

# Proximal Humerus Fracture: Surgical Outcome and Complications in A Prospective Study Of 99 Patients and review of literature

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## Abstract

**Objective:** To report the outcomes of proximal humerus fracture operated with angular stability locking plate with regards to fracture pattern.

**Design:** Prospective clinical study.

**Setting:** Level 1 trauma center.

**Patients:** During a 24-month period, 99 patients with proximal humerus fracture with OTA type 11A, 11B, 11c were treated operatively with open reduction and internal fixation with angular stability locking plate at a level 1 trauma center. 37 patients were OTA type 11A, 33 and 29 patients were OTA 11B and OTA 11C respectively.

**Main Outcome Measurements:** Radiological outcome, functional outcome and complication of proximal humerus fractures with respect to fracture pattern, age, and gender.

**Results:** At 1 year follow up DASH score, Constant Murley score and range of motion showed a significant difference with respect to fracture type. Outcome was better in <50 years of age group while gender showed no difference. Varus collapse was observed with 5 cases, stiffness and restricted mobility in 4 patients, implant loosening and avascular necrosis in 3 patients each, post op infection, rotator cuff weakness, screw backout, screw penetration and sub acromial impingement due to superior plate placement was found in 1 patient each.

**Conclusions:** Angular Locking plate fixation for proximal humerus fracture gives satisfactory results, good functional and radiological outcome. Occurrence of complications is independent of age and gender. Older patients (>50 years of age) have inferior functional outcomes as compared to younger patients (<50 years of age).

**Keywords:** PHILOS, Angular stability locking compression plate, Proximal humerus fracture, Neer's fracture

## Introduction

Proximal humeral fractures (PHF) are the seventh most frequent fractures [1] and third most common fracture seen in elderly persons, with an incidence of 82 per 100,000 person-years, with an annual increase in the rate by 13.7% over the past 33 years [1-3]. They comprise of 45% of all humeral fractures [4, 5]. Nonunion, malunion and avascular necrosis resulting in a painful dysfunction is associated with conservative treatment [6-8]. Good results are seen in several clinical studies with PHF fixation with angular stability locking plates (ASLP) in relation to shoulder function [9, 10].

Studies done so far have not shown any conclusive evidence on outcomes of PHF fixed with proximal humerus ASLP with regards to fracture pattern. According to some studies the functional outcome does not depend on fracture type, also few studies gives us information about influence of fracture type, age and gender on complications [14-16]. Thus with this background we decided to do a prospective study that will help us in better understanding of the functional outcome with each Neer's fracture and OTA classification type, and influence of various factors affecting complications.

## Materials and Methods

This was a prospective study conducted in our hospital over 24 months duration. Patients were screened using the inclusion and exclusion criteria. They were assessed clinically and radiographs were taken. Informed consent and approval from the ethic committee were taken for all the patients included in the study. Inclusion criteria was closed OTA 11A, 11B, 11C proximal humerus fractures in skeletally mature patient. Exclusion criteria were Pathological fractures of proximal humerus, skeletally immature patients and patients with neurological degenerative disorders.

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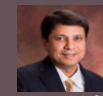
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Table 1- Constant Murley and DASH score with respect to Fracture pattern				
SCORES AT 1 YEAR	OTA 11A (Neer's 2part)	OTA 11B (Neer's 3part)	OTA 11C (Neer's 4 part)	p value
Constant Murley	83.24±9.26	80.79±13.61	74.52±10.79	0.009
DASH	20.19±9.18	20.87±10.19	28.83±10.64	0.001

Table 2- Comparison of Range of Motion with Each Fracture type				
ROM(MEAN)	OTA 11A (Neer's 2part)	OTA 11B (Neer's 3part)	OTA 11A (Neer's 4part)	p value
FLEXION	165 ±20.62	161 ±20.66	160 ±20.59	0.032
ABDUCTION	148 ±26.54	152 ±23.22	146±23.31	0.045
EXTERNAL ROTATION	60 ±18.45	59 ±17.16	56 ±16.40	0.011

