



## Management of Proximal Humeral Fractures with Philos Plate- A Clinical and Radiological Outcome

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### Abstract

Proximal humeral fractures are, an increasingly common fractures, accounting for 4%–5% of all and 45% of humeral fractures. 85% of these fractures are minimally displaced, effectively treated by immobilization followed by early range of motion exercises; the remaining 15% of these are either displaced or unstable. Neer's classification evaluates the proximal humerus in four parts, any translations more than 1 centimeter or angulations more than 45 degrees in any part of the humerus are defined as displacement. PHILOS plate, since made of titanium is lighter with a good biocompatibility has an additional advantage over other implants for ORIF. The analysis of radiological and functional outcome of proximal humeral fractures managed with philos plate was the aim of this study. Results showed an excellent constant murley score in 16%, good result 60%, fair result in 16% and poor in 8%. Mean constant murley score was 59.4. we concluded that proximal humerus locking plate (PHILOS) gives satisfactory functional outcome in patients with proximal humerus fractures

**Keywords:** proximal humerus, philos, constant murley score.

### Introduction

Proximal humeral fractures are, an increasingly common fractures, accounting for 4%–5% of all and 45% of humeral fractures.<sup>1,2</sup> It is the 3<sup>rd</sup> most common fracture after hip and distal radius fracture, in people > 65 years of age.<sup>3</sup> 85% of these fractures are minimally displaced, effectively treated by immobilization followed by

early range of motion exercises; the remaining 15% of these are either displaced or unstable.<sup>4</sup> Elderly women constitute largest group sustaining humeral fractures, largely attributable to osteoporotic change after menopause. Fracture is usually by a simple fall on outstretched hand or direct fall on shoulder in comparison to active

patients where high-energy trauma is the cause, and displacement is often more severe. The younger ones usually present with fracture dislocation.<sup>5,6</sup>

**Neer's classification** evaluates the proximal humerus in four parts, any translations more than 1 centimeter or angulations more than 45 degrees in any part of the humerus are defined as displacement.<sup>7</sup>

A proximal humeral fracture might result in up to four major fracture fragments, namely humeral head superior to the anatomical neck, greater tuberosity, lesser tuberosity and humeral shaft.<sup>8</sup> Tuberosity fractures in association with a fracture of the surgical neck of the humerus may result in rotational deformity of the humeral head. A fracture of the greater tuberosity will allow internal rotation due to unopposed subscapularis action & if the lesser tuberosity is fractured the stabilizing effect of subscapularis is lost. Surgical treatment is necessary especially in young patients or active elderly persons to prevent minimal dislocations of tuberosity or articular surface from compromising the long-term articular function.<sup>9</sup>

Accurate imaging with good quality views, an AP, an axial lateral & a third view, the lateral scapular, gives required information.<sup>10</sup> A computed tomography (CT) is recommended for complex fractures.<sup>11</sup> Most of the fractures are minimally displaced and can be treated nonoperatively. Unless medical contraindications exist, operative management is recommended for displaced proximal humerus fractures.<sup>12</sup> The need for operative treatment has become increasingly apparent due to post-traumatic impingement syndrome and the loss of rotator cuff function.<sup>13-18</sup>

Different techniques for fixation of comminuted and displaced proximal humeral fractures include sutures, cerclage wires, K-wires, screws and plates, intramedullary devices, and shoulder arthroplasty with various complications.<sup>19</sup> Recently AO/ASIF group developed the PHILOS (The Proximal Humeral Internal Locking Osteosynthesis) plate (Synthes, Stratec Medical Ltd, Mezzovico Switzerland); an internal fixation

system that enables angled stabilization with multiple interlocking screws.<sup>20</sup> This study was planned to evaluate the outcome of proximal humerus fractures managed with PHILOS plate.

The two most commonly adopted classification system are those described by Neer<sup>21</sup> in 1970, and the AO Association for the study of internal fixation system, described in 1990 by Muller et al<sup>22</sup>

### Treatment Modalities

#### • Non Operative

- Rest/Immobilization (shoulder immobilizer) / Cast application.

#### • Operative

Open reduction and internal fixation with PHILOS plating. It has following advantages:

- The screws in the humeral head are locked to the plate, a significant advantage in osteoporotic bones.
- Enables the placement of screws in different directions.
- Permits indirect fracture reduction thus lowering the possibility of AVN.
- Locked interface also provides fixed stability.
- Reduces the risk of loss of reduction and preserves the blood supply.
- The smaller holes allow passage of sutures for reattachment of tuberosities with their corresponding rotator cuff.

