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Assessment of the functional outcome including clinical and radiological in proximal humerus fractures treated with PHILOS

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Abstract

Introduction: Proximal humerus fractures are among the most common injuries in the human skeletal system. The aim of treatment should be pain free with restoration of daily activities. Different techniques have been described for displaced proximal humerus fractures are k wires, tension band wiring, intramedullary devices, anatomic plate osteosynthesis like PHILOS (proximal humerus interlocking system) and shoulder arthroplasty. The PHILOS plate is a part of latest generation of locking compression plates. They alleviate the risk of malreduction and allows anatomical reduction head of humerus and shaft with early postoperative mobilization. PHILOS plate provides rigid fixation and more angular stability.

Aim and Objectives: To assess the functional outcome including clinical and radiological in proximal humerus fractures treated with PHILOS.

Materials and methods: The present study is a prospective and observational study conducted at Sri Guru Ram Das Institute of Medical Sciences and Research, Vallah, Sri Amritsar from Jan 2019 to June 2020. 30 patients coming to emergency/outpatient department was included in study after written and informed consent. Follow-up is done for 6 months at 2 weeks and 1-, 3- and 6-months' intervals.

Results: A total of 19 patients were treated with PHILOS plates. 7 patients were lost tofollow up. Out of 12 patients, the mean age at the time of injury was 59.53 years and 9 (75%) patients were female. The most common trauma mechanism was injury due to fall (63%) followed up by road traffic accident. There were 8 patients with 2-part and 4 patients had 3-part fractures according to the Neer's classification. The average surgery duration was 92±10 minutes. Mean union time was 12±4 weeks follow up. No non-union was observed at follow-up. Mean BMD in females was measured at 0.7024g/cm^2 and .7185g/cm^2 in males. On postoperative examination Head Shaft Angle was measured with mean $126.50^0 \pm 4.04^0$ and Humeral Head Height with mean value 2.5mm. Out of 12 patients, after functional assessment with DASH score 4 cases had an excellent score, 7 cases had a good score and 1 case had scored poor.

Conclusion: This study was done on 19 patients out of which only 12 patients came for follow-up. In conclusion, due to lesser number of patients and short term follow up period this study is inconclusive to assess the functional outcome after PHILOS in proximal humerus fractures in elderly patients. Large sample size is required to evaluateclinical and radiological outcome and also follow-up in study should extend beyond one year after surgery.

Introduction

Proximal humerus fractures are among the most common injuries in the human skeletal system.[1] Proximal humerus fractures comprise nearly 4% of all fractures and 26% of fracture of humerus. The proximal humerus fracture is the third most common fractureseen in elderly persons, with an incidence of 82 per 100,000 person-years, with an annual increase in the rate by 13.7% over the past 33 years.

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The typical patient is a woman aged 65 years or older and less frequently in young adults due to high energy trauma.[2] There is a 3:1 female-to-male preponderance in this age group.[3] Eighty-five percent of these injuries are minimally displaced and amenable to nonoperative treatment. The true challenges for the shoulder surgeon lie in the 15 % of significantly displaced fractures that require accurate diagnosis and treatment. Accurate diagnosis and classification of the fracture are the first steps in the successful treatment of these injuries.[4]

The aim of treatment should be pain free with restoration of daily activities.[5] With more standard use of Neer's 4-part Classification system for fracture andfracture dislocation, a protocol for management and comparison of long term outcomeof similar injuries have been made possible. Off all the proximal humerus approximately half (49%) are minimally displaced one part fractures or undisplaced Two part fractures occur in 37% of the cases, surgical neck fractures represented 28% of the whole group. Three-part fractures and four-part fractures comprises 9% and 3%of all fractures respectively.[6]

Different techniques have been described for displaced proximal humerusfractures are k wires, tension band wiring, intramedullary devices, anatomic plate osteosynthesis like PHILOS (proximal humerus interlocking system) and shoulder arthroplasty.[7-9] Over the past decade, there has been an increasing trend of interest inproximal humerus internal locking system (PHILOS) in proximal humerus fractures to achieve more reliable fixation in osteoporotic fractures and stability.[10] The PHILOS (Proximal humerus internal locking system) plate is a part of latestgeneration of locking compression plates. The screws are placed in converging and diverging directions to provide stable fixation and has a benefit over conventional plates[11]. These locking plates are so designed for fixation of proximal humerus giving special consideration to anatomy of this region. They alleviate the risk of malreduction and allows anatomical reduction head of humerus and shaft with early postoperative mobilization. PHILOS plate provides rigid fixation and more angular stability.[12] This study enlightens the functional outcome and management of the fractures of proximal humerus, with PHILOS plate.

Aim and objectives

To assess the functional outcome including clinical and radiological in proximal humerus fractures treated with PHILOS.

