



## A study to evaluate functional outcome of various treatment modalities (surgical) of proximal humerus fracture

Debojyoti Mukherjee<sup>1</sup>, Anirban Paul<sup>2</sup>

<sup>1</sup> Associate Professor, Department of Orthopaedics, R.G.Kar Medical College and Hospital, Kolkata, India

<sup>2</sup> Senior Resident, Department of Orthopaedics, R.G.Kar Medical College and Hospital, Kolkata, India

**\*Corresponding author:** Dr Debojyoti Mukherjee, **Address:** Department of Orthopaedics, R.G.Kar Medical College and Hospital, Kolkata, India, **Email:** sk02433@yahoo.com, **Tel:** +91 033 2555 7656

### Abstract

**Background & Aims:** Proximal humerus fractures comprise almost 5.7% of all fractures and represent the most common humerus fractures (80%). In addition, proximal humeral fractures (PHFs) are the third most common fracture in geriatric patients, typically associated with systemic osteoporosis. Their incidence is expected to triple over the coming three decades. This study aims to evaluate the functional outcome of various treatment modalities (Surgical) for Proximal humerus fracture treatment modalities (Surgical) of Proximal humerus Fracture.

**Materials & Methods:** This study is a prospective and analytical one. The patients admitted to the orthopaedics ward with fractures of the proximal humerus in the adult age group (above 18) were screened and recruited based on the fulfilment of inclusion and exclusion criteria. Fifty patients were taken in which plain radiographs of the shoulder (trauma series, i.e. AP, lateral and axillary view), CT scan if needed, and routine pre-anaesthetic investigations were assessed. For statistical analysis, data were entered into a Microsoft excel spreadsheet and then analyzed by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5. Two-sample t-tests for a difference in mean involved independent samples or unpaired samples.

**Results:** In our study, 18(36.0%) patients were treated with closed reduction + percutaneous pinning, 9 (18.0%) patients were treated with hemiarthroplasty, and 23(46.0%) patients were treated with open reduction and internal fixation with PHILOS plate. In our study, 13 (26%) patients had four-part fractures, out of which 5(10.0%) patients had four-part fractures with head split, 23(46.0%) patients had three-part fractures, and 14(28.0%) patients had two-part fractures. In our study, 10(20.0%) patients had Abduction Score 4 (61-90), 22(44.0%) patients had Abduction Score 6 (91-120) and 18(36.0%) patients had Abduction Score 8 (121-150).

**Conclusion:** Good surgical skills and experience of the surgeon in the selection are necessary to achieve the correct and best outcome irrespective of the surgical modality chosen. Proper patient selection and thorough knowledge of anatomy and biomechanical principles are the prerequisites for successful surgery and good functional outcome.

**Keywords:** Abduction Score, Hemiarthroplasty, Proximal Humerus Fracture

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## Introduction

Proximal humeral fractures, which occur at or proximal to the surgical neck of the humerus, are the commonest fracture affecting the shoulder girdle in adults (1). Proximal humerus fractures comprise almost 5.7% of all fractures and represent the most common humerus fractures (80%). In addition, proximal humeral fractures (PHFs) are the third most common fracture in geriatric patients, typically associated with systemic osteoporosis. Their incidence is expected to triple over the coming three decades (2,3)

The non-surgical treatment is the most common; 20% of these fractures need Surgical treatment due to increasing complications with the patient's age. Open reduction and fixation with locking plates are the most common interventions for displaced proximal humerus fractures. However, other options exist, such as closed reduction and percutaneous pinning, proximal humeral interlocking nailing, and primary hemiarthroplasty of the shoulder (4).

Numerous surgical techniques for treating Proximal Humerus Fractures have been described and developed, with locking plate osteosynthesis being the most frequently used method. Direct exposure of the fracture site offers the advantages of allowing direct fragment manipulation and visualization of reduction and implant position. However, this technique has widely reported a high rate of complications, especially varus collapse with screw cut-out and increased risk of avascular necrosis of the humeral head. Osteoporosis, patient age and insufficient medial cortical support are generally considered the main risk factors for proximal humerus fracture fixation failure (5).

