

# Locking compression plate for proximal humerus fracture: A functional outcome analysis.

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## Abstract

**Introduction:** Proximal humerus fractures are often the result of a fall in an osteoporotic patient, but can also occur in young adults due to high energy trauma. They account for 4-5% of all fractures. Over the past few decades, several operative techniques have been described for the treatment of proximal humerus fractures. Currently locking compression plate is gaining popularity. This plate combines the feature of compression of regular plate and locking into one system. **Methods:** The present study is a prospective study conducted at Department of Orthopedics, S.B.H. GMC Dhule over a period of 2 years from March 2015 to March 2017. Total 34 patients of proximal humerus fracture which were admitted in Orthopedics ward were included in the present study. X ray of proximal humerus was taken and the fractures were classified according to Neer's classification. All the patients were subjected for open reduction and internal fixation with locking compression plate i.e. PHILOS (Proximal Humerus Interlocking System). Fracture approached through anterior deltopectoral approach. Post operatively patients were mobilized as early as possible. Patients were followed up and functional outcome was assessed using Neer's functional scoring system. Mean follow up was 1 year. **Results:** All the 34 patients of displaced proximal humerus were operated by open reduction and internal fixation using locking compression plate (PHILOS). Among these 19 (55.88%) were males and 15 (44.12%) were females. Age of patients ranged from 29 to 75 years with mean of 52 years. All fractures were classified according to Neer's functional scoring system. 8 (23.5%) patients were type II, 11 (32.35%) were type III and 15 (44.11%) were type IV. Functional outcome was assessed using Neer's functional scoring system. According to Neer's score 60% of our patients had satisfactory to excellent results and 40% of the patients had unsatisfactory to poor results. **Conclusion:** According to present study results of locking compression plate, PHILOS, for proximal humerus fracture type II and type III are satisfactory and encouraging in all age groups. Still there is scope to improve results in type IV fractures especially in elderly with osteoporotic bones.

**Key words:** Proximal humerus fractures, Locking compression plate, Open reduction internal fixation

## Introduction

Proximal humerus fractures are often the result of a fall in an osteoporotic patient, but can also occur in young adults due to high energy trauma. They account for 4-5% of all fractures [1,2]. Fractures of proximal humerus are still an unsolved problem in many ways. Disagreement exists regarding reliability of classification system.

The indication for surgical management continues to be modified. Fixation techniques are myriad and none is ideal for all cases. About 80% of fractures of the

proximal part of the humerus are undisplaced or minimally displaced and yield a good functional result when treated non operatively, but another 20% of fracture are a therapeutic challenge and have variable prognosis due to various complications like failure of osteosynthesis, avascular necrosis of the humeral head, and also a nonunion or malunion of the fracture, which may all result in a painful shoulder with poor function [3,4,5].

For optimal treatment of displaced or unstable fractures various techniques, including open reduction and internal fixation with proximal humeral plates, intramedullary nailing, percutaneous or minimally invasive

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techniques with pins or screws and arthroplasty, have been described in literature [6,7-10]. Currently locking compression plate is gaining popularity. This plate combines the feature of compression of regular plate with locking into one system. It provides angular

stability and act as an internal fixator [11]. The present study was carried out to assess the functional outcome of the displaced proximal humerus fractures treated with locking compression plate.

**Materials and Methods**

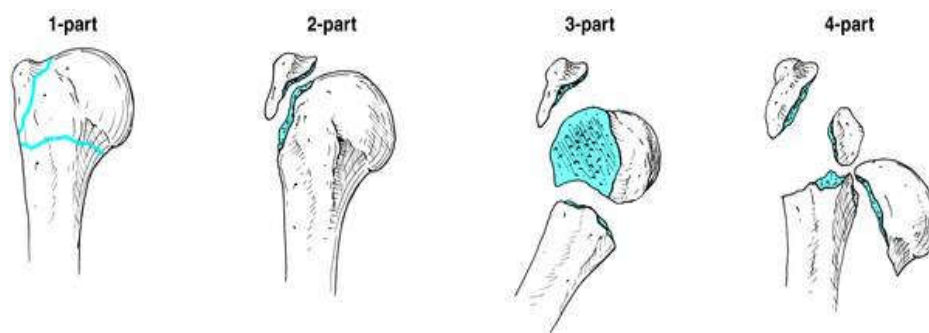
The present study is a prospective study conducted in department of Orthopedics, S.B.H.GMC Dhule over a period of 2 years from March 2015 to March 2017.

**Inclusion criteria-** Displaced two part, three part and four part fractures of proximal humerus with or without shoulder dislocation in age group >18 years and surgically fit patients were included.

**Exclusion criteria-** Acute infections, pathological fractures, associated neuro vascular injury, fractures in children during growth phase and compound fractures were excluded.

**Statistical analysis-** The statistical analysis was carried out with SPSS VER. 18.0 Software. All the data were presented as mean, standard deviation, and percentage of efficacies. Chi-square and paired 't' test is used to evaluate the statistical significance in Neer's study ( $P < 0.05$ ) is considered as significant.

