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A Prospective Study to Analyse the Functional and Radiological Outcome of Proximal Humerus Fracture Treated with Philos Plate

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ABSTRACT

Proximal humerus fractures accounts for approximately 4-5% of all the fractures and are next to hip fractures and distal radius fractures in the elderly population. The majority of the patients with this fracture are elderly, which increasesthe risk of their bones to be osteoporotic or brittle. The majority of proximal humerus fractures are caused by low energy trauma. The proximal humerus interlocking system(PHILOS) plates fixation provides greater angular stability than conventional implants. It works as a locked internal fixator and provides better anchorage of screws in osteoporotic bone, with good functional outcome. A minimum of 30 patients with proximal humerus fracture will be taken for study. Patients will be treated by open reduction internal fication with PHILOS plate. Follow up will be for a minimum period of 6 months. The functional outcome was assessed with subjective questionnaire scoring system i.e, constant score and radiological union with cortical continuity across the fracture in 3 out of 4 cortices at 6weeks, 12weeks, 24weeks and 36weeks post operatively. With each follow up clinical and radiological evaluation will be done. The average age was 44.53 years. As per the Neers classification system, there were 6 (20%) 2-part, 14 (46.7%) 3-part and 10 (33.3%) 4-part fracture respectively. The average duration of hospitalization was 12.93 days. The average duration of radiological union was 12.4 weeks. There were 2 (3.77%) cases of varus collapse. Out of the 11 instances studied, 36.7% experienced complications, with Varus Malunion being the most prevalent complication, observed in 16.7% of the cases. Additional problems included Stiffness 3 (10.0%), Superficial Infection 1 (3.3%), Avascular Necrosis 1 (3.3%) and Implant Failure 1 (3.3%). As per the Neer's scoring system, An excellent outcome was observed in 17 patients, accounting for 56.7% of the total. A good outcome was observed in 6 patients, representing 20.0% of the total. A fair outcome was observed in 3 patients, accounting for 10.0% of the total. Lastly, a poor outcome was observed in 4 patients, representing 13.3% of the total. The Proximal Humeral Internal Locking System (PHILOS) is the preferred implant for treating displaced fractures of the proximal humerus, since it results in favourable functional outcomes for patients.

OPEN ACCESS

Key Words

Proximal humerus, fracture, philos platting, neer's scoring system

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INTRODUCTION

Proximal humerus fractures rank as the third most prevalent kind of fracture in the senior population, trailing behind hip fractures and distal radius fractures. They constitute roughly 4-5% of all fractures. The yearly occurrence is roughly 3 per 10,000 individuals and is progressively rising at a rapid rate as individuals get older[1-3]. Females are impacted at a rate that is twice as elevated as that of males[2].

Low-energy trauma is the attributable factor contributing to the majority of proximal humerus fractures, for example a fall from a standing posture with an extended arm. The high correlation between morbidity and epidemiological trends, which point to an aging population, highlights the increasing importance of proximal humerus fractures as a significant medical issue[3,5]. During the process of rehabilitation, the physical and mental condition of an elderly patient can present difficulties in reaching a return to a level of normality[2-5].

Treatment options for complex proximal humerus fractures encompass a range of procedures, such as blade plates, T-plates, intramedullary nails, twin tubular plates, tension bands, percutaneous pins, bone sutures, hemiarthroplasty, Plant Tan humerus fixator plates and Polarus nails. Approximately 20% of patients[6,7] should consider undergoing surgery, either to enhance functional outcomes or owing to the intricate nature of the fracture. Treatment options for these injuries are constantly expanding, with each reconstructive method having advantages and disadvantages of its own[8]. Among the possible adverse consequences of these treatments are screw and plate dislodgement, avascular necrosis, failure of bone healing, improper alignment of bones, migration of the nail and damage to the rotator cuff.

Inadequate fixation provided by traditional implants can result in premature loosening and failure, especially in bones with osteoporosis[9]. PHILOS or The Proximal Humeral Internal Locking System plate fixation offers higher angular stability compared to traditional implants. It acts similar to a secure internal device that strengthens screw attachment in osteoporotic bone[10,11] while also ensuring positive functional results[12,13].

