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A study of long term results of the use of proximal humeral locking plates (PHLP) for the fixation of proximal humerus fractures

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Abstract
Background: Proximal humeral fractures are one of the commonest fractures in elderly population. They are right behind hip and distal radius fractures in incidence constituting about 1/7th of all fractures. Due to the debatable management of proximal humerus fractures in elderly population, we decided to evaluate the long term outcome of the same.
Method: In this study 62 patients having proximal humerus fracture were included who were treated with locking plate fixation over a period of 4 years. Out of those patients, 51 patients who completed 3 years of follow up were evaluated for this study by using Constant Morley score (CMS). We used SPSS 16 for statistical analysis. (P <0.04).
Result: Excellent outcome was seen in 17.64%; Good in 35.32%; Moderate in 33.32% and Poor in 13.72%. Score was found to be less in AO-OTA Type 3 fractures & for older patients (>60 years age). Loss of fixation was seen more with a varus malalignment. Complications included Infection, avascular necrosis, loss of fixation, axillary nerve palsy, screw perforation of head and sub acromial impingement.
Conclusion: The use of PHLP for fixation of Proximal Humerus fractures leads to reasonably good functional outcomes. It is much better than the use of non-locking plates. However the procedure requires extensive surgical skill and knowledge of mechanisms of locking plates.

Keywords: Proximal humerus fracture, proximal humerus locking plates (PHLP)

Introduction
Proximal humerus fractures are one of the most common fractures in the elderly. Minimally displaced proximal humerus fractures can be treated successfully none operatively. However, displaced fractures require surgical intervention.
Various types of surgical intervention have been studied and described. These include Tension band wiring, intramedullary nailing, closed reduction and percutaneous pinning, Plate fixation and hemiarthroplasty. In comminuted fractures, closed reduction is unstable [1]. Surgical management of three and four part fractures is necessary to achieve proper functioning, but it involves extensive surgical exposure and damage to vascular supply of bony fragments.
Neer classification system[2] and AO/ASIF classification systems have been shown to be insufficiently reproducible, hence appropriate treatment protocols have not been able to applied successfully.
Research suggests that plates with locked screws can improve fracture stability and healing by mechanically recreating a point of cortical bone contact. These plates also have a preconfigured shape and predetermined screw direction, thus reducing hardware complications. The results with new locking plates have been proved to be really good. Hence with this study, we aim to review long term results of PHLP fixation of proximal humerus fractures at our institution.

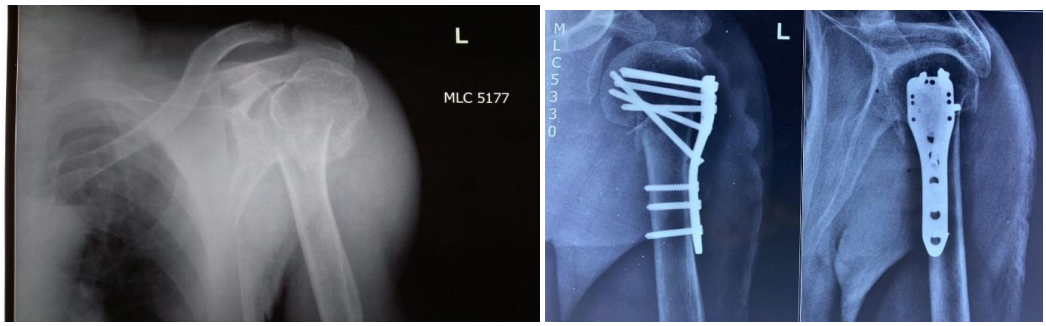
Materials and Methods
Our study was performed from July 2015 to February 2019 at the Department of Orthopedics, Shardaben General Hospital, Ahmedabad, India. The average follow up period was 20 months. (20 months (12-36 months). There were 21 women and 30 men in our study with a mean age of 62.4 years (21-76). Out of the 51 patient in the study, 28patients were above the age of 65

years which suggests a strong relation of proximal humerus fractures with osteoporotic conditions. 35patients suffered fracture due to fall down, 14 patients suffered fracture from road traffic accident and 2 patient suffered fracture from direct assault. AP and trans axillary radiographs of shoulder were taken of all patients at time of injury, after surgery and during follow-up. These were used to classify the fracture and measure the fracture displacement and head-neck angle. CT scan was used in some fractures as well.

