



INDUS JOURNAL OF BIOSCIENCE RESEARCH

<https://induspublishers.com/IJBR>

ISSN: 2960-2793/ 2960-2807



Functional Outcomes of Proximal Humerus Fractures with PHILOS in a Tertiary Care Setup

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ARTICLE INFO

Keywords

Functional Outcomes, Proximal Humerus Fractures, Proximal Humerus Interlocking Osteo-Synthesis System.

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Declaration

Author's Contributions: All authors contributed to the study and approved the final manuscript.

Conflict of Interest: The authors declare no conflict of interest.

Funding: No funding received.

Article History

Received: 17-10-2024

Revised: 07-12-2024

Accepted: 21-12-2024

ABSTRACT

Background: Proximal humerus fractures are favorably classified according to AO classification and NEERS classification. Proximal humeral internal locking system (PHILOS) is representative of locking plates. In spite of being superior to conventional plates PHILOS is associated with complications. **Objective:** To determine the functional outcomes of proximal humerus fractures treated by PHILOS (Proximal Humerus Interlocking Osteo-synthesis system). **Material and Methods:** Overall 94 patients were included and operated using PHILOS by deltoid splitting approach. Patients were discharged on 3rd postoperative day. Skin staples were removed at 15th day. Arm was kept in polysling for 3 weeks. After 3 weeks pendulum exercises and range of motion exercises were started. Functional outcomes were assessed by Constant shoulder score at 6 weeks and 3 months. Descriptive statistics were calculated. Stratification was done and post-stratification chi square test was applied considering p-value ≤ 0.05 as significant. **Results:** Total 68.1% patients were male and 31.9% were female. The mean constant murley's shoulder score after 6 weeks and 3 months was 57.10 ± 7.02 and 87.54 ± 9.64 . as per Neer classification 9.6% had part-II, 81.9% had part-III and 8.55 had part-IV fracture. The functional outcome assessed by constant shoulder score status showed 59.6% had moderate and 40.4% had poor after 6 weeks and after 3 months 74.5% had excellent, 18.1% had good and 7.4% had moderate outcome. **Conclusion:** In our study, 74.5% patients had excellent, 18.1% had good and 7.4% had moderate functional outcome at end of follow-up after 3 months.

INTRODUCTION

Fractures of the proximal humerus are bi-modal with two primary mechanisms seen: low-energy falls in older patients and high-energy accidents in younger patients.¹⁻³ Proximal humerus fractures are considered a fragility fracture when seen in the elderly and have an increasing incidence rate in older individuals (in particular in older women) secondary to osteoporosis.²⁻⁴ The proximal humerus typically breaks into four fragments along the physeal lines of fusion - two tuberosities, the humeral head, and the shaft. Most tuberosity

fractures take place secondary to the displacement of the head fragment and their degree of spatial displacement is initially minimal, relative to their normal anatomic position.^{5,6}

Proximal humerus fractures comprise nearly 4%-5% of all fracture types and nearly 25% of fracture humerus. These fractures are commonly seen in the elderly population (people aged 60 years or more).⁶ Proximal humerus fractures are three times more common in women than in men.⁷⁻⁹ Majority of these fractures are closed.¹⁰



Depending on the patient, factors and fracture category, there are several treatment options available to treat proximal humerus fractures such as conservative treatment, Open Reduction Internal Fixation (ORIF), PHILOS, arthroplasty, intramedullary nailing, etc. Appropriate procedure selection and implant fixation requires orthopaedic surgeon's expertise.⁷

The major goal in the treatment of this fracture is to promote complication-free healing to recreate a pain-free mobile, stable and functional shoulder joint.^{11,12} There is debate in the literature as to how these fractures should be managed, both in terms of operative versus non-operative treatment and type of surgical intervention if operative treatment is indicated.^{2,13,14} With non-operative management, progressive displacement may occur because of the unopposed pull of the rotator cuff muscles. Non-operative treatment may result in complications like non-union, osteonecrosis, and malunion. Hence, in the majority of cases, operative management becomes mandatory for better outcomes.^{5,15} The use of a locking plate offers several advantages in that it provides good functional outcomes with a relatively low complication rate, and can overcome the challenges of treating fractures in patients with poor bone quality.¹⁶⁻¹⁸

