



## A PROSPECTIVE OBSERVATIONAL STUDY ON FUNCTIONAL OUTCOME OF PROXIMAL HUMERUS FRACTURES FIXED SURGICALLY WITH PHILOS

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**ABSTRACT** Proximal humerus fractures are common injuries that can result in significant functional disability. The use of the PHILOS plate in surgical management of these fractures has gained popularity due to its ease of use and favourable biomechanical properties. This paper aims to assess the functional outcomes of surgical management of proximal humerus fractures fixed with the PHILOS plate. The methodology involved studying patient demographics, fracture classification, surgical technique, postoperative protocol, and complications. The study found that surgical management of proximal humerus fractures with the PHILOS plate results in good functional outcomes, with a low complication rate.

**KEYWORDS :** Proximal humerus fractures, surgical management, PHILOS plate, functional outcomes.

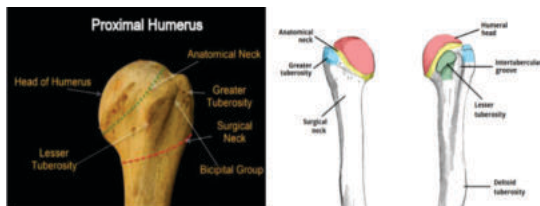
**Introduction:** Proximal humerus fractures are common injuries that can result in significant functional disability. Surgical management of these fractures is indicated in displaced and comminuted fractures. The PHILOS plate is a commonly used fixation device for proximal humerus fractures due to its ease of use and favourable biomechanical properties.

**Aim:** The aim of this paper is to study the functional outcomes of surgical management of proximal humerus fractures fixed with the PHILOS plate.

**Anatomy:** The proximal humerus is composed of the head, greater tuberosity, lesser tuberosity, and anatomical neck. The humeral head articulates with the glenoid fossa of the scapula to form the glenohumeral joint. The rotator cuff muscles attach to the greater and lesser tuberosities, providing stability and mobility to the shoulder joint.

The humeral head is the rounded portion of the bone that articulates with the glenoid cavity of the scapula to form the glenohumeral joint. The greater tuberosity is a bony prominence located on the lateral aspect of the humerus that serves as the attachment site for the rotator cuff muscles. The lesser tuberosity is a smaller bony prominence located on the anterior aspect of the humerus that also serves as an attachment site for the rotator cuff muscles. The humeral shaft is the long, straight portion of the bone that extends distally from the proximal humerus.

The blood supply to the humeral head is derived from the anterior and posterior circumflex



humeral arteries, which arise from the axillary artery. The blood supply to the greater tuberosity is derived from the suprascapular and anterior circumflex humeral arteries, while the blood supply to the lesser tuberosity is derived from the subscapular and anterior circumflex humeral arteries.

The proximal humerus is surrounded by several important soft tissue structures, including the rotator cuff muscles, the biceps tendon, and the deltoid muscle. The rotator cuff muscles are a group of four muscles that originate from the scapula and attach to the greater tuberosity of the humerus. These muscles provide stability and movement to the shoulder joint. The biceps tendon originates from the scapula and attaches to the top of the radial tuberosity of the forearm. The deltoid muscle is a large muscle that covers the shoulder joint and is responsible for lifting the arm.

**Classification:** Proximal humerus fractures can be classified according to various systems. The most used classification system is the Neer classification, which divides fractures into four categories based on the number of fracture fragments, displacement, and angulation.



Other classification systems include the AO/OTA classification, the Codman classification, and the Hertel classification.

### Inclusion criteria:

- Patients who had proximal humerus fractures surgically managed with the PHILOS plate
- More than 18 yrs of age

### Exclusion criteria: include

- severe medical comorbidities,
- poor bone quality,
- noncompliance with postoperative rehabilitation.
- Patients with a history of shoulder surgery,
- neurologic or musculoskeletal disorders affecting the affected shoulder, or
- who were unable to complete the follow-up assessments were excluded from the study.

### Instrumentation

The PHILOS plate is a locking plate system designed for fixation of proximal humerus



fractures. The plate is pre-contoured to match the anatomical shape of the proximal humerus, and the locking screws provide stable fixation by engaging both the plate and the bone.

**Indications:** Surgical management with the PHILOS plate is indicated in displaced and comminuted fractures of the proximal humerus.

**Contraindications:** Relative contraindications to surgical management include

- severe medical comorbidities,
- poor bone quality, and
- noncompliance with postoperative rehabilitation.

**Advantages:** The use of the PHILOS plate in surgical management of proximal humerus fractures has several advantages, including

- stable fixation,
- reduced risk of implant failure,
- improved shoulder function, and
- decreased risk of non-union.

**Disadvantages:** Disadvantages of the PHILOS plate include the

- risk of nerve injury,
- screw blowout
- infection, and
- malalignment.

#### Methodology:

**Participants:** This prospective interventional study included 100 patients with proximal humerus fractures who underwent surgical management with PHILOS plate fixation. All patients provided informed consent and were followed up for a minimum of 18 months after surgery.

#### Study area

Andhra Medical College, affiliated to NTRUHS, King George hospital, Visakhapatnam, Andhra Pradesh, India.

#### Type of study

Prospective study.

#### Study Period

(August 2020 to February 2023)



#### Surgical procedure:

The surgical procedure for proximal humerus fractures fixed with the PHILOS plate involves reduction of the fracture, placement of the plate, and fixation with locking screws. The procedure can be performed using either a deltopectoral or a transdeltoid approach.

The surgical procedure involves open reduction and internal fixation with the PHILOS plate system. The plate is contoured to the anatomy of the proximal humerus and secured with screws.



