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# A Study of Proximal Humerus Fractures Treated with Philos Plate (30 Cases)

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**ABSTRACT**
A study of functional outcome of proximal humerus fracture treated with PHILOS (Proximal Humerus Internal Locking System) Plate. A prospective study was conducted over a period of around 18 months. 30 patient within 4-17 years with long bone fractures of lower limb fulfilling the selection criteria admitted in Department of Orthopaedics at tertiary health care hospital, Surat were operated using Enders Nailing. Proximal humerus fractures occur more commonly in elderly age group. Out of 30 cases, 25 were male and 5 were female. Most common means of injury seen was Fall followed by Road traffic accidents (RTA). Mean duration of union for two part fracture was 12 weeks, for three part fracture was 14 weeks and for four part fracture 15 weeks. Mild pain in activity was seen in (VAS <2 or=2) 27 patients. Discomfort in ordinary activity was seen in (VAS 2-4) 3 patients. Pain limiting routine activity was not found in (VAS 5 or more) any patient. Only 3 cases had minor complications of which one superficial infection, two stiffness. No major complications were noted in any patients. Based on our experience and results, we concluded that the locking compression plate offers both mechanical and biological advantages in treating proximal humeral fractures, particularly in cases of comminuted fractures or osteoporosis bones in elderly patients. This implant facilitates early mobilization, contributing to improved recovery outcomes.

## INTRODUCTION

Proximal humerus fractures account for 4-5% of all fractures, being the third most common in the elderly after hip and distal radius fractures. These injuries are prevalent in older adults due to reduced bone density and in younger individuals due to high-energy trauma (e.g., accidents, assaults). The complexity of these fractures, influenced by multiple muscle attachments and limited implant space, poses treatment challenges, especially in articular fractures with a high risk of humeral head necrosis. Neer"s classification divides these into two-part, three-part, four-part fractures, and those with dislocation, with three-and four-part fractures comprising 13-16% of cases[1-5]. Historically, 80-85% of cases were managed non-surgically with good outcomes, but displaced or comminuted fractures (15-20%) often require surgical fixation (e.g., open reduction and internal fixation) for better alignment and early mobilization[6-8]. Complications like non-union, malunion and a vascular necrosis are risks with conservative management, while surgical delays can complicate reduction. This study, conducted to evaluate and compare surgical techniques using the PHILOS plate[9].

**Aims and Objectives:** This prospective study evaluates the functional outcomes of proximal humerus fractures treated with the PHILOS (Proximal Humeral Internal Locking System) plate[10-12].

**Key Objectives Include:**

- Assessing functional recovery and fracture healing duration.
- Identifying and analyzing treatment-related complications.
- Investigating epidemiological, radiological and surgical factors, comparing two surgical approaches for different fracture types.

The focus is on union rates, complications and rehabilitation insights to enhance understanding of locking plate efficacy[13].

**History and Review of Literature:** Early management of proximal humerus fractures dates to 460 BC with Hippocrates using traction. Progress accelerated in the 20th century with Kocher s (1896) classification, Keen s (1907) open reduction and Codman s (1934) four-part classification. Neer s seminal 1970 studies on 300 cases emphasized surgical intervention for displaced fractures, noting poor outcomes with closed reduction in three-and four-part fractures (e.g., 75% osteonecrosis in four-part cases). Advances in plating (e.g., AO techniques, locking plates) and studies by Gerber, Brunner and others (2004-2012) highlight improved union rates (up to 97%) but persistent complications like screw perforation and impingement[14-16].

**Surgical Anatomy and Approaches:** The proximal humerus includes the humeral head, lesser/greater tuberosities and surgical/anatomical necks, with ossification completing by age 19. The rotator cuff (subscapularis, supraspinatus, infraspinatus, teres minor) and deltoid muscles stabilize the joint, while the arcuate artery (from the anterior humeral circumflex) supplies the head. Nerve injuries (e.g., axillary nerve) are risks during trauma or surgery[17].

**Surgical Approaches:**

**Anterior (Deltopectoral):** Patient supine, incision along the deltopectoral groove (10-15 cm), retracting deltoid and pectoralis major. Used for fracture reduction.

