

Assessment of Functional and Radiological Outcome in Patients of Proximal Humerus Fractures Managed by Proximal Humerus Locking Compression Plate - A Longitudinal Observational Study from Moradabad, Uttar Pradesh

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ABSTRACT

BACKGROUND

The proximal humerus fractures are mostly undisplaced fractures. Various complications which were encountered with the closed treatment included: sub-acromial impingement, malunion, shoulder pain, avascular necrosis, stiffness secondary to osteoarthritis and the rotator cuff deficiency. In order to overcome these complications, trend has shifted towards surgical management. The present study was conducted to assess the functional and radiological outcome in patients with proximal humerus fracture managed by proximal humerus locking compression plate.

METHODS

This was a longitudinal observational study (combination of retrospective and prospective design) conducted in the Department of Orthopaedics in Teerthanker Mahaveer Medical College and Research Centre, Moradabad. All patients with proximal humerus fractures under Neer's classification who fulfilled our inclusion criteria were included. The radiological assessment was done by union, complication or any failure on x-ray and functional outcome was assessed by University of California at Los Angeles (UCLA) score. Surgery was performed under general/brachial anaesthesia in beach chair position. Delto-pectoral approach was used. Injectable antibiotics (3rd generation cephalosporin) and analgesic (paracetamol/tramadol) were given for 3 days after surgery. Post op. X- ray of shoulder with arm antero-posterior and lateral view were taken on 2nd day of surgery.

RESULTS

A total of 34 patients were included in the study who were followed up for a minimum of one year. At the end of the follow up, 25 patients showed union except for 3 non-union, 1 delayed union, 2 valgus and 2 varus deformity, 2 avascular necrosis (AVN) and 2 infections. The functional outcomes were excellent in 5 patients, good in 14 patients, fair in 9 patients and poor in 6 patients.

CONCLUSIONS

Proximal humerus locking compression plate is a safe and effective procedure for the management of proximal humerus fracture for young as well as older age group individuals with good functional outcome. The complications are acceptable and can occur in any hospital with any experienced surgeon.

KEYWORDS

Proximal Humerus, Fracture, Compression Plate

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BACKGROUND

Proximal humerus fractures account for 5.7 % of all the fractures, with an overall incidence rate of 63 cases per thousand adult individuals per year. The incidence is increasing due to population ageing and osteoporosis. About 80 % of these fractures are stable and minimally displaced, while the remaining 20 % are displaced and are unstable and may have disrupted vascular supply.¹

The incidence is higher in the older individuals due to osteoporosis and fall onto an out stretched upper extremity is the most common mechanism. High-energy trauma typically in young patients leads to proximal humerus fracture resulting in more severe fractures and dislocation.¹

Conservative treatment was done for a short period of immobilisation in a sling and analgesia was given followed by various rehabilitation and physiotherapy regimes. Better functional results with early physiotherapy commencing within two weeks from injury has been associated than prolong immobilisation.² Various complications which were encountered with the closed treatment included: sub-acromial impingement, malunion, shoulder pain, avascular necrosis and stiffness secondary to osteoarthritis and the rotator cuff deficiency.³

Numerous authors have concluded that non-operative management may be used for two, three, and four-part proximal fractures in elderly individuals but there have been high percentages of pain and loss of function reported in this approach. The fracture stability is determined by the fracture displacement. The goal of operative management is to restore proximal humerus anatomy with stable fixation that restores early range of motion.⁴

Traditional surgical treatment methods included percutaneous or minimally invasive techniques such as pinning, osteosynthesis using cancellous screws, open reduction and internal fixation with proximal humeral plates and intramedullary nails and hemiarthroplasty.⁵ Surgical treatment is necessary especially in young patients and active elderly people in order to prevent minimal dislocations of tuberosity or articular surface from compromising the long term articular function.⁶ The principal behind this is to provide a smooth, lubricated surface for articulation and to facilitate the transmission of loads with a low frictional coefficient.

