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The use of locking plates in proximal humerus fractures-functional outcome based on age and fracture pattern

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Abstract

Background: Proximal humerus fractures accounts for 4-5% of all fractures. This is the third most common fracture in the elderly population. Surgical treatment is advised for displaced proximal humerus fractures. This study was done to evaluate the functional outcome of fractures operated with locking plates and to evaluate any significant difference of outcome present between age (< 60 years and > 60 years) and fracture pattern (AO Type A, B, C).

Materials and methods: This is a Prospective study conducted at Government Kilpauk Medical College Hospital. 25 cases of proximal humerus fractures operated with proximal humerus locking plates. Post operatively functional outcome was evaluated with Constant Murley Shoulder score and radiological followup.

Results: In our study, 14 cases were < 60 years and 11 cases were > 60 years. The mean constant score was 86.75 and 67.1 for < 60 and > 60 years respectively and it was statistically significant. The difference in the functional outcome of three fracture types was statistically significant with a p value of 0.048.

Conclusion: Proximal Humerus Locking Plate is the implant of choice for treating displaced proximal humerus fractures. It provides stable internal fixation, allows early mobilisation and prevents secondary loss of fixation. The functional outcome was decreased in elderly individuals when compared to younger individuals. More complex initial fracture patterns have decreased functional outcome postoperatively, hence adequate stable fixation and appropriate physiotherapy and rehabilitation protocols should be followed to achieve optimal functional outcome.

Keywords: Proximal humerus fractures, PHILOS Plating, Calcar screws

Introduction

Proximal humerus fractures account for 2 to 4% of all upper limb fractures. The treatment modality depends upon many factors like mechanism of injury, patient's health and activity level, bone quality and initial fracture pattern. Fracture that are undisplaced or minimally displaced are treated conservatively and fractures that are displaced require surgical treatment. Seventy five percent of proximal humerus fractures occurs in older patients aged more than 60^[1, 10]. The mechanism of injury in this patients are a low energy trauma. The risk factors associated with fractures in older age group are osteoporotic bone quality, associated medical comorbid conditions, complex fracture pattern because of poor bone quality. Most of the fractures were treated conservatively or by semi rigid fixation. Recently with the increased use of proximal humerus locking plate the functional outcome of fixation of these fractures has improved a lot. This series has 25 cases of proximal humerus fractures, all were fixed with proximal humerus locking plate. The outcome was analyzed by the pain, range of movements, ADL and stability (bony union) using the Constant Murley scoring system.

Materials and methods

This is a prospective study of 25 proximal humerus fracture cases treated surgically with Proximal Humerus locking plate fixation. The functional outcome of patients with proximal humerus fracture treated by locking plate fixation was evaluated in our study.

In our study, we also evaluated any significant difference in the functional outcome in patients with age less than 60 and more than 60 and between fracture types A, B, C classified using AO classification.

Study Design: Prospective Study

Study Period: February 2016 to September 2017

Study Population: 25 cases were randomly selected with proximal humerus fractures admitted in Government Kilpauk Medical College and Hospital.

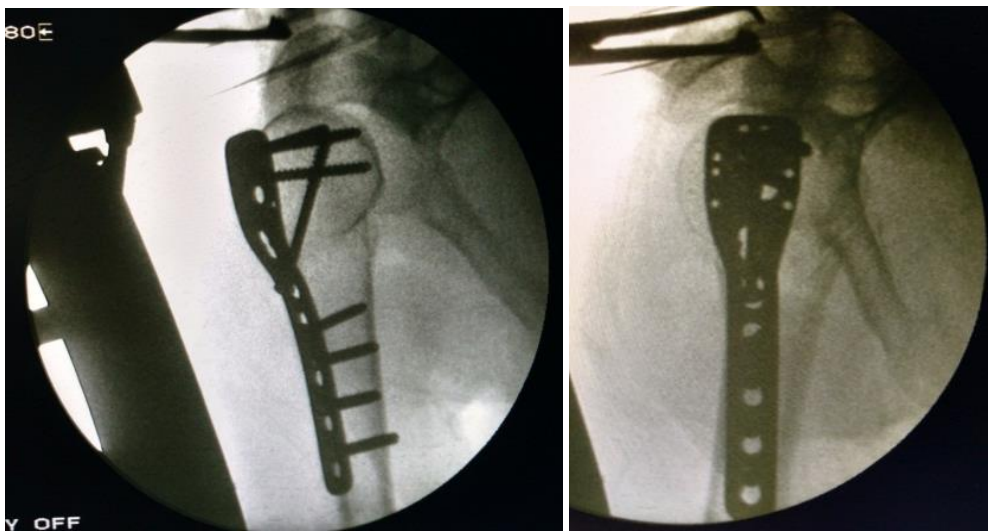
Study Centre: Government Kilpauk Medical College & Hospital.

