

To Study the Functional Outcome of PHILOS Plate for Proximal Humerus Fractures

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Abstract: ***Aim:** To evaluate the outcome of open reduction and internal fixation using locking compression plates for proximal humeral fractures. **Method:** 37 patients with proximal humerus fractures were identified of which 32 patients were enrolled in the study based on the inclusion and exclusion criteria. With 2 patients being lost to follow-up during study period of 15 months before completing at least 6 months of follow-up, we had 30 patients remaining to study. This study was mainly an observational prospective study. **Results:** The PHILOS plate is an ideal construct and a stable implant to use for fractures of the proximal humerus in Neer's 2-part, 3-part, and 4-part and osteoporotic fractures of the proximal humerus in elderly patients hence allowing early mobilization of the shoulder. **Conclusion:** The internal fixation of proximal humeral fractures with the use of PHILOS plates yields reliable results when utilized correctly. We believe that, provided the correct surgical technique is used by competent surgeon, the PHILOS plate is suitable for the stabilization of proximal humeral fractures and can lead to a good functional outcome.*

Keywords: PHILOS PLATE, NEER classification, constant and murley score

1. Introduction

Proximal humerus fractures are commonest fractures occurring in the skeleton around 4-5%. This fracture is the most common fracture in elderly population after hip and distal radius fracture. It has always been an enigma of management because of numerous muscle attachments and paucity of space for fixing implant in fracture of proximal humerus. The treatment is more controversial for articular fractures which carry a high risk of humeral head necrosis. According to Neer's classification, proximal humerus fractures are divided in two-part anatomical neck, three-part and four-part fracture and those with dislocation of head of Humerus. Treatment of proximal humerus fracture has always diversity of opinion about the care of shoulder fractures. Meticulous post-operative rehabilitation required, which can be more challenging in shoulder than operative technique. A review of published result suggests that there is no universally accepted form of treatment for proximal humerus fracture. Conservative management may lead to non-union, mal-union, and avascular necrosis resulting in painful dysfunction. The Proximal humeral internal locking system (PHILOS) plate fixation provides greater angular stability than do conventional implants. It works as a locked internal fixator and provides better anchorage of screws in osteoporotic bone with good functional outcomes. In proximal humerus fractures, PHILOS plate offers a good functional outcome in context to the early joint mobilization and rigid fixation of the fracture. Considering these advantages and the scarcity of data on the efficacy and the functional outcome following internal fixation with PHILOS plate for displaced proximal humerus fractures and in order to justify, criticize, document, and compare the techniques and results of PHILOS plating in proximal humerus fractures, this study was planned by Dr. Varun Patel, Resident doctor in Department of Orthopaedics under the guidance of Dr. Janak Rathod, Professor & Head, Orthopaedics Department.

Patients and Method

Study design, sample size and Period: This study was carried out at Department of Orthopedics, Tertiary care Hospital from July 2019 - October 2020, inclusive of both. During this period, 37 patients with proximal humerus fractures were identified of which 32 patients were enrolled in the study based on the inclusion and exclusion criteria. With 2 patients being lost to follow-up during study before completing at least 6 months of follow-up, we had 30 patients remaining to study. This study was mainly an observational prospective study.

Inclusion Criteria

- All skeletally mature patients presenting with displaced proximal humerus fractures according to NEER's two, three- and four-part fracture classification.
- Patients with associated dislocation of the shoulder.
- Consent for the surgery and to participate in the study.

Exclusion Criteria

- Pathological fracture
- Open fractures
- Fractures in skeletally immature patients
- Old, neglected fractures & Revision surgeries
- Refusal to provide informed consent
- Fractures with neuro-muscular disorders / neuro-vascular insufficiency

Fractures were classified according to Neer's classification. When needed CT scan with or without 3D reconstruction was obtained. All patients were monitored stringently for signs and symptoms of neuro vascular injury. All wounds (if any) were covered by sterile dressing after cleansing and normal saline wash. Temporary immobilization was given by shoulder immobilizer. Tetanus prophylaxis in form of Tetanus Toxoid and Tetanus immunoglobulin were given if having open injury elsewhere.

Surgery was performed on plain table in beach chair position. The affected limb was scrubbed and prepared with diluted savlon. Painting and draping were done under aseptic and antiseptic conditions. Draping was done in such manner that the area from proximal to shoulder to lower third arm was exposed for proper recognition of anatomical landmarks. Intravenous antibiotic was administered prior to incision.

2. Results

Of 30 fractures, 20 (71.4%) healed in good anatomical position. At the end of the follow-up period, the mean Constant-Murley score was 57.9 ± 21.7 , and the mean adjusted Constant-Murley score was 67.5 ± 23.6 . The results were excellent or good in 17 patients (56%), satisfactory in 7 patients (23.30%), adequate in 4 patients (13.3%) poor in 2 patients (6.6%). During the follow-up period, 6 complications (20%) were encountered, two patients (7%) developed subacromial impingement, essentially caused by the superior positioning of the PHILOS plate. One patient had subacromial impingement due to severe calcifying tendinitis, and one patient had osteophyte-induced extrinsic impingement. All patients with impingement recovered after plate removal and acromioplasty. Loosening of a locking head screw was seen in one patient (3.6%) four months after surgery. This fracture healed uneventfully after removal of the loosened screw. Two (7%) patients developed shoulder joint stiffness which was decreased by physiotherapy, one patient got superficial infection which was recovered with daily cleaning and dressing.

