



FUNCTIONAL EVALUATION OF PROXIMAL HUMERUS FRACTURES TREATED BY PHILOS PLATING

Dr. Ashok Kumar Patnala*

Professor and Head of the Department, Department of Orthopaedics, Andhra Medical College, Visakhapatnam, A.P. India. *Corresponding Author

Dr. Geetha Sri Sai Bolisetty

Junior Resident, Department of Orthopaedics, Andhra Medical College, Visakhapatnam, A.P. India.

Dr. P.S. V.R. V.G. Vijay Kumar

Junior Resident, Department of Orthopaedics, Andhra Medical College, Visakhapatnam, A.P. India.

Dr. Sunkara Naveen

Junior Resident, Department of Orthopaedics, Andhra Medical College, Visakhapatnam, A.P. India.

ABSTRACT

Introduction Proximal humeral fractures are now recognized as an increasingly common fracture, accounting for 4%–5% of all fractures and 45% of all humeral fractures [1,2]. It is the third most common fracture, in people above 65 years of age, after fractures of the hip and distal radius [3]. These fractures have a bimodal distribution occurring either in young people after high energy trauma or in those older than 50 years with low-velocity injuries like simple fall [3]. 85% of these fractures are minimally displaced and are effectively treated with immobilization followed by early motion. The remaining 15% of these are either displaced or unstable. These fare poorly with non-operative treatment and are better treated with surgical intervention. Surgical treatment is necessary especially in young patients and active elderly people in order to prevent minimal dislocations of tuberosity or articular surface from compromising the long-term articular function. This study was planned to evaluate the outcome of proximal humerus fractures managed with PHILOS plate after approval by the Institutional Ethical Board. **Aims And Objectives** To evaluate the efficacy of PHILOS plate in the treatment of proximal humeral fractures and assess its functional outcome. To assess any complications that could arise postoperatively. **Early rehabilitation of the patient** **Methods And Materials** **Study Design:** Hospital Based Prospective study. **Study Period:** October 2019 to September 2022. **Study Setup:** Study is conducted in Department of Orthopaedics, Andhra Medical College, Visakhapatnam. **Study Population:** Patients attending emergency/orthopaedic OP and admitted in department of orthopaedics in King George Hospital, Visakhapatnam with proximal humerus fractures and are classified according to Neer's Classification **Sample Size:** 30 patients admitted in the Department of Orthopaedics, King George Hospital, Visakhapatnam with proximal humerus fractures in the above said period. **Results** We have included 30 proximal humeral fractures in our study. Males dominated and left side is more common than right. Domestic falls are common than road traffic accidents. 2-part fractures are more common than 3- and 4-part fractures. All of them are treated with PHILOS stable angled plate. Complications like stiffness, screw penetration and superficial infection occurred in our study which are dealt appropriately. Significantly, we could prevent varus malunion which is notable in our study. Rehabilitation started early with pendulum exercises and could achieve good range of useful movements for most of the cases. Average range of radiological union is 13.5 weeks. **Conclusion** PHILOS plate, stable, angled construct is used in all our cases and the results evaluation done with Constant Murley score which ranged 54 to 87. Our average score is 67.43 which is in concurrence with few of the studies. The rehabilitation after operation started early with pendulum exercises as soon as the patients compliance within the limits of pain. The range of movements in our study, abduction maximum range obtained is 120 to 150 degrees and forward flexion 90 to 120 degrees and rotations average score is 7. Though we have few complications like stiffness of shoulder (5), AVN (1), intra-articular screw penetration (1), superficial infection (1) and subacromial impingement (1), we have dealt with all these complications appropriately. Significantly, varus malunion did not occur in our study.

KEYWORDS :

INTRODUCTION

Proximal humeral fractures are now recognized as an increasingly common fracture, accounting for 4%–5% of all fractures and 45% of all humeral fractures [1,2]. It is the third most common fracture, in people above 65 years of age, after fractures of the hip and distal radius [3]. These fractures have a bimodal distribution occurring either in young people after high energy trauma or in those older than 50 years with low-velocity injuries like simple fall [3]. 85% of these fractures are minimally displaced and are effectively treated with immobilization followed by early motion.

The remaining 15% of these are either displaced or unstable. These fare poorly with non-operative treatment and are better treated with surgical intervention. Surgical treatment is necessary especially in young patients and active elderly people in order to prevent minimal dislocations of tuberosity or articular surface from compromising the long-term articular function.

