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Philos Plating for Proximal Humeral Fractures: Outcome of 41 Consecutive Fixations

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Abstract

Background: Proximal Humeral fractures (PHFs) are a growing concern in older adults. Proximal Humeral Internal Locking System (PHILOS) plate has been designed to overcome the challenges of traditional fixation methods. This study assesses the clinical and radiological outcomes of PHFs treated with PHILOS plate in Nigeria.

Methods: A retrospective study on 41 patients with PHFs treated with PHILOS plating between January 2018 and December 2020. Inclusion criteria were adults who had PHFs with complete follow-up data. We evaluated time to radiological union, Neer's shoulder scores, range of motion (ROM) at union and post-operative complications. Data was analyzed using descriptive statistics and chi- square testing with significance set at $p \leq 0.05$.

Results: Most patients (87.7%) were above 50 years with a female predominance (58.5%). Falls were the most common mechanism of injury (78%). Most fractures were classified as Neer 3- part (65.9%). Radiological union was achieved within 14 weeks in 82.9% patients. At union, 51.2% of patients attained a Neer's score > 89 with flexion and abduction > 160° in 75.6 % and 73.2% respectively. Forty-one percent of patients had subacromial impingement being the most common complication, followed by screw pull-out, superficial infection and reoperation (7.3%).

Conclusion: PHILOS plate yields dependable fixation and satisfactory functional outcomes for proximal humeral fractures especially in elderly patients. While there are some complications, the benefits of early union and excellent shoulder function support its use as an effective operative strategy. Long-term follow-up is necessary to better assess the avascular necrosis and implant longevity

Keywords: Proximal Humeral fractures, Neer's score, PHILOS plate, Fracture fixation.

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INTRODUCTION

Proximal humeral fractures (PHFs) are common in orthopedic practice constituting 4-6% Of all bone fractures[1]. These injuries typically occur as high-energy injuries in the young population or low energy injuries in an osteoporotic bone. Reported epidemiologic variables therefore differ based on population variables at the various study centers. The elderly female is the most affected in most developed nations because of the ageing population[2,3]. Kale et el[4] in Maharashtra India however reported male predominance with a mean age of mean age of 55.63 ± 10.37.

Non-displaced fractures make up 45-80% of all proximal humeral fractures[5,6.] Most of these have been treated non-operatively with good-excellent results[7]. Though complications of non-union, malunion, avascular necrosis, joint stiffness and reduced shoulder range of motion have been observed[5-7].

Operative fixation is the most optimal treatment for displaced proximal humeral fractures. Fractures with >1cm displacement, >45degree valgus or varus angulation and rotational displacement are typically regarded as displaced fractures[7].

Several operative treatment modalities exist and include plate fixation, suture fixations, proximal humeral nail fixation with multi-lock, k-wire fixation, tension band wire fixation, screw fixation, anatomic shoulder replacement and reverse shoulder replacement based on the severity of the fracture, the age of the patient, the functional demands of the shoulder, the status of the rotator cuff tendons, the stability of the medial calcar, available implant resources and level of expertise[6,7].

There is clearly no consensus on the most optimal operative treatment modality for displaced PHFs, however prosthetic replacement surgery is generally preferred for severely comminuted intra-articular fractures especially in the osteoporotic bone while reverse shoulder replacement is more preferred when rotator cuff tendonitis is present or when the former fails. Plate fixation is considered more ideal for 2-part or 3-part fractures and some 4-part fractures with stable medial calcar.

Pre-contoured anatomic locking plates have more benefit of stable fracture fixation, less subsidence at the metaphyseal region, more preservation of the blood supply to the head, minimal interference with the rotator cuff tendons and minimally invasive fixation option. Reports have shown good to excellent results with the proximal humeral internal locking system (PHILOS)[10,11]. Some complications including avascular necrosis of the head, screw pull out, fracture non-union, exaggerated neck angulation, transient nerve injuries and disturbance of the rotator cuff tendons have also been reported[11,12,13] .

