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PROXIMAL HUMERUS FRACTURES FIXED WITH PHILOS PLATE AND ITS FUNCTIONAL OUTCOME

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ABSTRACT **BACKGROUND:** Proximal humeral fractures account for almost 7% of all fractures and make up 80% of all humeral fractures. Open reduction and internal fixation (ORIF) of proximal humerus fractures with conventional plates has been associated with loss of reduction, screw loosening, and osteonecrosis. The proximal humeral internal locked system plate (PHILOS plate) is a device intended to avoid such complications. The objective of this prospective clinical study was to assess the functional outcome and the complications in proximal humeral fractures operated with proximal humerus locking plates using Neer's shoulder score. **MATERIALS AND METHODS:** This prospective study was based on a series of 34 patients who were operated on from July 2019 to May 2021 for proximal humerus fracture using the PHILOS plating system and all the patients were clinically assessed for pain, function and range of movements **RESULTS:** As per the Neer's scoring system, 11 cases had excellent results, 15 had satisfactory, 6 had unsatisfactory while 2 cases had poor outcome. There was one case of varus collapse, two cases had screw back out and three cases of superficial infection. **CONCLUSION:** PHILOS Plate gives superior results compared to other treatment options. Achieving anatomical reduction and avoiding varus malreduction with proper placement of the plate in relation to shoulder joint is the key for a favourable functional outcome.

KEYWORDS : Humerus, shoulder fractures, fracture fixation, internal fixators, orthopedic surgery

INTRODUCTION:

It is the commonest fracture affecting the shoulder girdle in adults and its incidence is rising[1]. Proximal humeral fractures account for almost 7% of all fractures and make up 80% of all humeral fractures. In patients above the age of 65 years proximal humeral fractures are the second most frequent upper extremity fracture, and the third most common non-vertebral osteoporotic fracture after proximal femur and distal radius fractures[2,3,4].

In the adult population, proximal humeral fractures have a unimodal distribution[5]. Majority of un-displaced proximal humeral fractures can be treated with a sling immobilization and physical therapy[6]. However, approximately 20% of displaced proximal humeral fractures require surgery[7]. Conservative Management most of the time is associated with non-union, malunion and avascular necrosis leading to a painful dysfunction of shoulder[8].

Many different techniques have been described for the fixation of these fractures and they include bone sutures, tension band, cerclage wires, K-wires, T-plates, intramedullary (IM) devices, prosthetic replacements, double tubular plates, the Plan Tan Humerus Fixator Plate (Plan Tan Medizintechnik GmbH, Lambrechtshagen, Germany), and the Polarus nail (Acumed, Inc., Beaverton, OR)[9-14]. However Open reduction and internal fixation (ORIF) of proximal humerus fractures with conventional plates has been associated with loss of reduction, screw loosening, and osteonecrosis[15-19].

The proximal humerus internal locking system plate (PHILOS plate) is a device intended to avoid the complications related to the fixation of proximal humerus fractures.

The objective of this study was to assess the functional outcome and the complications in proximal humeral fractures operated with proximal humerus locking plates using Neer's shoulder score.

MATERIALS AND METHODS:

This prospective study was based on a series of 34 patients who were operated on from July 2019 to May 2021 for proximal humerus fracture using the PHILOS plating system. The inclusion criteria into the study were: (1) closed proximal humerus fractures (or fracture dislocations) that were two-part, three-part, or four-part according to the Neer classification system[20]; (2) failed conservative treatment (unsatisfactory position); (3) fracture less than 3 weeks old; and (4) age older than 18 years. Exclusion criteria included: (1) fractures more than 3 weeks old; (2) pathologic fractures and refractures; (3) open fractures; or (4) concomitant fractures of the ipsilateral elbow or distal radius; and (5) patients with polytrauma with an Injury Severity Score greater than 16; and (6) patients with posttraumatic brachial plexus injury or peripheral nerve palsy were excluded. All 34 patients had their fractures fixed within 3 weeks of the injury and they were all available for follow-up. The mean follow-up time was 12.3 months

Plain radiographs (anteroposterior [AP], lateral, and axillary views) were obtained preoperatively and the classification of the fractures was confirmed intraoperatively. Eleven patients had four-part proximal humerus fractures, fifteen patients had three-part proximal humerus fractures, and eight patients had two-part proximal humerus fractures at the level of the surgical neck (**Table 1**).

