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Functional outcome of proximal humerus fracture treated with proximal humerus locking compression plate in adults: A prospective study

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Abstract

Background: Proximal humerus fractures are common and debilitating injuries and their incidence is increasing especially in elderly. Treatment of unstable, displaced, and comminuted fractures of the proximal humerus remains a challenging issue and significant controversy exists regarding the best method of treating these fractures. Various operative procedures are carried out nowadays, with the recent trend being internal fixation using locking plates. The present study is undertaken to evaluate the functional outcome of proximal humerus fractures treated by proximal humerus internal locking system (PHILOS) plate.

Methods: The proposed study is a prospective study conducted between May 2017 to June 2019 in a tertiary care center in Bangalore. In this study 30 post traumatic cases of proximal humeral fractures (Neers type 2, type 3) were treated by ORIF with proximal humerus internal locking system (PHILOS) plate and functional and radiological outcome was assessed using Constant score at 6weeks, 3months, 6months and 1year post-op.

Results: Majority of the patients in the study were males (63.3%), RTA being the commonest mode of injury in young population and fall being most common mode in elderly. 11(36.7%) and 19(63.3%) patients had Neers 2 part and 3 part fractures respectively. Radiologically, time to union ranged between 12 to 18 weeks. Mean constant score at one year follow-up was 73.63 and it was found that there was a significant reduction in favorable outcome with increase in age ($p < 0.001$).

Conclusion: PHILOS plating has a good functional outcome for proximal humerus fractures. Accurate anatomical reduction and early fracture fixation are essential for good functional outcome. A proper surgical technique will minimize complications and an aggressive rehabilitation regime will ensure the best possible functional outcome for the patient.

Keywords: Proximal humerus fractures/ ORIF (Open reduction and internal fixation) / proximal humerus internal locking system (PHILOS)/ Constant Score

1. Introduction

Fractures of the proximal humerus comprise nearly 4% of all fractures and 26% of fractures of humerus [1]. Proximal humeral fractures are mostly common in elderly patients due to osteoporosis and less frequently seen in young adults in whom it is mostly due to high energy trauma [2]. Neer's classification distinguishes between the number of displaced fragments with displacement defined as greater than 45° of angulations or > 1 cm of separation. There are different modalities of fixation for proximal humerus fractures like k-wires, screw fixation, T buttress plate, conventional plate, locking plate and prosthetic replacement. Every fixation has its own complication. The proximal humerus with poor cancellous bone quality especially in older patients, results in a higher risk of failure of fixation with conventional plating system [3-5]. The Proximal Humerus Internal Locking System (PHILOS) plate has been introduced to reduce these complications especially in older osteoporotic individual. Minimally displaced fracture and highly comminuted 3 & 4 part fractures can be reconstructed with rotator cuff sutural ties with PHILOS plate to allow early mobilization thereby preventing shoulder stiffness and improving the functional outcome. This study evaluates the functional outcome of management of the fracture of proximal humerus, using proximal humerus internal locking compression plate in adults.

Objectives

1. To evaluate the functional outcomes of proximal humerus fracture treated with proximal humerus internal locking plate in adults.
2. To assess the preservation of biological integrity of the humeral head and attainment of anatomical reduction with multiple locking screws with angular stability.
3. To assess the stability in osteoporotic humeral bones.

Methodology

This prospective study, was conducted at Sanjay Gandhi Institute of Trauma and Orthopaedics Bangalore in Department of Orthopaedics on patients who were admitted with displaced fracture of Proximal Humerus from May 2017 to June 2019. Informed consent was obtained and ethical committee clearance was obtained for the same.

Inclusion criteria

1. Patients age more than 18 years.
2. Patients with closed proximal humerus fracture, two part and three part on basis of Neer's classification.

Exclusion criteria

1. Pathological fractures.
2. Patients age less than 18 years.
3. Undisplaced fractures and isolated avulsion fracture of greater and lesser tuberosity (Neer one part).
4. Paralytic limb.
5. Associated other fracture of same limb interfering with assessment of outcome.

