

A PROSPECTIVE STUDY ON FUNCTIONAL OUTCOME IN DISPLACED PROXIMAL HUMERUS FRACTURES

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Received : 20/10/2024
Received in revised form : 12/12/2024
Accepted : 28/12/2024

Keywords:

Proximal humerus, proximal humerus fracture by locking compression plate. (PHILOS PLATE), Constant Murley Scoring (CMS).

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DOI: 10.47009/jamp.2024.6.6.160

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2024; 6 (6); 844-849



Abstract

Background: To analyze the functional outcomes of patients with proximal humerus fracture with philos plate fixation. **Material and Methods:** This prospective study encompasses on 30 patients diagnosed with displaced fractures of the proximal humerus, categorized according to Neer's classification. Aged >18 years who all sustained trauma to limb. Pathological and undisplaced patterned proximal humerus fractures were excluded from this study. All the patients underwent open reduction and internal fixation with philos plate. **Results:** Constant Murley Scoring (CMS) patients were assessed by CMS on basis of pain, activities of daily living (ADL), range of motion (ROM), power. 7 patients (22%) had satisfactory, 13 (40.6%) patients had good results, and 12 patients (37.5%) had excellent results. UCLA scoring among 32 patients 5(15.6%) had fair, 22(68.8%) had good results, 5(15.6%) excellent results. **Conclusion:** The utilization of stable and rigid fixation provided by Philos plate fixation offers several advantages. Early mobilization facilitated by this technique enables patients to swiftly return to their pre-fracture functional status, consequently reducing the risk of shoulder stiffness, restricted range of motion, head collapse, and ultimately enhancing their overall quality of life.

INTRODUCTION

Proximal humerus fractures are one of the commonest fractures occurring in the skeleton. They account for approximately 4 – 5% of the all fracture,^[1,2] Proximal humeral fractures are the second most common upper- extremity fracture and the third most common fracture, after hip fractures and distal radial fractures, in patients who are older than sixty-five years of age.^[3] Proximal humerus fractures are common and have a bimodal age distribution. Fracture-dislocations in younger patients result from high energy trauma and most surgeons attempt open reduction and internal fixation, if at all possible. Osteoporotic fractures in elderly patients are commonly associated with lower energy trauma such as ground level falls and most are minimally displaced, impacted fractures that can be treated successfully with non-operative means. However, the optimal surgical management of three and four-part proximal humeral fractures in elderly osteoporotic patients remains controversial, with many advocating prosthetic replacement of the humeral head.

The Neer classification system, despite limitations, categorizes these fractures by displacement and angulation, guiding treatment. Non-operative management, including immobilization and rehabilitation, suffices for non-displaced fractures, while complex cases may require surgical interventions like open reduction, internal fixation, or arthroplasty. Displaced 3-part or 4-part fractures can disrupt the glenohumeral joint and compromise blood supply, impacting healing. Stable fixation is crucial, with methods like K-wire pinning, screw fixation, plates, and prosthetic replacement, each with potential complications. Poor bone quality in the elderly heightens the risk of fixation failure.^[4]

The Proximal Humerus Internal Locking System (PHILOS) addresses these issues, enabling early mobilization and reducing shoulder stiffness, even in minimally displaced fractures. For highly comminuted fractures, PHILOS with rotator cuff sutural ties improves outcomes. This study highlights the effectiveness of the PHILOS plate in managing proximal humerus fractures.

MATERIALS AND METHODS

This prospective study on 32 patients diagnosed with displaced fractures of the proximal humerus, categorized according to Neer's classification.

Inclusion criteria: Aged between 22 - 66 years who all sustained trauma to limb.

Exclusion criteria: Pathological and undisplaced patterned proximal humerus fractures.