SURGICAL TECHNIQUE:

General anaesthesia or regional block or combined anaesthesia was used and a beach chair position was given to all the patients. One dose of third generation cephalosporin (Ceftriaxone 1g) were given perioperatively. A deltopectoral approach was used for all patients and the necessary surgical steps were followed. An 8 cm to 10 cm incision starting from coracoid process was taken and was extended along the line of deltopectoral groove. The internervous plane was identified between deltoid and the pectoralis major muscle and separated. The cephalic vein was retracted either laterally or medially depending upon the exposure and the need. The subscapularis muscle was made taut with external rotation and incised in line with its fibres. The fracture fragments were identified and the haematoma was cleared off. Tag sutures were taken through the rotator cuff muscles for later repair.

Preliminary reduction was done with the help of K wires and checked in both the AP and Lateral views with fluoroscopy on table. PHILOS plate was applied about 5-8 mm distal to the greater tuberosity and around 2-4 mm posterior to the bicipital groove. The plate was first fixed to the distal fragment and then screws were inserted in the head as per the woodpecker technique. Final reduction was checked in both the orthogonal views. The tagged rotator cuff sutures were passed through the holes in the plate and sutured. Wound was thoroughly irrigated and was closed in layers with drain in place. All the patients were kept in arm pouch postoperatively. Mobilization was started from postoperatively following 48 hours.

All the patients were assessed at a regular interval of three, six and twelve months. Clinical assessment was done in the form of pain, function and range of movements. Antero-posterior and axial radiographs were performed for all the patients at each follow up to assess position of plate and progress of fracture healing.

RESULTS:

The average age of the patient was 57.3±4.8 years. A total of 24 (70.59%) cases were males and 10 (29.41%) were females in the study, of which 27 (79.41) cases had right sided involvement while 7 (20.59%) cases had left side involvement. 19 cases (55.88%) had road

traffic accident while 15 (44.12%) cases had a slip and fall resulting in fracture (Table 2). All the fractures were classified as per the Neer's classification system which showed that there were (Eleven patients had four-part proximal humerus fractures, fifteen patients had three-part proximal humerus fractures, and eight patients had two-part proximal humerus fractures at the level of the surgical neck (Table 1)

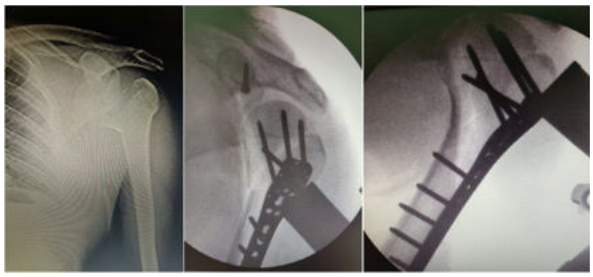

Figure 1: Pre-operative AP Radiograph showing Neer's 3-part fracture of right proximal humerus and Intra-operative Fluoroscopy images showing optimal fixation of fracture with PHILOS plate and screws.

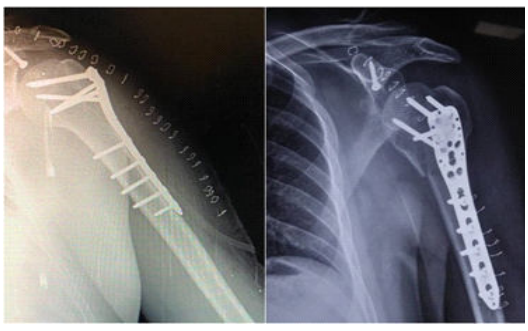

Figure 2: 6 weeks follow-up AP and Lateral radiograph of the same patient with stable fixation and reduction of fracture showing early signs of healing.

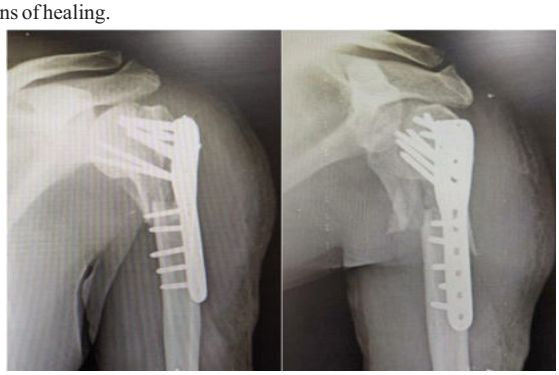

Figure 3: Severely comminuted Neer's 4-part fracture with varus malreduction. However, fracture healed without complications

Figure 4: Post operative day 4 of surgical site showing superficial infection, inflammation and induration

The average surgical duration was 85±8.2 minutes. Radiological union was seen at 14±3.2 weeks. There was one (02.94%) case of varus collapse (Figure 3) with unsatisfactory results. Union was however achieved in this patient. And the patient had limited range of movements at the terminal follow up. Two (05.88%) cases had screw back out which was later revised with long PHILOS Plate and screws resulting in a favourable outcome. The reason for the backout could be a severe comminution of fracture and osteoporosis in elderly patients. No patient had shoulder impingement.