This study reports the outcome of surgical treatment of proximal humeral fractures (PHFs) using the proximal humeral internal locking system (PHILOS) from 41 consecutive surgeries.

METHODOLOGY

This study was a retrospective study of adult patients with proximal humeral fractures who presented to the orthopedic department of the University of Port Harcourt Teaching Hospital (UPTH) and three private hospitals from 1st of January 2018 to the 31st of December 2020 (three-year period).

Sampling: The clinical records, operation notes and follow-up notes of all patients who had surgery using PHILOS at the study centers for proximal humeral fractures within the study period were consecutively sampled for recruitment into the study.

Exclusion criteria: Patients with the following clinical notes were excluded from the study.

a. Incomplete clinical data
b. Lost to follow up
c. Open fractures
d. Patients whose fractures were fixed with another implant

Study variables: Secondary data from patients who met the inclusion criteria, were recruited into the study. Relevant data concerning patient's biodata, possible etiology, severity of trauma involved, fracture classification based on Neer's classification, presence or absence of open wound and treatment variables were retrieved from recruited patients' folders.

Initial radiographs at presentation were also retrieved and evaluated. A radiograph of the affected limb which adequately reveals the fracture site, as well as the shoulder joint was accepted for enrolment. This served as basic diagnostic tool and aided in classification. Computed tomography scans were also retrieved and analyzed for three patients.

Treatment notes including operation notes, follow up notes, follow-up radiographs and physiotherapy notes

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were also retrieved and analyzed. Where necessary, patients were contacted to obtain more information to augment what was available in the notes.

All surgeries and follow-up evaluations were performed by the primary investigators and other orthopaedic surgeons in the study facilities.

Post- operative protocol for all patients in terms of intravenous fluids, analgesics, and intravenous antibiotics (third-generation cephalosporin and metronidazole) were similar.

Notes from follow-up visits done at 2weeks, 6weeks, 12weeks, 18weeks, and 24 weeks and 1-year post-intervention were analyzed. Radiographs of the limb which was done at the immediate post-operative period, 6 weeks, 12 weeks, and 18 weeks were also analyzed. Other Radiographs done at other times as requested were also retrieved and evaluated.

A fracture was considered to have united if no tenderness was elicited on palpation or attempted motion at the fracture site as well as radiologic evidence of union across the fracture site.

Outcomes measured include

1. Neer's score
2. Interval from fixation to radiologic evidence of fracture union
3. Functional range of motion in the ipsilateral shoulder at the point of radiologic union
4. Post-operative Complications

Data analysis: Frequencies and cross tabulations were used to create two- way and multi-way tables. Charts and graphs were used to display appropriate variables. Certain numerical results were also expressed in mean, median (inter-quantile range), proportion and standard deviation. Statistical methods were carried out using Microsoft excel sheet.

Ethics and confidentiality: The hospital number of the patient were used, instead of the name, for data collection. All primary and secondary data retrieved from patients were kept in strict confidentiality.

RESULTS

Most patients (87.7%) were above 50 years with a mean age of 58.2years and a male: female ratio of 1:1.4. falls were most responsible (78.0%) for the fractures than any other etiology. Union rates after 14 weeks were 82.9%. results are as shown in tables and charts below

Table 1: Patient Demographics

Age range	Frequency	Percentage
21-30	1	2.4
31-40	2	4.9
41-50	2	4.9
51-60	16	39.0
61-70	12	29.2
Above 70	8	19.5
Male	17	41.5
Female	24	58.5
Retired	20	48.8
Self-employed	17	41.5
Other occupations	4	9.8
Total	**41**	**100**

Table 2: Possible Fracture Etiologies

Etiologic considerations	Frequency	Percentage
Falls	32	78.0
Road traffic accident	8	19.5
Industrial injury	1	2.4
Total	**41**	**100**

