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## Functional outcome and complication of PHILOS plating in proximal humeral fractures

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### Abstract

**Introduction:** Proximal humeral fractures account for 5% of all fractures. Displaced and unstable fractures are difficult to manage. New plating techniques have been developed to improve stability.

**Aim:** Aim of this study was to evaluate functional outcome and complication of Proximal Humeral Internal Locking System (PHILOS) in proximal humeral fractures.

**Materials and Methods:** Thirty patients of proximal humeral fractures were treated by open reduction and proximal humeral internal locking system (PHILOS) plate fixation. Out of thirty patients of proximal humeral fractures are 24 Male and 6 Female with age group of 22years to 62years. Fractures were caused by low-energy trauma (fall from height) 14(46.66%) patients, RTA 10(33.33%) patients and Direct trauma 6(20%) patients. All fractures were closed with no associated injuries and according to Neer classification, classified as 2-part (n=17) and 3-part (n=13). Functional outcomes and shoulder range of movement were assessed based on the Constant scoring system.

**Results:** Out of 30 cases 24 (80%) healed satisfactorily, one case of 3-part fracture in whom there was fracture collapse and one case 3-part fracture developed non-union, one case of 3-part fracture screw penetration of the humeral head at 8 weeks developed avascular necrosis and two cases with valgus 3-part fracture who had malunion. No wound infections and vascular injuries. One case with axillary nerve palsy recovered within 2 months.

**Discussion:** In our study constant shoulder score was 70. 14 patients had a score above 75, 12 were scored between 50-75 and 4 were below 50.

**Conclusion:** PHILOS plate provided stable fixation in displaced proximal humeral fracture.

**Keywords:** proximal humeral internal locking system (PHILOS)

### Introduction

In the aging population, the proximal humerus fracture is the third most common osteoporotic fracture type after hip and distal radius fractures constitute 5% of all fractures and they account for 45% of all humeral fractures. When considering adults over the age of 40 years, this increases to 76% [1-2].

These fractures have a dual age distribution occurring either in young people following low energy trauma or in those older than 50 years with low velocity injuries. The mechanism of low-energy injury in elderly patients is usually falling from standing [3].

Approximately 85% of patients with a proximal humerus fractures are non-dislocated and treated conservatively resulting in satisfactory results [4]. Most of the proximal humerus fractures are either non-displaced or minimally displaced and can be treated non surgically [5]. Nonsurgical options focus on early functional exercises with the goal of achieving a functionally acceptable range of motion (ROM). For the 15% to 20% of displaced proximal humerus fractures that may benefit from surgery, no single approach is considered to be the standard of care [6].

Various methods of treating proximal humerus fractures are intramedullary devices [7], internal fixation using tension bands [8], k-wires, percutaneous pins [9-10], bone suture [11] and screws, T-plates [12-15], blade plates [16] and shoulder arthroplasty [17-18]. Complications of these fixation non-union, mal union, avascular necrosis, cutout or back-out of screws and plate, rotator cuff

Impairment, nail migration and impingement syndromes. Proximal Humeral Internal Locking System (PHILOS) plate has been introduced to reduce these complications especially in older osteoporotic individual. Even minimally displaced fracture can be treated with philos plate to early mobilise the fracture thereby to avoid shoulder stiffness. Highly comminuted fractures can be reconstructed with rotator cuff sutural ties with plate and thereby enhance the functional outcome.

### Aim

Aim of this study was to evaluate functional outcome and complication of Proximal Humeral Internal Locking System (PHILOS) in proximal humeral fractures.

### Materials and Methods

Thirty patients of proximal humeral fractures were attended in the casualty and OPD and admitted in the hospital were treated by open reduction and proximal humeral internal locking system (PHILOS) plate fixation. This study conducted at Pravara Rural Hospital, Loni, between October 2016 to November 2018.

#### Including criteria

- All patients with Age of 18 years and older.
- Patients of either gender.
- Patients with non-compound two and three part fractures.
- Patients with fresh fractures of the proximal humerus.

#### Excluding criteria

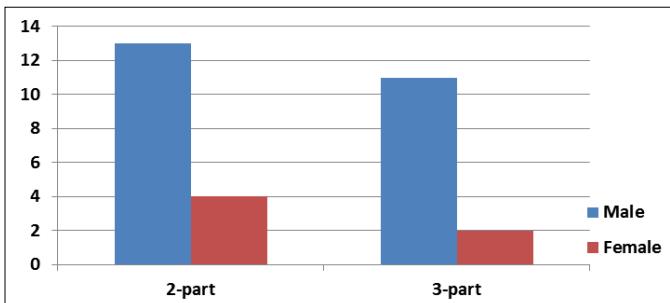
- Patient with pathological fractures.
- Fractures with non-union.
- Patients with primary or metastatic bone tumours.
- Four part fracture proximal humerus.
- Patients with neurological deficits.
- Patients treated non-operatively for fracture proximal humerus that was not willing for surgery.