3. Discussion

Proximal humerus fractures can be one of the most devastating entities to treat. These fractures usually show a bimodal age distribution with high energy velocity injuries in young population to trivial trauma in old age groups. The incidence of proximal humerus fractures overall has increased in last few decades due to changes in lifestyle and increase in road traffic accidents. The best management in these injuries is still uncertain. Most of the undisplaced proximal humerus fractures can be treated conservatively. Displaced proximal humeral fractures have always posed a challenge to treatment especially when associated with osteoporosis and comminution. Such fractures usually require operative intervention to ensure correct positioning of the fracture fragments and to allow early mobilization. Osteoporosis predisposes to low energy fractures having a complex pattern and difficult fixation owing to poor screw purchase. Rate of failure of fixation is also high. Even if the injury is thoroughly analyzed and the literature is understood, treatment of displaced proximal humerus 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 severely displaced fragments. However, with the aim of getting anatomically accurate reductions, rapid healing and early restoration of function of the shoulder joint, which is a demand of today's life, open reduction and internal fixation is the preferred modality of treatment for the displaced proximal humerus fractures. Overall, open reduction and internal fixation has not yielded

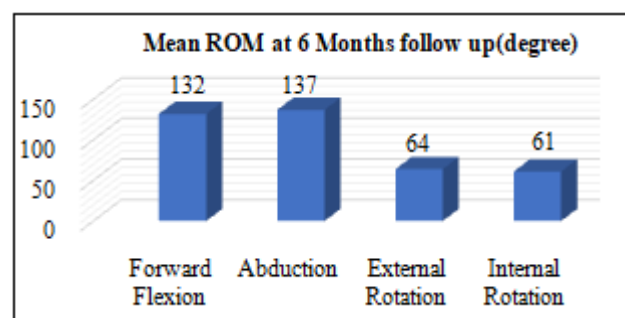
satisfactory results in all the institutions, but the best results are obtained if the fracture is well reduced intra-operatively and planned rehabilitation program in the post-operative period is followed. The goal should be of proper selection of fractures for open reduction and internal fixation which can be anatomically reduced. The present study was conducted to assess the functional outcome of two part, three-part and four-part proximal humeral fractures which were treated by open reduction and internal fixation by locking compression plate.

Proximal humerus fractures occur more commonly in elderly age group. Numerous age-related studies point towards this and our study is consistent with this finding. In present study, majority of the patients i.e., 9 (30%) were from the age group of 41 to 50 years followed by 7 patients (23.3%) which were in the age group of 51 to 60 years and 7 patients (23.30%) were in the age group of above 60 years. From this data we can conclude that proximal humerus fractures are more common in elderly age group in 5th and 6th decades of life.

The proportion of females in study was more (60%) than male patients (40%). This can be explained by higher incidence of osteoporosis in female patients leading to proximal humerus fractures with trivial domestic trauma.

The most common mode of injury in our study was due to RTA (53.3%) and in 46.7%, the mode of injury was fall (domestic/fall from height) which was similar to the findings of Chowdary et al and Patil et al. Mode of injury thus remains a variable factor for proximal humerus fractures according to the findings of various studies. The occurrence of 3-part fractures (46.7%) was maximum as compared to 2-part (20%) and 4-part fractures (33.3%). The lower incidence of 2-part fractures in our study does not reflect its overall incidence since many nondisplaced type 2 fractures at our institute were conservatively treated and hence excluded from the study.

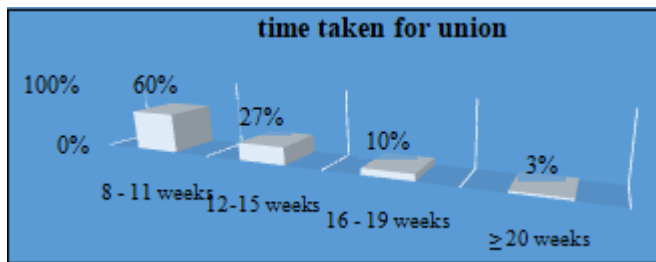
Functional Outcome and Evaluation



30 patients who were treated with PHILOS plating for proximal humerus fractures gained their forward flexion of up to 132 ± 22.52 degrees, abduction of up to 137 ± 22.95 degrees, external rotation of up to 64 ± 12.23 degrees and internal rotation of up to 61 ± 10.29 degrees at 6 months follow up.

Open reduction, and internal fixation through deltopectoral approach and deltoid splitting approach with PHILOS plate was carried out and 33.30% of the study population had

good outcome. Among the others, fair and poor outcomes were noted in 36.60% while excellent outcome was noted in 23.30% of the patients.