Proximal humerus fractures remained a challenging problem for most of the orthopaedic surgeons. There are different methods of surgical fixation of these fractures like closed reduction and percutaneous K-wire fixation, open reduction and fixation with transosseous sutures, tension band wire, T plate, locking plates and screws, intramedullary nails, and prosthetic replacement [4, 5]. Several complications such as penetration of K wires, varus collapse, cut-out or back-out of the screws and plates, non-union, osteonecrosis, nail migration, and rotator cuff impingement syndrome. In order to decrease the high complication rates of proximal humeral fractures, the AO/ASIF group developed the PHILOS (The Proximal Humeral Internal Locking Osteosynthesis) plate; an internal fixation system that enables angled stabilization with multiple interlocking screws. It reduces soft tissue dissection and gives both axial and angular stability, hence, reducing the risk of fracture displacement. Pre-contoured locking compression plates are fixed angled devices which prevent subsidence in the metaphyseal areas [6,7,8]. These plates

alleviate the risk of mal-reduction and preserve the blood supply to the bone This study was planned to evaluate the outcome of proximal humerus fractures managed with PHILOS plate after approval by the Institutional Ethical Board.

AIMS AND OBJECTIVES

To evaluate the efficacy of PHILOS plate in the treatment of proximal humeral fractures and assess its functional outcome.

1. To assess any complications that could arise postoperatively
2. Early rehabilitation of the patient

METHODS AND MATERIALS

3. Study Design: Hospital Based Prospective study.

4. Study Period: October 2017 to September 2019.

5. Study Setup: Study is conducted in Department of Orthopaedics, Andhra Medical College, Visakhapatnam.

6. Study Population: Patients attending emergency / orthopaedic OP and admitted in department of orthopaedics in King George Hospital, Visakhapatnam with proximal humerus fractures and are classified according to Neer's Classification

7. Sample Size: 30 patients admitted in the Department of Orthopaedics, King George Hospital, Visakhapatnam with proximal humerus fractures in the above said period.

Inclusion Criteria:

1. Proximal humerus fracture 2 part, 3part and 4part.
2. Adult (> 18yrs) is included.
3. Patients of both sexes included.

Patients with osteoporotic fractures are also included.

Exclusion Criteria:

4. Patients who are < 18yrs old
5. Open fractures
6. Patients medically unfit for surgery
7. Pathological fractures
8. Associated humerus shaft fracture

METHODOLOGY

Patients admitted with proximal humerus fractures are subjected to General Physical Examination, Systemic Examination and the neurovascular status of the upper limbs is examined.

X-ray shoulder anteroposterior and lateral views, x-ray chest posteroanterior view are taken to evaluate the fracture morphology and to classify the fracture pattern.

The fractures are classified according to Neer's classification into 2-part, 3-part and 4-part fractures Routine pre op investigations and preparation is done.

After pre anaesthetic check-up, under General anaesthesia Open reduction and internal fixation of the fracture is done using standard deltopectoral approach to proximal humerus.

Post-operative x ray of the shoulder is taken. Patient is discharged after 5th post operative day and followed up on 10th day, 1 month, 3 months and 6 months interval.

Functional status of the shoulder is evaluated using Constant Murley scoring. The average time for union of the fracture is noted.

Data Analysis

The data collected from the patients is entered in the case

proforma prepared for the study and is transferred to Master sheet.

The data is subjected to statistical analysis with ANNOVA test

Patient Position And Draping:

The patient is kept in Beach Chair position or supine on the operating table with a sand bag under the back between spine and medial border of scapula to push the affected side forward while allowing the arm to fall backward. The arm was draped free, because it would have to be moved during the approach.

Procedure:

Under aseptic conditions, scrubbing of surgical site and draping done.

Under C-arm guidance, make a Delto-pectoral approach to the proximal humerus. Delto-pectoral approach:

It is classically described as an incision starting over the coracoid process and advanced along the deltopectoral groove with subsequent identification and lateral reflection of the cephalic vein. To identify the cephalic vein a full-thickness skin flap is developed medially in the proximal extent of the incision to about 1 to 2 cm medial to the coracoid process. At this level a fat triangle is invariably found with its base at the clavicle. The cephalic vein can be readily identified traveling from this triangle distally. Delto-pectoral groove is identified by cephalic vein. The inter-nervous plane is between the deltoid muscle, supplied by axillary nerve, and the pectoralis major muscle, which is supplied by the medial and lateral pectoral nerves. Retract pectoralis major medially and deltoid laterally, splitting the two muscles apart. The cephalic vein is retracted either medially or laterally. The conjoint tendon of the short head of biceps and the coracobrachialis must be displaced medially before access can be gained to anterior aspect of shoulder joint. Beneath the tendons lie the transversely running fibres of subscapularis muscle. The arm is rotated externally to stretch the subscapularis, bringing the muscle belly into wound and making its superior and inferior borders easier to define. Pass a blunt instrument between the capsule and the subscapularis, then divide the subscapularis from insertion onto to the lesser trochanter of humerus.

