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**Dr. Purushotham K**  
Professor & HOD  
Dept. of Orthopaedics,  
Dr. BR Ambedkar Medical  
College Hospital, Rajiv Gandhi  
University of Health Sciences,  
Bangalore, Karnataka, India

**Dr. Krishnamurthy T**  
Assistant Professor,  
Dept. of Orthopaedics,  
Dr. BR Ambedkar Medical  
College Hospital, Rajiv Gandhi  
University of Health Sciences,  
Bangalore, Karnataka, India

**Dr. Abhishek M Matapathi**  
Post-Graduate  
Dept. of Orthopaedics,  
Dr. BR Ambedkar Medical  
College Hospital, Rajiv Gandhi  
University of Health Sciences,  
Bangalore, Karnataka, India

**Dr. Dhanunjaya Reddy**  
Senior Resident, Post-Graduate  
Dept. of Orthopaedics,  
Dr. BR Ambedkar Medical  
College Hospital, Rajiv Gandhi  
University of Health Sciences,  
Bangalore, Karnataka, India

**Corresponding Author:**  
**Dr. Abhishek M Matapathi**  
Post-Graduate  
Dept. of Orthopaedics,  
Dr. BR Ambedkar Medical  
College Hospital, Rajiv Gandhi  
University of Health Sciences,  
Bangalore, Karnataka, India

## Functional outcome of PHILOS plate in proximal humerus fractures

**Dr. Purushotham K, Dr. Krishnamurthy T, Dr. Abhishek M Matapathi and Dr. Dhanunjaya Reddy**

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### Abstract

**Introduction:** Proximal humeral fractures (PHFs) are the seventh most frequent fractures in adults <sup>[1]</sup>. Proximal Humerus Fractures constitute about 4% of all fractures and 26% of all humerus fractures <sup>[2]</sup>. Management of three-part and four-part fractures is still a challenge owing to associated complications including osteoporosis, angulation, unstable reduction, varus collapse, screw back out etc. Aim of our study was to assess the functional outcome proximal humerus fractures (Neers classification 2 part, 3 part and 4 part) treated with PHILOS (Proximal humeral internal locking system).

**Methods:** Our study was a prospective study conducted at our institution from October 2018 to December 2019. The study group consisted of 30 patients including 6 female patients and 24 male patients. The Proximal humerus fractures were classified using Neer's classification system. Open reduction and internal fixation with a PHILOS plate was carried out on all the patients under general anesthesia. All patients underwent a similar post-operative physiotherapy. Functional parameters were assessed using Constant-Murley scoring system.

**Results:** In our study, 14 (46.7%) cases showed Excellent outcomes, 9 (30%) showed good outcomes, 4 (13.3%) showed fair outcomes and 3 (10%) showed poor outcomes. The mean constant score was 78 in our study. Our study group had 7 (23.3%) cases of complications. The most common complication was varus malunion which was seen in 3 (10%) cases.

**Conclusion:** PHILOS plate provides a high degree of angular and axial stability eliminating screw loosening and backout. The divergent and convergent orientation of the screws engaging in the humeral head prevent pull out and failure of fixation.

**Keywords:** Functional outcome, PHILOS plate, proximal humerus fractures

### Introduction

Proximal humeral fractures (PHFs) are the seventh most frequent fractures in adults <sup>[1]</sup>. Prevalence varies from 4% to 10% of all fractures according to several studies performed in different countries and populations <sup>[1]</sup>. Proximal Humerus Fractures constitute about 4% of all fractures and 26% of all humerus fractures <sup>[2]</sup>.

Fractures are more common in aged people due to osteoporosis and less common in young people which is mostly due to high energy trauma <sup>[3]</sup>.

Treatment of these fractures are exigent because of osteoporosis in elderly and due to the deforming forces of the muscles attached. Proximal humerus fractures are stable & slightly or nondisplaced in young as well as in elderly patients. They constitute about 80% of the proximal humerus fractures and can be treated non operatively <sup>[4]</sup>. The remaining 20% of the fractures require surgical fixation for better shoulder mobility or in cases of severe fractures Neer's classification is used to differentiate between the number of displaced fragments of the fracture with displacement defined as greater than 45° of angulation or > 1 cm of separation.