Closed reduction with percutaneous fixation of proximal humerus fracture has the advantage of minimal soft tissue violation, thus promoting healing and reducing avascular necrosis of the humeral head. Previous studies have suggested that percutaneous fixation may decrease the risk

of osteonecrosis in patients who have sustained a proximal humeral fracture. The prevalence of osteonecrosis after percutaneous pinning has been reported to be 4% to 16%, which is lower than the

prevalence of 12.5% to 71% after using other open techniques. Therefore, percutaneous pinning substantially reduces, although does not eliminate, the risk of the poor clinical outcomes seen in patients who develop osteonecrosis (6).

Our study took two and three-part fractures for closed reduction and percutaneous pinning. The main disadvantage of percutaneous pinning is the technical challenge. A good understanding of fracture morphology and a detailed understanding of the structures at risk of iatrogenic injury is required as this is a closed procedure. In addition, pin placement along safe zones is required. Bone quality also plays a vital role in achieving adequate fixation and avoiding pin migration and construct failure (7).

Primary hemiarthroplasty, also known as a humeral head replacement, is indicated when the humeral head is deemed to be reconstructable or when its viability is compromised. For example, comminuted head-splitting and head depression fractures involving more than 40% of the articular surface are considered non-reconstructable. Predictors of ischemia are also considered before deciding between operative fixation and primary replacement.

## Materials & Methods

This is a Prospective and analytical study conducted at the orthopaedics department of KPCMCH, Kolkata. The institutional ethical committee approved the study, and all the patients were included after the consent. The patients admitted to the orthopaedics ward with fractures of the proximal humerus in the adult age group (above 18) were screened and recruited based on the fulfilment of inclusion and exclusion criteria. Fifty patients were taken after the sample size calculation.

### Patient selection criteria:

#### Inclusion criteria:

1. Skeletally mature patients of both sexes having proximal humerus fracture and consenting to the study
2. Displaced proximal humerus fracture [ NEER two, three, four-part fractures]
3. Closed fractures

**Exclusion criteria:**

1. Pathologic fractures from primary or metastatic tumours
2. Patients aged less than 18 years.
3. Undisplaced fractures
4. Open fractures
5. Fracture with the distal neurovascular deficit
6. Polytrauma
7. Infection [Acute or chronic osteomyelitis, or patients with sepsis]
8. Medically unfit from an aesthetic point of view

**Investigations to be done pre-operatively:**

Plain radiographs of the shoulder (trauma series, i.e. AP, lateral and axillary view), CT scan if needed, and Routine pre-anaesthetic investigations.

**Modalities of treatments to be studied:**

1. Closed reduction and percutaneous pinning
  2. Open Reduction and Internal Fixation with proximal humerus internal locking system [PHILOS]
  3. Primary hemiarthroplasty of the shoulder
- A detailed description of each treatment modality, i.e. patient positioning, surgical steps and techniques, has been explained in the previous management section.

**Indications for choosing different treatment modalities:**

1. **Closed reduction and percutaneous pinning:**
  - Minimally displaced fractures
  - Displaced but reducible by closed manipulation [Neer two-part, three-part and valgus impacted four-part fractures]
2. **Open reduction and internal fixation with Philos plate:**

Displaced fractures of the proximal humerus, not reducible by closed manipulation [Neer two-part, three-part and four-part fractures]

**Table 1:** Distribution of Age in Years

Age in Years	Frequency	Percent
41-50	2	4.0%
51-60	30	60.0%
61-70	11	22.0%
71-80	7	14.0%
Total	50	100.0%

**3. Primary hemiarthroplasty of the shoulder:**

Neer four-part fractures with comminution when the Humeral head is unreconstructable, i.e. comminuted head splitting fracture and head depression fractures involving more than 40% of the articular surface. Neer four-part fracture with comminution when biologic viability of head is compromised severely.