The new locking plates are so designed for fixation of proximal humerus giving special consideration to anatomy of the proximal humerus. Biomechanically, these implants are not very stiff and their locking screw head ensures that periosteal blood flow is not impaired. So they are best suited for osteoporotic bones.⁷

Complications which have been associated with the locking compression plate fixation include screw perforation into glenohumeral joint or humeral head, screw loosening and backing out, secondary implant dislocations from the humeral head, avascular necrosis of the humeral head, pseudoarthrosis with a broken plate, subacromial impingement requiring plate removal, non-union, malunion due to loss of purchase in the humeral head, broken distal screw with separation of the plate from the bone and transient axillary nerve palsies.⁷

The aim of the treatment in proximal humerus fractures is to achieve a painless mobile and functional shoulder. These results depend on age, medical condition, bone quality and expectations of the patient as well as a good evaluation of the current fixation technique.⁸ The objective of the study was as follows:

Objectives

This study was conducted to assess functional and radiological outcome of proximal humerus fracture after being managed by locking compression plate method and to assess any complications with the use of proximal humerus locking compression plate.

METHODS

This was a longitudinal observational study conducted on 34 patients with proximal humerus fracture at Department of Orthopaedics, Teerthanker Mahaveer Medical College and Research Centre, Moradabad having previous records of 2 year (February 2017 - February 2019) with follow-up of at least 1 year (March 2019-March 2020). These patients were managed with proximal humerus locking compression plate. All fractures were classified as per the criteria of Neer's classification (1 Part fracture, 2 Part fracture, 3 Part fracture and Fracture dislocation).

Inclusion Criteria

Age between 18 - 60 years and both genders, closed fractures, fractures < 2 weeks, and open grade Gustilo Anderson 1 and 2.

Exclusion Criteria

Any other ipsilateral injury, patient with neurological deficient, patients with any previous shoulder pathology, and frozen shoulder. All the fracture was classified using plain radiographs (antero-posterior and lateral views) and computerised tomography (CT) scans. Surgery was performed through a deltopectoral approach in all the patients who were followed for functional and radiological examination for a minimum of one year.

Operative Technique

The patient was mounted on the radiolucent operation table with a sandbag under the spine and medial border of the scapula in the supine position to push the affected side forward while allowing the arm to fall backward. The entire shoulder joint and the proximal part of arm is prepared, so that extension of the incision can be done. Arm should be draped and free as it will have to be moved during the surgery. To decrease venous pressure, the head end of the table was raised to 30° - 45°. Operative procedure was done under Brachial or general anaesthesia. Deltopectoral approach was used. Firstly, following the delto-pectoral groove line, straight skin incision was made of approximately

10 - 15 cm, incision was started just above the coracoid process, and then internervous plane which lies between deltoid muscle and pectoralis major muscle was made and then groove was formed between fascia overlying pectoralis major and deltoid muscle. Cephalic vein medially and deltoid laterally was retracted. Before accessing the anterior portion of shoulder joint, the biceps short head and the coracobrachialis were medially displaced and simple medial retraction was provided to the overlying fascia to reveal the proximal humerus part and then the locking compression plate was inserted once the fracture was reduced.

Post-Operative Follow Up (Figure 1)

Injectable antibiotics (3rd generation cephalosporin) and analgesic (paracetamol/tramadol) were given for 3 days after surgery. Post-operative X- ray of shoulder with arm antero-posterior and lateral view were taken on 2nd day of surgery. Each patient was given shoulder immobilizer immediately post-operatively. Sutures were removed after 12 days from the first day of surgery. Active assisted range of motion exercises of the shoulder were started as soon as the pain subsided.

Data Collection

Retrospective cases from past 2 years were called at the commencement of study and data was recorded. New patients enrolled were discharged after suture removal and were explained about the physiotherapy and were followed up for every 3 months consecutively, after that every 6th month for minimum of 1 year. Patients were assessed functionally by UCLA score and radiologically by assessing the X-ray (antero-posterior and lateral view) for signs of union, any complications or to look for any implant failure.

Statistical Analysis

Data collected was tabulated in an Excel sheet, under the guidance of statistician. The means and standard deviations of the measurements per group were used for statistical analysis (SPSS 22.00 for windows; SPSS inc, Chicago, USA). Difference between the subjects according to age and gender was determined using Fisher exact test as well as chi square test and the level of significance was set at P < 0.05.



Figure 1. Pre- Post Op X-Rays and Clinical Picture

RESULTS

The mean age of the patients in this study was 40.47 ± 14.09 years with minimum age of patient being between age group of 41 - 50 years and maximum age group > 50 years. More than half of the patients were males (52.9 %) in this study. Right side was involved among majority of the patients (71 %). Majority of the patients in our study had Neer’s 2-part fracture (58.8 %) followed by fracture-dislocation (23.5 %), 3-part fracture (11.8 %) and minimum number of patients with 1-part fracture. Most of the patients had road traffic accident (70.59 %) followed by fall from height (26.47 %) and trivial trauma (2.94 %) as a mode of injury. Table 1 shows the distribution of patients according to type of fracture. More than half of the patients had 2-part fracture (58.8%).