Thus PHILOS plate, since made of titanium is lighter with a good biocompatibility has an additional advantage over other implants.

### Aims and Objectives

The analysis of radiological and functional outcome of proximal humeral fractures managed with PHILOS PLATE.

### Materials and Methods

This prospective study was conducted in the department of orthopedics at a tertiary hospital of Punjab. A total of 25 adult patients of either sex with proximal humerus fractures were included after having informed written consent.

**Inclusion criteria**

Displaced proximal humerus fracture

**Exclusion criteria**

Undisplaced fracture proximal humerus, fracture dislocation and head splitting fracture, pathologic fractures, infection at fracture site, skeletally immature patients

**Preoperative management**

Patients were investigated and anaesthesia was given as per anaesthetic’s choice (mostly general anaesthesia).

**Surgical Technique**

All surgeries were done under controlled fluoroscopy in supine position under general anaesthesia with head elevated at about 30°.

An anterior deltopectoral approach was used to expose the fracture site. In fracture-dislocation cases, and in split head fractures, the head or a head segment was located anterior and medial to the glenoid along the glenoid neck. In these cases, the release of the pectoralis major tendon and the

lateral conjoined tendon, as well as the subcoracoid and subdeltoid spaces was often released before any attempts at fracture reduction in order to preserve the blood supply for the head fragments and to avoid forcible reduction. On the anteroposterior view, the plate was ideally placed 8–10 mm distal to the superior tip of the greater tuberosity; from the lateral view, the plate was centred against the lateral aspect of the greater tuberosity.

After achieving the appropriate fracture reduction and plate position, the locked screws were inserted into the humeral head. At least three distal shaft screws were inserted. A final fluoroscopic image was taken to ensure adequate reduction and proper medical support. The wound was closed in layers and a suction drain was be inserted.

Follow up was done at 4 weeks, 12 weeks and 24 weeks on basis of *Constant* and *Murley* score.

**Observations**

**Table I** Distribution of Patients according to Mode of Injury

Mode of Injury	No. of patients	Percentage
Road traffic accident	17	68.00%
Fall on out stretched hand	5	20.00%
Direct injury	3	12.00%

Majority of patients sustained injury due to road traffic accident (17 patients, 68%).

**Table II** Distribution of Patients according to Associated Injuries

Associated injuries		No. of patients	Percentage
Upper limb injuries	Radius	1	4.0
	Ulna	2	8.0
	Hand and wrist	1	4.0
Lower limb injuries	Femur	1	4.0
	Both bone leg	1	4.0
Soft tissue injury		4	16.0
Head Injury		2	8.0
BTC		2	8.0
Spine		1	4.0

**Table III** Distribution of Fracture according to Neer’s Classification

Neer’s Type	No. of fractures	Percentage
2 part	11	44.0
3 part	11	44.0
4 part	3	12.0

Maximum numbers of fractures (88%) were of 2 part and 3 part fractures

**Table IV** Post Operative Complications

Complication	No of patients	Percentage
<u>Wound infections</u>		
Superficial	04	16.00%
Deep	01	04.00%
<u>Soft tissue complications</u>		
Impingement	01	04.00%
Adhesive capsulitis/frozen shoulder	02	08.00%
Malreduction	05	20.00%
Screw perforation	4	16.00%
Distal screw and plate pullout	1	04.00%

Wound infections & Malreduction (20% each) were major complications.

**Table V** Time to Union of Fracture

Time taken for union	No. of fractures	Percentage
< 9 weeks	1	4.0
9-16 weeks	20	80.0
> 16 weeks	1	4.0

80% of the fractures united between 09-16 weeks (2-4 months)

### Results at 6 Month Follow Up

**Table VI** Distribution of Cases According to the Level of Pain

Level of pain	Points	Number of patients	Percentage
No pain	15	13	52.00%
Mild pain	10	5	20.00%
Moderate pain	5	7	28.00%
Severe pain	0	0	0.00%

18 patients (72%) had no pain or mild pain.

**Table VII** Limitation of Occupation or Daily Living (Constant Scale)

Level of limitation	Points	No of patients	Percentage
No limitation	8	0	0
Moderate limitation	4	21	84.0
Severe limitation	0	4	16.0

Majority of patients 21 patients (84%) had moderate limitation of shoulder.

**Table VIII** Level of Painless Activity of the Arm

Level of painless activity	Points	No of patients	Percentage
Above head	10	0	0
Head	8	9	36.0
Neck	6	9	36.0
Xiphoid	4	5	20.0
Waist	2	2	8.0

72% of the patients could do activities at head or up to neck level.