Thirty patients of proximal humeral fractures were attended in the OPD and casualty and admitted in the hospital were treated by open reduction and proximal humeral internal locking system (PHILOS) plate fixation. Out of thirty patients of proximal humeral fractures are 24 Male and 6 Female with age group of 22years to 62years. In our study, maximum fracture cases were reported by low-energy trauma 14(46.66%) due to fall from height, followed by RTA 10(33.33%) and Direct trauma 6(20%). Significantly more number of injuries were reported in the right side (60%) compared to left side (40%). All fractures were closed with no associated injuries. According to Neer's classification, classified as 2-part (n=17) 3-part (n=13).

We collected records of all cases by detail history and physically examining the patients. Essential investigations were done and patients followed up taken at regular interval.

**Table 1:** According to Neer's Classification distribution of patients

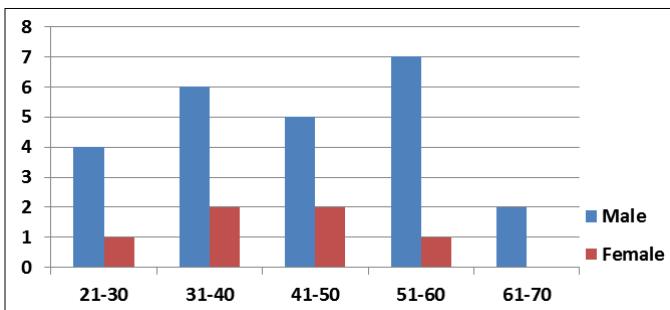
Sex	2-part	3-part	Total
Male	13	11	24
Female	4	2	6
Total	17	13	30



**Graph 1:** According to Neer's Classification distribution of patients

**Table 2:** Age distribution of patients

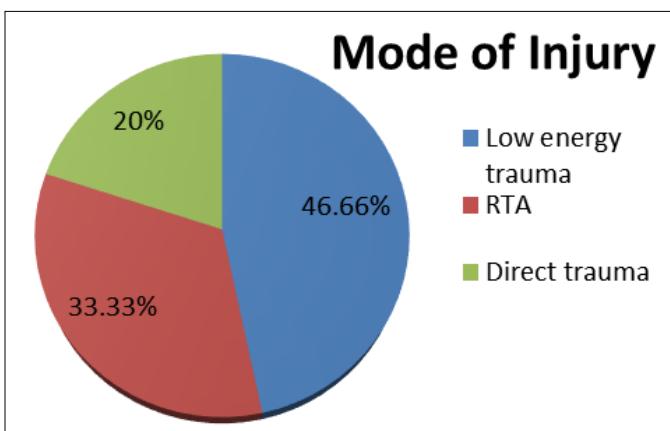
Age Distribution(yrs)	Male	Female
21-30	4	1
31-40	6	2
41-50	5	2
51-60	7	1
61-70	2	0
Total	24	6



**Graph 2:** Age distribution of patients

**Table 3:** Mode of Injury

Mode of Injury	Number of Patient
Low energy trauma	14
RTA	10
Direct trauma	6
Total	30



**Graph 3:** Mode of Injury

Functional outcomes were assessed based on the Constant scoring system. The Constant score assigns points for Pain, Range of movements, Power and Activities of daily living. Muscle strength was measured with use of a 1 kg weight in the patient's hand and the shoulder in 90° of abduction, or, if 90° could not be reached, in maximum active abduction as described by Constant [19].

The Constant score was graded as

- Poor (0 to 55 points)
- Moderate (56 to 70 points)
- Good (71 to 85 points)
- Excellent (86 to 100 points)

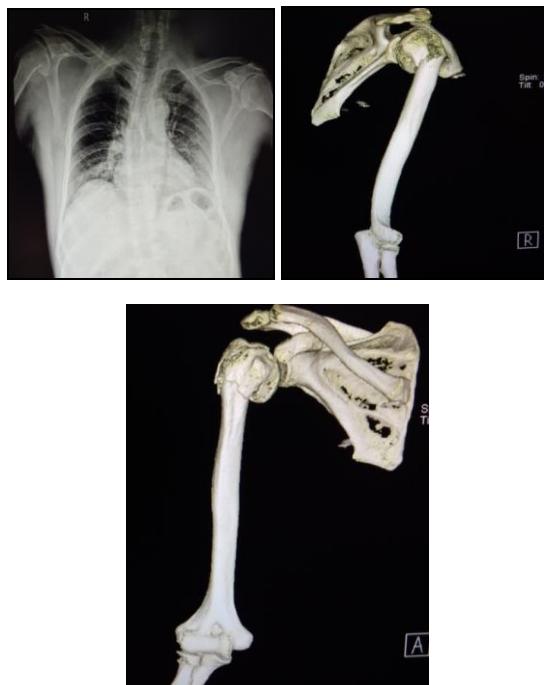
Shoulder range of movement was graded as