Proximal humerus fractures with poor cancellous bone quality which is common in elderly patients has higher failure rate with conventional plating system <sup>[5-7]</sup>. The divergent and convergent orientation of the screws engaging in the humeral head prevent pull out and failure of fixation. PHILOS plate provides a high degree of angular and axial stability eliminating screw loosening and backout <sup>[8]</sup>.

PHILOS plating in fractures of proximal humerus has the best results particularly in the osteoporotic bones and elderly <sup>[9-10]</sup>.

PHILOS plate fixation provides stable fixation, minimal metal work problems and enables early range-of-motion exercises to achieve acceptable functional results. Hence it is used even in minimally displaced fracture to avoid shoulder stiffness. Rotator cuff sutural ties with plate are used to reconstruct highly comminuted 3 & 4 parts fractures and hence augments the functional outcome [11].

The functional outcome of management of the fracture of humerus involving the proximal part of humerus, with PHILOS plate has been discussed in this study.

**Methodology**

**Source of data:** The study group will be obtained from patients having Proximal Humerus fracture, visiting orthopaedics OPD in Dr. B.R. Ambedkar Medical College Hospital, Bangalore. Patients of age 18 to 65 years of either sex were included in the study. 30 patients were included in the study.

**Study period:** October 2018 to October 2020

**Method of collection of data**

**Initial data:** As the patients arrived at casualty, demographic details and mechanism of injury were collected. A careful detailed physical examination is carried out. Assessment for may associated injuries is done. X-Ray of the shoulder AP view is taken for all patients. Occasionally CT scan with 3D reconstruction is advised based on the requirement after seeing the x-ray. The fractures are then classified according to Neer’s Classification: Routine preoperative investigations are done and fitness for surgery obtained.

**Surgical Procedure:** Patients were operated by Open reduction and internal fixation with PHILOS plate under general anesthesia. Either Delto-pectoral or Deltoid-splitting approach is used.

**Post operative protocol:** The shoulder was immobilized with an arm pouch. Pendulum exercises started from the first week postsurgery. Gentle passive forward flexion and rotation exercises were initiated by second week. Active range of motion exercises and resistive exercises were started by 3-5 weeks.

**Follow up:** Patients were followed up at 3weeks, 6 weeks and every month thereafter. The range of motion was monitored along with physiotherapy for functional recovery. Check xrays were taken at 3weeks, 6 weeks and 4 months. The functional outcome was assessed by using Constant-Murley Score at 4 months.

**Constant-Murley Score [12]**

The Constant-Murley score is a 100-points scale composed of a number of individual parameters. It is divided into four subscales where 35 points are allocated for subjective parameters and 65 points are allocated for objective measures. A young healthy patient can therefore have a maximum score of 100 points. The four subscales are as follows:

**2 Subjective parameters**

- Pain (15 points maximum)
- Activities of Daily Living i.e. ‘sleep, work, recreation’ (20 points max)

**2 Objective parameters**

- ROM (40 points maximum)
- Strength (25 points maximum).

The Scores of the 4 subscales are then added to obtain the final score. The outcome was interpreted as below.

Excellent - 86 to 100 points

Good - 71 to 85 points

Fair - 56 to 70 points

Poor - 0 to 55 points

**Results**

We studied 30 patients with proximal humerus fractures. All patients were examined clinically and radiologically. Patients were operated with PHILOS plate and received similar post-operative care. Final analysis by constant score was done at 4 months.

The patients in our study aged between 22 years and 64 years. The maximum incidence was in the age group of 30-50 years accounting to 73.3 %. The mean age was 39.56 years.

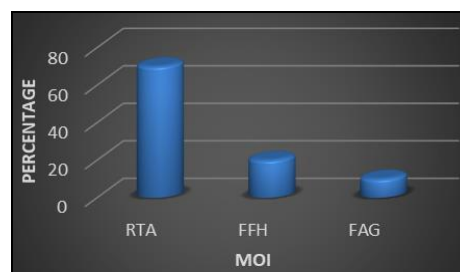
**Table 1:** Age frequency distribution of patients studied

Age in Years	No. of Patients	%
<30	5	16.7
30-50	22	73.3
51-70	3	10
Total	30	100.0

Mean ± SD: 39.56±9.41

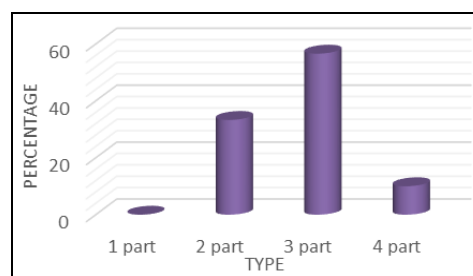
Our study group had a significant male predominance consisted of 20 male patients (66.6%) and 10 female patients (33.3%). The male to female ratio was 2:1.