6. Those who are not willing for surgery.

After hemodynamic stabilization, detailed clinical history and clinical examination was undertaken from the patients who have been admitted in department of Orthopaedics. Patients were treated with appropriate analgesics. Then splinted with U-slab and cuff & collar was given. AP, lateral and axillary view radiographs and CT scan / special views were taken preoperatively. These were reviewed by the Neer's classification of the proximal humerus fracture. All patients were operated with deltopectoral approach. The drain was removed on 1st or 2nd post-operative day. The time for commencement of shoulder rehabilitation was determined by stability of fixation, quality of bone, and compliance of patient. Passive ROM exercises (i.e. pendulums, passive forward elevation and external rotation) generally were begun on the first postoperative day. The patient then progressed through a three-phase rehabilitation program, consisting of passive assisted exercises early, active exercises starting at approximately 6 weeks postoperatively, and strengthening or resisted exercises beginning 10 to 12 weeks after surgery. Shoulder strengthening and resistance exercises were initiated only after bony consolidation was confirmed on plain radiographs and adequate coordination of the extremity had been achieved.

Patients will be followed up at 6 weeks, 3 months 6 months and 1 year with radiographic evaluation and clinical examination and functional outcome. All patients at each assessment undergo radiological and functional evaluation using the Constant score [6].

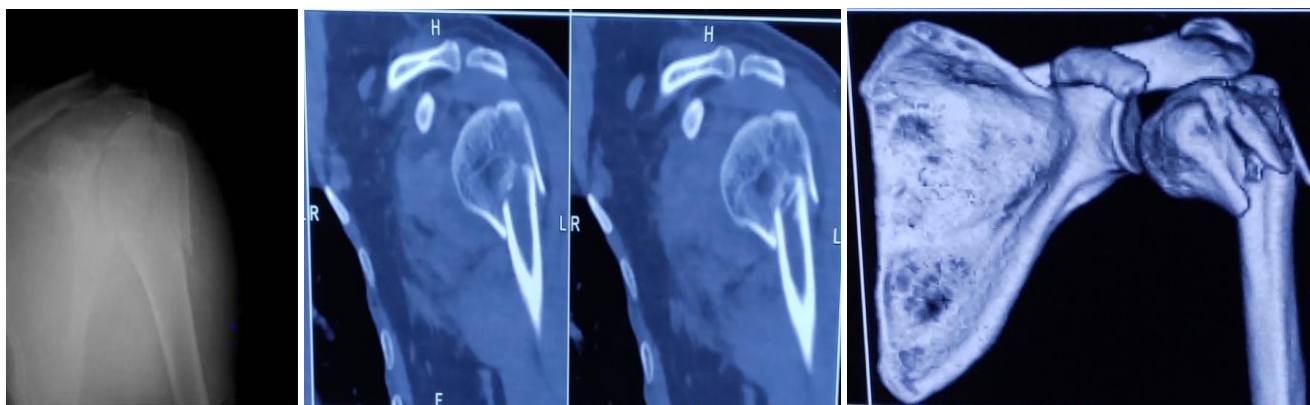


Fig 1: Pre-op X ray and CT scan

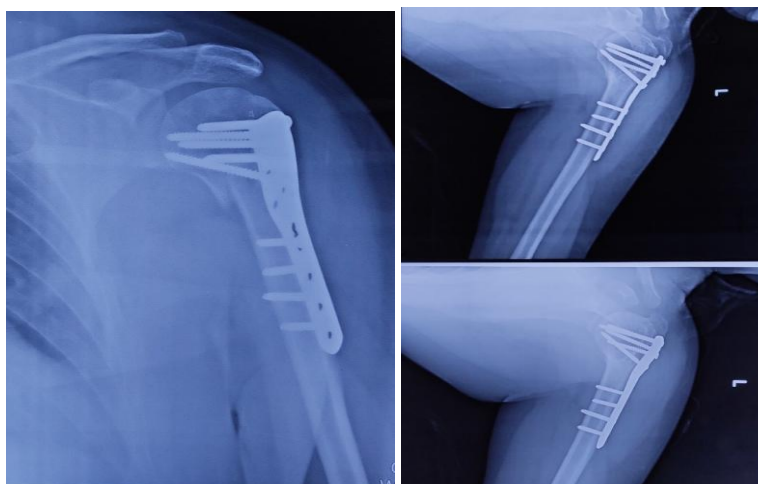


Fig 2: Post Op



Fig 3: Range of Motion

Results

This study comprises the sample of 30 patients, in which 11 were females and 19 were males. The age distribution was varied from 20 years to 75 years with an average age of 49.67 years. 11 patients belongs to 20-40 age group, 10 patients belong to 41-60 age group, 9 patients belong to 61-80 age group. Out of 30 patients, 19 patients were victim of road traffic accident, 9 patients had fall, 1 patient was victim of assault and 1 was victim of an animal attack. 17 patients had

right side and 13 patients had left side fracture of the proximal humerus. 11 patients were 2 parts fracture and 19 patients were 3 parts fracture. Radiologically, time to union ranged between 12 to 18 weeks. Constant score was found to be poor in 3(10.0%) patients, 10(33.3%) patients had moderate score, 7(23.3) patients had good score and 10(33.3) patients had excellent post-op scores at 1year of follow-up. Mean Constant score is 73.63 with minimum score of 48 and maximum score of 90 at 1 year follow-up.