- Excellent when the loss of movement was  $<10^\circ$
- Moderate when the loss of movement between  $10^\circ$ - $30^\circ$
- Poor when the loss of movement  $>30^\circ$

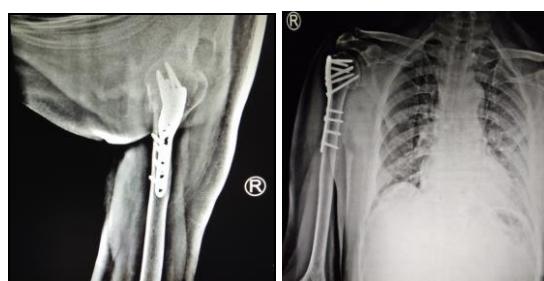
#### Procedure of PHILOS Plate Fixation:

- Patients were placed in a beach-chair position under general anaesthesia.
- A Deltopectoral approach taken.
- The fractures were reduced and temporarily held with k-wires and sutures.
- Reduction was confirmed by using an image intensifier.
- PHILOS plate was applied with at least 4 locking proximal screws and 4 non-locking distal screws.
- Postoperatively the arm was placed in a sling.
- Passive-assisted movements were started on day 1, followed by active-assisted exercises after 3 weeks.
- Patients were assisted radiologically and functionally using the Constant shoulder score.

#### Case 1



**Fig 1:** Pre op X-ray and CT Shoulder Shows fracture proximal humerus right side



**Fig 2:** Post op X-ray of fracture proximal humerus right side treated with PHILOS plate fixation

#### Case 2



**Fig 3:** Pre op X-ray of fracture proximal humerus left side



**Fig 4:** Post op X-ray of fracture proximal humerus left side treated with PHILOS plate fixation

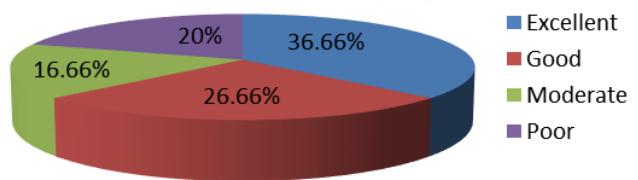
#### Observations and Results

Out of thirty patients according to the Constant scoring system, functional outcomes were excellent in 11 patient, good in 8 patient, moderate in 5 patient and poor in 6 patients. The mean constant shoulder score were 70. Out of thirty patients, 14 had a score above 75, 12 were scored between 50-75 and 4 were below 50.

**Table 4:** Constant scoring systems

Result	Number of Patients
Excellent	11
Good	8
Moderate	5
Poor	6
Total	30

#### Constant scoring system

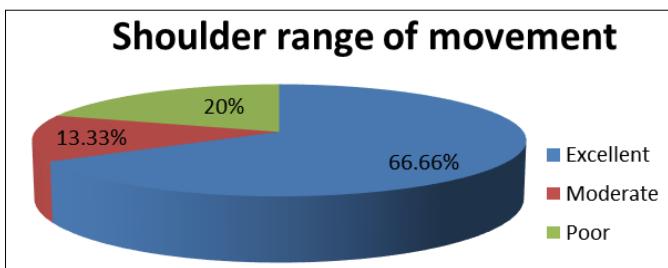


**Graph 4:** Constant scoring systems

Out of thirty patients shoulder range of movement was excellent in 20 cases, moderate in 4 cases and poor in 6 cases.