The Mode of injury was by RTA in 21 (70%) patients, fall from height (FFH) in 6 (20%) patients and fall at ground level (FAG) in 3 (10%) patients.



**Chart No. 1:** Mode of injury (MOI)-frequency distribution of patients studied

In our study, there were 10(33.3%) cases of 2-part fractures, 17(56.6%) cases of 3-part fractures, 3(20%) cases of 4-part fractures.



**Chart No 2:** Fracture classification frequency distribution of patients studied

In the study, 26(86.6%) patients were operated with Deltopectoral approach and 4(13.3%) patients were operated by Deltoid Splitting approach.

The Flexion range was less than 100 degrees in 6(20%) cases and between 100-150degrees in 6(20%) cases). Majority of the

cases i.e. 18 (60%) had a flexion range of more than 150 degrees. Similarly, Abduction range was less than 100 degrees in 6(20%) cases and between 100-150degrees in 4(13.3% cases). Rest of the 20 (66.6%) cases had Abduction range of more than 150 degrees.

**Table 2:** ROM distribution in patients studied Flexion/Abduction Range

Variables	No. of Patients	%
<b>Flexion</b>		
• <100°	6	20.0
• 100-150°	6	20.0
• >150°	18	60.0
<b>Abduction</b>		
• <100°	6	20.0
• 100-150°	4	13.3
• >150°	20	66.6
Total	30	100.0

The External rotation points was between 4-6 in 4 (13.3%) patients, 6-8 in 3 (10%) patients and 8-10 in 23 (76.7%) patients. Similarly, the internal rotation points were between 4-6 in 3 (10%) patients, 6-8 in 4 (13.3%) patients and 8-10 in 23 (76.7%) patients.

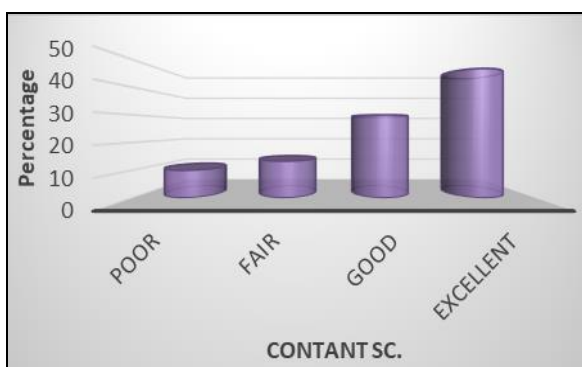
External Rotation Points/Internal Rotation Points

Variables	No. of Patients	%
<b>EXT R points</b>		
• 0-2	0	0.0
• 2-4	0	0.0
• 4-6	4	13.3
• 6-8	3	10.0
• 8-10	23	76.7
<b>INT R points</b>		
• 0-2	0	0.0
• 2-4	0	0.0
• 4-6	3	10.0
• 6-8	4	13.3
• 8-10	23	76.7
Total	30	100.0

In the evaluation at 4 weeks, 3 (10%) patients had poor outcome, 4 (13.3%) patients had fair outcome, 9 (30%) patients had good outcome and 14(46.7%) patients had excellent outcomes.

**Table 3:** Functional Outcome based on constant score distribution in the patients studied

Contant Sc.	Functional outcome	No. of Patients	%
0-55	Poor	3	10.0
56-70	Fair	4	13.3
71-85	Good	9	30.0
86-100	Excellent	14	46.7
Total		30	100.0



**Chart No 3:** Functional outcome based on constant score distribution in the patients studied

The minimum Flexion was 50 and maximum flexion was 170 degrees with a mean of 140.50 degrees. The minimum Abduction was 45 and maximum abduction was 170 degrees with a mean of 138.83 degrees. The minimum points for both External rotation and internal rotation was 4 points and maximum were 10 points. The minimum Constant score was 52 and maximum was 94 with a mean score of 77.63.