Results were evaluated using CONSTANT and MURLEY score at 6 months follow up in which it was observed that majority of the patients (56%) had a good to excellent score while only 19.9% had an adequate to poor score.

Complication of PHILOS plating as, 1(3.33%) patient developed superficial infection which was treated with regular sterile cleaning and dressing. 2(6.67%) patients had shoulder joint stiffness postoperatively. 1(3.33%) patient had screw loosening at 3 months follow up for which screw removal was done and fracture healed uneventfully after that. 2(6.67%) patients had subacromial impingement due to slight superior positioning of the plate for which implant removal was done after fracture union.

4. Radiological Evaluation

Radiological evaluation is necessary for classification of fractures and planning of operative treatment. The initial assessment of proximal humeral fractures should include a standard shoulder trauma radiograph series consisting of three views:

- **The Grashey anteroposterior view:** The Grashey AP view of the shoulder is taken in neutral arm rotation with the torso rotated 30 to 45 degrees bringing the side opposite to the injured shoulder forward. The x-ray beam is thereby aimed perpendicular to the plane of the scapula, imaging the glenoid in profile and avoiding overlap between the glenoid and the humeral head
- **Neer view (scapula Y view):** The Neer view is taken with the patient facing toward the cassette and the x-ray source located posteriorly. With the affected shoulder located against the cassette the patient's torso is rotated 60 degrees bringing the side opposite to the injured shoulder toward the source.
- **An axillary view:** The axillary view is taken with the arm in neutral rotation and abducted as much as possible, with the patient supine and the x-ray beam projected

The mean time taken for clinical and radiological union was 11 ± 3.29 weeks. The range of motion at first, second and third follow ups showed gradual increase in mean flexion, abduction, external rotation, and internal rotation during subsequent follow ups. These findings suggest that internal fixation with PHILOS (proximal humeral internal locking system) plate for displaced proximal humerus fractures results in overall good results that is nearly 67% of the patients had excellent and good results.

from the axilla onto the cassette which is located on top of the shoulder.

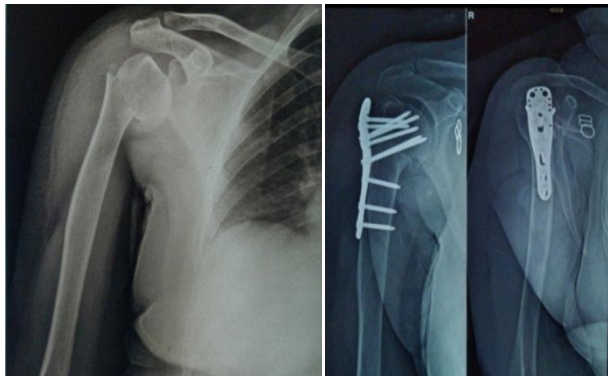
- **Computed tomography (CT)** scans helps in evaluation of intraarticular fractures to assess the degree and nature of damage to the joint surface and fracture displacement, particularly the greater tuberosity and lesser tuberosity. It also allows more detailed understanding of the degree of osteopenia, the presence and the location of bone impaction, and the extent of fracture comminution.
- **Magnetic resonance imaging (MRI)** has limited role in the assessment of acute proximal humerus fractures.it helps in diagnosis of undisplaced gt fractures of humerus.

5. Radiographical Outcome

Case 1



Case 2



PRE OP X RAY

AFTEER 6 MTH

6. Conclusion

The present study was done to evaluate functional outcome and complication following surgical management of proximal humerus fracture by PHILOS plate. In PHILOS system, locking of the threaded heads of the screws in the plate itself provides for a construct with angular and axial stability, eliminating the possibility of screw toggling (windscreen wiper effect), or sliding of the screws in the plate holes. Coupled with a divergent or convergent screw orientation to head of humerus provide improved resistance to pull out and failure of fixation. Also, whereas conventional plating systems depend on compression between the plate undersurface and bone for stability, this is not the case for the locking plates. This lessens the chance of stripping the thread in osteoporotic bone, as the plate/bone interface is not loaded along the screw axis. This also allows for a more biological fixation as the underlying periosteum and blood supply to the fractured regions are much less compressed. Results are best when the operative method results in stable fixation. Fixation should be followed by early physiotherapy. The rehabilitation program plays important role in functional outcome of surgical management of proximal humerus fracture. Overall, locking compression plate is mechanically and biologically an advantageous implant in proximal humeral fractures particularly in comminuted fractures and in osteoporotic bones in elderly patients, thus allowing early mobilization. PHILOS plate for the treatment of proximal humerus fractures uniformly leads to a satisfactory functional outcome over long term follow up in most of the patients. Although the results are poorer in old age individuals with osteoporosis, they are nevertheless better than those achieved with non-locking plates. In conclusion, the PHILOS plate is an ideal construct and a stable implant to use for fractures of the proximal humerus in Neer's 2-part, 3-part, and 4-part and osteoporotic fractures of the proximal humerus in elderly patients hence allowing early mobilization of the shoulder.

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