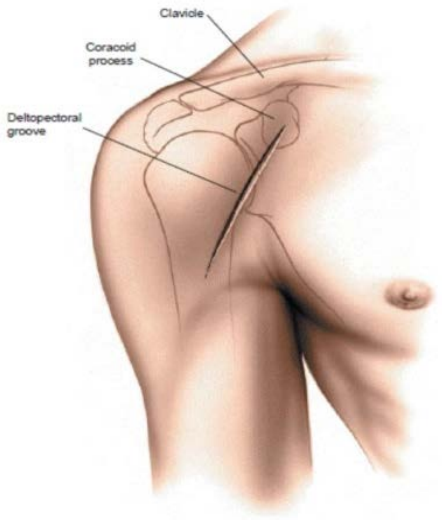


Fig. 1: Anterior (Deltopectoral)

**Minimal Access Lateral:** Supine, 5-6 cm incision below the acromion, splitting deltoid fibers, avoiding axillary nerve.

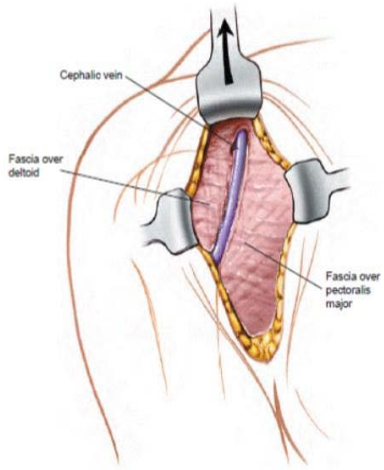


Fig. 2: Minimal Access Lateral

**Posterior:** Lateral position, incision along the scapular spine, dissecting between infraspinatus and teres minor.

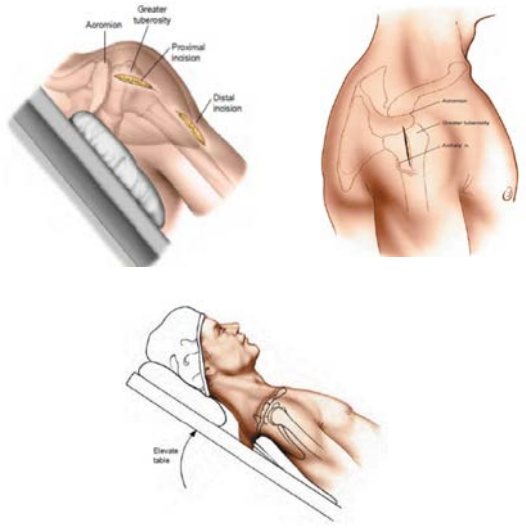


Fig. 3: Posterior

**Internervous Plane:** The Internervous plan lies between the teres minor muscle, which is supplied by the axillary nerve and the infraspinatus muscle, which is supplied by the supra scapular nerve.

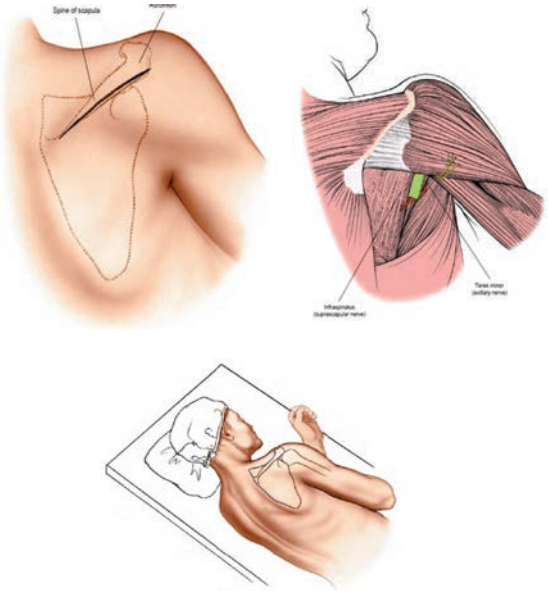

Fig. 4: Internervous Plane

**Relevant Biomechanics and Patho-Mechanics:** The glenohumeral joint s ball-and-socket design allows wide motion but relies on the glenoid labrum, capsule, ligaments (e.g., inferior glenohumeral) and rotator cuff for stability. Patho-mechanically, falls (90% in elderly) or high-energy trauma cause fractures via compression (glenoid impact), bending (surgical neck), or tension (rotator cuff pull). Osteoporosis increases comminution risk. Associated injuries (10% of cases) include distal radius fractures, while vascular (axillary artery) and nerve (axillary, supra scapular) injuries occur in severe cases.