Surgical procedure

All patients were positioned supine on the operating table with a sand bag placed in the Interscapular Region. All

patients were operated with standard Deltopectoral approach. The interval was developed, the deltoid was retracted laterally along with cephalic vein and the Pectoralis major was retracted medially. Biceps tendon was used as a landmark between the two tuberosities. The capsule of the shoulder joint was never opened. The reduction of articular surface was indirect using the image intensifier. Kirshner wires (K wire) were used temporarily to hold the reduced fragments. Non Absorbable suture materials (Ethibond 5) were used to restore the greater tuberosity anatomy. Screws are applied in different directions in the head for better stability and holding of the head fragment. The Calcar screw is then applied. Then the shaft screws were applied. 3.5 mm cortical non-locking screws were applied first in the shaft for better approximation of the plate to the bone. Finally, screw positions and stability of fixation was checked under image intensifier.

Intra Op Pictures



Results

In our study 14 cases were < 60 years and 11 cases were > 60 years. The mean constant score was 86.75 and 67.1 for < 60 and > 60 years respectively and it was statistically significant. The difference in the functional outcome of three fracture types was statistically significant with a p value of 0.048.

Post Operative Protocol

Following surgery, the operated arm was immobilized in a shoulder sling. Postoperative rehabilitation is important to achieve a optimal functional outcome. Adequate and stable fixation allows early rehabilitation and functional recovery. Hughes and Neer devised a three phased rehabilitation protocol. The application of this protocol is variable and it depends upon factors such as stability of fixation, fracture pattern, and patient's compliance towards rehabilitation. Elbow, wrist and fingers active ROM exercises were started immediately after surgery.

Discussion

Recent studies shows that the incidence of proximal humerus fractures have increased to 7% of all fractures and 80% of all humerus fractures. The treatment option depends upon many factors such as fracture pattern, patient's age, quality of the bone, patient's functional demand and associated comorbid conditions and patient's general wellbeing. Many studies conducted in the past support nonoperative

management of undisplaced proximal humerus fractures. The indications for nonoperative treatment are patients with undisplaced or minimally displaced fractures, valgus impacted fractures, patients not medically fit for surgery and elderly patients with low functional demand. But prospective studies conducted in the past reveals marked functional impairment may occur in the setting of fracture treated non operatively and this patients are reported to have chronic pain at the affected arm.

The outcome predictors which determine the results of treatment of a proximal fractures are Age of the patient and AO/OTA classification of fractures. The main aim of the surgical fixation is to achieve anatomical reduction and stable fixation of the tuberosities, restore the rotator cuff mechanism and to give a functional outcome which is near normal to the preinjury status of the patient.

Open Reduction and Internal Fixation is the frequently used method of surgical treatment. Over the past five decades, fixation with compression plates and screws has been the standard treatment modality. High rates of postoperative fracture displacement and varus collapse has been reported with conventional compression plate and screw fixation. This is found especially in elder patients owing to the osteoporotic nature of the bone. This led to the advent and popularizing of locking plates.

Locking plates are precontoured and vary in terms of number of proximal locking screws and their arrangement and also

vary with ability to place screws at different angles with regards to the plate. Locking plates allows angular stability between screws and plates. Constructs using locking plates are biomechanically superior in strength and more resilient than constructs using nonlocking plates. They help to prevent postoperative displacement and varus collapse of the fractures.