**Table IX** Grading: Constant – Murley Scoring System

Result	As per constant score	Percentage
Excellent (80 to 100)	4	16.0
Good (59 to 79)	15	60.0
Fair (40 to 59)	4	16.0
Poor (0 to 39)	2	08.0

Means constant score is 59.4.



Case I : Pre- Operative X Ray



Case I : Post Operative X-Ray



Case II : Pre- Operative X Ray



Case II : Post Operative X-Ray

### Discussion

In our study, 25 patients within age group 19 years to > 80 years were studied for fractures of the proximal humerus, more prevalent in middle age group with average age 49.24 years, (76% of patients between 20 to 60 years of age), in contrast to other studies in which fracture was found to be more prevalent in more than 50 years of age group.

In a prospective series of 27 patients by Sharafeldin KN et al, the mean age of the group was 61.1 + 15.5 years (range: 30–88 years).<sup>23</sup>

In another retrospective study by Klitscher et al of 30 patients, the mean age was 59 years (range: 22–84 years).<sup>24</sup>

### Sex Incidence

In present study, 20 were males and 05 were females (Male: Female = 4: 1).

In a retrospective study by Klitscher et al of 30 proximal humeral fractures, treated by PHILOS-plate, 36.7% were male & 63.3% were female patients.<sup>24</sup>

In a study of 47 patients Clavert P et al, 57.5% were males while 42.5% were females.<sup>25</sup>

### Mode of Injury

In our study, 68% had road traffic accident while 32% got injuries by other modes.

In a prospective study Sharafeldin KN et al of 27 patients, 77.8% patients sustained their fractures from simple falls, with 5 (18.5%) being injured in road traffic accidents. The remaining patient (3.7%) suffered their fracture secondary to an epileptic fit. Thus the ratio of low energy to high-energy injury was 22:5.<sup>23</sup>

In a retrospective study of 77 patients by Clavert P et al, the cause of the initial fracture was a simple fall in 68 patients (93.2%) and a motor vehicle accident in 5 cases (6.8%).<sup>25</sup>

In contrast to majority of studies in documenting low energy falls as a more common cause for proximal humerus fractures, our study had 68% patients with history of RTA.

### Associated Injuries

In our study the most common associated injury was soft tissue injury (16%) and upper limb injury (16%), we had a high number of polytrauma

patients with an array of associated injuries, ranging from head injury to nerve injuries.

In a study of 77 patients by Clavert P et al, 19.2%, the fracture was associated with an anterior shoulder dislocation, with injury of acetabulum(.01%), tibia (.01%), the contralateral distal humerus (.02%), and the thoracic spine (.01%), 6.8% had a preoperative nerve injury.<sup>25</sup>

#### Neer's classification

88% presented with Neer II & Neer III part fractures (44% each),

A retrospective series of a 51 humerus fractures by **Egol KA et al**, there were twelve 2-part fractures (23.5%), thirty-three 3-part fractures (64.8%), and six 4-part fractures (11.7%).<sup>26</sup>

#### Union, Delayed Union & Non-Union

In present study the average union time was 11.2 weeks with a minimum of 8 weeks and maximum of 17 weeks; 4% had delayed union; 12% had non-union due to a vascular necrosis, and plate pull out in 4%.

In a retrospective study by Klitscher D et al of 30 proximal humeral fractures, treated by PHILOS-plate, the average time to union after surgery in their study was 10.7 weeks (range: 34–202 days).<sup>24</sup>

In an another retrospective study by Egol KA et al, radiographic assessment showed that 98% of 47 acute fractures united by 3 months after surgery had similar results.<sup>26</sup>

#### Level of Pain

The pain was assessed as per constant murley scoring scale. 52% had no pain, 20% developed mild pain, 20% had moderate pain and 8% had severe pain after 6 months.

In a retrospective study by Klitscher D et al of 30 proximal humeral fractures, treated by PHILOS-plate, 86.7% patients had no or mild pain, 13.3% had moderate pain.<sup>24</sup>

#### Range of Movement

44% had an abduction of 121° – 150°, 28% had 91° – 120° respectively. Only 12% had an

abduction of 61° – 90°. 16% had an abduction of less than 61°.

44% had a forward flexion of 121° – 150°; 28% had a forward flexion of 91° – 120°. 16% patients had forward flexion of 61° – 90°. 16% patients had a forward flexion of < 61°.