Type of Fracture Neer’s Classification	No. (N=34)	%
1 Part fracture	2	5.9
2 Part fracture	20	58.8
3 Part fracture	4	11.8
Fracture dislocation	8	23.5

Table 1. Distribution of Patients According to Type of Fracture

At the final follow up, functional outcomes were excellent in 5 patients, good in 14 patients, fair in 9 patients and poor in 6 patients according to UCLA score. No patient was lost to follow up. Age-wise average UCLA score distribution.



1a. Pre-Op

There was no significant difference in outcomes between age of the patient with the final outcome (P – value = 0.779). There was no significant difference in outcomes between gender of the patient with the final outcome (P - value = 0.56) as shown in [Table 2].

Age in Years	No. of patients	Excellent No. %	Fair No. %	Good No. %	Poor No. %	Fisher Exact Test	p-Value
< 30	9	2 22.2	3 33.3	4 44.4	0 0.0	3.98	0.779
30 - 40	9	0 0.0	2 22.2	5 55.6	2 22.2		
41 - 50	6	1 16.7	3 50.0	2 33.3	0 0.0		
>50	10	2 20.0	1 10.0	3 30.0	4 40.0		
Gender							
Male	18	2 11.1	6 33.3	8 44.4	2 11.1		
Female	16	3 18.8	3 18.8	6 37.5	4 25.0		

Table 2. Association of Final Results with Age and Gender

There was a significant difference in mean UCLA between final follow up, 1st month, 2nd month, 3rd month and at 9 months. It can be well appreciated from table 3 that there is continuous improvement in the mean UCLA at all the intervals.

No nerve injury, vascular injury or implant failure was observed. Of all the 34 patients, 25 patients healed uneventful in a good anatomical position. 3 patients reported non-union who were re-operated, 1 delayed union, 2 valgus and 2 varus deformity, 2 AVN and 2 infections.

UCLA Follow-Up	Mean ±S. D	P-Value
At 1st month	18.20 ± 5.08	< 0.002*
At 2nd month	21.53 ± 5.90	
At 3rd month	26.33 ± 5.38	
At 9th month	27.73 ± 5.14	
Final follow up	27.73 ± 5.14	

Table 3. Comparison of Mean UCLA between Final Follow Up, 1st Month, 2nd Month, 3rd Month and at 9th Month

DISCUSSION

In the past few decades, with the increase in the proportion of population with osteoporosis, there had been a rise in patients with proximal humerus fractures. Various studies had shown that failure rate has increased as there is adverse effect in anchorage of internal fixation due to osteoporosis. There had been / were various methods for fixation of proximal humerus fracture in the past which had variable outcomes. Sadowski in the year 2003 had done a study, in which he used Plant Tan plate fixation for proximal humerus fracture which showed 100 percent complication rate especially in elderly, with most common complication being penetration of proximal screw.⁸

In the present study, nearly one third of the patients were < 30 & > 50 years (29.4 %) followed by 30 - 40 (23.5 %) and 41 - 50 (17.6 %) years. The mean age of patients was 40.47 ± 14.09 year ranging from 18 - 60 years. This study found that more than half of the patients were males (52.9 %). In a study done by Vinoth et al. in the year 2017, 20 patients were included in the study having mean (SD) of 47.9 (11.9) and years ranging from 20 years to 65 years with majority being females (60 %).⁹ Vijayvargiya et al. in his study in year 2016, found that the mean age of the patient in his study was 46 years with minimum and maximum age of the patient being 22 years and 68 years respectively. The

ratio of male and female was 1.3:1 with predominance of male.¹⁰

This current study observed that more than half of patients had 2-part fracture (58.8 %) followed by fracture dislocation (23.5 %), 3 part fracture (11.8 %) and 1 Part fracture (5.9 %). Vinoth et al. in his study in year 2017, found that most common type of fracture was 2-part fracture which was 60 % (12 patients), fracture-dislocation was 10 % (2 patients), 3 part was 35 % (7 patients) and 4 part fracture was 5 % (1 patient).⁹ Vijayvargiya et al. in his study done in the year 2016 found that most of the fracture was 3-part fracture which was 46.1 % followed by 4 part fracture which was 34.7 %, with the minimum patient of 2 part fracture which was 19.2 %.¹⁰