We classified the fractures using AO/OTA classification system. Out of 51 patients, were 16 Type IIA (2-part), 19were Type IIB (3-part) and 16 were Type IIC (4 part). All of these patients met the operative indications given by Neer *et al*. angulation of the more than 45 degree of articular surface OR displacement of more than 1 cm between the major fracture fragments. Hemiarthroplasty is used for management of fracture dislocations in the physiologically elderly, head-splitting fractures and impression fractures that involve more than 40% articular surface.

Case Scenario

A 60 year old male patient came with history of Road Traffic Accident and a left sided Proximal Humerus fracture. The fracture was classified as a Type IIB fracture according to AO/OTA classification system. The patient was operated with a Proximal Humerus Locking Plate (PHLP).



Pre OP Post OP

Fig 1: X-ray images of Pre OP and Post OP

Operative Technique: These cases were operated by a senior orthopedic surgeon. Anesthesia was decided by consultant anesthetist. Preoperative IV antibiotics were given. Patients were placed in supine position with C-arm positioned parallel to the patient at the head of the table. A delto pectoral approach was used. The biceps tendon was identified and retracted exposing the fracture. If the biceps tendon as found to be interposed in the fracture fragment, it was mobilized. Traction sutures were placed around the tendon-bone interface of rotator cuff and tuberosity fragments. If the head fragment was involved, it was reduced from its typical varus position through manipulation of the arm. Traction sutures wee then used to bring the fragments beneath the head to buttress the articular fragment. The reduction was then kept in place by k-wires and was checked under IITV. After confirming reduction, the traction sutures were then passed through proximal eyelets on the plate and PHLP was applied lateral to the bicipital groove. A non-locking screw was introduced into the slotted gliding hole on the plate. Minor adjustments in plate height and position were made under IITV guidance. Locking screws were then inserted into the head and the shaft. Negative suction drain was put and closure done. The arm was put in a sling support in post-operative period.

Periodic dressing was done. Drain was removed 72 hours post op. Patient discharged from hospital at Day 5 if no evidence of infection. Stitch removal done on day 15. Periodic follow up of patient done at 1 month, 3 month, 6 months. Wrist and elbow mobilization was started immediately post op. Pendulum exercise started at 4 weeks post op. Passive to active range of motion with physiotherapist was started at 4-6 weeks post op. Once fracture union was ensured, resistive strengthening was begun.

A record was made of all postoperative complications. Routine clinical and radiographic examinations were performed 4 to 6 weeks and 3 months after surgery. In our study average follow-up is of 20 months. At final follow-up shoulder ROM and strength was evaluated by a neutral person. We also looked for signs of fracture healing, loosening of implants, loss of fixation, non-union, mal union, avascular necrosis of the head of humerus. Radiological healing was said to have been achieved when all fragments showed cortical continuity. Functional outcome was assessed using Constant-Murley score. The outcome was divided on basis of this score into Excellent (86-100), Good (71-85), Moderate (56-70) or Poor (0-55 points). To assess the potential effect of learning curve on the outcome we divided the patients into 2 groups; those operated after January 2017 and those operated before December 2016.

Results

At final follow up, mean forward flexion was 122 degrees, mean abduction was 112 degrees. Mean external rotation and abduction were not found to be significantly improved. This was likely due to extensive surgical dissection.

Our analysis suggests that patients with Type C fractures had the lowest Constant scores while patients with Type A had the highest Constant scores and these results were statistically significant (p value 0.037). The scores were found to be higher in younger patients. This result was also statistically significant (p value = 0.11). Overall outcome was found to be moderate to excellent in 86% of these patients. Almost 13% patients had poor outcome. (Table 1)

On the initial shoulder AP radiograph, the angle of displacement was measured between the inferior edge of the head fragment and the adjacent edge of shaft. Average initial head-shaft displacement was found to be 25 mm on average. Average time of union was 21 weeks. A varus head shift on postop X rays and follow up x rays is a strong predictor of poor outcome. A valgus shift does not have significant effect on the Constant score. We also found that patients operated by us earlier (before Dec 2011) had somewhat inferior Constant scores at follow up as compared to the patients operated by us later on (after Jan 2012).