Total 34 patients of proximal humerus fracture which were admitted in orthopedics ward were included in the present study. X ray of proximal humerus was taken and the fractures were classified according to Neer's classification.

**Neer's Classification**

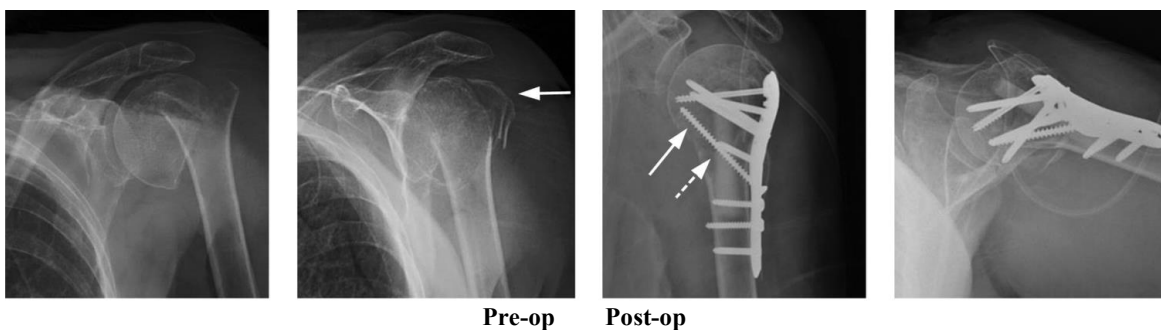
Patients were evaluated for surgical fitness. All the patients were subjected for open reduction and internal fixation with locking compression plate i.e. PHILOS (Proximal Humerus Interlocking System).

**Surgical approach-** A deltopectoral approach was used. Once through the interval, an extensive hematoma is usually encountered and is evacuated by aspiration or digitally to expose the fracture. Slight abduction of the arm relaxes the deltoid muscle and enables better access to the humeral head. The long head of the biceps tendon is identified at the upper border of the pectoralis major muscle, and its course is followed proximally. This tendon is important in orienting the anatomy of the proximal humerus because it runs in the inter tubercular groove between the greater and lesser tuberosities. The biceps tendon is particularly useful for orientation in the presence of four part fractures, when anatomy can be significantly distorted. Prior to attempted fracture reduction, the rotator cuff is generously tagged with non absorbable sutures anteriorly, posteriorly, and superiorly to assist with reduction of the fracture fragments and ultimately, to reinforce fixation of the fracture to the plate.

Now the head fragment can be gently manipulated under direct visualization with aperiosteal elevator introduced into the fracture gaps. In the presence of varus tilt of the head fragment, the position can be corrected by pulling on the superior suture loop through the supraspinatus tendon while maintaining longitudinal traction on the arm. Tagged tuberosity fragments can be reduced to the humeral shaft and may also indirectly reduce a head fragment. Once the head fragment has been reduced, the tuberosities are pulled together with the sutures and fitted via digital manipulation. Poor results

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have been shown with improper reduction of the tuberosities. In comminuted fractures, temporary fixation with K-wires is recommended to hold the fracture reduction. Care must be taken so that the wires do not interfere with subsequent plate positioning. After temporary fracture reduction is achieved, the precontoured anatomic locking compression plate, PHILOS, is positioned approximately 1cm distal to the upper edge of the greater tuberosity to avoid subacromial impingement. However, care should also be taken to avoid placing the plate too low which could prevent optimal screw placement in the humeral head. Correct plate position checked and the adequacy of fracture reduction confirmed on fluoroscopic imaging. K-wires are temporarily inserted into the screw holes to hold the plate in place. With the plate appropriately positioned and the fracture fragments reduced, proximal and distal screws are placed in the plate. We prefer to insert the tip of each locking screw to a distance at least 5 mm short of the subchondral bone. Placement of calcar screws is of paramount importance to avoid varus collapse of the fracture. When all screws have been placed, the rotator cuff sutures are threaded through the small holes in the proximal end of the plate and tied down for additional fixation. During wound closure, we placed a drain deep to the deltopectoral interval to close down any dead space. All patients received perioperative antibiotics. Adjuvant bone grafting or bone graft substitutes were not used.



**Postoperative care-** Postoperatively, the arm was immobilized in a shoulder immobilizer. The drain removed 48 hours after surgery. Postoperatively patients were mobilized as early as possible depending upon stability of fixation. The patient progresses through a three-phase rehabilitation program consisting of I) Passive or assisted exercises. II) Active exercises starting at approximately 4-6 weeks postoperatively. III) Strengthening or resisted exercises beginning 10 to 12 weeks after surgery.

**Follow up-** All the patients were followed up by clinical and radiographic assessment immediately after treatment and at 1, 3, and 6 months and 1 year. Radiographic assessment was made by anteroposterior and axillary views taken immediately after surgery. Union was defined with presence of bridge callus in two views and AVN was defined with loss of bony substance and presence of diffuse sclerotic area in the humeral head. Malunion was defined if there was displacement of more than 5mm or an angulation of more than 40 degrees of any fragment. The functional assessment was done according to Neer’s functional scoring system at the end of 1 year.

