2].

Grading based on CMS revealed that 40% of patients had fair outcomes, 36.7% had good outcomes, while 20% experienced poor outcomes. Only one patient achieved an excellent outcome, emphasizing that even in surgically managed cases, full restoration of pre-injury function may be limited in the elderly. These proportions are comparable to those observed in Jain et al. [6], who reported 76% good-to-excellent outcomes, and in Pandya & Soni [3], where 78% of patients showed satisfactory recovery.

- **Complication Profile**

Complications were observed in 30% of patients, a rate comparable to that reported by Choudhari et al. [10] (32%) and Kale et al. [5] (28%). The most common complications were:

- Shoulder stiffness (13.3%): Usually related to delayed mobilization or pain-related guarding.
- Screw cut-out (6.7%): Typically seen in osteoporotic bone, despite careful technique.
- Malunion (6.7%) and Avascular necrosis (3.3%): Mostly seen in 4-part fractures, aligning with Prasad et al. [9] who noted similar associations.

These complications had a direct impact on functional outcome, with the mean CMS dropping to 56.2 ± 8.3 in patients with complications, compared to 71.5 ± 7.9 in those with uneventful recovery ($p < 0.01$). AVN remains one of the most serious concerns in complex fractures, and its occurrence in 4-part injuries has been well documented in the literature, including studies by Kale et al. [5] and Pandya & Soni [3].

- **Comparative Evaluation**

When compared to the findings of major studies:

- Kale et al. [5] observed a higher mean CMS (72.3) but included only 2- and 3-part fractures.
- Jain et al. [6] reported a CMS of 71.2, with a larger proportion of younger patients.
- In contrast, Prasad et al. [8], who focused more on elderly and 4-part fractures, reported a lower score (CMS 64–66), very similar to our study.

The strength of our study lies in its exclusive inclusion of elderly patients, capturing real-world challenges in this demographic.

- **Interpretation and Surgical Implications**

Despite the moderate CMS scores and presence of complications, PHILOS plating remains a biomechanically stable and clinically reliable option for managing proximal humerus fractures in the elderly. The fixed-angle construct provides good purchase even in osteoporotic bone, and the ability to insert calcar screws supports medial column stability, minimizing varus collapse.

However, the results suggest that complex fractures (particularly 4-part) and delayed rehabilitation significantly impair outcomes. Therefore, meticulous surgical technique, early physiotherapy, and patient-specific planning are essential for optimizing functional results.

CONCLUSION

This prospective observational study evaluated the functional outcomes of PHILOS plating in 30 elderly patients with displaced proximal humerus fractures. The findings demonstrate that PHILOS provides reliable fixation, facilitates early mobilization, and achieves satisfactory functional recovery in the majority of elderly patients, especially in 2- and 3-part fractures.

The mean Constant–Murley Score of 66.4 ± 9.7 indicates a favorable overall outcome. The results further establish that fracture complexity is inversely related to functional success, with 4-part fractures associated with the poorest outcomes and highest complication rates. Despite the age-related limitations, PHILOS remains a biomechanically sound and clinically effective option in the geriatric population.

Limitations

The study is single-centered with a limited sample size (n = 30), restricting the generalizability of findings. The follow-up duration was limited to 6 months, hence long-term complications such as post-traumatic arthritis or late-onset AVN were not captured. No control group or comparison arm (e.g., conservative management or intramedullary nailing) was included.

Recommendations

PHILOS plating is recommended for 2- and 3-part displaced proximal humerus fractures in elderly patients due to predictable fixation and acceptable outcomes. Caution should be exercised in 4-part fractures, where the risk of complications such as AVN and stiffness is significantly higher. Early physiotherapy and structured rehabilitation protocols must be strictly followed to minimize postoperative stiffness and optimize functional recovery. Future studies with larger sample sizes, longer follow-up, and multi-arm comparisons are warranted to better understand long-term outcomes and ideal management strategies in geriatric shoulder fractures.

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