

## Original Research Article

# Study of operative management of proximal humerus fracture treated with locking plates

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### ABSTRACT

**Background:** This study was undertaken to evaluate the efficacy of Philos plate and to specifically study the clinical outcome of the patient treated with Philos plate for proximal humerus fracture on the radiological head shaft angle basis.

**Methods:** 40 cases of proximal humerus fracture fixed by using Philos plate were reviewed.

**Results:** Average constant shoulder score as Neer type-3 fracture is 83.8% and for type- 4 part fracture is 86%. Average radiological union was seen at 10.2 weeks. There was no major difference in clinical and radiological union.

**Conclusions:** Good functional outcome with Philos plate irrespective of fracture type was obtained.

**Keywords:** Locking plates, Proximal humerus fracture, Philos

### INTRODUCTION

Proximal humerus fractures are common accounting for 5-9% of all fracture.<sup>1</sup> Their incidence is particularly higher in patients over 65 years age in whom they represent the most common fracture type.<sup>2,3</sup> Most proximal humerus fractures are stable, minimally displaced and can be managed conservatively.<sup>4</sup> The surgical treatment of displaced fracture however remaining a challenge. Non operative management of the more severe fracture is associated with poor results.<sup>4</sup> The large range of operative techniques described (e.g. K-wire, TBW, plating, nailing, arthroplasty) for managing the more complex fracture is a testament to the lack of clear superiority of any one method.<sup>5-9</sup> Most of these techniques have been associated with complications related to hardware failure, osteonecrosis, nonunion, malunion, rotator cuff impingement.<sup>10</sup>

Proximal humeral locking plates such as proximal humeral interlocking plate (Philos, Synthes, Switzerland) offer several potential advantages in the treatment of these injuries. They are site specific, low profile plates.

The plate is precontoured for proximal humerus and insertion of locking screws obviates the need for a plate to bone compression preserving the blood supply to the bones. The insertion of multiple polyaxial locking screws through the specific targeting device into humeral head fragment provides a fixed angle support in multiple planes, which should in theory, maintain the reduction achieved, while allowing for early mobilisation.<sup>1</sup> However inspite of all potential benefits significant level of construct failure and revision surgery with the use of proximal humerus locking plates have been reported particularly in patients over 65 years of age.<sup>11,12</sup>

This study was undertaken to evaluate the use of Philos plate system for the treatment of proximal humeral fracture. We specifically wanted to examine the effectiveness of Philos plate on the humeral head shaft angle attained following fixation.

### METHODS

From July 2013 to December 2015, 40 patients with displaced fractures of proximal humerus had open

reduction and internal fixation with a Philos plate (Synthes).

There were 23 males and 17 females with mean age of 41 years (age ranged 21-90). 20 of the patients sustained their injury following RTA, 19 from fall at home and one from convulsion.

Fractures were classified according to Neer and all fractures met the indication for operative treatment outlined by Neer et al that is angulation  $>45^{\circ}$  or displacement between the major fragments of more than 1 cm.<sup>13</sup> Using the immediate anteroposterior post-operative radiograph the head shaft angle was determined. The normal anatomical head shaft angle of humerus is considered to be approximately  $130^{\circ}$ .<sup>14,15</sup>

Radiographic follow up consisted of plane radiograph on the second postoperative day, at 6 weeks and every 3 months after that for approximately one year. The mean time for radiological union was 10.2 weeks.

Patients with age  $>18$  years, proximal humerus fractures complex variety of Neer's classification: grade 2, 3, 4 were included in the study.

Exclusion criteria were medically unfit patients, fractures in pediatric age group, shaft humerus fractures with proximal extension, Neer's classification grade one fracture, open fractures and associated neurovascular injuries with fracture.

### Operative technique

The patients received prophylactic intravenous antibiotic. All patients were placed in supine position with sandbag under scapula and c-arm was positioned opposite side of the operative site. Deltoid split approach was used. Skin incision may follow the direction of muscle fibers along the upper deltoid at the junction of the anterior and middle thirds. The deltoid is split along its fibers no more than 5 cm from acromian in order to avoid injury to the axillary nerve. The head fragment when involved was then reduced from its typical varus position through manipulation and flexing of the arm. Once in position, the fracture was then held temporarily with K-wire and the reduction checked fluoroscopically. The Philos plate was then applied lateral to the bicipital groove, 1-2 cm distal to the upper end at the greater tuberosity conventional non locking screw was then inserted into the slotted gliding hole on the plate. When brought the plate to the bone and allowed for minor adjustments in the plate height and position when checked on fluoroscopy. Polyaxial locking screw inserted into the head, locking screw were also inserted into the shaft.<sup>16</sup>

The arm was placed in the sling after wound closure. Only pendulum exercise were permitted for the first four weeks postoperatively with elbow and wrist range of motion also encountered. 4-6 weeks postoperatively

passive progressive to active range of motion then started under the guidance of physiotherapist. Postoperative outcome was measured with constant shoulder score at a minimum of 1 year follow up.

## RESULTS

All fractures were united clinically and radiologically. The mean time for radiological union was 10.2 weeks (8-12 weeks). At the final follow-up, the mean Constant shoulder score was 84. The results were excellent in 20 patients, good in 10 patients, fair in 7 patients and poor in 3 patients. During the follow-up, 6 cases of varus malunion. Other complications were not symptomatic enough to undergo additional surgery. No cases of infection, AVN, hardware failure, locking screw loosening or non-union were noted.