The undesirable effects of PHILOS plate fixation include pseudoarthrosis. with a vascular, shattered plate, screw backout and loosening. subacromial and humeral head necrosis. Impingement that requires screw penetration through the glenohumeral or humeral head and plate removal. Joint, non-union, malunion brought on by the humeral head losing its grip, fractured distal screws causing the plate to separate from the bone, as well as temporary axillary nerve palsies[9].

The use of a PHILOS plate in proximal humerus fractures can lead to a favourable functional outcome when combined with early joint mobilization and firm fixation of the fracture. The locking plate can be utilized in conjunction with a minimally invasive approach, enabling indirect realignment of fractures. This technique reduces the risk of “avascular necrosis (AVN)” as well as the immobilization time. In addition, the proximal locking screw's capacity to be applied in multiple directions makes it a stabilizing device with great stability in osteoporotic bones[14].

MATERIAL AND METHODS

A minimum of 30 patients with proximal humerus fracture will be taken for study. Patients will be treated by open reduction internal fication with PHILOS plate. Follow up will be for a minimum period of 6 months.

Study Design: The study design is a prospective study.

Study Period: Present study was conducted from September 2022-February 2024. The study included patients hospitalized as inpatients in the orthopedic department of Narayana Medical College and Hospital, Nellore, who had proximal humerus fractures.

Sample Size: The study included a total of 30 patients that met the specified inclusion criteria.

Inclusion Criteria:

- Age >20 years
- Both male and female patients
- Based on Neer’s classification two part, three part and four part fractures of proximal humers.
- Both open and closed fractures of proximal humerus.
- For the patient to take part in the study, they must be willing and provide written informed consent.

Exclusion Criteria:

- <18 years
- Acute infections
- Pathological fractures
- Malignancy
- Polytrauma

Ethical clearance: The study received approval from the Institutional Ethics Committee of Narayana Medical College in Nellore.

Procedure: All patients were administered a preventive dose of intravenous antibiotics. The procedure was performed in the beach chair position with either brachial block or general anesthesia. The fracture site was revealed and minimized using a delto-pectoral and deltoid splitting technique, with minimal disruption to the surrounding soft tissues. In summary, the anatomical connection between the humeral head and greater tuberosity was temporarily restored and

secured with K wires. If there was a clear rotation or movement of the humeral head, the joystick approach was employed. Next, the shaft fragment was diminished using abduction, traction and rotation of the arm.

The fragments would be indirectly diminished with the use of traction sutures, which were positioned at the points where the rotator cuff tendons attach and by rotating the extremity. Once an appropriate reduction was achieved, the PHILOS plate was positioned at a minimum distance of 1cm from the upper end of the larger tuberosity and secured to the humeral shaft. Subsequently, an aiming device was affixed to the upper section of the plate and the head fragments were stabilized using Kirschner wires under the guidance of an image intensifier.

The necessary dimensions of the locking head screws were ascertained using a direct measuring instrument and then a specially engineered hexagonal screwdriver was employed to insert four to six locking screws. Proximal locking screws were implanted to secure the humeral head in place. The proximal locking screws were inserted unilaterally using an external guide and their placement within the humeral head was verified using intraoperative fluoroscopy.

AP views, which involve internal and external rotation and axillary views at a 90-degree angle were employed to visualize the positioning of the screws. The screws in the distal shaft were inserted through both cortices. Fluoroscopic images were captured to verify the successful alignment of the broken bone, the accurate placement of the plate and the appropriate length of the screws in the upper arm bone. The range of motion of the shoulder was assessed on the table to determine if there was any impingement. The wound was sutured using a layered closure technique

Functional Outcome: We conducted the assessment of the functional outcome using the Constant Shoulder Score.

Constant Shoulder Score Table

- Scoring system used in the study is Constant-Murley Shoulder Outcome Score. It includes.
- Pain score
- Functional assessment
- Range of motion
- Strength measures

RESULTS AND DISCUSSION

Our study consists of 30 patients with proximal humerus fracture. All 30 patients were taken for final analysis and all were treated with PHILOS plate. The following parameters were included. The age range of the patients in the cohort was 22-71 years, with the age group of 31-40 years having the highest incidence (40.0%) and the mean age is 44.53 years.