## MATERIALS AND METHODS

**Study Design and Duration:** Conducted from June 2023 to September 2024 at a Tertiary Care Hospital, this observational study included 30 patients (initially 35, with 2 lost to follow-up) with a minimum 6-month follow-up.

**Inclusion Criteria:** Skeletally mature patients with displaced two-, three-, or four-part fractures (Neer s classification), no dislocations and informed consent.

**Exclusion Criteria:** Pathological/open fractures, immature skeletons, neglected fractures, or neurovascular issues.

**Management:**

- **Primary:** ATLS protocol, X-rays/CT scans, immobilization with a shoulder immobilizer.
- **Pre-Operative:** Fitness assessment, edema management, PHILOS plate selection based on X-ray geometry.
- **Surgery:** Beach chair position, anterior approach, plate fixation with K-wires and locking screws, confirmed by fluoroscopy.
- **Post-Operative:** Immobilization, antibiotics (6 days IV, then oral), mobilization exercises, follow-ups every 4 weeks.

Fig. 5: Beach Chair Position

Fig. 6: Draping

Fig. 7: Landmarks

Fig. 8: Incision

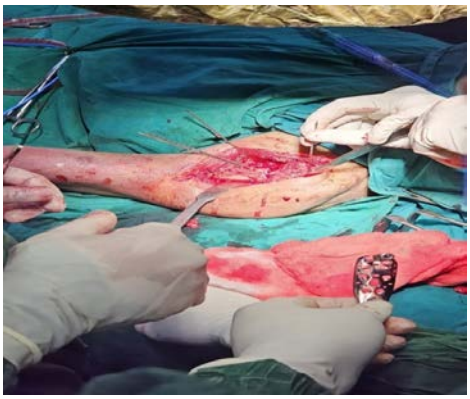

Fig. 9: Primary Reduction

Fig. 10: Provisional Plate Placement

Fig. 11: Suturing

Fig. 12: Final II TV Images

## RESULTS AND DISCUSSIONS

**Demographics:** 30 patients, mean age 39 years, 19 males, 11 females (2:1 ratio), 31-50 years dominant (77%).

**Injury:** Road traffic accidents (46%), falls (54%), right side affected (66%).

**Fracture Types:** Two-part (66%), three-part (20%), four-part (14%).

**Treatment:** 72% operated within 1 week, average hospital stay 10 days.

**Union:** 90% united (mean 12.88 weeks), 10% delayed union, no non-union.

**Complications:** 4% superficial infection, 6% stiffness, 4% implant failure, 17% plate impingement/joint subluxation.

**Range of Motion (at 6 Months):**

- **Flexion:** 30% (150-180°), 50% (120-150°), 14% (90-120°), 6% (<90°).
- **Abduction:** 26% (150-180°), 46% (120-150°), 20% (90-120°), 6% (<90°).
- **Rotation:** 34% external (60-90°), 60% (30-60°); 40% internal (60-90°), 54% (30-60°).

- **Outcomes (Constant-Murley Score):** 26% excellent, 54% fair/good, 20% poor.

**Analysis:**

**(A)Analysis of Time of Union:**

**(I) Time of Union with Fracture Classification:**

- We found grossly that average time to union was more in three-and four-part fractures.

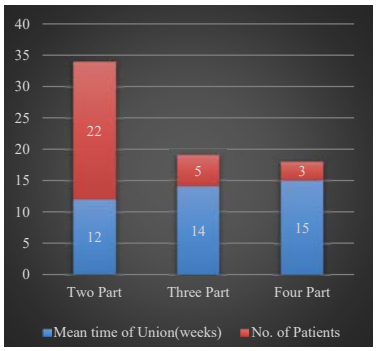


Fig. 13: Fracture Type with Union Time

**(B)Analysis of Range of Motion:**

**(I) Shoulder Range of Motion with Injury Surgery Interval:**

- With reference to the time interval between injury and surgery shoulder Abduction and forward flexion at final follow-up was evaluated.