**Table 5:** Shoulder range of movement

Shoulder range of movement	Number
Excellent	20
Moderate	4
Poor	6
Total	30



Graph 5: Shoulder range of movement

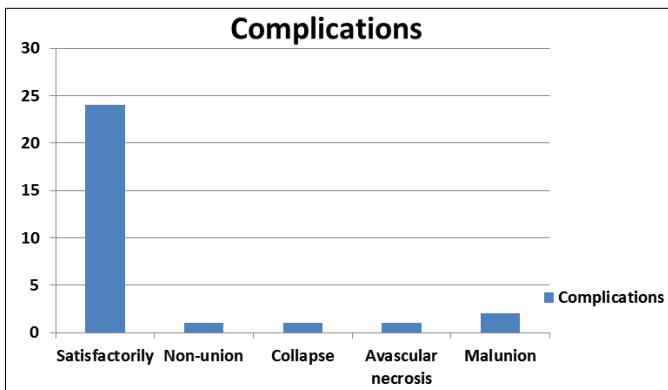
### Complication

The common complications after fixation of fractures of proximal humerus are restricted movements, wound infection, failure of fixation, and avascular necrosis of humeral head and late rupture of the rotator cuff [20-21].

Out of 30 cases of proximal humeral fractures 24 (80%) healed satisfactorily. One case of 3-part proximal humeral fracture in which there was fracture collapse and one case 3-part fracture developed non-union. One case of 3-part fracture screw penetration of the humeral head at 8 weeks developed avascular necrosis. Two cases with valgus 3-part fracture who had malunion. One case of proximal humeral fracture with axillary nerve palsy recovered within 2 months. No wound infections and vascular injuries.

Table 6: Complications

Complications	Number
Satisfactorily	24
Non-union	1
Collapse	1
Avascular necrosis	1
Malunion	2
Axillary nerve palsy	1
Total	30



Graph 6: Complications

### Discussion

The treatments of comminuted proximal humerus fractures are risk of fixation failure. The surgeon must obtain an exact anatomical reduction and stable fixation, and at the same time minimize the iatrogenic risk of screw penetration and avascular necrosis of humeral head by maximal protection of the peri articular soft tissues. Poor results in these complex fractures are due to following causes:

- Inadequate fracture reduction especially medial cortex
- Unstable fixation
- Incorrect positioning of the fixation devices.
- Minimally invasive methods of plate osteosynthesis may increase the risk of neurovascular structural damage.

In recent decade, rigid internal fixation of fracture has been increasingly used in the operative care of proximal humeral fractures. Inspite of an early and secure functional postoperative therapy, it was believed that this implant would reduce the risk of secondary reduction loss in osteoporotic patients.

In the very old age group with osteoporosis, functional outcome after conventional plate osteosynthesis was poor [22]. In order to obtain better and reproducible results, the AO/ASIF has developed a special locking compression plate (PHILOS) for fractures of the proximal humerus [23]. Patients with good bone quality have previously been treated successfully with the conventional plate osteosynthesis [24].

Table 7: Functional scores achieved with different treatment options for proximal humeral fractures in the current literature. [25-28]

Study	Type of fixation	Constant score	Neer's Classification
Kuchle <i>et al</i> (2006)	Cloverlaef plate	72.4	2,3& 4 part fracture
Ketter <i>et al</i> (2006)	Angle stable humerus plate	70.0	2,3& 4 part fracture
Lill <i>et al</i> (2003)	Angle stable humerus plate	72.5	2,3& 4 part fracture
Kollig <i>et al</i> (2003)	T plate, screws & k wires	72.1	3& 4 part fracture
Wijgman <i>et al</i> (2002)	Classic T Plate cerclage	80.0	3& 4 part fracture
Gerber <i>et al</i>	Internal fixation	78	2,3& 4 part fracture
Hessman <i>et al</i>	T plate	69	2,3& 4 part fracture
Our study	PHILOS plate	70	2 & 3 part fracture

In our study Constant shoulder score were 70.

- 14 patients had a score above 75.
- 12 were scored between 50-75.
- 4 were below 50

In our study the PHILOS plate fixation was suitable for proximal humeral fractures. Out of 30 cases of proximal humeral fractures 24 (80%) healed satisfactorily. One case of 3-part proximal humeral fracture in which there was fracture collapse and one case 3-part fracture developed non-union. One case of 3-part fracture screw penetration of the humeral head at 8 weeks developed avascular necrosis. Two cases with valgus 3-part fracture who had malunion. One case of proximal humeral fracture with axillary nerve palsy recovered within 2 months. Complication rate of PHILOS plate fixation was low, probably because our patients were young and both the bone quality and surgical technique were good.

### Conclusion

Accurate anatomical reduction gains and early fracture fixation are more important than the implant used, to get a good final functional outcome and this factor is independent from the implant design and procedure selected. There is no much difference among 2&3 parts of fracture with PHILOSplate. All are nearly more or less with good function outcome.

In general, Proximal humeral internal locking system (PHILOS) plate for the treatment of proximal humeral fractures leads to a satisfactory functional outcome in majority of the patients. PHILOS plate provided stable fixation in proximal humeral fractures.

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