**Statistical analysis:**

For statistical analysis, data were entered into a Microsoft excel spreadsheet and then analyzed by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5. Two-sample t-tests for a difference in mean involved independent samples or unpaired samples. Paired t-tests were a form of blocking and had greater power than unpaired tests. One-way analysis of variance (one-way ANOVA) was a technique used to compare the means of three or more samples for numerical data (using the F distribution). Finally, a chi-squared test ( $\chi^2$  test) is any statistical hypothesis test wherein the sampling distribution of the test statistic is chi-squared distribution when the null hypothesis is true.

**Results**

In this study, 2(4.0%) patients were 41-50 years old, 30(60.0%) patients were 51-60 years old, 11(22.0%) patients were 61-70 years old and 7(14.0%) patient was 71-80 years old (Table1). Gender predilection in the present research was 28(56.0%) patients were Female, and 22(44.0%) patients were male (Table2). Distribution according to treatment modalities was 18(36.0%) patients were treated with closed reduction + percutaneous pinning, 9(18.0%) patients treated with hemiarthroplasty and 23(46.0%) patients treated with open reduction and internal fixation with PHILOS plate (Table 3).

**Table 2:** Distribution of Sex

Sex	Frequency	Percent
Female	28	56.0%
Male	22	44.0%
Total	50	100.0%

**Table 3:** Distribution of Group (Treatment Modality)

Group	Frequency	Percent
Closed reduction + percutaneous pinning	18	36.0%
Hemiarthroplasty	9	18.0%
Open reduction & internal fixation with philos plate	23	46.0%
Total	50	100.0%

In our study, 27(54.0%) patients developed fractures due to FALL, and 23(46.0%) patients developed fractures due to road traffic accidents (Table 4). In this present study, 13 (26%) patients four-part fracture, out

of which 5(10.0%) patients had a four-part fracture with a head split, 23(46.0%) patients had three-part fracture, and 14(28.0%) patients had two-part fracture (Table 5).

**Table 4:** Distribution of mechanism of injury

Mechanism of injury	Frequency	Percent
Fall	27	54.0%
Road traffic accident	23	46.0%
Total	50	100.0%

**Table 5:** Distribution of type of fracture

Type of Fracture	Frequency	Percent
Four part	8	16.0%
Four part, head split	5	10.0%
Three Part	23	46.0%
Two Part	14	28.0%
Total	50	100.0%

In our study, 10(20.0%) patients had abduction Score 4 (61-90), 22(44.0%) patients had abduction Score 6 (91-120) and 18(36.0%) patients had Abduction Score 8 (121-150) (Table 6). In our study, 13(26.0%)

patients had Forward flexion Score (61-90), 28(56.0%) patients had Forward flexion Score (91-120) and 9(18.0%) patients had Forward flexion Score (121-150) (Table 7).

**Table 6:** Distribution of Abduction Score

Abduction Score	Frequency	Percent
4 (61-90)	10	20.0%
6 (91-120)	22	44.0%
8 (121-150)	18	36.0%
Total	50	100.0%

**Table 7:** Distribution of Forward flexion Score

Forward flexion Score	Frequency	Percent
4 (61-90)	13	26.0%
6 (91-120)	28	56.0%
8 (121-150)	9	18.0%
Total	50	100.0%

## Discussion

In our study, 4.0% of patients were 41-50 years old, 60.0% were 51-60 years old, 22.0% were 61-70 years old, and 14.0% were 71-80 years old. The mean age was 60.58 years, similar to Soni R et al (8). with a mean age of 55.6 years, the study of Thyagarajan DS et al. (9) with an average age of 58 years. Age was an essential parameter for choosing treatment modality and also affected the outcome of our study. Shahid R et al (10). found that better results were achieved in younger than older patients. In our study setting most common Mechanism of Injury (MOA) was low-energy trauma i.e. domestic fall [54.0% patients had a fall] than high-velocity trauma, i.e. RTA, which was Mechanism of Injury for patients (46.0%). The finding was consistent with the findings of Soni R et al (8) as they found domestic falls as a mechanism of Injury for 64% of fractures in their study. It is consistent with much other literature mentioned here. It signifies fragility fracture as the primary concern in our study setting and affects outcome, though the association of Mechanism of Injury vs surgical modality chosen was not statistically significant ( $p=0.0623$ ).