Table 3- Constant Murley and DASH score with respect to Age (<50years and >50 years)			
SCORES AT 1 YEAR	Age≤50 years	Age≥50 years	p value
Constant Murley	81.56±12.58	78.00±10.61	0.048
DASH	20.79±11.03	25.34±9.59	0.031

Table 4- Comparison of range of motion with normal side					
Range of Motion	Affected Side (n=99)		Unaffected (n=99)		p-value
	Mean	SD	Mean	SD	
Flexion	160.3	21.16	179.7	2.24	< 0.001
Abduction	146.87	24.81	179.49	2.99	< 0.001
Extension	53.74	8.43	59.75	1.8	< 0.001
External Rotation	56.11	18.09	89.29	4.1	< 0.001
Internal Rotation	78.08	15.92	90	0	< 0.001

Table 5- Table showing complications and their percentage		
Complications	Number of patients	Percentage (%)
Varus collapse	5	26.3
Stiffness and restricted mobility	4	21.1
Implant loosening	3	15.8
Avascular necrosis	2	10.5
Avascular necrosis and post op infection	1	5.3
Rotator cuff weakness and stiffness	1	5.3
Screw backout and varus collapse	1	5.3
Screw penetration	1	5.3
Sub acromial impingement due to superior plate placement	1	5.3
<b>Total</b>	<b>19</b>	<b>100</b>

A total of 99 patients with proximal humerus fractures were operated with open reduction and internal fixation with proximal humerus locking plate in which 58 male and 41 female patients were there; mean age was 48.4±14 (20-75) years. 37 patients were OTA 11A

(Neer's 2 part), 33 and 29 patients were OTA 11B (Neer's 3 part) and OTA 11C (Neer's 4 part) respectively. Surgical procedure was carried out by standard deltopectoral approach, with the patient in supine position with sandbag

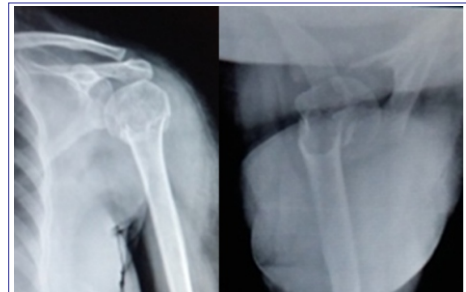


Figure 1a: OTA 11A Fracture



Figure 1b: Good Reduction in immediate post-operative radiograph

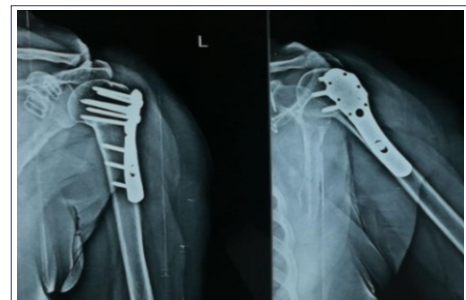


Figure 1c: Radiological union at 1 year followup



Figure 1d: Good range of motion at 1 year followup

under the shoulder. After the exposure the head fragment was manipulated by periosteal elevator introduced in the fracture gap. After reduction of the head fragment tuberosities were fixed and fracture reduction was temporarily secured by using 2 or 3 K-wires. With help of fluoroscopic guidance reduction and position of fragments was confirmed. Rotational alignment was checked by accessing the course of bicipital groove. Angular stability proximal humerus locking

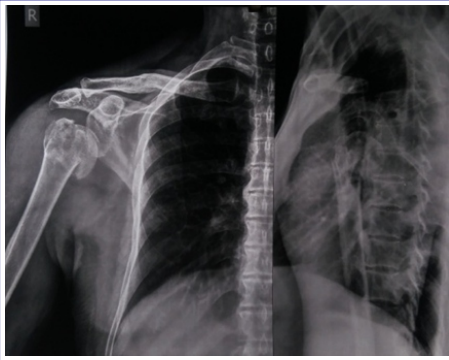


Figure 2a: OTA 11C Fracture

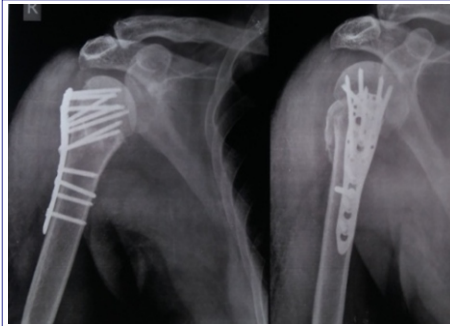


Figure 2b: Good plate positioning and good fracture alignment in immediate post-operative radiograph