**Table 1: Interval, Patients and Mean Forward Flexion**

| Interval | Patients | Mean Forward Flexion At final follow-up | Mean Abduction At final follow-up |
|---|---|---|---|
| <1 week | 22 | 140 | 115 |
| >1 week | 8 | 135 | 100 |

**Table 2: Duration of Union**

| Duration of Union | Patients | Mean Forward Flexion At final follow-up | Mean Abduction At final follow-up |
|---|---|---|---|
| <=12 | 18 | 140 | 115 |
| 12 14 | 8 | 135 | 100 |
| >14 | 4 | 137 | 104 |

**(C)Functional Analysis:**

**(I) Pain:**

- Mild pain in activity was seen in (VAS <2 or=2) 27 patients.
- Discomfort in ordinary activity was seen in (VAS >2 to <4 or=4) 3 patients.
- Pain limiting routine activity was not found in (VAS 5 or more) any patient.

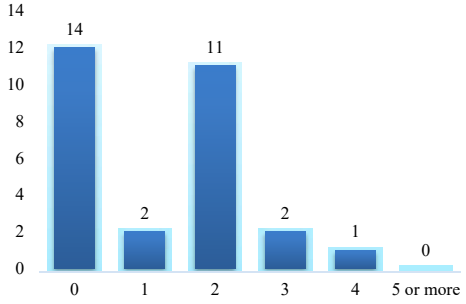


Fig. 14: Pain in Terms of VAS (Visual Analog Scale)

**(II) Recreation:**

- 24(80%) patients had full recreation and were able to perform activities which they were performing before trauma.
- 6(20%) patients had partial recreation., most of cases were of delayed union and non-union.

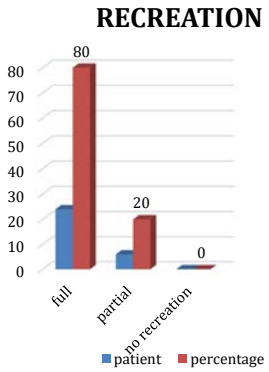


Fig. 15: Recreation

**(D) Analysis of Results:**

- Constant and Murley Shoulder Score was used for assessment of shoulder function.

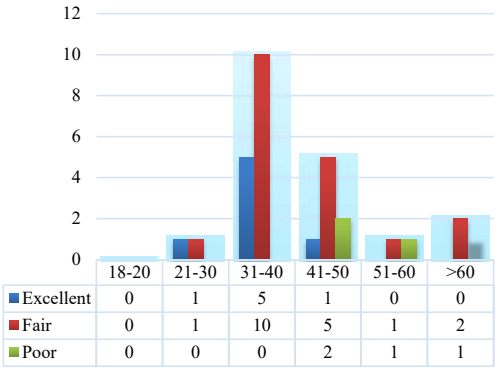


Fig. 16: Age with Results

**(II) Results with Classification:**

- No age group >40 years seems to be immune to fair and poor results.
- Out of 23 patients in age group of 31-50 only 6 showed excellent result.
- Factors other than age seem to influence the fractures more in functional outcome.