There were three (8.82%) cases of superficial infection (Figure 4) which responded well to parenteral antibiotics. There were no incidents of avascular necrosis observed in the present study. As per the Neer's scoring system, 11 (32.35%) cases had excellent results, 15 (44.12%) had satisfactory, 6 (17.65%) had unsatisfactory while 2 (05.88%) cases had poor outcome (Table 2).

Table 1: Details of fracture pattern and gender distribution

Neer's Type	Patient	Males	Females	Side	
				Right	Left
Four part	11	7	4	5	1
Three part	15	11	4	14	4
Two part	8	6	2	6	2
One part	0	0	0	2	1
Total	34	24	10	27	7

Table 2: Patient profile in the present study

VARIABLE	VALUE			
Mean Age	57.3±4.8 years			
Mean Follow-up time	12. Months			
Mode of Injury	RTA*	Slip and fall		
	19	15		
Mean Surgical Duration	85±8.2 minutes			
Mean time for Radiological Union	14±3.2 weeks			
Outcome (Based on Neer's Scoring System)	Excellent	Satisfactory	Unsatisfactory	Poor
	11	15	6	2
Complications	Varus Collapse	Screw Backout	Superficial Infection	
	1	2	3	

*RTA = Road Traffic Accidents

DISCUSSION:

Operative treatment of comminuted and displaced fractures with superadded osteoporotic bone quality is a challenging and complicated problem. Various techniques have been tried for the fixation of these fractures9-14. These techniques had wide variety of complications such as failed union, screw cut out or back out, failure to unite, avascular necrosis etc15-19. PHILOS plate has got an internal locking system such that all the forces are transmitted from bone via the locking head screws to the blade and vice versa, which in turn provides torsional stability and stiffness to the construct there by improving the outcome22. This study was carried out to evaluate the functional outcome following PHILOS Plating and its complications during follow-up.

Internal fixation with non-locking plates has resulted in poor clinical outcomes and high failure rates in the past. Fixed angle anatomical locking compression plates are more versatile with higher rates of union23,24. These plates also provide more stable buttress laterally and with its diverging screws in to the cancellous bone, makes them a better implant for complicated fractures. Here the forces are transmitted from the bone to the screw head and then to the plate, thereby providing better stability compared to non-locking plate. A cadaveric study has also suggested that locking plates have better torsional stability when compared to non-locking plates22.

The complications that have been frequently associated with PHILOS are plate breakage, screw cut out, avascular necrosis, varus mal-reduction and revision surgery25. Owsley et al states that the reason for revision surgery was mostly because of screw cut-out. In present study the screw cut-out rate was 5.88% and was majorly due to elderly osteoporotic bone26. Hertel R et al., has concluded that anatomical neck fracture, shorter calcar and disruption of the posteromedial hinge when present together has a positive predictive value for ischaemia of 97%27. Avascular necrosis is a delayed complication which occurs usually in severe comminuted three- and four-part fractures15,28. In

the present study there was no occurrence of AVN which might be attributed to the shorter follow-up period.

In the present study varus mal-reduction has occurred in one of the cases 02.94% and is one of the dreaded complications expected, which will ultimately result in early failure. Anatomical reduction is the key for a successful union.

Plate placement has an important role in development impingements post operatively. According to AO-OTA the upper extend of plate should be 6-8mm below the level of greater tuberosity. Literature suggests 01.8-08.0% occurrence of impingement postoperatively24,29. However, in the present study no cases of impingement were found.

Radiological union time was found to be 14±3.2 weeks which is comparable to previous studies30. Final results were compared with Neer's study by Neer's scoring system and was found to be statistically significant ($p<0.05$)

LIMITATIONS:

The number of patients studied is less and follow-up period of just 1 year is the limitations of the present study.

CONCLUSION:

Proximal humerus fractures are very complicated cases, especially three- or four-part comminuted fracture with osteoporosis in elderly. However, PHILOS Plate has been proved useful in such situations where it gives superior results compared to other treatment options. Achieving anatomical reduction, avoiding varus mal-reduction with proper placement of the plate in relation to shoulder joint is the key for a favourable functional outcome.

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