40% patients had movement at level of hand behind back with elbow back. 36% patients could not take dorsum of their hand above level of twelfth thoracic vertebra. 40% patients could not take dorsum of their hand above the level of waist. 4% patients could not take dorsum of their hand above the level of Sacroiliac joint. 20% patients could not take dorsum of their hand above the level of buttock.

In our study at final follow up, mean abduction is 115°, mean forward flexion is 110°, mean external rotation is hand behind head with elbow back and mean internal rotation is up to waist.

In a study by Klitscher D et al of fifty-two patients (54 shoulders) with 2-part (30%), 3-part (56%), and 4-part (14%) had the mean forward elevation for all patients at final follow-up was 130.1° + 24.4°, and the mean external rotation was 127.7° + 5.7°.<sup>27</sup>

In a multicenter analysis of 129 patients, Brunner F et al at 6 months observed abduction to be 108° + 38.8°, forward flexion to be 125° + 38.4°, external rotation to be 143° + 22.4°, showed internal rotation to be 82° + 20.0°.<sup>12</sup>

In a retrospective study Klitscher D et al of the mean active forward flexion was 130° and the mean active abduction was 128°. 86.7% patients were able to abduct the arm over 90° and to elevate the arm over 90°.<sup>24</sup>

#### Constant Murley Score

The score was assessed at a minimum of 6 months follow-up, showed an excellent constant score in 16%, good result 60%, fair result in 16% and poor in 8%). Mean constant score is 59.4. These results were somehow inferior to those reported in the western literature.

In a retrospective study by Thalhammer G of 42 patients had an excellent functional outcome, 19%

a good outcome, 33% had moderate functional results, 14% had a poor outcome with less than 55% on Constant Score.<sup>28</sup>

In a primary prospective cohort study by Hirschmann MT et al with a minimum 4-year follow up of 57 patients (65 ± 14 years), 77% of patients presented good, 12% satisfactory, and 11% poor results. Patients on an average improved in all scores between the 1years to 4-6year follow-up.<sup>29</sup>

Thyagarajan et al in their study on 30 patients showed an overall average Constant score of 57.5.<sup>30</sup> Systematic review by Thanasis et al reported an overall Constant score of 74.3.<sup>31</sup>

In our study also the mean Constant score for 4-part fractures was 48.3.

A prospective study by Aggarwal S et al in which the mean Constant score for 4-part fractures was significantly inferior to other types.<sup>32</sup>

## Complications

### 1) Screw perforation

Screw perforation was observed in 4 patients (16%).

In a retrospective study of Klitscher D et al, out of 30 proximal humeral fractures, screw perforation was found in 10% cases.<sup>24</sup>

In the systematic review by Thanasis C et al, the most common intraoperative error found is incorrect choice of screw length resulting screw perforation.<sup>31</sup>

### 2) Impingement

In our study of 25 patients, impingement was observed in 4%.

Similar results were shown by Thalhammer G et al, in which 0.04% patients had complaints of subacromial plate impingement out of 52 patients.<sup>28</sup>

Thanasis et al reported an impingement rate of 5.5%.<sup>31</sup>

### 3) Malunion

A varus malunion was observed in 20% and was commonest complication in our study. Thus a varus malalignment was a strong predictor of loss of fixation with poor outcome in four patients in

similar to one prospective study as pointed out by Aggarwal S et al and must be taken care of intra-operatively.<sup>32</sup>

### 4) Avascular necrosis

8% in our study were reported to have developed AVN of the humeral head and poor results.

Agudelo et al reported an avascular necrosis rate of 4.5%.<sup>33</sup>

### 5) Infection:

Deep wound infection was seen in 4% cases for which Implant removal was done. Superficial wound infection was seen in 12% cases which resolved with oral antibiotics.

Brunner et al reported an infection rate of 2%.<sup>10</sup>

Agudelo et al published a rate of 4.5%.<sup>33</sup>

Thyagarajan DS et al has reported a total infection rate of 4.2%.<sup>30</sup>

### 6) Removal of implant

24% cases in our study got their implant removed because of deep infection & AVN and implant loosening & also due to screw perforation.

In a retrospective study by Clavert P et al, locked proximal humerus plates were removed in 5 of 47 (10.7%) patients because of varus malalignment.<sup>25</sup>

## Conclusion

Following the principles of locking plate fixation we can achieve a stable osteosynthesis and start early mobilization even in severely osteoporotic comminuted fractures. So we concluded that proximal humerus locking plate (PHILOS) gives satisfactory functional outcome in patients with proximal humerus fractures. However, certain complications are associated with its use can be eliminated with meticulous application of the technique.

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