In our study, the group consisted of 6 females (20.0%) and 24 males (80.0%), with a clear prevalence of fractures in males. The male to female ratio is 4:1.

Out of the 30 patients 2-part fracture were 6 (20%) cases, 3-part fracture 14 (46.7%) cases and 4-part fracture were 10 (33.3%) cases.

In our study, the duration of hospital stay was less than 7 days for 2 patients (6.7%), 7-14 days for 22 patients (73.3%), 15-30 days for 5 patients (17.2%) and more than 30 days for 1 patient (3.3%). The average duration of hospitalization was 12.93 days. In our study there were only 7 (23.3%) osteoporotic patients compared to 23 (76.7%) not osteoporotic patients.

In Study 6, 20.0% of patients obtained radiological union after 8 weeks of follow-up. After 12 weeks' follow-up, this number improved to 90% and after 24 weeks, all 30 patients (100%) had achieved radiological union. The majority of the patients, specifically 27 out of 30 (90%), achieved radiological union within the 12-week follow-up period. The average duration of union was 12.4 weeks.

Our study demonstrated a significant statistical improvement in the Constant Score after 36 weeks ($p < 0.001$), with the mean score increasing from 51.83 at 8 weeks-80.50 at the 36-week follow-up. The most significant increase in score occurred throughout the 8 to 12-week follow-up period (from 51.83-67.93) due to 90% of the patients achieving fracture union. There was minimal increase in the score from 24 weeks to 36 weeks follow up (78.07-80.50) since all patients had achieved complete healing of the fracture by 24 weeks. The study found no statistically significant correlation with pre-operative MetaPhyseal extension and functional result ($p=0.125$).

However, there was a statistically significant correlation between post-operative medial hinge displacement and functional result ($p=0.010$). Likewise, there was a statistically significant correlation ($p=<0.001$) between post-operative CCD angle and maintainance of the Subacromial space and the functional outcome.

In our study most of the patients had excellent outcome (53.3 %) followed by good outcome (23.3 %), poor outcome (16.7 %) and fair outcome (6.7%). Achieving anatomical alignment and stable stabilization is the main goal of surgically correcting a displaced proximal humerus fracture. This allows for the restoration of the rotator cuff mechanism and the achievement of a functional outcome that nearly mimics the patient's pre-injury state. The optimum surgical treatment option is open reduction and internal fixation. It enables the direct observation of the broken pieces of the fracture and assists in directly aligning them to achieve precise anatomical alignment.