**Table 1: Number of patients with mal/non-union.**

Mal/non-union	Total	
	Number	Percentage
<b>Union</b>	36	90%
<b>Malunion</b>	04	10%
<b>Nonunion</b>	00	0%
<b>Total</b>	40	100%

**Table 2: Number of patients with varus collapse.**

Varus collapse	Total	Percentage
<b>Yes</b>	6	15%
<b>No</b>	34	85%
<b>Total</b>	40	100%

**Table 3: Results after final follow-up.**

Grading	Total	
	Number	Percentage
<b>Excellent</b>	20	50%
<b>Good</b>	10	25%
<b>Fair</b>	7	17.5%
<b>Poor</b>	3	7.5%
<b>Total</b>	40	100%

Neer constant shoulder score= $\geq 30$  Poor; 21-30 Fair; 11-29 Good;  $<11$  Excellent.

## DISCUSSION

Our study implies that treatment of proximal humerus fractures with Philos plate may give a satisfactory outcome. It allows early mobilization as the fixation is usually stable. An improved outcome requires precise knowledge and adequate surgical expertise. In addition, treatments of these fractures are challenging, especially in the elderly. Different techniques have been described for the fixation of comminuted and displaced proximal humerus fractures.<sup>8-11</sup> All these techniques have been associated with a varying rate of complications such as

cut-out or back-out of the screws and plates, nonunion, AVN, and fracture distal to the plate.<sup>14,17-19</sup>



**Figure 1: Radiographic images.**



**Figure 2: Clinical follow-up.**

Locking periarticular plate fixation offers more advantages compared to many implants and have been shown to be superior to non-locking plates.<sup>19-21</sup> Meticulous care must be taken to preserve the overlying soft tissues during open reduction and internal fixation since damage to these soft tissues may disturb the vascularity of fracture fragments.<sup>22-24</sup> In our study, we used the standard deltoid split approach in most of the patients. Important aspects of the surgical technique include placement of the plate in strict adherence to the technique, determination of appropriate length and placement of the screws with fluoroscopy, insertion of screws to the head in adequate number and position, providing medial cortex support for the prevention of varus displacement and to fix tubercle fragments, fixation of the sutures passing through the junction of the tubercle and rotator cuff to the plate.<sup>25-27</sup> In our study, overall complication rate was 16.32%. The main complications were varus malunion in six patients. Egol et al observed only one case of acute infection in their series of 51 patients who mainly had 3- and 4- part fractures.<sup>28</sup> Gardner et al reported superficial wound dehiscence in

one patient and Moonot et al reported one superficial infection that healed with oral antibiotic treatment.<sup>23,27</sup> No incidence of infection in our study was attributed to meticulous surgical techniques and the special attention paid to soft tissue preservation. Humeral head screw penetration (0-23%) is noted in various studies.<sup>28-32</sup> In our study, there is no such case. We executed intraoperative fluoroscopic monitoring of the drill bit while drilling and also monitored the screw position in two views to avoid articular penetration. In the past, incidences of AVN have been reported in a wide range, 4-75% of cases.<sup>24,28,33-36</sup> In our study we did not notice a single case. However follow-up was short term. More cases of AVN could potentially arise with longer observation.<sup>37-39</sup> Hertel et al evaluated risk factors for humeral head ischemia following intracapsular proximal humerus fracture and found that the most relevant predictors were the length of the dorsomedial metaphyseal extension (<8 mm), the integrity of the medial hinge (defined by greater than 2 mm shaft displacement in any direction), and fracture with an anatomic neck component (types 2, 9, 10, 11 and 12 in their binary description system). When three of these criteria were present, the positive predictive value for ischemia was 97%.<sup>40</sup>

There was statistically no significant difference in the clinical outcome between those who had restoration of their humeral head shaft angle to greater than 90° at the time of surgery and those who did not. As with all locking plates, fracture reduction must be achieved prior to plate application, this can be technically demanding. Only 7.5% of patients operated by Philos plate showed poor radiological result as calculated by head shaft angle on radiograph. It has been shown that unstable proximal humerus fractures have a tendency toward varus collapse, even in the presence of locking plate fixation. While we have not encountered this problem to date, we advocate optimal restoration of the head shaft angle to guard against these potential complications.

However we need a much longer follow-up period to come to any strong conclusions. Implant failure and loss of primary fixation of the implants occur in 2.7% to 13.7% of cases following open reduction and internal fixation with locking plates in proximal humeral fractures.<sup>13,27,28,30</sup> In our study we didn't have any case of fixation failure in the early postoperative period. Varus malunion is one of the potential complications following fixation of proximal humeral fractures. It is defined as a head shaft angle of less than 120 degrees. Moonot et al reported the incidence of malunion in 3- and 4 part proximal humeral fractures.<sup>27</sup> Bjorkenheim et al reported 26.3% of the fractures having 2, 3 and 4 part united in slightly varus position after open reduction and internal fixation with locking plate.<sup>13</sup> Agudelo et al considered primary varus reduction to be an important risk factor which may cause poor results.<sup>30</sup> In our study we observed 6 (15%) cases of varus malunion. We did not notice nonunion and heterotopic ossification in our series. According to constant shoulder score, excellent/good

results accounted for 75%, and only 25% had fair/poor results. These results were comparable to those previously reported.<sup>41</sup> A relatively small sample size was the main limitation of this study.

In conclusion, Philos plate provides stable fixation in proximal humerus fractures. Additionally, meticulous surgical dissection to preserve vascularity of humeral head is necessary to prevent potential complications such as AVN.

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