The proximal humerus internal locking system (PHILOS) is an anatomical locking plate that was created by the AO/OTA (American orthopaedic foundation and orthopaedic trauma association) to improve functional outcomes, particularly for osteoporotic patients.¹⁹ PHILOS enables angled stabilization with multiple interlocking screws than conventional plates. The ability of screws to lock provides better anchorage in the osteoporotic bone to a plate gives angular stability to the construct and maintains postoperative reduction during early functional rehabilitation and avoids joint stiffness and enhances functional outcome.²⁰ Various studies report good results from this implant.²¹⁻²⁴ Proximal humerus can be operated by two basic approaches, conventional deltopectoral, and lateral deltoid-split approach. Neer's classification is commonly used for such fractures.²⁵

Patient-reported outcomes are used to evaluate outcomes of treatment as well as the success of surgical procedures.²⁶⁻²⁹ There are many studies that examine short-term outcomes such as

postoperative complications, length of hospital stay, disposition, and mortality, yet few studies examine preoperative characteristics about long-term outcomes.^{30,31}

Proximal humerus fractures has better functional outcomes when fixed with Proximal humerus interlocking osteo-synthesis system (PHILOS), but data regarding its application is very scarce in our region demographical, geographical, ethnicity, and lifestyle vary (having different height weight or BMI, bone density tissue quality). Therefore we are conducted this study to evaluate functional outcomes of proximal humerus fractures treated with PHILOS.

MATERIAL AND METHODS

This study was a prospective observational study which was conducted over a period of 6 months from February 2021 to October 2021 on patient presented through Out-patient department (OPD) and emergency department (ER) with proximal humerus fracture at Department of Orthopaedic surgery, Liaquat National Hospital, Karachi, Pakistan. The research proposal was approved by the Research and Ethics Committee of the hospital. Participants were explained about the study purpose and associated risk and benefits of the procedure to obtain their consent. The written and informed consent was also obtained from the participants before enrollment in the study. Total 94 patients were included in the study. The sample size was calculated Open Epi sample size calculator. The non-probability consecutive sampling was used for sample selection.

Constant-Murley score (CMS), which is a 100-points score scale composed of parameters that define the level of pain and the ability to carry out the normal daily activities of the patient was used to evaluate functional outcomes at 6 weeks and 3 months. The test was divided into four parameters, (1) Pain-15 points, (2) Activities of daily living-20 points, (3) Strength-25 points, (4) Range of motion (forward elevation, external rotation, abduction and internal rotation of the shoulder)-40 points.

Functional outcomes were assessed by using constant shoulder score as it determines the functionality after the treatment of a shoulder injury. The higher the score, the higher the quality of the function, as poor (0-55 points), moderate (56-70), good (71-85), excellent (86-

100). The ASA Physical status classification system was used to assess and communicate a patient's pre anesthesia medical co-morbidities. NEER's classification based on anatomic relationship of 4 segments greater tuberosity, lesser tuberosity, articular surface, shaft and considered a separate part if displacement of > 1 cm 45° angulation. All patients between 20-70 years of age of both genders, having ASA grade 1, 2 & 3 and on X-rays shoulder AP & Lateral views found out to be proximal humerus fractures that requires fixation were included. Patients with pseudoarthrosis, pathological fracture, open fracture, and associated post-traumatic brachial plexus injury or peripheral nerve palsy were not part of this study.

Confidentiality of the participants was maintained throughout the study. Their record number was tagged with other serial number to conceal patient's identity and only principal investigator had the access to original data. The study variables were recorded in the predesigned proforma. All the patients fulfilled the inclusion criteria were given standard treatment and all patients were operated by for proximal humerus fracture using PHILOS by deltoid splitting approach. Post operative patients were discharge home on 3rd Post operative day after doing first dressing, than every 5th day change of dressing than skin staples removed at 15th day in OPD. Arm was kept in polysling for 3 weeks, than after 3 weeks pendulum exercises than Range of motion exercises were started. Data were collected through a self-administered proforma containing variables regarding patient's demographics, co-morbid, fracture classification (Neer's classification), duration of injury, smoking, site of fracture, mechanism of injury, and functional outcome (assessed by Constant shoulder score at 6 weeks and 3 months).