Through this approach, fracture site was exposed with minimal soft tissue dissection and fracture reduced. The humeral head and greater tuberosity were reduced anatomically and fixed temporarily with K wires. In case of obvious rotation or displacement of the humeral head, a joystick technique was used. Then the shaft fragment was reduced by abduction, traction and external rotation and flexion of the arm. Also, in 4 part fractures reduction of the tuberosities is achieved by placing strong sutures through the distal tendons of the rotator cuff for fragment manipulation. The greater tuberosity is controlled by two separate sutures placed into the infra- and supraspinatus tendons, while the lesser tuberosity is controlled with a suture placed through the subscapularis tendon. Reduction was checked under image intensifier.

Correct plate position:

Plate is to be placed in appropriate position to prevent compromise of blood supply, neurological deficits and post-operative reduced range of movements due to impingement of plate. It is said to be placed correctly when it is:

about 5-8 mm distal to the tip of the greater tuberosity

properly aligned along the axis of the humeral shaft

slightly posterior to the bicipital groove (2-4 mm)

To confirm a correct axial plate position, a K-wire is inserted

through the proximal hole of the insertion guide. It should rest on the top of the humeral head.

A plate applied too proximal carries two risks:

1. The plate can impinge under the acromion
2. The most proximal screws might penetrate or fail to securely engage the humeral head

Do not drill through the sub-chondral bone and into the shoulder joint. Avoiding intra-articular screw placement.

Primary penetration occurs when the screws are initially placed. Secondary penetration is the consequence of subsequent fracture collapse.

Drilling into the joint increases the risk of screws becoming intra-articular. Screws that penetrate the humeral head may damage the glenoid cartilage significantly that may lead to early development of shoulder arthritis.

Correct rotational alignment must be confirmed.

The bicipital groove is a good indicator for correct rotation. In case of correct rotation, no gap/angulation should be visible at the level of the fracture.

Calcar screws:

It is strongly recommended to place “calcar screws” in all Varus displaced fractures, especially, in cases where there is medial comminution (A3.3). Their purchase in the inferomedial humeral head adds mechanical stability.

The stability of shoulder was checked over range of motion on the table and assessed for any impingement. Thorough wound wash was given. The wound was closed in layers over suction drain followed by application of sterile dressings.

Post Operative Protocol

Post operatively opioids were administered for analgesia along with antibiotic regimen intravenously for 48 hrs.

The suction drain was removed after 24-48 hours. Dressing was changed on 2nd post-op day.

The patient was usually discharged on the 4th or 5th post-op day with oral medication.

Rehabilitation: Physiotherapy was initiated in phases:

Early rehabilitation: surgery to 2 weeks

- Passive accessory movements to the shoulder.
- Active elbow, wrist and finger movements.
- Gravity assisted pendulum exercises

Intermediate rehabilitation: 2-8 weeks post -op

- Supervised passive shoulder exercises in supine.
- Functional exercises without causing pain exacerbation.
- Increase passive physiologic movements to full range

Late rehabilitation: 8weeks or more

- Active exercise against gravity.
- Isometric strengthening of rotator cuff muscles.
- Encourage functional exercise without sling.

Follow Up

Patients are followed up on 10th day, 1 month, 3 months and 6 months interval. Functional status of the shoulder is evaluated using Constant Murley scoring. The average time for union of the fracture is noted

Constant And Murley Scoring

This scoring system consists of four variables that help

evaluation of the function of the shoulder. The right and left shoulders are evaluated separately.

OBSERVATION AND RESULTS

Our study sample consisted of 30 patients with proximal humerus fractures treated surgically with PHILOS Plating in King George Hospital, Visakhapatnam between October 2017 to September 2019.

In our study, we had patients with minimum age of 20 years and maximum age of 73 years with an average of 46.2 years. There were 21 (70%) males and 9 (30%) females involved in the study. There were 9 (30%) patients who presented with road traffic accidents, and 21 (70%) patients with low velocity injuries like domestic fall at home or workplace due to causes other than vehicular accidents. In our study, left sided injuries are more than right sided injuries. There were 17 (56.7%) patients with injury left shoulder and 13 (43.3%) patients with injury right shoulder. There were 20 (66.7%) patients with 2-part fractures, 8 (26.7%) patients with 3-part fractures and 2 (6.7%) patients with 4-part fractures. There were 6 (20%) patients with comorbidities like Diabetes mellitus and Hypertension.