Materials and methods

The present study is a prospective and observational study conducted at Sri Guru Ram Das Institute of Medical Sciences and Research, Vallah, Sri Amritsar from Jan 2019 to June 2020. 30 patients coming to emergency/outpatient department was included in study after written and informed consent. Follow-up is done For 6 months at 2 weeks and 1, 3 and 6 months' intervals.

Inclusion criteria:

- Patients more than 50 years of age.
- Acute fracture.
- Satisfy Neer's criteria for operative displacement i.e. displacement of >1 cm between the major fracture fragments or angulation of the articular surface of >45 degrees.

Exclusion criteria:

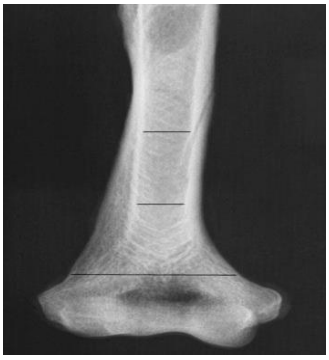
- Psychiatric illness that precludes informed consent
- Pathologic fractures from primary or metastatic tumours
- Open fractures
- Poly trauma

After initial resuscitation a detailed history was taken and thorough clinical examination was done to rule out any other associated injuries. Distal neurovascular status was also assessed. And informed consent was obtained forthe surgery. Routine investigations were done. Radiographs of the affected shoulder was taken in shoulder AP glenoid view (Grashey view), Y view and axillary view and fractures were classified according to Neer's classification. CT pictures were taken in selected patients with complex fracture patterns to know the articular involvement. Anaesthetic fitness was obtained for

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 06, 2023

all the patients before surgery. Patients were assessed for BMD by following method.[13] Determination of the cortical thickness of the distal humerus diaphysis and the cortico-medullar index (CMI) from radiographs: A radiopaque ruler was positioned next to the first AP view to make sure that the magnification factor was 1:1. The lateral and medial thickness of the distal humeral diaphysis was measured at two different levels: the first one 3 cm above the superior dense line of the olecranon fossa of the distal humerus and the second one 7 cm above the same line. The cortical thickness was measured using OsiriX software. The width of the medulla was measured at those two levels. The cortico-medullar index (CMI) was calculated as cortical thickness divided by total bone thickness on AP views.

Equation to determine the BMD (distal humerus) from CMI: BMD (g/cm2) = 0.78 –0.15*CMI at 7 cm.[13]



Calculation of BMD (distal humerus)

All patients received prophylactic antibiotic intravenously thirty minutes prior to surgery. General anesthesia/Block was given. Patient was kept in beach chair position and standard deltopectoral

approach was used. Pre-operative intravenous (IV) antibiotic prophylaxis and administration of a general anaesthetic was utilized. Beach-chair position and the standard approach was utilized.

Identification of cephalic vein

Application of PHILOS plate

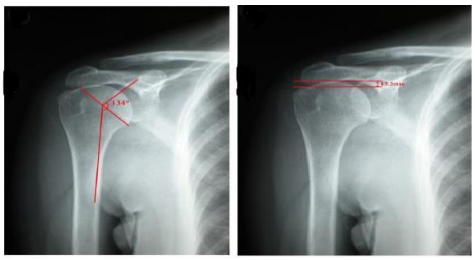
Through a deltopectoral approach, the fracture site was exposed taking care of the soft tissue envelope to maintain a good vascular supply. Philos plate fixed to greater tuberosity and posterior to the biceps tendon. Fracture reduction checked under c-arm and plate fixed with proximal locking and distal cortical screws and tuberosities with non-absorbable sutures. The surgical incisionsite aseptic dressings done on alternate days and stitches were removed 10–14 days postoperatively. Collar-and-cuff sling was applied to the arm.

POST-OP CLINICAL ASSESSMENT:

All the patients were followed up by clinical and radiographic assessment immediately after treatment at 2 weeks and at 1, 3 and 6 months. Radiographic assessment was made by x-rays. Post operatively: wound healing, complications, range of motion and time for union were assessed. Passive elbow

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 06, 2023

flexion and extension exercises were started immediately. Exercises consisting of pendulum exercises started from the 1st week. Gentle
passive forward flexion, internal and external rotation exercises were initiated by end of 2nd week. Lifting of lightweight objects was started after 3 months. Functional outcome was assessed by DASH scoring system. The HSA was measured at the intersection of the tangent line of the articular surface with a line parallel to the long axis of the humerus shaft and the humerus head height (HHH) was measured on the anteroposterior radiographic image by calculating the vertical distance between the tangent line of the highest point of the humerus head and the greater tuberosity.[14]