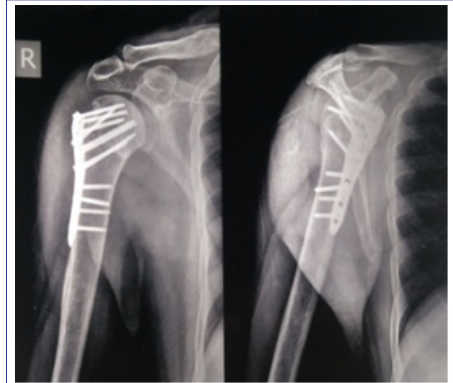


Figure 2c: Well united fracture at 1 year followup



Figure 2d: Good range of motion at 1 year followup

plate was positioned around 2mm to 4mm posterior to the bicipital groove and around 5mm to 8mm distal to the top of greater tuberosity. Definitive fixation was done with locking screws after fracture reduction and plate was fixed at an appropriate position using minimum 5 locking screws in head and minimum 2 distal locking screws. Tuberosities were fixed to plates with help of suture knots. Immobilization of shoulder was done with universal shoulder immobilizer for at least 2 weeks. Passive range of motion was started as early as possible. After 2 weeks duration, gravity assisted pendulum exercises were done. Shoulder bracing and full elbow range of motion exercises were allowed for the first 3 weeks. At 3 weeks post operatively, assisted forward elevation and supine external rotation with stick were performed. After a radiological evidence of fracture healing, supervised shoulder stretching and strengthening exercises with the help of thera bands were started.

Patient was followed up on 1 month, 3 months, 6 months and 1 year after treatment. At each follow up patient assessed using DASH and Constant-Murley scoring system. Range of motion in the form of flexion, abduction, extension, external rotation and internal rotation were noted.

Data analysis was performed by using SPSS (Statistical Package for social sciences) version 25:0, Qualitative data variables

**Table 6- Review of literature and various complications**

	Owsley et al <sup>30</sup>	Hepp et al <sup>31</sup>	handschin et al <sup>10</sup>	Our study
Follow-up period (mean)	44 months	12 months	19 months	12 months
No. of Patients	53	83	31	99
Cases with Complications	19	26	6	19
Screw penetration	12	12	--	1
Varus inclination	13	3	--	6
Avascular necrosis	2	4	2	3
Delayed union	-	-	-	--
Nonunion	-	3	-	--
Subacromial impingement	-	2	2	1
Adhesive Capsulitis	-	-	-	1
Infection	-	1	-	1
Wound problem	-	-	-	--
Heterotrophic Ossification	-	-	-	--
Implant Failure	-	1	1	3
Rotator Cuff tear	-	-	1	--
Fixation failure	-	-	-	--

expressed by using Frequency and percentage (%), Quantitative data variables expressed by using Mean and SD, ANOVA test used to compare the mean constant score, DASH score, ROM with respect to fracture pattern, Unpaired t-test used to compare the mean constant score, DASH score, ROM with respect to Age group and Gender. Chi-square test used to compare management for complication with respect to Neer's classification, p-value <0.05 considered as significant

**Results**

Mean follow up was of 1 year. With respect to fracture pattern, statistically significant difference was found in DASH score and

Constant Murley Score. (Table- 1) With respect to fracture classification impaired flexion, abduction and external rotation was found in at the end of 1 year. (Table-2) No statistical impact was found in extension and internal rotation at 1 year. Age cause reduced Mean DASH score at 1 year while no difference was observed for Constant Murley Score. (Table-3) Significant difference was found in flexion (p value 0.013) and abduction (p value 0.011), external rotation (p value 0.003) and internal rotation (p value 0.003) when age factor is considered at 1 year. No statistically significant difference is found in extension (p value 0.073) at 1 year. With respect to gender, no statistically significant was found in DASH score (p value 0.511),

Constant Murley score ( p value 0.306) and shoulder ROM( p value >0.05) at 1 year. There was no statistically significant difference in the range of motion between operated and unoperated limb, indicating good results following the procedure (Table-4).