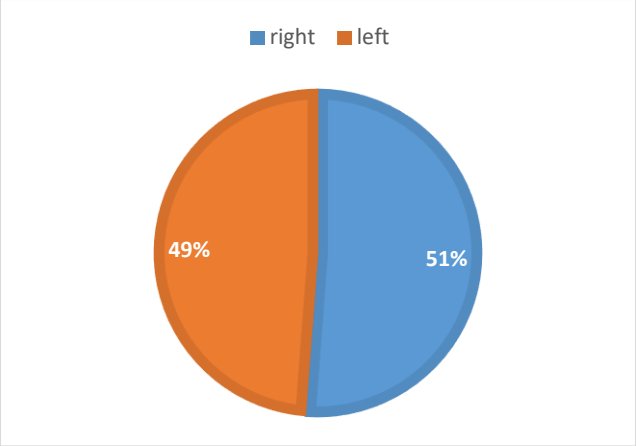

Figure 1: laterality of fractures

Table 3: Fracture Types Based On Neer's Classification

Fracture patterns	No	Percentage
2 Part	8	19.5
3 part	27	65.9
4 part	6	14.6
Total	**41**	**100**

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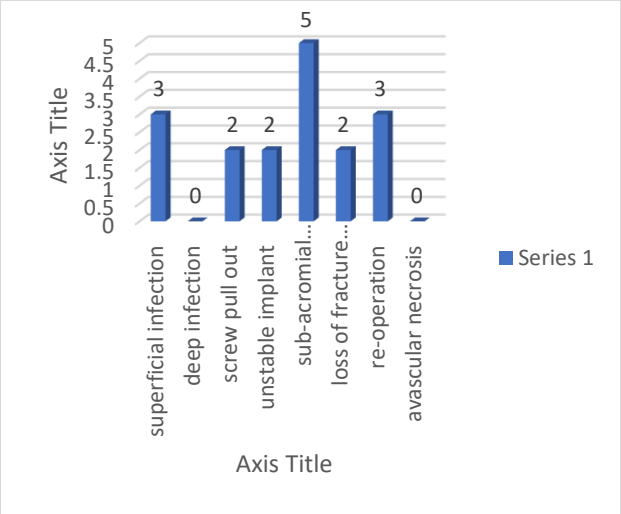

Figure 2: Post-operative Complications

Table 4: Outcome Measures of Philo's Plating for Proximal Humeral Fractures

Time to bone union	Frequency	Percentage
12-14 weeks	34	82.9
>14-18weeks	4	9.6
>18weeks	3	7.3
NEER's shoulder score		
>89	21	51.2
80-89	13	31.7
70-79	5	12.2
<70	2	4.9
Shoulder ROM @union in degrees		
Flexion		
160-180	31	75.6
140-159	8	19.5
<140	2	4.9
Abduction		
160-180	30	73.2
140-159	10	24.4
<140	1	2.4
External rotation		
80-90	28	68.3
79-70	9	22.0
<70	4	9.8

DISCUSSION

Patients above the 5th decade of life made up 87.7% of the study population with a mean age of 58.2years. there were more females than males in a ratio of 1:1.4. Most fractures in the study 78.0% resulted from falls with three-part fractures constituting nearly 70%. Union rates after 14 weeks were 82.9%. subacromial impingement was the most common complication.

Demographics of patients showed that the 87.7% were above 50 years. This corroborates findings from Dewarrat et al[14] and Olsson et al [3]. The osteoporotic spectrum of fractures clearly includes proximal humeral fractures and are becoming of increasing public health concern as the ageing population expands.

Both Srikanth et al[15] and Kale et al[4] have however reported young male patient dominance in their different studies. This study showed a slight female gender dominance.