All the patients underwent open reduction and internal fixation with philos plate. Patient data recorded included age, profession, sex, mechanism of injury, injury severity, associated injuries, time since injury, and functional demands. Radiographic evaluation, including standard and special views, was used to confirm the diagnosis. In cases where the fracture geometry was uncertain, thin-slice CT scans were used to assess the intra-articular extent of the fracture

The fracture was classified according to the Neer's Classification system, and a pre-operative plan was developed based on this classification. Prior to surgery, the patient was managed with analgesics and immobilization in a U-slab. Additionally, any comorbidities were addressed and treated as necessary. During surgery, any events, difficulties, or complications were recorded. Post-operative radiological assessments and monitoring of bony union were conducted. Patients were regularly followed up at specified intervals (3 weeks, 6 weeks, 3 months, 6 months, and 12 months) for radiographic evaluation and clinical examination to track their progress and outcome. At the final assessment, all patients underwent a thorough evaluation, encompassing both radiological as well as functional assessments utilizing the Constant score, to ascertain their overall outcome and functional status.

Pre-op clinical evaluation- Following hemodynamic stabilization, a comprehensive history was obtained from patients admitted to the Department of Orthopedics, focusing on the mode of injury, clinical history, presence of any co-morbidities, and clinical examination.

All patients received preoperative treatment with appropriate analgesics and antibiotics if necessary. Subsequently, they were splinted with a U-slab or cuff and collar to alleviate pain, restrict unnecessary movement of the injured limb, and prevent damage to the neurovascular bundle.

Radiological evaluation- Following radiographs were taken in every case:

1. Antero-posterior view (Grashey's view)
2. Lateral view (Neer's-Y view)
3. Axillary view

The records were examined to determine the Neer classification of the fracture.^[4] In specific cases, CT scans or special views were utilized to assess the extent of involvement of the articular surface.

Preoperative planning goals of treatment include evaluating the functional outcome in patients treated with Proximal Humerus Locking Plate for displaced

fracture of proximal humerus. To improve stability in osteoporotic humeral bones and to preserve the biological integrity of the humeral head and to secure an anatomical reduction with multiple locking screws with angular stability. Fixation must be stable enough to allow early motion & minimize the wound complications. X ray of the shoulder joint (AP & Lateral and Y-view) was assessed thoroughly and graded according to the fracture classification. Plan and determine proper plate positioning or if necessary, plan for soft tissue suturing using parachute technique.

All the cases were operated under general anaesthesia, in some cases supplemented with brachial block. All the cases were operated in a modification of delto-pectoral approach where instead of developing delto- pectoral plane we go through the substance of deltoid leaving a 1 cm of deltoid intact adjacent to delto-pectoral groove. This modification enabled us for the proper lateral placement of plate, easier reduction of displaced greater tuberosity fracture, and better rotator cuff repair and also to reduce the displaced Greater tuberosity fracture.

Ideal placement of the PHILOS plate is usually 8 mm inferior to upper border of greater tuberosity and 5 mm posterior to bicipital groove. C arm assistance may be utilized to check proper placement of plate and avoid screw penetration.

Post-operative management- Most case were given an arm pouche and gentle active pendular excercises started on 3rd post-operative day. Rigid immobilisation with J Slab was reserved for fixation in communitied proximal humerus injuries. Suture removal done at average of 10 days. Pendulum excercises started on 10 th post op day. Controlled abduction and flexion beyond 90 degree was allowed by the end of 3 nd week. At each follow up patient is examined and evaluated for pain, available range of motion, functional capability, muscle strength and tone. Standard AP, scapular Y and axillary radiographic views were taken immediately after surgery, with routine follow-up radiographs scheduled at 3, 6 weeks, and 3, 6, and 12 months postoperatively to monitor pin migration, loss of reduction, evidence of callus formation, and fracture consolidation.

RESULTS

The study of treatment of displaced proximal humerus fractures was conducted in the department of Orthopaedics. During this period 32 cases were treated surgically with PHILOS locking plates and follow up.

The following observations were made of the DATA collected from the study.