Time of fracture union on an average in our study is 13.5 weeks with Minimum of 11 Weeks and Maximum of 18 Weeks.

Complications

Out of 30 patients, 9 (30%) patients developed postoperative complications like stiffness in 5 patients (16.7%), Avascular necrosis in 1 patient (3.3%), intraarticular screws in 1 patient (3.3%), infection in 1 patient (3.3%) and subacromial impingement in 1 patient (3.3%).

RESULTS

Percentage of patients with poor and moderate score is 60% with an average score of 63. This is because most cases in the study are in the score range of satisfactory or moderate outcome.

Percentage of patients with good and excellent score is 40 % with an average score of 74.08.

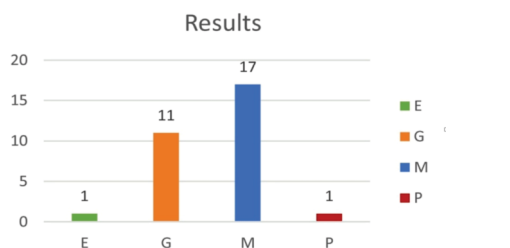
Overall, the minimum score is 54 and maximum score is 87.

The average Constant Murley Score is 71.3 in patients with 2-part fractures., 60.5 and 56.5 in patients with 3 part and 4- part fractures respectively.

On an average the Constant Murley score of all the patients in the study is 67.43.

E excellent, G- good, M – moderate P- poor

Fracture type	Mean Constant Murley score
2 part	71.3
3 part	60.5
4 part	56.5
Total	67.43



Graph 1: Distribution of overall functional outcome

DISCUSSION

Proximal humeral fractures, especially in elderly patients, remain a challenging problem for the surgeon because the complication rate for these fractures still remains high. Various treatment options of displaced fractures are known but are still associated with high complication rates.

The aim of treatment in proximal humeral fractures is to achieve a painless and simultaneously functional shoulder. This result depends on the age, medical condition, bone quality and expectations of the patient as well as a good evaluation of the current fixation techniques. Traditional treatment techniques include open reduction and internal fixation with proximal humeral plates, hemiarthroplasty, and percutaneous or minimally invasive techniques such as pinning, screw osteosynthesis, and the use of intramedullary nails. Loosening or failure of the implant and nonunion are possible complications of surgery in humeral fractures.

Open reduction and internal fixation (ORIF) of proximal humerus fractures with conventional plates has been associated with loss of reduction, screw loosening, and osteonecrosis. Consequently, angular stable plates have been developed in recent years to preserve anatomic reduction with stronger anchorage, especially in osteoporotic bone. Among them, the 3-dimensional anatomically adjusted PHILOS plate provides a locking system for its proximal part contacting the humeral head.

The internal locked system (PHILOS) plate is a new device used for proximal humerus fracture fixation is designed to decrease the high complication rate.

The PHILOS plate provides excellent fixation to the humeral head, even in osteoporotic bone. Angular stability, adequate buttressing, and load sharing support prevent collapse of the fragments. It attempts to achieve these aims through a combination of multidirectional locking screws for the head, pre-contoured plate, and locking screws in the shaft.

This study evaluated the clinical and radiological results of the PHILOS plate used in thirty patients, over a two-year period in King George Hospital, Andhra Medical College, Visakhapatnam. This study was planned to evaluate the outcome of proximal humerus fractures managed with PHILOS plate after approval by the Institutional Ethical Board.

Functional outcome using Constant Murley score:

The average Constant Murley score in the present study is 67.43. The overall functional outcome of the study was moderate based on the Constant Murley score. About 11 out of 30 patients had good outcomes. One patient had excellent outcome and seventeen had moderate outcome and one patient had poor outcome due to post op complications. About 3 percent had excellent outcome and 37 percent had good outcome. 57 percent had moderate outcome and 3 percent of the patients had poor outcome.

The result of the present study are in consistence with that of Moonot et al [6] with average CM score around 66.5.