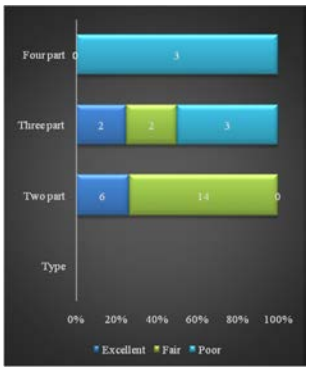


Fig. 17: NEER S Classification of Fracture with Results

**Clinical and Radiological Photographs (Case 1)**:

Fig. 18: Pre-Op X Ray

Fig. 19: Immediate Post Op X Ray

Fig. 20: 6 Month Post Op X Ray

Fig. 21: Forward Flexion

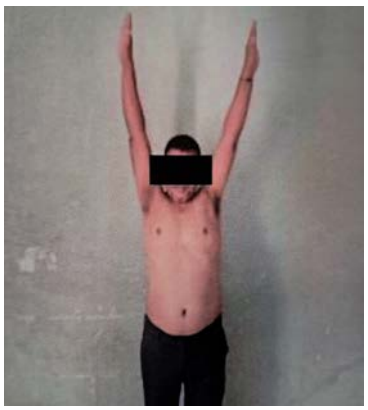

Fig. 22: Abduction

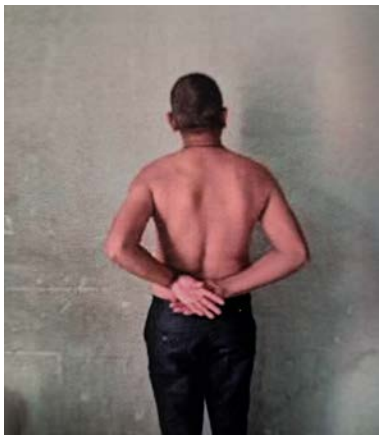

Fig. 23: Internal Rotation

Fig. 24: External Rotation

The incidence of proximal humerus fractures has increased in last few years due to changes in life style and increase in road traffic accidents. The best management in these injuries is still uncertain. Most of the proximal humerus fracture which are un-displaced 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. Many studies have shown that the displaced fracture of the proximal humerus have a poor functional prognosis when left untreated because of severe displacement of fragments[1-5]. However, with

the aim of getting anatomically accurate reductions, rapid healing and early restoration of function, which is a demand of today s life, open reduction and internal fixation, is the preferred modality of treatment[11]. Overall, open reduction and internal fixation, although not in all Institution, have yielded satisfactory results. The best results are obtained if the fracture is well reduced and planned rehabilitation program followed. It must be the goal to select fractures for open reduction and internal fixation which can be anatomically reduced. The present study was conducted to assess the results of two part, three-part and four proximal humeral fracture treated by open reduction internal fixation by locking compression plate[8]. In our study majority of the patients i.e. 23 (76%) were from age Group of 31-50 years followed by 3 patients(10%) in above 60 yrs. The Average age of patient was 49 yrs. Majority of the patient in our group are elderly in our study[19]. Further as with other studies, our study showed a higher incidence of fractures in men than in women. The gender ratio was 5:1. This higher ratio can be explained by a higher involvement of male in day to day activities in compare to female[20]. Major cause of fracture in our study was RTA in 14 cases (46%) and in 16 cases (54%) the mode of injury was fall (domestic/fall from height). In our present study fracture occurred on right side in 20 patients and on left side in 5 patients. Only 5 cases had minor complications of which one superficial infection (cured by dressing and oral antibiotic treatment), two cases of stiffness (cured by physiotherapy), one case of varus malunion and one case of impingement(Implant removed after union). No major complications were noted in any patients[21-23].

The final results are graded according to Constant and Murley s score. We had good to excellent results in 24(80%) of patients treated in our institution. All patients with excellent results and satisfactory results had normal muscle function and functional range of motion. We had unsatisfactory results in 5 patient. 1 patient had plate impingement with restriction of abduction beyond 90°. Plate should be placed 5 mm below the tip of greater tuberosity and lateral to bicipital groove sparing tendon of long head of biceps. Proximal positioning of plate may lead impingement of plate to acromion leading to limitation of abduction beyond 90°. 1 Case developed Varus malunion. Decreasing neck shaft angle <120°. It was probably due to commination of underlying osteoporotic bone which may go impaction at the fracture site after reduction leading to varus malunion. 2 patient had stiffness with restriction of movements and with persistent mild to moderate pain which cured by physiotherapy. 1 patient had superficial infection over stitch line (cured by dressing and oral antibiotic treatment). All fracture united by 3 months on an average of 10 weeks (8-12 weeks). There were no case of failure in our study. In comparison to other study on surgical management of proximal humerus we had similar results.

## CONCLUSION

In the PHILOS system, the threaded screw heads lock into the plate, creating a construct with both angular and axial stability. This design prevents screw toggling (often referred to as the "wind screen wiper effect") and eliminates the risk of screws sliding within the plate holes. Additionally, the divergent or convergent orientation of the screws within the humeral head enhances resistance to pull-out forces and reduces the likelihood of fixation failure. Unlike traditional plating systems, which rely on compression between the plate and the bone for stability, locking plates do not require this mechanism. This feature minimizes the risk of thread stripping in osteoporotic bone, as the screw axis does not load the plate-bone interface. Furthermore, this approach promotes biological fixation by reducing compression on the periosteum and preserving blood supply to the fractured area. Optimal results are achieved when the surgical technique ensures stable fixation, which should be followed by early physiotherapy. The rehabilitation program is a critical factor in determining the functional success of surgical management for proximal humerus fractures. In summary, the locking compression plate offers both mechanical and biological advantages in treating proximal humeral fractures, particularly in cases of comminuted fractures or osteoporotic bones in elderly patients. This implant facilitates early mobilization, contributing to improved recovery outcomes.

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