Measurement of HSA and HHH

The DASH (Disabilities of the Arm, Shoulder, and Hand) questionnaire has been developed to measure disability and symptoms related to upper extremitymusculoskeletal disorders, thus eliminating the need for separate questionnaires for the shoulder, wrist, or elbow. The 30-item questionnaire included 21 physical function items, 6 symptom items, and 3 social/role function items. This questionnaire is a self-report questionnaire that patients can rate difficulty and interference with daily life on a 5 point Likert scale.[15] The response to the first 30 items of the DASH were added to form the raw, oractual, score. The raw score was then transformed to a zero-to-100 scale with zero reflecting no disability (good function) and 100 reflecting maximum disability (poor function). To transform the score to the zero-to-100 scale, subtract the minimum possible score, or 30, to from the raw score and divide by 1.2, which is the possible scorerange (120) divided by 100. Raw score – 30 (minimum score) 1.2 (range of scores ÷ 100).

Observations

In our study, the sample size was 19 patients with a mean age of 59.53 years. Out of 19 patients, 7 patients were lost to follow up due to corona pandemic. In 12 patients, the age group varied from 50 years to 74 years with 7 cases present within 50-60, 3 cases in 61-70 and 2 cases were more than 70.

TABLE 1 AGE INCIDENCE

Age group	No. of cases	%age
50-60	7	58.33
61-70	3	25.00
>70	2	16.67
Total	12	100.00
Minimum	50.00	
Maximum	74.00	

In our study out of 12 cases, 9 patients were female and 3 patients were male.

TABLE 2: SEX INCIDENCE

Sex	No. of cases	%age
Female	9	75.0
Male	3	25.0
Total	12	100.00

In our study out of 12 patients, 8 patients had Neer's 2-part fracture and 4 patients had 3 part fracture.

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 06, 2023

TABLE NO. 3 FRACTURE TYPE

Fracture type	Total no.
4-part	0
3-part GT	4
3-part LT	0
2-part	8

TABLENO. 3A NEER'S FRACTURE

Neer parts	No. of cases	%age
2	8	55.00
3	4	45.00

In our study of 12 patients, mean Head Shaft Angle was found to be 126.5^0 (SD4.04), mean Humeral Head Height was found to be 2.5±0.41mm and mean BMD was found to be.7093g/cm^2.

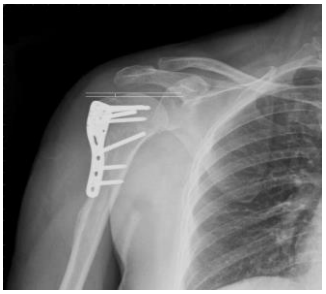
TABLE NO 4 HEAD SHAFT ANGLE

Head shaft angle	
Mean	126.5
Standard deviation	4.04
Minimum	121.00
Maximum	134.00

Measurement of head shaft angle

TABLE NO: 5 HUMERAL HEAD HEIGHT

Humeral head height	
Mean	2.53±0.41
Minimum	2.00 mm
Maximum	3.10 mm



Measurement of humeral head

TABLE NO: 6 AGE GROUP

Age group	No. of cases	BMD	
		Mean	SD
50-60	5	0.705	0.041
61-70	4	0.703	0.038

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 06, 2023

>70	2	0.690	0.011
Total	11	0.702	0.037

Measurement of BMD

In our study group of 12 patients, 4 patients had excellent score, good score was observed in 7 patients and 1 patients scored poor results. Mean DASH score was 27.33±11.44.

TABLE NO. 7 DASH SCORE

DASH score	No. of cases	%age
Excellent	4	34.00
Good	7	58.00
Poor	1	8.00
Mean DASH score	27.33±11.44	

RESULTS

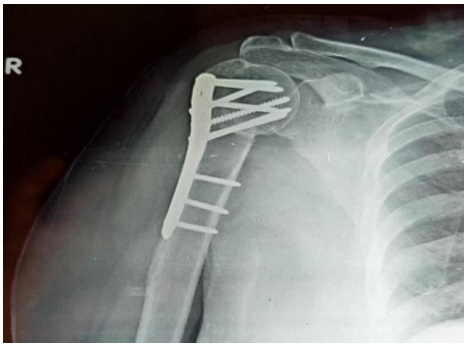
A total of 19 patients were treated with PHILOS plates. 7 patients were lost to follow up. Out of 12 patients, the mean age at the time of injury was 59.53 years and 9 (75%) patients were female. The most common trauma mechanism was injury due to fall (63%) followed up by road traffic accident. There were 8 patients with 2-part and 4 patients had 3-part fractures according to the Neer's classification. The average surgery duration was 92±10 minutes. Mean union time was 12±4 weeks follow up. No non-union was observed at follow-up. Mean BMD in females was measured at 0.7024g/cm^2 and .7185g/cm^2 in males. On postoperative examination Head Shaft Angle was measured with mean $126.50^0 \pm 4.04^0$ and Humeral Head Height with mean value 2.5mm. Out of 12 patients, after functional assessment with DASH score 4 cases had an excellent score, 7 cases had a good score and 1 case had scored poor.