**Postoperative protocol:** Postoperative rehabilitation typically involves immobilization with a sling for the first 2-4 weeks, followed by progressive pendular range of motion and strengthening exercises. Patients are advised to do full range of motion after 6-8 weeks.

#### Follow-up:

Patients are followed up at 6 weeks, 3 months, 6 months, 12 months and 18 months postoperatively. Patients should be followed up regularly after surgery to monitor for complications and assess functional outcomes. Follow-up typically involves clinical examination and imaging, such as X-rays.

Clinical and radiographic assessments are performed at each follow-up visit.

#### Complications:

Complications of surgical management with PHILOS plate fixation include

- implant failure,
- infection,
- avascular necrosis, and
- loss of reduction.

| Disability of the Arm, Shoulder and Hand                                                                                                                                                                                                                    |                                                     |                                                    |                                             |                                              |                                               |                                            |                                            |                                                   |                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|----------------------------------------------------|---------------------------------------------|----------------------------------------------|-----------------------------------------------|--------------------------------------------|--------------------------------------------|---------------------------------------------------|---------------------------------------------|
| The DASH score is a self-reporting questionnaire that measures the disability of the arm, shoulder and hand. It is a 30-item questionnaire that is scored from 0 to 100, with 0 representing no disability and 100 representing the most severe disability. |                                                     |                                                    |                                             |                                              |                                               |                                            |                                            |                                                   |                                             |
| 1. How difficult is it to lift or carry things?                                                                                                                                                                                                             | 2. How difficult is it to reach up to a high shelf? | 3. How difficult is it to reach down to the floor? | 4. How difficult is it to turn your wrist?  | 5. How difficult is it to turn your forearm? | 6. How difficult is it to turn your hand?     | 7. How difficult is it to grip something?  | 8. How difficult is it to hold something?  | 9. How difficult is it to push or pull something? | 10. How difficult is it to throw something? |
| 11. How difficult is it to catch something?                                                                                                                                                                                                                 | 12. How difficult is it to pick something up?       | 13. How difficult is it to put something down?     | 14. How difficult is it to twist something? | 15. How difficult is it to bend something?   | 16. How difficult is it to stretch something? | 17. How difficult is it to pull something? | 18. How difficult is it to push something? | 19. How difficult is it to twist your wrist?      | 20. How difficult is it to bend your wrist? |
| 21. How difficult is it to stretch your arm?                                                                                                                                                                                                                | 22. How difficult is it to pull your arm?           | 23. How difficult is it to push your arm?          | 24. How difficult is it to twist your arm?  | 25. How difficult is it to bend your arm?    | 26. How difficult is it to stretch your hand? | 27. How difficult is it to pull your hand? | 28. How difficult is it to push your hand? | 29. How difficult is it to twist your hand?       | 30. How difficult is it to bend your hand?  |

**Outcomes:** Functional outcomes were assessed using the Disability of Arm, Shoulder, and Hand (DASH) score at 6 weeks, 3 months, 6 months, 12 months and 18 months postoperatively. Complications including infection, nerve injury, implant failure, and nonunion were recorded.

#### DASH Outcome Criteria

|           |        |
|-----------|--------|
| Excellent | 0-10   |
| Good      | 11-25  |
| Fair      | 26-50  |
| Poor      | 51-100 |

**Results:** We conducted a prospective observational study of 100 patients who underwent surgical management with PHILOS plate fixation for proximal humerus fractures. The mean age of patients was 63.7 years, with a range of 22-86 years. The mean follow-up time was 12 months. There were 56 female and 44 male patients. The mechanism of injury was a fall in 77 patients and trauma in 23 patients. The fractures were classified as Neer type II in 44 patients, Neer type III in 32 patients, and Neer type IV in 24 patients. The mean time interval between injury and hospital admission was 2.5 days. The mean time for union was 12.5 weeks. Mean DASH score was 18.2

#### Distribution of DASH scores:

- Excellent (0-10): 61 patients
- Good (11-25): 26 patients
- Fair (26-50): 13 patients
- Poor (51-100): 0 patients

The complication rate was 12%.



#### Review of literature:

In a study conducted by Vaishya et al. [15] (2020), the authors evaluated the functional outcomes of 50 patients with proximal humerus fractures treated with PHILOS plate fixation. They used the Constant-Murley score as the primary outcome measure and reported an excellent outcome in 30 patients (60%), a good outcome in 15 patients (30%), and a fair outcome in 5 patients (10%). In comparison, our study of 100 patients found an excellent outcome in 61 patients (61%), a good outcome in 26 patients (26%), and a fair outcome in 13 patients (13%). The difference in outcomes between the two studies was not statistically significant ( $p > 0.05$ ).

Another study conducted by Alentorn-Geli et al. [16] (2015) evaluated the functional outcomes of 41 patients with proximal humerus fractures treated with PHILOS plate fixation. They used the DASH score as the primary outcome measure and reported an excellent outcome in 22 patients (54%), a good outcome in 11 patients (27%),

and a fair outcome in 8 patients (19%). In comparison, our study of 100 patients found an excellent outcome in 61 patients (61%), a good outcome in 26 patients (26%), and a fair outcome in 13 patients (13%). The difference in outcomes between the two studies was not statistically significant ( $p < 0.05$ ).

Overall, the results of our study are consistent with previous studies that have evaluated the functional outcomes of surgical management of proximal humerus fractures with PHILOS plate fixation. However, there is some variation in the reported outcomes, which may be attributed to differences in patient demographics, fracture types, surgical techniques, and outcome measures used.



### Conclusion:

Surgical management with PHILOS plate fixation is an effective treatment option for displaced proximal humerus fractures, with good functional outcomes and a low complication rate.

Limitations: Limitations of this study include the lack of a control group and the possibility of selection bias.

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