Osterhoff *et al* in a recent study emphasized about the use of calcar screws in the prevention of secondary loss of reduction. Calcar screws are applied tangentially to the medial curvature of the surgical neck of humerus. Previous studies report that use of calcar screws have complications like axillary nerve damage, screw cut out and avascular necrosis of humeral head especially when done percutaneously as in minimally invasive technique.

Loss of reduction and varus malunion results in short lever arm of rotator cuff and subacromial impingement because of decreased acromio humeral distance. In this study, they concluded that the placement of calcar screws prevents secondary loss of reduction by providing inferomedial support.

In our study, we have analyzed twenty five cases of proximal humerus fractures which were treated surgically using Proximal Humerus Locking plates in Govt. Kilpauk Medical College Hospital.

Out of 25 cases, 13 cases were males and 12 cases were females. In a study conducted by Hawkins and Bell involving 15 patients and in a study conducted by Kristiansen *et al* involving 565 patients with proximal humerus fractures shows female preponderance. This is attributed to advanced osteoporosis in elderly women.

The average age of the patients in our study is 52 years and this corresponds with reports of studies conducted by Hawkins, Bell and Gurr, Cornell CN, Pagnani M J and Flatow *et al*. Also in our study we studied the functional outcome of proximal humerus fractures based on patient's age. Patients

who are less than 60 years and patients with more than 60 years age are divided into two groups and their outcome studied.

In our study, we had statistical significance in the constant scores between patients with age less than 60 and in patients with age more than 60 and this results were concurrent with study conducted by Agarwal *et al*. The mean functional scores in younger age group is 86.75 and mean value in elderly patients is 67.10 and the statistical significant value is (p-0.00). This may be due to osteoporotic bone quality, initial fracture pattern, associated comorbid conditions and patients poor compliance in post operative physiotherapy and rehabilitation protocols. Hence proper preoperative counseling should be given regarding the variable results and high surgical caution should be excised.

Age		
N	Valid	25
	Missing	0
Mean		52.50
Median		55.00
Minimum		22
Maximum		72

Mann-Whitney Test

Ranks					
	Age	N	Mean	Mean Rank	p value
SCORE	< 60 yrs	14	86.7500	16.50	
	> 60 yrs	11	67.1000	5.50	.000
	Total	25			

In our study, the fractures are classified using AO/OTA classification of proximal humerus fractures. There were 7 patients in Type A fractures, 11 with Type B, 7 in Type C fractures. In our study, we found that there is statistical significance between the mean functional constant scores of the patients within Type A, B, C with a p value of 0.048.

Classification					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	7	27.3	27.3	27.3
	B	11	45.5	45.5	72.7
	C	7	27.3	27.3	100.0
	Total	25	100.0	100.0	

The mean age of the patient with classification Type C is 61.5 years. Also type C fractures initially have more displacement of fracture fragments which makes reduction difficult intraoperatively and adversely affects the fracture stability. As already stated, initiation of rehabilitation phases depends upon many factors such as fracture pattern, stability of fixation and patients compliance, these factors cumulatively may have reduced the functional outcome of patients with type C

fractures. We consider age as a confounding factor in this statistically significant association. The limitation of our study is small sample size and this association have to evaluated in further studies.

The average Constant Score in our study was 77.8 and this score was in concurrent with the results of similar studies conducted in the past.

Study	Bulent <i>et al</i> . 2008	Martinez <i>et al</i> . 2009	Handschin <i>et al</i> . 2009	Our study 2017
Constant Shoulder Score	75.5	81	80	77.8

Conclusion

Proximal Humerus Locking Plate is the implant of choice for treating displaced proximal humerus fractures. This variable angle locking plate provides stable internal fixation, allows early mobilisation and prevents secondary loss of reduction and hence we recommend the use of proximal humerus locking plate in osteoporotic fractures. Anatomic restoration of tuberosities should be achieved for optimal functional outcome postoperatively. The use of Calcar screws prevents

secondary loss of reduction by providing inferomedial support. The functional outcome was decreased in elderly individuals when compared to younger individuals. More complex initial fracture patterns have decreased functional outcome postoperatively, hence adequate stable fixation and appropriate physiotherapy and rehabilitation protocols should be followed to achieve the optimal functional demand of the patient.

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