64 year old female with 2-part fracture and unionof proximal humerus

Preoperative X-ray

At 1 month

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 06, 2023



At 3 months

Assessment at 6 months

Discussion

Proximal humeral fractures represent an increasing challenge for the health-caresystem because of the increasing proportion of elderly individuals in the population. Asestimated by a Finnish study group, the number of fractures may triple by the year 2030.[16] Although the healing progresses through the normal stages, the process is prolonged. The quality and the quantity of healing are reduced in osteoporotic bone models in animal studies. The PHILOS provide more stable buttress laterally and the diverging screw options in the cancellous bone, makes them the implant of choice in complex fractures. Siffri PC et al., in their cadaveric study suggested that locking plates (PHILOS) have better torsional stability when compared to non-lockingplates.[17] And also biomechanical investigations have shown the advantages of lockingplates compared with non-locking Plates.[17,18] The PHILOS locking plate system facilitates early limb mobilisation, which may minimise complications and improve postoperative shoulder function.[16] In 2014 Erasmo et al studied a total of 81 patients with 82 proximal humerus fractures that were treated with PHILOS plate system. Twelve of these patients also had a dislocation of the proximal humerus.[19] There were 7 two-part fractures, 40 three-part fractures and 35 four-part fractures. Mean final follow-up was 32 months. Twenty- three patients (28%) had complications during the follow-up period. Reoperation was required in 12 patients. Complications included avascular necrosis of the humeral headin 10 patients (12%), varus positioning of the head in four patients (4.8%), impingement syndrome in three patients (3.6%), secondary screw perforation in three patients (3.6%), non-union of the fracture in two patients (2.4%) and infection in one patient (1.2%). Functional outcome was made by Constant score and was graded as excellent for eightpatients, good for 52, moderate for 17 and poor for five. In our study no non-union, AVN, or impingement was observed but 1 patient had superficial infection which wastreated with appropriate antibiotics. In our study functional outcome was studied was DASH score and 4 cases had an excellent score, 7 cases had a good score and 1 case had scored poor. Mean DASH score was 27.33±11.44. In 2016 Fattoretto et al evaluated 55 patients treated with PHILOS. They analysed clinical and radiological results.[20] The mean age was 63.4 (range 33–89), while the mean follow-up time was 21.5 months. Complications were encountered in seven patients (12.7 % of all cases). Pseudarthrosis in one patient (1.8 %) and one patients (1.8 %), with an implant loosening and 1 case of axillary nerve neuropraxia. This study

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 06, 2023

observed avascular necrosis in four patients (7.2 %) but we observed no case of avascular necrosis and this can be attributed to their long follow up period of 21.5 months. The mean head-shaft angle was 131.18 which is quite similar with our meanhead shaft angle of 126.5. In their study two patients had head shaft angle of less than 1200 which scored poored. We observed one patient with head shaft angle of 1210 which had good functional outcome with DASH score of 35.

In 2017 Doshi C et al conducted study on 53 consecutive patients treated with PHILOS plating between August 2013 and August 2014.[21] The average age of the patient was 54.3±5.8 years and 54.71% were females. There were 6 (11.32%) 1-part,19 (35.85%) 2-part, 17 (32.08%) and 11 (20.75%) 3 and 4-part fracture respectively. Radiological union was seen at 12±4.6 weeks. There were 2 (3.77%) cases of varus collapse, 3 (5.66%) cases of screw back out and 1 (1.89%) case of superficial infection.There were no cases of avascular necrosis, shoulder impingement and non-union were seen. The outcome was assessed using Neer's scoring system with 7 (13.21%) cases had excellent results, 37 (69.81%) had satisfactory, 6 (11.32%) had unsatisfactory while 3 (05.66%) cases had poor outcome. In our study also, mean age of patients was 59.53 years and 9 (75%) patients were female. Radiological union was seen at 12±4 weeks which is similar to above study. We observed no non-union case and no case of screw back out. There was also no case of avascular necrosis and shoulder impingement. Short term follow-up period can be one of the reasons that avascular necrosis complication was not seen. Limited sample size and short duration of follow-up remains the major limitations of the study. As study was commenced before corona pandemic so long termstudy with large number of patients are required to better evaluate the outcome.

CONCLUSION

This study was done on 19 patients out of which only 12 patients came for follow-up. In conclusion, due to lesser number of patients and short term follow up period this study is inconclusive to assess the functional outcome after PHILOS in proximal humerus fractures in elderly patients. Large sample size is required to evaluate clinical and radiological outcome and also follow-up in study should extend beyond one year after surgery.

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ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 06, 2023

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