Table 1: Constant Score Vs Age

Age	Constant Score				Total	Fisher's Exact Test p-value
	Poor	Moderate	Good	Excellent		
20 – 40 Years	0	0	2	9	11	<0.001*
	0.0%	0.0%	18.2%	81.8%	100.0%	
41 – 60 Years	0	6	3	1	10	
	0.0%	60.0%	30.0%	10.0%	100.0%	
61 – 80 Years	3	4	2	0	9	
	33.3%	44.4%	22.2%	0.0%	100.0%	

* $p < 0.05$ Statistically Significant, $p > 0.05$ Non- Significant, NS

In 20-40 years, age group 81.8% of the participants had excellent outcome and 18.2% of the participants had good outcome. In 41- 60 years age group only 10% participants had excellent outcome, 30% had good and 60% had moderate outcome. In 61 – 80 years age, 22.2% of the participants had good outcome, 44.4% had moderate and 33.3% had poor outcome. There was a significant reduction in favorable outcome with increase in age ($p < 0.001$).

In our study there were 6 case got complicated in which 3(10.0%) cases had stiffness, 1(3.3%) case superficial skin infection, 1(3.3%) case plate impingement and 1(3.3%) case fixation failure.

Discussion

Poor functional outcome proximal humerus fractures are mainly due to inadequate fracture reduction of the medial cortex, unstable fixation and incorrect positioning of the fixation plate. In the study conducted by Moonot *et al*, they found that regardless of the procedure and the implant chosen, a good functional final result depends mainly on anatomical reduction of the fracture combined with a stable fixation, and early initiation of functional rehabilitation of the shoulder [7]. But in this study, we found that younger age group patients who had early fixation of fracture, had better functional outcome and this was found to be statistically significant.

Patients with good bone quality have previously been treated successfully with the conventional plate osteosynthesis [8]. In normal conventional plates, the chance of backing out or

cutting out of screws is more. It is difficult to hold the bony fragments as they are highly fragile due to osteoporosis, thereby affecting proper reduction. In the very old age group with osteoporosis, functional outcome after conventional plate osteosynthesis was poor [9]. 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 [10].

With advent of locking plates, the fraction of backing out or cutting out of screws are reduced due to the locking head and fixed angle present in fixed angle screws. Due to multidirectional nature of screws in the locking plate, which spans through sphericity of head and not the center alone, increases pullout strength thereby reduces the failure in fixation and collapse of head of humerus.

Suturing of rotator cuff tendons with eyelets of plate is possible in locking plates which reduces the risk in fixation of free small fragments of osteoporotic bone which was otherwise hard to fix, and also reduces the possibility of collapse.

The good clinical result obtained in our study, with a mean Constant score of 73.63 points at 1 year follow-up is comparable with other studies of internal fixation of proximal humerus fractures. The outcome seems to correlate with fracture severity, anatomic reduction, age of the patient, etiology, bone quality, length of time elapsed from injury to surgery, concomitant injuries and the exact positioning and fixation of the plate [11]

Table 2: Functional scores achieved with different treatment options for proximal humeral fractures in the current literature [12-18].

Study	Type of Fixation	Constant Score	Neer's Classification
Kuchel <i>et al.</i> (2006)	Cloverleaf 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, screw & k wires	72.1	3- & 4-part Fracture
Wijgman <i>et al.</i> (2002)	Classic T plate cerclage	80.0	3- & 4-part Fracture
Hessman <i>et al.</i>	T plate	69	2, 3- & 4-part Fracture
Our study	PHILOS	73.63	2 & 3-part Fracture

The complications found in our study were, 3 cases (10%) with stiffness, 1 case (3.3%) with impingement, 1 case (3.3%) with superficial skin infection and 1 case (3.3%) with implant failure. The superficial skin infection rate in our study was comparable to Paavolainen *et al.* who had infection rate of 2.5% (2 / 41 patients) [19]

Conclusion

PHILOS plating has a good functional outcome for proximal humerus fractures. Accurate anatomical reduction and early fracture fixation are essential for good functional outcome. A proper surgical technique will minimize complications and an aggressive rehabilitation regime will ensure the best possible functional outcome for the patient. There is no much difference among 2 & 3 parts of fracture with locking plate. All are nearly more or less with good function outcome.

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