Most fractures (78.0%, n=32) were caused by falls. Falls constitute the commonest fracture mechanism in the elderly population. The dwindling level of muscle grip, reduced gait-balance, sub-optimal vision as well as other underlying medical conditions may have independent contributions to falls among this population. Geiger et al[16] in a similar study reported 75% (21/28) contribution from falls. Road traffic accidents (19.5%, n=8) and industrial accidents (2.4%, n=1) were the other injury mechanisms seen in this study

Neer's three-part fractures were by far the commonest fracture pattern (n= 27, 65.8%) followed by two-part (n= 8, 19.5%). This is consistent with reports from other scholars[15,16,17]. This may indicate the propensity of surgeons to use PHILOS plating for relatively less comminuted fractures compared to other fixation methods.

Fracture union rate at 14 weeks was 82.9% (n=34) with excellent Neer's score in 51,2% (n=21) of the patients. Agrawal et al in India[17] have also reported similar finding and have opined that the lateral buttress stability, diverging screw options in cancellous bone, pre-contoured configuration and locking screw properties render the PHILOS plates the implant of choice for complex PHFs. Brunner et al[18] have also reported that PHILOS plates optimally maintains fracture reduction, provides stable fixation and have good functional outcome.

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The plate configuration, screw orientation, locking options combined with proper plate placement and incorporation of holes for reconstruction of the rotator cuff tendons are key qualities with the PHILOS and may perhaps explain the good outcomes reported in several studies[16-19]. Leonard et al[20] have also reported that these plates are one of the most advanced options of fixation of PHFs and are considered by many as a successful implant in providing stability, promoting bone union and improving the range of motion in the shoulder. They however also reported high implant-related complication rates. Reported complication rates from use of PHILOS in other studies are as high 33% (n=7182) by Panagiotopoulou et al[21] and 49% (n=514) by sproul et al[22]. Complication rate from this study was 41.5% (n=17/41) with subacromial impingement being the most common complication (29.4% n=5/17). Superficial wound infection, screw pull out, and loss of fracture reduction were other complications seen in this study. Three patients (7.3%) had reoperation for an unstable implant with poor union.

Sproul et al[22] have reported 14% reoperation rate and several other complications like varus malunion, subacromial impingement and screw perforation. Other workers[23,24] have shown a high rate of screw cut out and avascular necrosis with Owsley & Gorczyca[25] reporting screw cut out (23%) as the highest contributor to re-operation. Though this study didn't report any avascular necrosis and a low screw pull out rate (4.9%), the osteoporotic nature of bones commonly involved in fragility fractures may explain the high rates reported in other studies. Osteoporosis is perhaps a less public health problem in the study population. A longer follow-up period may be required to reveal avascular necrosis of the humeral head.

Subacromial impingement as reported in this study was mainly a clinical diagnosis. The presence of pain in the ipsilateral shoulder with limitation in abduction motion by the 24-weeks follow-up period was reported as impingement. Radiologic evaluation may have further streamlined and reduced the reported number. Reported impingement rates range from 1.8-8%[26,27] with most reports citing superior placement of the plate as the cause of the impingement.

Superficial infection was essentially treated with broad spectrum antibiotics and wound dressing in line with the study center's protocol and they all healed within 2 weeks. Dewarrat et al[14] also found 7% superficial infection rate and no deep infection.

The range of motion in the ipsilateral shoulder was good to excellent in flexion, abduction and external rotation in more than 80% of patients at the 24th week follow-up visit. Other studies[14, 26,27] involving longer follow-up period of 18-24 months also showed good range of motion in flexion, abduction and external rotation.
Results from this study show that the proximal humeral internal locking system plates are an optimal implant option for the fixation of proximal humeral fractures at the study center.

Limitations of the study
The study was a retrospective study hence certain variables cannot be controlled
Only three CT scans were retrieved for analysis
Certain data may also be missing from the records.

CONCLUSION
The PHILOS plates provide good stability and acceptable complication rate for the fixation of proximal humeral fractures. Short-term follow-up have shown good fracture union, excellent range of flexion, abduction and external rotation movement of the ipsilateral shoulder.

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