Total seven patients underwent further management for complications, five patients underwent longer supervised physiotherapy (four patients with stiffness and restricted mobility and one patient with rotator cuff weakness and stiffness) which subsequently lead to improved range of motion in them. Hemiarthroplasty was done in one patient with avascular necrosis, which lead to decrease in pain and improved function. One patient of avascular necrosis with infection required implant removal and debridement, culture specific antibiotic was given (Table-5).

With respect to complications, no statistically significant was between fracture types ( p value 0.475 ), age ( p value 0.444 ) and gender ( p value 0.610 ) at 1 year.

## Discussion

In our study, at final follow up mean Constant Murley and DASH score is least for OTA 11C followed by OTA 11B and OTA 11A respectively which was comparable to other studies [10, 11]. Underlying reason may be, it is technically demanding to hold reduction and fix the implant in correct position in OTA 11C fracture followed by OTA 11B and OTA 11A fracture, and quality of reduction dictates the final functional outcome [12, 13]. Constant Murley score decreased as the degree of comminution increased. Some studies showed no correlation between the Neer's fracture type and the final functional

outcome as they found significant relationship between poor score and poor anatomical reconstruction [14-18]. There was a significant difference in the flexion, abduction and external rotation between the three types of fracture fixed with angular stability proximal humerus plating at the end of one year, which further adds to the evidence that OTA 11C fractures have lower functional outcomes followed by OTA 11B and OTA 11A fracture pattern. Apart from fracture pattern the functional outcome also depends on the position of the plate and screws which will be easier to achieve in OTA 11A fracture followed by OTA 11B and OTA 11C fracture respectively [19-24].

Patient's age is a parameter that has an influence on the final result, old age has decreased functional outcome, our study which showed lower mean Constant Murley score (78) for age >50 years and higher (81.5) Constant Murley Score for age <50 years which is also observed in other studies [24-27]. Lower DASH score (20.79) in age group <50 years and higher DASH score for age >50 years (25.34) were noted. Comparable finding was observed in other studies [28][29].

With respect to gender no statistically significant difference was found at the end of one year with respect to constant score ( p value 0.306), DASH score ( p value 0.511) and range of motion, this is because similarity in the mechanism of injury, bone mass and anatomy of the shoulder region in both the genders

In our study out of 99 patients, 19 patients had complications out of which 7 patients underwent further management of complications in form of supervised physiotherapy or surgery (Table-6).

We have found that the occurrence of

complications is independent of fracture type, age and gender of the patient, none of the studies which have been done so far to the best of our knowledge has shown these results. (Table-6) The factors contributing to complications include how well the dissection has been performed, for achieving a good clinical result, adequate reduction of the proximal humeral fracture is essential. [30-33] More patients with implant failure were observed in our study due to more patients in elderly age group may be who has senile osteoporosis and non-compliance of the patients to physiotherapy protocol. Prospective design of this study gives advantage and sample size of 99 patients further strengthen our views on the final functional outcomes and factors affecting complication

Limitations to our study were the average follow up was 12 months and quality of bone as determined by DEXA scan or Tingart index as in osteoporosis was not taken into consideration, which has effect on the final functional outcomes.

## Conclusion

In our study we concluded that as the complexity of fracture increases the functional outcome decreases. Older patients (>50 years of age) have inferior functional outcomes as compared to younger patients (<50 years of age). No difference in functional outcomes is there between males and females. The occurrence of complications is not dependent on the complexity of fracture, age or gender. Good range of motion is achieved after fixing these fractures with locking plates Fig:1(a-d) , Fig:2(a-d).

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