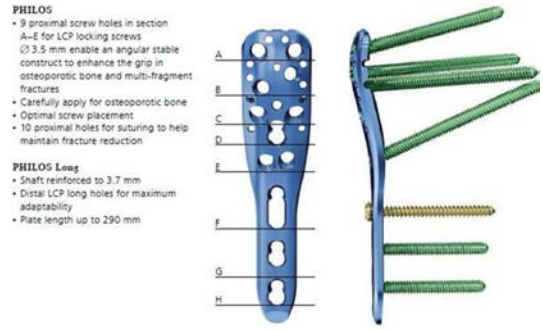

Fig. 1: Proximal humeral internal locking system plate

Fig. 2: Position and Drapping

Fig. 3: Incision

Fig. 4: Fracture fixed with PHILOS

Fig. 5: Wound Closure plate and screws

Fig. 6: PRE-OP XRAY

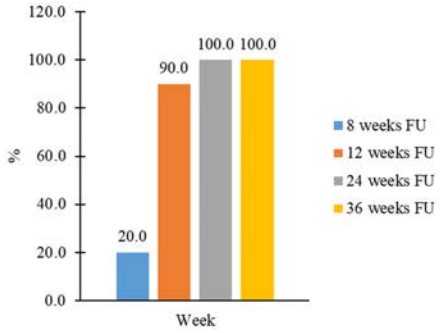

Fig. 7: Radiological Union distribution of patients

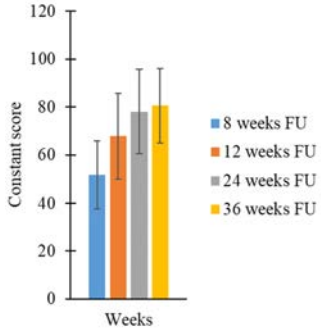

Fig. 8: Constant score at different follow ups of patients

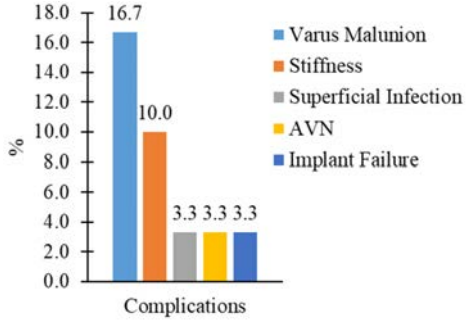

Fig. 9: Complications

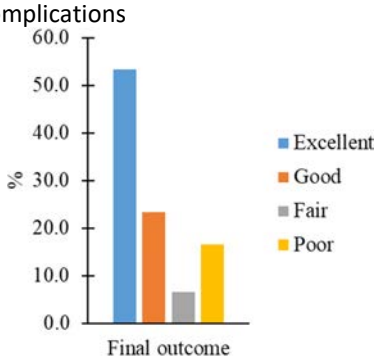

Fig. 10: Final outcome

Table 1: Constant score at different follow ups of patients

Constant score	Min-Max	Mean ± SD	Difference	t value	P value
8 weeks FU 20-69	51.83 ± 14.08	-	-	-	
12 weeks FU24-89	67.93 ± 17.73	-16.1	-16.5363	<0.001**	
24 weeks FU39-94	78.07 ± 17.71	-26.24	-21.2542	<0.001**	
36 weeks FU48-94	80.50 ± 15.59	-28.67	-24.3010	<0.001**	

Table 2: Complications distribution of patients studied

Complications	No. of patients (n = 30)	%
No	19	63.3
Yes	11	36.7
Varus Malunion	5	16.7
Stiffness	3	10.0
Superficial Infection	1	3.3
AVN	1	3.3
Implant Failure	1	3.3

Table 3: Association of Radiological parameters and Outcome of patients

Radiological Parameters		Outcome				Total(n = 30)	P value
		Excellent(n = 16)	Fair(n = 2)	Good(n = 7)	Poor(n = 5)		
Pre op MetaPhyseal	More than 8 mm	13 (81.25%)	0 (0.0%)	7 (100%)	4 (80.0%)	24	0.125
extension	Less than 8 mm	3 (18.75%)	2 (100%)	0 (0.0%)	1 (20.0%)	6	
Post op Medial Hinge	Less than 2 mm	7 (43.75%)	1 (50.0%)	2 (28.57%)	4 (80.0%)	14	<0.001**
Displacement	More than 2 mm	9 (56.25%)	1 (50.0%)	5 (71.43%)	1 (20.0%)	16	
Post op Sub acromial space maintainance	More than 50 % of normal	10 (62.50)	2 (100%)	5 (71.43%)	3 (60.0%)	20	<0.001**
space maintainance	Less than 50% of normal	6 (37.50%)	0 (0.0%)	2 (28.57%)	2 (40.0%)	10	
Post op CCD Angle(Deg)	<127	4 (25.0%)	0 (0.0%)	3 (42.86%)	1 (20.0%)	8	<0.001**
	127-145	12 (75.0%)	2 (100%)	4 (57.14%)	3 (60.0%)	21	
	148	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (20.0%)	1	

Table 4: Final Functional Outcome

Final outcome	No. of patients	%
Excellent	16	53.3
Good	7	23.3
Fair	2	6.7
Poor	5	16.7
Total	30	100.0

Additionally, it aids in the accurate placement of the implant.