**Table 4:** Descriptive Statistics

Variables	Minimum	Maximum	Mean	Standard Deviation
Flex	50.00	170.00	140.50	37.56
Abd	45.00	170.00	138.83	37.10
Ext R Points	4.00	10.00	8.06	2.06
Int R Points	4.00	10.00	7.86	1.814
Contant Sc.	52.00	94.00	77.63	13.14

There were no post-operative complications in 23 (76.6%) patients. 1 (3.3%) patient ended up with Avascular necrosis (AVN). 1 (3.3%) patient had impingement. 2 (6.6%) patients had stiffness of the shoulder. 3 (10%) patients had varus malunion.

**Table 5:** Complication frequency distribution of patients studied

Complication	No. of Patients	%
Nil	23	76.6
Yes	7	23.3
▪ AVN	1	3.3
▪ Impingement	1	3.3
▪ Stiffness	2	6.6
▪ Varus Malunion	3	10.0
Total	30	100.0

**Discussion**

The treatment of complex humeral 3- or 4-part fractures represents a challenge. The surgeon must obtain an exact anatomical reduction and stable fixation, and at the same time minimise the iatrogenic risk of screw penetration and avascular necrosis of humeral head by maximal protection of the periarticular soft tissues<sup>[13]</sup>.

Studies show that conventional compression plates show a very high incidence of post operative displacement of fracture<sup>[14]</sup>. The ages of the study patients varied between 22 years and 64 years. Majority of the patients were in the age group 30-50 years. These constituted 22 (73.3%) of the total study subjects. The mean age in our study was found to be 39.56±9.41 years. These findings were similar to the studies by Gerber C, *et al.* which reported a mean age of 44.9 years<sup>[15]</sup>.

Our study showed a male preponderance of 66.6% with a Male to Female ratio of 2:1. This is relatable to a study by Agarwal S, *et al.* who reported a male to female ratio of 1.7:1<sup>[16]</sup>. However a study by Ash Wood N, *et al.* showed a female preponderance with male to female ratio of 0.4:1<sup>[17]</sup>.

Our study showed the most common mode of injury to be road traffic accident with an incidence of 70%. The other 30% patients were injured by either fall from height (20%) or by fall at ground level (10%). These findings were consistent with similar study by Patil SN, *et al.* who reported 70 % cases from road traffic accident<sup>[18]</sup>.

Our study had Neer's 2part, 3part and 4part fractures of 33.3%, 56.6% and 10% respectively. Majority of the cases were 3part constituting 56.6%. Similar findings were seen in a study by Rizwan Shahid, *et al.* which showed majority of 3part fractures constituting 42% cases followed by 2part and 4part fractures respectively<sup>[19]</sup>.

In the present study, Constant score was employed as a measure for the outcome at 4 months follow-up. 14 (46.7%) cases showed Excellent outcomes, 9 (30%) showed good outcomes, 4 (13.3%) showed fair outcomes and 3 (10%) showed poor outcomes. The mean constant score was 78 in our study. The mean constant score of 4 part fractures was 59.3, mean of 3 part fractures was 78.8 and the mean of 2 part fractures was 81.2. Mean constant score in a similar studies conducted by Rao AS, *et al.*<sup>[20]</sup> and Patil MY, *et al.*<sup>[21]</sup> were 76 and 80 respectively which was comparable to our study.

### Conclusion

Although our study was relatively short, the results are comparable with other published journals.

Accurate anatomical reduction gains, pattern of the fracture, the quality of the bone encountered and early fracture fixation are significant to get a good final functional outcome.

In this regard, PHILOS plate provides for a stable internal fixation and provides scope for early mobilization. The repair of rotator cuff ensures functional restoration of the tuberosity. Secondary reduction loss is rare if fixation is stable.

As PHILOS plate has options for more number of screws for humeral head than conventional locking plate and as it has options of multidirectional screws, it will lead to more stable fixation of fracture fragments and helps in early mobilization of the patients.

The mean constant score in our study for 2 part fractures was above 80. Thus functional outcome of 2 part fractures is better than 3 part and 4 part fractures. An aggressive dedicated rehabilitation regime including ROM exercises and strengthening exercises will ensure the best possible result.

Finally, we concluded that proximal humeral fractures when treated surgically using PHILOS plate provides very good stability and ensure early mobilization, and thus delivers a good functional outcome.

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