Proximal humerus fractures were found to have high incidence in the 41 to 50 age group. There were 12 males and 20 females i.e 37.5 % males and 62.5 % females. Females predominated over females in our

study. Ratio of males to female was 1:1.6. 19 Patients had right sided involvement and 13 patients had left side involvement. No patients had bilateral involvement. Most of the patients had sustained injury by RTA 21 (65.6%) and 11 (34%) patients had Fall. [Table 1]

According to Neers classification 3-part greater tuberosity are 40.6%. [Table 2]

Radius fractures are in 4(12.5%) patients and acetabulum fractures in 3(9.4%) patients. 4 of our patients had stiffness of shoulder (12.5%) and 2 patient had hardware prominence.

mean follow up of patients is 13.3 months. Average time to fracture union is 12.8 weeks. [Table 3]

Range of movements with flexion 18 (56.3%) of patients had flexion between 151-180, 7 patients (22%) had 121-150 and 4 patients (12.5%) had 91-120, and 3 patients (9.4%) had < 90.

17(53%) patients had abduction 151-180, 6(18.8%), 5(15.6%) patients had each of 121-150 and 91-120 and 4(12.5%) patients had < 90 of abduction

External rotation 20 patients (62.5) had 71-90 of external rotation and 10 patients (31%) had 51-70, 2(6.3%) patients 31-50.

Internal rotation 17(53%) patients had 71-90 and 15 patients (47%) had 51-70. [Table 4]

Constant Murley Scoring (CMS) patients were assessed by CMS on basis of pain, activities of daily living (ADL), range of motion (ROM), power, power. 7 patients (22%) had satisfactory,13 (40.6%)patients had good results, and 12 patients (37.5%) had excellent results. UCLA scoring among 32 patients 5(15.6%) had fair, 22(68.8%) had good results, 5(15.6%) excellent results. [Table 5]

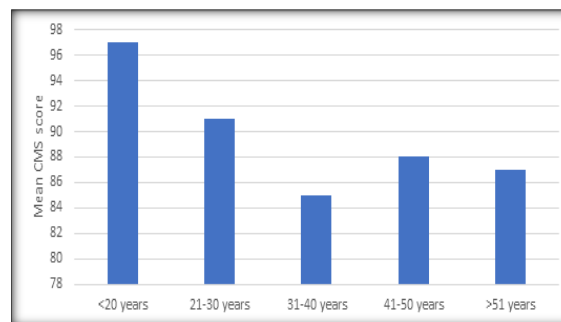


Figure 1: Age group wise mean CMS score in present study

Mean CMS score in <20 is high with excellent ie more that 91 score followed by 21-30 years.

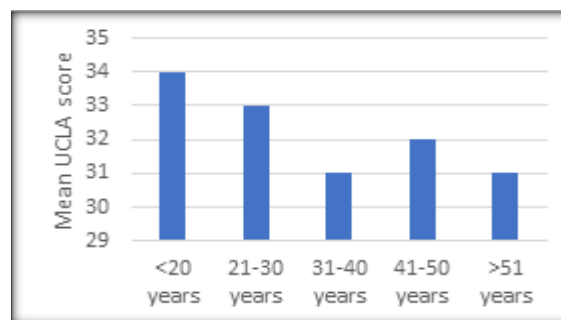


Figure 2: Age group wise mean UCLA score in present study

Mean UCLA score in <20 is high with excellent with more that 34 score followed by 21-30 years.

Table 1: Distribution of patients in present study

Age intervals	Number of patients	Percentages
<20 years	2	6.25
21-30 years	5	15.62
31-40 years	10	31.25
41-50 years	11	34.375
>51 years	4	12.5
Gender		
Males	12	37.5
Females	20	62.5
Site involved		
Left	13	40.6
Right	19	59.4
Mode of injury		
Road traffic accident	21	65.6
Fall	11	34.4

Table 2: Fracture type on Neers classification

Fracture type	Number of patients	Percentages
2 part surgical neck	5	15.6
2 part greater tuberosity	2	6.3
3 part greater tuberosity+ surgical neck	13	40.6
4 part	3	9.4
Fracture dislocation	9	28.1

Table 3: Significant Associated Injuries and complications

Associated Injuries	Number of patients	Percentages
Femur fracture	2	6.3
Acetabulum fracture	3	9.4
Radius fracture	4	12.5