**Results**

**Table-1: Age wise distribution of patients**

Age in years	No of patients	Percentage
20-40	6	17.6%
40-60	10	29.4%
>60	18	52.94%

**Table-2: Sex distribution of patients**

Sex	No. Of Patients	Percentage
Males	19	55.88%
Females	15	44.12%

**Table-3: Neer's classification wise distribution of fracture**

Neer's Fracture Type	No. Of Patients	Percentage
Type II	8	23.5%
Type III	11	33.35%
Type IV	15	44.11%

**Table-4: Average Neer's functional score according to fracture type**

Neer's fracture Type	Average Score
Type II	80
Type III	70
Type IV	50

All the 34 patients of displaced proximal humerus were operated by open reduction and internal fixation using locking compression plate i.e. PHILOS (Proximal Humerus Inter locking System). Among these 19 (55.88%) were males and 15(44.12%) were females. Age of patients ranged from 29 to 75 years with mean of 52 years. All fractures were classified according to Neer's classification system. 8 (23.5%) patients were type II,11 (33.35%) were type III and 15(44.11%) were type IV.

Functional outcome was assessed using Neer's functional scoring system. Average Neer's score for type II fracture was 80, for type III fracture 70 and for type IV was 50. According to Neer's score 60% of our patients had satisfactory to excellent results and 40% of the patients had unsatisfactory to poor results. High percentage of unsatisfactory to poor results was observed in Neer's type IV fractures especially in patients with age >60 years and with highly osteoporotic bones.

All the fractures united without any infection although there were some complications like AVN with humeral head collapse in 1 patient with type IV fracture and implant loosening accounted in one. Varus malunion was observed in 5 patients.

## Discussion

Proximal humeral fractures represent an increasing challenge for health-care system because of the increasing proportion of elderly individuals in the population. The majority of patients with these fractures are more than 60 years old, and most these fractures are related to osteoporosis.

Nevertheless, stable reduction is essential for healing of these fractures and for achieving early functional recovery of the shoulder. In patients with osteoporotic bones and/or comminuted fractures, operative stabilization is challenging and remains controversial.

Newer techniques involving the use of locking compression plates and screws with angular stability have been introduced in order to avoid complications associated with traditional plates. The anatomic locking compression plates (PHILOS: proximal humerus interlocking system) are designed to maintain a stable fracture reduction even in osteoporotic bone. Advantages of these plates include gentle fracture

reduction with the use of indirect reduction maneuvers, resistance to screw pull out even in patients with poor bone stock because of the combination of fixed-angle screw –plate locking and three – dimensional placement of screws in humeral head and possibility of early exercise and a short period of immobilization because of high initial stability achieved [12].

Brunner et al. evaluated the incidence of complications and functional outcome after open reduction and internal fixation with PHILOS. Study was prospective, multicenter study between September 2002 to September 2005, with 158 fractures in 157 patients.

They had primary screw perforation of 14% and secondary screw perforation of 8% and a vascular necrosis of humeral head 8%.

They concluded that fixation with PHILOS plate preserves achieved reduction and a good functional outcome can be expected. More accurate screw length

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measurement and shorter screw selection should prevent primary screw perforation [13]. Liu et al in 2010 concluded that treatment of proximal humeral fractures in elderly patients with application of PHILOS plate combined with injectable artificial bone as satisfactory, especially suitable for osteoporotic and comminuted proximal humeral fractures. They studied 17 patients from March 2007 to March 2009 with an average age 71 years (66 to 81). The clinical outcome was excellent in 9 patients, good in 6, moderate in 2 cases [14].

Though in our study we did not use any bone grafts or bone graft substitutes, results are comparable.

Various fixation methods have been used in the past for treatment of proximal humeral fractures which showed variable outcomes. Complications like screw loosening, subacromial impingement and a vascular necrosis of humeral head upto 40% has been reported with AO-T plates and clover leaf plates [15,16]. According to Weinsten D et al and Walsh S et al locking plates provide better stability than conventional plates that were used in the past [17,18].

In the present study proximal humerus fractures were observed commonly in elderly age group (mean 52 years) which is comparable with the findings by Robinson C et al [19].

In a study carried out by Arumugam S et al satisfactory to excellent results were found in 76.7% of patients while poor results were found in 23.3% of the patients [20]. These findings slightly vary from the findings of present study where satisfactory to excellent results were found in 60% of patients while poor results were found in 40% of the patients. The slight variation is attributable to more no. of type IV patients in the present study.

## Conclusion

According to present study results of locking compression plate for proximal humerus fracture type II and type III are satisfactory and encouraging in all age groups. Still there is scope to improve results in type IV fractures especially in elderly with osteoporotic bones.

**Conflict of interest:** None declared.

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