Table 1: Results

Outcome	No. of cases	%age of cases
Excellent	9	17.64
Good	18	35.32
Moderate	17	33.32
Poor	7	13.72

Table 2: Constant and Murley Score[8]

No.	Question	Responses	
	During the past 4 weeks,		
1	Pain :	Severe	
		Moderate	
		Mild	
		None	
2	Activity Level	Unaffected sleep Y/N	
		Full Recreation/Sport Y/N	
		Full Work Y/N	
3	Arm Positioning	Up to waist	
		Up to xiphoid	
		Up to neck	
		Up to Top of Head	
		Above Head	
4	Strength of Abduction (Pounds)	0	13 to 15
		1 to 3	15 to 18
		4 to 6	19 to 21
		7 to 9	22 to 24
		10 to 12	>24
	Range Of Motion		
5	Forward flexion	31 to 60 degrees	
		61 to 90 degrees	
		91 to 120 degrees	
		121 to 150 degrees	
		151 to 180 degrees	
6	Lateral Elevation	31 to 60 degrees	
		61 to 90 degrees	
		91 to 120 degrees	
		121 to 150 degrees	
		151 to 180 degrees	
7	External Rotation	Hand behind head, elbow forward	
		Hand behind head, elbow back	
		Hand to top of head, elbow forward	
		Hand to top of head, elbow back	
		Full elevation	
8	Internal rotation	Lateral thigh	
		Buttock	
		Lumbosacral Junction	
		Waist (L3)	
		T12 Vertebra	
		Interscapular (T7)	
Grading the Constant Shoulder Score (Difference between Normal and Abnormal side) >30 Poor 21-30 Fair 11-20 Good <11 Excellent			

Discussion

Proximal humerus fracture is the most common fracture of the shoulder and the second most common site of fracture in the upper limb after distal radius. Treatment of these fractures focuses on the displaced fracture fragments, as these may have limited vascularity and may benefit from reduction and fixation. According to Neer's classification [2], 1 part fractures which are >85% of proximal humerus fractures should heal successfully after a brief period of immobilization followed by early physiotherapy. In our retrospective study, we included displaced 2, 3 and 4-part fractures. In elderly patients fragility of the bone and comorbidities complicates the management of fracture.

On analysis of results of other techniques, Stableforth[3] followed by Fallow [4] *et al* found upto 90% satisfactory results with a suture tension band in 3 part fractures and upto 100% in 2 part fractures. This technique is less reliable in younger patients with complex high energy fractures or multiple extremity injuries. Kristiansen and Christensen reported 45% satisfactory results according to Neer criteria for AO T plate for 3 part fractures [9] Savolainen *et al* obtained 63% results using the same technique but positioning the T plate more inferiorly on the greater tuberosity [7]. To avoid complications of T plate, Esser used a cloverleaf plate and obtained 92% satisfactory results [5].

Bjorkenheim *et al* described the result of 72 elderly patients (mean age 67 years) with isolated proximal humerus fracture treated by a Locking compression plate.[7] 36 patients (50%) achieved a good or excellent Constant score at 1 year follow up. Reduced scores were noted in elderly patients and those

with Type C fractures. There were 2 cases of nonunion, 3 cases of osteonecrosis and 19 cases of Varus malalignment. Initial varus malreduction increases the risk of fixation failure. Fankhauser *et al*. described loss of proximal screw fixation and varus malalignment in 10% cases. They recommended augmenting the proximal fixation with sutures placed through the rotator cuff and attached to the plate [6, 10]

The results of our study showed Excellent to Good outcomes in around 52.96% patients. These results were inferior to those reported in Western literature. We found that patients operated by us earlier showed inferior results and higher rate of complications as compared to those operated later with a p value of 0.084 on Chi square analysis suggesting a significant result. This leads us to conclude that application of locking plate for proximal humerus fractures has a steep learning curve. Our results were also found to be inferior in AO-OTA type 3 fractures and in patients older than 65 years. However, our results in older patients are better than those of traditional plates used in such osteoporotic fractures. We believe that a locking plate for proximal humerus fractures gives a satisfactory functional outcome in most patients including old age and poor bone density patients.