Both bone leg fracture	1	3.1
Hip dislocation	2	6.3
Lateral condyle fracture tibia+ zygoma fracture	1	3.1
Complications		
Shoulder stiffness	4	12.5
Hardware problem	2	6.3
Impingement syndrome	0	0
AVN Humerus head	0	0
Infection	0	0
Implant failure	0	0
Nil	26	81.3

Table 4: Range of Movements in patients

Range of movements	Number of patients	Percentages
Flexion		
<90	3	9.4
91-120	4	12.5
121-150	7	21.9
151-180	18	56.3
Abduction		
<90	4	12.5
91-120	5	15.6
121-150	6	18.8
151-180	17	53.1
External Rotation		
<30	0	0.0
31-50	2	6.3
51-70	10	31.3
71-90	20	62.5
Internal Rotation		
<30	0	0
31-50	0	0
51-70	15	46.9
71-90	17	53.1

Table 5: Constant Murley Scoring (CMS) and UCLA scoring

Constant Murley Scoring		Number of patients	Percentages
<60	Poor	0	0.0
61-70	Adequate	0	0.0
71-80	Satisfactory	7	21.9
81-90	Good	13	40.6
91-100	Excellent	12	37.5
UCLA scoring			
0-20	Poor	0	0.0
21-27	Fair	5	15.6
28-33	Good	22	68.8
34-35	Excellent	5	15.6

DISCUSSION

The incidence of proximal humerus fractures has increased in last few years due to changes in life style and increase in road traffic accidents when compared to the previous decade. Treatment option of proximal humerus fractures were restricted to Tbutress plate, K-wires, TBW, however the best management in these injuries is still uncertain. Most of the proximal humerus fracture which are undisplaced can be treated conservatively. Even if the injury is thoroughly analyzed and the literature is understood, treatment of displaced fracture or fracture dislocation is difficult. The literature agrees that achieving a good functional outcome in humeral fracture treatment relies primarily on two key factors: anatomical fracture site reduction and stable fixation. Additionally, early initiating functional rehab of the shoulder is crucial. However, this study reveals that three specific factors - patient age, minimal

fragmentation of the fracture part, and eager fixation of the fracture - have a direct positive impact on functional outcomes, suggesting that these factors can influence the success of treatment.^[5,6]

In recent years, there has been a noticeable trend towards employing rigid internal fixation in the surgical management of proximal humeral fractures. This approach has gained significant popularity in the operative treatment of these fractures. Despite prompt and secure functional post-op therapy, there was an expectation that these implants could reduce the risk of secondary loss of reduction in patients with osteoporosis. In elderly individuals with osteoporosis, traditional plate osteosynthesis often yields unsatisfactory functional outcomes. To address this challenge and achieve more consistent and improved results, the AO/ASIF developed the Philos locking compression plate, a specialized implant designed specifically for fractures involving proximal humerus.^[7] Patients with optimal bone

quality have typically achieved positive outcomes with traditional plate osteosynthesis treatment.^[8] In this study, the majority of patients (12 out of 20) belonged to the age group of 41-60 years, a demographic highly susceptible to osteoporosis. Proximal humerus fractures were found to have high incidence in the 41 to 50 age group. Majority of the patient in our group are middle aged in our study probably that is most active and working group of the population which is in correlation with study of Crosby L.A. et al,^[9] Eichenseer P et al,^[10] and Postacchini R et al.^[11] Yahuaca et al,^[12] reported age to be associated with surgical treatment selection for proximal humerus fractures such that patients older than 65 years had significance. Our study showed a higher incidence of fractures in women than in men. The gender ratio was 1: 1.6. This higher ratio can be explained by a higher involvement of female. Most of these fractures are related to osteoporosis while injury in younger people is likely to be the consequence of high energy trauma. Because of increase in incidence of high velocity trauma, the fracture pattern in proximal humerus fractures are becoming complicated. Barvencik et al,^[13] demonstrated age and sex to be critical determinants of microarchitectural changes such that women older than 60 years had significant age-related decrease in bone mass with the greater tuberosity. The incidence of fracture due to road traffic accident is more with 21 (65.6%) and 11 (34%) patients had Fall. In a study conducted by Sudkamp et al,^[14] most common mode of trauma was low energy trauma in 162(87%), high energy trauma in 25(13%). In study conducted by F Muncibi,^[15] accidental falls were seen in 37 patients. MA Fazal, FS Haddad,^[16] in their study have reported 21 cases(77.8%) of fall and 6cases(22.2%) of RTA Sameer aggarwal, kamalali,^[17] in their study of 47 patients of proximal humerus fracture, fall accounted for 55% of fracture, road side accident 42.5% and 1 fracture(2.5%) was caused by seizure. Herbert Resch et al,^[18] in their study of 27 patients with 3 part and four-part fracture, 24 patients had history of high energy trauma. In present study right sided involvement and 13 patients had left side involvement. No patients had bilateral involvement. C. Gerber,^[19] reported, in their series of 34 fractures 16 were on left side and 18 were on right side . It corresponds to the normal right hand dominant strain of human beings and it is used to prevent from fall and subsequently after impact. In our study Neers classification 3-part greater tuberosity are more with range of movements with flexion 18 (56.3%) of patients had flexion between 151-1800. 17(53%) patients had abduction 151-180 0. External rotation 20 patients (62.5) had 71-900 of external rotation. Internal rotation 17(53%) patients had 71-900. In a study conducted by Ge et al.^[20] on 189 patients 2-part or 3-part fractures mean flexion at 6 month was 148.80 for patients treated with ORIF with plate and 140.70 with conservative treatment, whereas mean