In our study, we revealed that more than half of the patients had road traffic accidents (70.59 %) followed by fall from height (26.47 %) and trivial trauma was (2.9 %). In the study done by Vinoth et al. in the year 2017, it was found that half of the patients had fall on ground which was the most common mode in his study followed by the road traffic accidents which was 30 %. 1 patient had post epileptic seizure which caused the fracture.⁹ Vijayvargiya et al in his study done in 2016 found that predominant mode of injury was due to fall which was 53.8 % followed by the road traffic accident which was 46.2 %.¹⁰

The radiological assessment of our study found that fracture united and union was seen among more than one third of patients (44.1 %) at 1st follow-up. Fracture united and union was seen in half of the patients at 2nd follow-up (50 %) and in 66.7 % at 3rd follow-up. United was in majority of the patient at 4th follow-up (90.1 %). In the study by Vijayvargiya et al. done in year 2016, all the 26 patients showed fracture being united radiologically and clinically without any patient lost to follow up.¹⁰

In this study, out of total 34 patients, 32 patients (94.1) fracture had united at final follow up. In the study done in year 2018 by Dr. Vaibahv and Dr. Channabasava on total 30 patients reported that all the patient with proximal humerus fracture had radiological union (100 %).¹¹

In our study, 2 patients had valgus (5.8 %) and 2 patients had varus (5.8 %) as complication on radiological assessment. In a study done in the year 2007 by Bulent et al. on 22 patients, 2 patients had fixation associated varus deformity.¹²

Our study revealed that excellent result was in 20 % patients of age < 30 and > 50 years of age. Fair result was in half of the patients of age 41 - 50 years (50 %). In the present study, excellent result was higher among female patients (18.8 %) than males (11.1 %). Good result was higher among male patients (44.4 %) than females (37.5 %). However, there was no significant (P>0.05) association of final results with gender.

Vinoth et al. in the year 2017 reported that the functional outcome score was not associated with age (spearman's rank correlation coefficient was 0.121; p=0.612) and sex (P = 0.076).⁹ Vijayvargiya et al. in the year 2016 reported that when he compared the composite score in reference with age group (< 50 and > 50), the difference between the group was significant (P=.032) between two groups.¹⁰

Locking plates provide better stability than conventional plates which was used in the past. It gives better functional outcome and also decreases complications as demonstrated by many authors. Due to this, the use of locking plates has become the standard protocol for open reduction and internal fixation of proximal humerus fractures mainly in the elderly patients with poor bone quality.^{13,14}

The functional outcome also depends upon the stability provided by the implant. All the forces are transmitted from the bone via the locking head screws to the blade in the locking plate system and vice versa. Hence, these plates enable a gain in the torsional stiffness and stability and hence promote a superior outcome and low chances of complications like cut-out of the screws and plates, non-union, avascular necrosis, and fractures distal to the plate.¹⁵

Study	No. of Cases	Patient Age in years	Follow up Months	No. of Complications		
				Infection	Non-Union	Avascular Necrosis
Bjorkenheim et al. (2004)	72	67	>12	0	2	3
Hente et al. (2004)	31	60.7	18.5	0	0	5
Kettler et al. (2006)	176	66	9	3	1	14
Koukakis et al. (2006)	20	61.7	16.2	0	0	1
Charalambous et al. (2007)	25	63	6	1	2	1
Rose et al. (2007)	16	51	12	0	4	0
Fazal & Haddad (2009)	27	56	13	0	1	1
Klic et al. (2008)	22	56	12	0	1	2
Korkmaz et al. (2008)	41	-	14.6	0	0	0
Nourozi et al. (2012)	37	50.1	12	2	0	1
Present study (2020)	34	40.47	12	2	3	2

Table 4. Comparison of Different Studies with Our Studies in Which PHILOS Plates Were Used to Manage Proximal Humerus Fracture¹⁶

CONCLUSIONS

In our study, majority of the patients (90.1 %) showed radiological fracture union without any nerve or vascular injury. Plate fixation gives good functional outcome in proximal humerus fractures with early mobilisation. We concluded that proximal humerus locking compression plate was a safe and effective procedure for the management of proximal humerus fracture for young as well as older age group individuals with good functional outcome. The complications were acceptable and can occur in any hospital with any orthopaedic surgeons.

Limitation

There are two major limitations to this study. First, the number of patients were less and the mean time to follow-up was short. This study suggests that a large sample size and longer follow-up period will further validate the results obtained here in. Also, the study did not include 4-part fracture as per Neer’s classification.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
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