We recruited 13(26.0%) patients with Neer Four-part fracture, and 5(10.0%) of them had head split, 23(46.0%) patients with Neer three-part fracture and 14(28.0%) patients with Neer two-part fracture who met our inclusion and exclusion criteria. This distribution was similar to the study of Geiger EV et al. (11) [28.57% had a two-part fracture, 42.86% had a three-part fracture, and 28.57% had a four-part fracture], and the study of Kumar A et al (12), but contrary to the distribution of fractures in the study of Heers G et al. (13). They found two-part fracture through surgical neck a majority. In our study, 18(36.0%) patients were treated with closed reduction and percutaneous pinning, 9(18.0%) patients had primary hemiarthroplasty, and 23(46.0%) patients

had open reduction and internal fixation with PHILOS plate.

Our study found that in patients treated with closed reduction and percutaneous pinning, the mean Abduction of patients was  $121.1111 \pm 10.9216$ . The mean forward flexion of patients was  $110.0000 \pm 12.2474$ , 9(50.0%) patients had internal rotation up to L3, 7(38.9%) patients had internal rotation up to T12 and 2(11.1%) patients had internal rotation up to T7. Results were comparable with Jaberg H et al. findings with  $144^\circ$  of forwarding elevation,  $44^\circ$  of external rotation, and internal rotation to L2. Kayalar M et al. (15) also showed similar figures in their study: mean shoulder abduction of 134 degrees (range 30 degrees to 160 degrees) and the mean elevation of 118 degrees (range 30 degrees to 140 degrees).

Among patients treated with hemiarthroplasty, the mean Abduction was  $90.0000 \pm 7.0711$ , the mean Forward flexion of patients was  $87.7778 \pm 10.9291$ , 5(55.6%) patients had internal rotation up to levels of L3 and 4(44.0%) patients had IR up to the level of T12. The range of motion was similar to those in the study by Yang Shu-hua et al (16); the mean range of motion observed in their study was  $100^\circ(90^\circ-110^\circ)$  in Abduction,  $95^\circ(80^\circ-100^\circ)$  in forwarding flexion,  $35^\circ(30^\circ-40^\circ)$  external rotation. However, the result is contrary to findings found by Soete P. et al (17), as they found the mean maximum Abduction was  $111^\circ$  (SD,  $47^\circ$ ; range,  $30^\circ-180^\circ$ ), and the mean maximum forward flexion was  $143^\circ$  (SD,  $41^\circ$ ; range,  $45^\circ-180^\circ$ ) in their study.

In patients treated with open reduction and internal fixation with PHILOS plate, the mean abduction of patients was  $116.3043 \pm 15.3902$ , and the mean forward flexion of patients was  $112.3913 \pm 14.8377$ . 11(47.8%) Patients had internal rotation up to L3, 11(47.8%) patients had internal rotation up to T12, and 1(4.3%) had

internal rotation up to T7. Results were comparable to those of the study by Tenor Junior AC et al (18). They found results in their study as follows: mean elevation of the operated limb was 123.9° (80–180°), mean external rotation (ER) was 44.2° (5–80°) and mean internal rotation (IR) was thumb-T9 (T4-L5). The range of motion found was also similar to figures found in the study by Zhang H et al. (19) [found that forward elevation of the shoulder in the LCP group was 110.2 degrees (81 degrees to 130 degrees)].

### Conclusion

To conclude, the surgeon's good surgical skills and experience in the selection are necessary to achieve the correct and best outcome irrespective of the chosen surgical modality. Proper patient selection and thorough knowledge of anatomy and biomechanical principles are the pre-requisites for a successful surgery and good functional outcome.

### Acknowledgments

No Declared

### Conflict of interest

The authors have no conflict of interest in this study.

### Ethical statement

The institutional ethical committee approved the study, and all the patients were included after the consent.

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