flexion at 10 months was 153.450 for patients treated with ORIF with plate and 152.30 with conservative treatment.

As per our study range of motion is affected by increase in age, severity of fracture pattern, poor compliance to rehabilitation, rigidity of fixation. Range of motion is affected by increasing age in our study, best range of motion is found in age group of 20 – 30 years, range of motion reduced with advancing age in our study can probably explained by the age related Rotator cuff degeneration. Range of motion is also influenced by fracture pattern with best results in isolated greater tuberosity fractures and with least in fracture dislocations. Functional outcome is also influenced by pattern of fracture with best results in isolated 2-part greater tuberosity fracture (Constant-Murley score – 9 1) followed by 2-part surgical neck fractures (90) and 4-part fracture. Constant Murley Scoring (CMS) patients were assessed by CMS on basis of pain, ADL, ROM, power. 7 patients (22%) had satisfactory,13 (40.6%)patients had good results, and 12 patients (37.5%) had excellent results. UCLA scoring among 32 patients 5(15.6%) had fair, 22(68.8%) had good results, 5(15.6%) excellent results. simple fracture had a better functional outcome. These findings are comparable to earlier studies done by P. Moonot et al,^[21] David S. Thyagarajan,^[22] Rizwan Shahid et al,^[23] Jan-Magnus Björkenheim.^[24]

Research comparing internal fixation methods for fractures involving proximal humerus has yielded similar short-term outcomes. While our study's follow-up period was brief, existing literature suggests that early functional results are often indicative of long-term outcomes. The final outcome is influenced by various factors, including fracture severity, quality of anatomic reduction, etiology, bone density, time elapsed between injury and surgery, presence of accompanying injuries, and the precise placement and implant fixation.^[25] Employing an appropriate surgical technique can mitigate complications, while a rigorous rehabilitation regimen contributes to achieving optimal outcomes. Despite the limitations of our study, namely its relatively short duration and lack of randomization, our findings align with those reported in other scholarly publications.

CONCLUSION

Despite the limitations of our study, including its relatively short duration and non-randomized design, our findings align with published research in the field. Notably, accurate anatomical reduction and timely fracture fixation emerge as crucial factors in achieving optimal functional outcomes, superseding the specific implant used. This key takeaway is independent of implant design and surgical approach, highlighting the primacy of precise reduction and early fixation in driving successful patient outcomes.

The choice of surgical approach and implant type depends on various factors, including the fracture pattern, bone quality, patient goals, and the surgeon's expertise and comfort with specific techniques. Additionally, the learning curve associated with the chosen implant plays a significant role. A skilled surgical technique will help minimize complications, while a rigorous rehabilitation program will ensure optimal outcomes. The combination of these factors will ultimately determine the success of the procedure.

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