Name of the study	Constant Murley score
Moonot et al	66.5
Vivek Bansal et al.	57.4
Deenadayalan et al.	82
Gautam Kumar et al	81
Zu Bin Zhou et al	85.8
Alphonso Mariadoss et al.	78.52
A. Koukakis et al	76.1
Chodavarapu et al	76

Alexander Brunner et al.	74
Present study	67.43

Table-3: Comparison of functional outcome of different studies

Name of the study	% of cases with excellent outcome	% of cases with good out come	% of cases with fair outcome	% of cases with poor out come
Moonot et al.	47		37	16
Alphonse Mariadoss et al.	60		20	20
Present study	03	37	57	3

Functional Outcome As Per Fracture Pattern

In the present study, the functional outcome is much better in patients with Neer’s 2- part fracture when compared to that of patients with 3 part and 4-part fractures.

Patients with 2-part fractures fared well in their functional outcome, with an average Constant Murley score of 71.3, than patients with 3 part and 4 part fractures who had average scores of 60.5 and 56.5 respectively. The functional outcome of 3- and 4-part fractures is better in younger patients than elderly patients. Similar outcome as per age and fracture pattern is also reflected in the studies of Vivek Bansal et al.

Better Outcome With MIPO

Some of the studies like that of Zu Bin Zhou et al and Alexander Brunner et al worked on minimally invasive percutaneous osteosynthesis (MIPO) technique of fixation of proximal humerus fractures and gave better results of outcome. In the present study, all the patients were treated by open reduction and internal fixation by deltopectoral approach.

MIPO could give better results as there will be minimal soft tissue and vascular disruption in this technique. However, if minimally invasive approach is selected using a deltoid split, distal screw fixation into the humeral shaft is achieved by multiple stab incisions. They should be placed in such a manner that utmost care is to be taken to prevent injury to axillary nerve as this is one of the potential complications of MIPO technique. Further studies working out on these lines are recommended to know further improvement in functional outcome that arise out of newer techniques.

Limitations Of The Study

The sample size of the study is very small, due to which it is difficult to comment on certain complications and results.

The study period is short (2 years). Long term follow-up of the patients can enable to arrive at better conclusions with regard to functional outcome. Overall, open reduction and internal fixation of proximal humerus fractures by PHILOS plate can give satisfactory functional outcome to patients. However, results can be further improved by following proper principles of reduction and well planned post-operative rehabilitation.

CONCLUSION

PHILOS plate, stable, angled construct is used in all our cases and the results evaluation done with Constant Murley score which ranged 54 to 87. Our average score is 67.43 which is in concurrence with few of the studies.

The rehabilitation after operation started early with pendulum exercises as soon as the patients compliance within the limits of pain. The range of movements in our study, abduction maximum range obtained is 120 to 150 degrees and forward flexion 90 to 120 degrees and rotations average score is 7. Though we have few complications like stiffness of shoulder (5), AVN (1), intra-articular screw penetration (1), superficial

infection (1) and subacromial impingement (1), we have dealt with all these complications appropriately. Significantly varus malunion did not occur in our study.

REFERENCES

1. M, Kannus P, Niemi S, Parkkari J. Update in the epidemiology of proximal humeral fractures. *Clin Orthop* 2006;442:87–92.
2. Spence RJ. Fractures of the proximal humerus. *Curr Opin Orthop* 2003;14:269–80. 3. Baron JA, Barrett JA, Karagas MR. The epidemiology of peripheral fractures. *Bone* 1996;18(3):209S–13S
3. Park MC, Murthi AM, Roth NS et al. Two-part and three-part fractures of the proximal humerus treated with suture fixation [J]. *J Orthop Trauma*. 2003; 17(5):31925.
4. Resch H, Povacz P, Fröhlich R et al. Percutaneous fixation of three- and four-part fractures of the proximal humerus [J]. *J Bone Joint Surg Br*. 1997; 79(2):295-300.
5. Moonot P, Ashwood N, Hamlet M. Early results for treatment of three- and fourpart fractures of the proximal humerus using the PHILOS plate system. *J Bone Joint Surg Br*. 2007;89(9):1206–09.
6. Bigliani LU. The Shoulder. Philadelphia: W. B. Saunders; 1990. Fractures of the proximal humerus. In: Rockwood CA, Matsen FA, eds; pp. 278–334.
7. Nho SJ, Brophy RH, Barker JU, Cornell SJ, MacGillivray JD. Management of proximal humeral fractures based on current literature. *J Bone Joint Surg Am*. 2007;89(3):44–58.
8. Codman EA. Committee for Standardization of Hospitals [of the American College of Surgeons]. Minimum standard for hospitals. *Bull Am Coll Surg*. 1924;8(4).
9. Lous U, Bigliani, Chapter 9 The shoulder, Vol-1 ed. Charles Rockwood, Frederick A. Fractures of proximal humerus. In Rockwood CA, Matsen. Philadelphia:W.B. Saunders, 1990:p278-334