The PHILOS plate provides favorable functional results due to its combination of early joint mobilization and firm fixation in proximal humerus fractures. The study's objective was to assess the functional and radiological outcomes of treating displaced proximal humerus fractures with the PHILOS plate.

There were 30 patients who experienced proximal humerus fracture and they were included in the study. Patients had a surgical procedure, open reduction and internal fixation, in which a PHILOS plate was used.

The Following are our Observations: The age range of the group was 22-71 years, with the highest occurrence occurring in the 31-40 age group, which accounted for 12 individuals (40%). The majority of the participants were males, totalling 24 individuals (80%). The results were in line with the investigations conducted by Gerber[15] and Jagiasi[16] which revealed average ages of 44.9 and 47.1 years, respectively.

The primary cause of injury for the majority of patients was road traffic accidents (RTA), accounting for 70% of cases. A study conducted by Patil[17]. revealed comparable findings, with 70% of cases attributed to road traffic accidents. Additionally, a significant proportion of these injuries occurred on the right side, with 56.7% of patients affected. Out of the total number of patients, 14 (46.7%) had a 3-part fracture as per Neer's classification. The majority of patients (60%) underwent surgery within one week of the incident. The majority of patients, specifically 22 out of 30 (73.3%), had a hospital stay lasting between 7 and 14 days.

The deltopectoral method was the preferred approach in 26 cases, accounting for 86.7% of the total. A stainless steel implant was employed in a maximum of 27 individuals, which accounted for 90% of the total. Out of all the patients, only 7 (23.3%) were diagnosed with osteoporosis. The majority of the patients, specifically 24 out of 30 (80%), had a preoperative metaphyseal extension >8mm. The majority of patients (70%) had a postoperative CCD angle ranging from 127-145 degrees. In 16 (53.3%) instances, postoperative medial hinge displacement of l <2mm was seen. In a study conducted by Lupescu O. *et al*., it was observed that a displacement of <2mm in the medial hinge was linked to excellent results in 67.34% of the instances (33 out of 49).

Out of the total number of patients, 20 (66.7%) had a subacromial space that was >50% of the usual size. The vast majority of patients, specifically 27 out of 30 (90%), achieved radiological union within 12 weeks. The constant score showed a statistically significant improvement from 51.83 at 8 weeks-80.50 at 36 weeks (p=<0.001). The most prevalent complication seen was varus malunion, which occurred in 5 cases, accounting

for 16.7% of the total. AVN alterations were observed in only one patient, accounting for 3.3% of the total. No statistically significant differences were seen in the union rates for osteoporosis (p=1.0) and fracture classification (p=1.0) at the end of the follow-up. There was no statistically significant difference in metaphyseal extension when considering fracture classification (p=0.125) and outcome (p=0.186).

No statistically significant differences were found in fracture classification in relation to CCD angle (p= 0.63), medial hinge displacement (p=0.21) and subacromial space maintenance (p=0.07). Medial hinge displacement (p=0.010), subacromial space (p = 0.001) and CCD angle (p=<0.001) were found to have a statistically significant correlation with functional outcome.

A statistically significant correlation was observed at the final follow-up (p=0.01) between the mechanism of damage and the Constant score. The study found a statistically significant correlation between fracture classification and constant score at 24 weeks (p= 0.028) and 36 weeks (p=0.034). However, the results were not statistically significant at 8 and 12 weeks, with p-values of 0.214 and 0.066, respectively.

The Constant Score at the 36-week follow-up was 80.5±15.6. An excellent outcome was observed in 17 (56.7%) patients, a good outcome in 6 (20.0%) patients, a fair outcome in 3 (10%) patients and a poor outcome in 4 (13.3%) patients. No statistically significant correlation was found between the end outcome and the type of fracture(p=0.51).

At the conclusion of the trial, the functional outcome was classified as excellent in 16 patients (53.3%), good in 7 patients (23.3%), fair in 2 patients (6.7%) and poor in 5 patients (16.7%).

CONCLUSION

The Proximal Humeral Internal Locking System (PHILOS) is the preferred implant for treating displaced fractures of the proximal humerus, since it results in favourable functional outcomes for patients.

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