Data were analyzed using SPSS V 26. Qualitative data such as gender, Neer Classification, co-morbidities (diabetes, hypertension), type of fracture, mechanism of injury, smoking status, socioeconomic status and functional outcome were presented as frequencies and percentages. Quantitative variables such as age, duration of fracture, pain, activities of daily living, range of movement, power and overall constant score were summarized as mean $\pm$ SD for normality distributed data or median with inter-

quartile range for non-normally distributed data. Effect modifiers such as age, gender, socioeconomic status, comorbid (hypertension, diabetes), ASA grade, side of fracture, Neer's classification, mechanism of injury, smoking status were addressed through stratification. Post stratified chi-square test was applied by taking p value ≤ 0.05 as statistically significant.

RESULTS

In our study, 68.1% patients were male and 31.9% patients were female. We observed that 35.1% patients were diabetic and 39.4% were hypertensive. The side of fracture was found as 46.8% had right site fracture and 53.2% had left site fracture. We noted 47.9% patients had fracture due to history of fall while 52.1% had road traffic accident. Total 42.6% patients were smokers. The ASA classification was contributed as 46.8% had grade II and 53.2% had grade III.

The Neer classification was contributed as 9.6% had part II, 81.9% had part III and 8.55 had part IV. The results are also presented in Table-1.

The overall mean age was 48.31 ± 13.7 years. 51% patients were belonged to age ≤ 45 years and 49% patients were aged > 45 years. The mean duration of fracture was 9.68 ± 2.15 days. The duration of fracture of 74% patients was ≤ 10 days and 26% patients had duration of fracture > 10 days. The mean body mass index (BMI) was found as 23.39 ± 3 Kg/m². It was observed that 66% patients had BMI ≤ 24.9 kg/m² and 34% had BMI > 24.9 kg/m². The mean constant murley's shoulder score after 6 weeks and 3 months was found as 57.10 ± 7.02 and 87.54 ± 9.64 respectively. Detailed results are presented in Table-2.

The functional outcome assessed by constant shoulder score status was found as 59.6% had moderate and 40.4% had poor after 6 weeks. However, after 3 months, the functional outcome assessed by constant shoulder score status was found as 74.5% had excellent, 18.1% had good and 7.4% had moderate, as presented in Table-3.

The results showed significant association of functional outcome after 3 months with gender ($p < 0.001$), age group ($p < 0.001$), body mass index ($p = 0.019$), socioeconomic status ($p = 0.007$), duration of fracture ($p = 0.002$), diabetes mellitus ($p < 0.001$), hypertension ($p < 0.001$), side of fracture ($P < 0.001$), mechanism of injury ($p < 0.001$), smoking ($p < 0.001$) and ASA grade ($p < 0.001$). The

detailed results of associations are presented in Table-4.

Table-1

Frequency Distribution of Demographic Characteristics

	n(%)
Gender	
Male	64(68.1)
Female	30(31.9)
Diabetic Mellitus	
Yes	33(35.1)
No	61(64.9)
Hypertension	
Yes	37(39.4)
No	57(60.6)
Side of Fracture	
Right	44(46.8)
Left	50(53.2)
Mechanism of Injury	
Fall	45(47.9)
RTA	49(52.1)
Smoking	
Yes	40(42.6)
No	54(57.4)
ASA Grade	
Grade II	44(46.8)
Grade III	50(53.2)
NEER Classification	
Part II	9(9.6)
Part III	77(81.9)
Part IV	8(8.5)