Various complications were encountered in this study. 2 of our patients showed Varus malalignment in immediate post op period. 4 other patients showed varus collapse in follow up. Loss of reduction was noted in all 6 of these patients. None of the patients having a neutral or valgus alignment showed a loss of fixation at follow up. Thus we conclude that varus malalignment was a strong predictor of loss of fixation.

We did not have any case of nonunion or delayed union. 2 of our cases showed axillary nerve palsy but it did not require any intervention. 2 of our patients with Type C fractures showed symptomatic humeral head AVN and were later operated with hemiarthroplasty with good results. 5 patients showed sub acromial impingement. Superficial wound infection was seen in 5 patients treated with IV antibiotics and Dressing. Deep wound infection seen in 3 patients. 2 of them were treated with debridement surgeries. 1 patient needed implant removal.

In our study we found a promising result of proximal humerus locking plate in management of displaced and comminuted proximal humerus fractures. We noted a trend towards improved fracture reduction with a mean displacement of 2.2 mm and valgus head neck alignment with a mean angle of 140.2 degrees in the proximal humerus locking plate. Our data does not establish a relationship between ROM and fracture alignment. 6 patients had a loss of reduction after implant loosening of proximal fragments. Varus malreduction has been found to be a predictor of loss of reduction and must be avoided.

Limitation

In our study we did not have a control group treated by a different modality for comparison. So we are unable to determine if any other method would have led to different results. However our results are better than those of previous studies where other modalities have been used. A significant sample size and adequate follow up period are strengths of our study.

Conclusion

With this study, we believe that a proximal humerus locking plate provides an excellent stable construct even in multi fragmented osteoporotic proximal humerus fractures and gives a satisfactory functional outcome over long term follow up in most patients. The results are less promising in elderly patients and Type C fractures, but those results are still good enough to recommend the use of these plates for fixation. Early loss of fixation is indicated by a Varus malalignment and hence it must be avoided. Initially the rate of complications is higher as the surgery has a steep learning curve. However, meticulous soft tissue handling, strict adherence to principles and aggressive post-operative rehabilitation gives us good and satisfactory long term functional outcomes.

References

1. Handoll HH, Gibson JN, Madhok R. Interventions for treating proximal humeral fractures in adults. Cochrane Database Syst Rev. 2003; 4:434.
2. Neer CS II. Displaced proximal humeral fractures. Part I. Classification and evaluation. J Bone Joint Surg Am. 1970; 52(6):1077-1089.
3. Stableforth PG. Four part fractures of the neck of humerus. J Bone Joint Surg Br 1984; 66:104-8.
4. Flatow EL, Cuomo F, Maday MG, Miller SR, McIlveen SJ, Bigliani LU. Open reduction and internal fixation of two-part displaced fractures of the greater tuberosity of the proximal part of the humerus. J Bone Joint Surg Am. 1991; 73(8):1213-1218.
5. Esser RD. Treatment of three- and four-part fractures of the proximal humerus with a modified cloverleaf plate. J Orthop Trauma. 1994; 8(1):15-22.
6. Fankhauser F, Boldin C, Schippinger G, Haunschmid C, Szyszkowitz R. A new locking plate for unstable fractures of the proximal humerus. Clin Orthop Relat Res. 2005; (430):176-181.
7. Björkenheim JM, Pajarinen J, Savolainen V. Internal fixation of proximal humeral fractures with a locking compression plate: a retrospective evaluation of 72 patients followed for a minimum of 1 year. Acta Orthop Scand. 2004; 75(6):741-745.
8. Constant CR, Murley AH. A clinical method of functional assessment of the shoulder. Clin Orthop. 1987; 214:160-4.
9. Kristiansen B, Christensen SW. Plate fixation of proximal humeral fractures. Acta Orthop Scand. 1986; 57(4):320-323.
10. Moonot P, Ashwood N, Hamlet M. Early results for treatment of three- and four-part fractures of the proximal humerus using the PHILOS plate system. J Bone Joint Surg Br. 2007; 89(9):1206-1209.