Table 2

Descriptive Statistics of Age, Duration, BMI, and Constant Murley Score

	Mean±SD	Median (Min-Max)
Age in years	48.31±13.87	40(30-70)
Duration of Fracture in days	9.68±2.15	9(6-15)
BMI in kg/m ²	23.29±3.00	22.99(19.2-27.6)
Constant Murley score after 6 weeks	57.10±7.02	58(41-70)
Constant Murley score after 3 months	87.54±9.64	31(67-98)

Table 3

Frequency Distribution of Functional Outcome

	After 6 weeks	After 3 months
Functional Outcome	n(%)	n(%)
Excellent	0 (0)	70 (74.5)
Good	0 (0)	17 (18.1)
Moderate	56 (59.6)	7 (7.4)
Poor	38 (40.4)	0 (0)

Table 4

Association of Functional Outcome after 3 Months

Constant Score status				P-value
	Excellent	Good	Moderate	
Gender				
Male	54(77.1)	10(58.8)	0(0)	<0.001*
Female	16(22.9)	7(41.2)	7(100)	
Age group				
≤45 years	48(68.6)	0(0)	0(0)	<0.001*
>45 years	22(31.4)	17(100)	7(100)	
BMI				
≤24.9 kg/m ²	48(68.6)	7(41.2)	7(100)	0.019*
>24.9 kg/m ²	22(31.4)	10(58.8)	0(0)	
Socioeconomic status				
≤80000 per month	61(87.1)	9(52.9)	5(71.4)	0.007*
>80000 per month	9(12.9)	8(47.1)	2(28.6)	
Duration of fracture				
≤10 days	56(80)	7(41.2)	7(100)	0.002*
>10 days	14(20)	10(58.8)	0(0)	
Diabetes Mellitus				
Yes	26(37.1)	0(0)	7(100)	<0.001*
No	44(62.9)	17(100)	0(0)	
Hypertension				
Yes	20(28.6)	10(58.8)	7(100)	<0.001*
No	50(71.4)	7(41.2)	0(0)	
Side of Fracture				
Right	37(52.9)	0(0)	7(100)	<0.001*
Left	33(47.1)	17(100)	0(0)	
Mechanism of Injury				
Fall	21(30)	17(100)	7(100)	<0.001*
RTA	49(70)	0(0)	0(0)	
Smoking				
Yes	23(32.9)	17(100)	0(0)	<0.001*
No	47(67.1)	0(0)	7(100)	
ASA Grade				
Grade II	44(62.9)	0(0)	0(0)	<0.001*
Grade III	26(37.1)	17(100)	7(100)	
NEER Classification				
Part II	9(12.9)	0(0)	0(0)	0.206**
Part III	53(75.7)	17(100)	7(100)	
Part IV	8(11.4)	0(0)	0(0)	

Fisher Exact Test was applied.

P-value ≤0.05 considered as Significant.

* Significant at 0.01 levels.

**Not Significant at 0.05 levels.

DISCUSSION

In our study the mean age was 48.31±13.87 years. In a study,⁵ the mean age was 54.5±6.4 years, which was similar to the age incidence observed by Egol et al.³² About half of the patients were in the

age range of 41 to 59 years. In our study, 51% patients were belonged to age ≤ 45 years and 49% patients were aged >45 years. In a previous study, 14(43.75%) individuals had a history of a fall, compared to 18(56.25%) subjects who had a history of RTA.⁵ These results are consistent with previous research by Kirsch et al. who found that out of 40 cases evaluated, 47.5% included traffic accidents, 50% had a history of falling, and 2.5% had a history of assault.³³ In our study 47.9% had history of fall and 53.2% had RTA history.

According to NEER's classification of fractures, 6.25% of cases in a study showed fracture dislocation, whereas 46.88% of cases had two-part fractures, 37.49% had three-part fractures, and 9.38% had four-part fractures. The mean constant Murley score was observed to be 85.8 at the end of the follow-up period.⁵ In our study, NEER's classification of fractures showed 9.6% of cases had two-part fractures, 81.9% had three-part fractures, and 8.5% had four-part fractures. The mean constant Murley score was observed to be 85.8 at the end of the follow-up period⁵ and in our study mean constant Murley score was 57.10 ± 7.02 after 6 weeks and 87.54 ± 9.64 after 3 months.

In another research by Yadav et al., in which 21 patients with fresh three- and four-part fractures of the proximal humerus were treated surgically using the PHILOS system. The mean constant Murley score in patients treated with open reduction and internal fixation using PHILOS was 85.29 at the end of the follow-up period.³⁴ The mean constant Murley shoulder score, according to a study by Jagiasi et al., was 61.8. The mean constant score was 50.53 for people over 45 years of age and 72.91 for people under 45 years of age.³⁵ In our study, the mean constant Murley shoulder score was 87.54 ± 9.64 at the end of follow-up.

According to a study by Jagiasi et al., the results were outstanding in 40% of the instances, very good in 6.66%, good in 30%, fair in 20%, and poor in 3.33% of the cases.³⁵ A study from Ganesan et al. also observed excellent results in 50% of the instances, satisfactory results in 30% of the cases, unsatisfactory results in 10% of the cases, and failure results in 10% of the cases.³⁶ A different study found that excellent results occurred in 54% of instances, satisfactory results in 24% of cases, unsatisfactory results in 12% of cases, and failures occurred in 10% of cases.³⁷

Madhya Pradesh noticed that at the final follow-up, eight patients had good scores, 10 patients had moderate scores, six patients had excellent outcomes and two patients had poor outcomes according to constant Murley score.³⁸ According to a study by Bansal et al., the results were excellent in 16% of the instances, good in 44%, fair in 16%, and poor in 24% of the patients.³⁹ The results of a study by Vijayanand et al. were excellent outcomes in 23 cases, satisfactory in four, unsatisfactory in two, and in one case a failure.⁴⁰ In our study, the functional outcome assessed by constant shoulder score status was found as 59.6% had moderate and 40.4% had poor after 6 weeks. However, after 3 months, the functional outcome assessed by constant shoulder score status was found as 74.5% had excellent, 18.1% had good and 7.4% had moderate.

Some authors have reported excellent results after conventional plate osteosynthesis of proximal humeral fractures, however this method of plating with conventional plate has also been associated with a high complication rate, namely: avascular necrosis, subacromial impingement, or screw loosening in osteoporotic bone particularly in elderly patients with comminuted fractures.⁴¹ In a study⁴¹ in case of Proximal humerus fractures, 63.33% of upper end humerus fractures were due to low energy trauma (i.e. 19 out of 30 cases); whereas in 10 patients, mode of trauma was road traffic accident and in one patient mode of injury was direct blow. The results are comparable to the study of Geiger EV⁴² in which out of a total of 30 patients, the injury was due an accident 7 patients (33%) and fall from height in 21 patients. In out of 30 cases of the same study there were 9 cases of type 2 fracture, 14 cases were of type 3 fracture and 7 cases were type four fracture. In the study of Geiger EV et al.⁴² out of 28 cases there were 8 cases of type 2 fracture, 12 cases of type 3 fracture and 8 cases of type 4 fracture. In a study,⁰ out of a total of 30 cases result excellent was achieved in 7 cases, good achieved in 16 cases, satisfactory in 5 cases and poor in 2 cases.

Limitation of the Study

The small sample size of this study does limit its applicability. The limitation of this study is lack of a control group and less follow up period and we do not evaluate any patient characteristics which can be risk factors for failure of this now common

fixation technique. It was conducted in urban environment therefore, the results might not be generalizable to larger populations.

CONCLUSION

Philos Plating provides stable fixation, early mobilization with excellent functional results with minimal complications. Our study results showed that at 6 weeks the functional outcome was

comparatively low i.e. 59.6% had moderate and 40.4% had poor outcome. Whoever, after 3 months, 74.5% patients had excellent, 18.1% had good and 7.4% had moderate outcome. Further, gender, age, BMI, socioeconomic status, duration of fracture, diabetes mellitus, hypertension, side of fracture, mechanism of injury, smoking, and ASA grade were observed as significant factors.

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