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A PROSPECTIVE STUDY TO ANALYZE THE OUTCOME OF PROXIMAL HUMERUS FRACTURE MANAGED WITH PROXIMAL HUMERUS LOCKING PLATE

Orthopaedics

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ABSTRACT

Background: The incidence of proximal humerus fractures has increased in last few years due to changes in life style and increase in road traffic accidents. Hence, the challenge of the modern day treatment was to get accurate reductions anatomically, fast healing and early restoration of function. Proximal humerus locking plate revolutionized the treatment without compromising fracture union. The present study aimed to evaluate the functional and radiological outcome of proximal humerus fracture managed with proximal humerus locking plate. **Methods:** This prospective study was conducted at Jhalawar Medical College Hospital for a period of two years from April 2024 to March 2025. 20 cases of proximal humerus fractures in adults after meeting inclusion criteria were participated and treated surgically with proximal humerus locking plate technique. Consent form was taken from all the patients. The final functional outcome was assessed by radiography and DASH scoring system. **Results:** Proximal humerus fractures were found to have high incidence in the 40 to 45 age group which had 37% of the study population. Males predominated over females in our study. Ratio of males to female was 3:1. Right sided fractures are more in the present study in both the sexes. The most common mechanism of injury was fall on the outstretched hand from a standing height or less with minor trauma seen in 34% of patients. High energy trauma was more frequently involved in younger patients (30%). According to Neer's classification two part fractures constituted the most common type 16 (54%) in this study. The collected data was analyzed using SPSS software version 23.0. A p value <0.05 was considered significant. **Conclusions:** The proximal humerus locking plate method for proximal humerus fracture emerges to be safe, effective, reliable fixation with minimal complications.

KEYWORDS

Proximal humerus fracture, Proximal humerus locking plate

INTRODUCTION

Fractures of the proximal humerus represent approximately 4% of all fractures and 26% of humerus fractures. Three and four part fractures (13-16% of proximal humerus fractures) have been a challenge to achieve stable fixation[1]. Humerus fracture Humerus fracture most commonly occur in the elderly due the weakened osteoporotic bone. In younger patients, high-energy trauma is the cause and displacement is often more severe. Treatment options for these displaced fractures include closed reduction and percutaneous screws fixation, closed reduction and percutaneous Kirschner (K)-wires fixation and open reduction and internal fixation.[2]

Insertion of proximal humerus locking plate for proximal humerus fractures has many advantages over conventional treatment. The lack of primary stability with conventional internal fixation for humeral fractures of osteoporotic bone and for comminuted humeral fractures among young people is well known.[3,4] Proximal humerus locking plate provides rigid fixation and more angular stability. Many studies also recommended the management of locking plate as it provides good fracture stability and allows early mobilization of the shoulder without compromising fracture union.[5-8]

The purpose of the present study was to evaluate the functional and radiological outcome of proximal humerus fracture managed with proximal humerus locking plate clinically by evaluating pain, range of motion and muscle power and radiological union of fracture, patient compliance and complications.

METHODS

This was a prospective study conducted at Narayana Medical College Hospital, Nellore for a period of two years from December 2014 to June 2016. The study was initiated after obtaining an ethical clearance from the institutions ethical clearance committee. The indications of operative treatment was carried out according to Neer's classification.[9]

All the patients of either sex with age group 25-55 years with closed fractures and with proximal humerus fractures of all 4 types as per Neer's classification were included in the study. Patients with age >55 years or <25 years, children, pregnant women, patients with neurological deficit, compound injuries and patients unfit for anaesthesia and/or surgery were excluded from the study. 20 patients were included in the study after meeting inclusion criteria. A written informed consent was taken from the patient or a legal heir before recruiting the patients to the study. All the admitted patients were evaluated clinically by both local and systemic examination. Following the clinical examination a radiographic study was done accordingly that includes anteroposterior view, lateral Y-view and axillary view of the scapula. Complete details of the patients including age, patients history, type of fracture, quality of bone were recorded.

Surgical Technique

Surgery was performed in supine position on a radiolucent table under general anaesthesia using the anterior deltopectoral approach, the fracture site is exposed taking care of the soft tissue envelope to maintain a good vascular supply. The cephalic vein was retracted laterally or ligated to prevent inadvertent injury during retractor placement. Exposing the tendon in the bicipital groove, the fracture is then reduced anatomically, and then proximal humerus locking plate is applied onto the proximal humerus, that is open reduction and internal fixation in the below said manner. The greater and lesser tuberosity fragments were tagged with non-absorbable sutures. The tuberosity fragments were reduced to the lateral cortex of the shaft. Reduction of the tuberosities may indirectly reduce the head fragment; alternatively, to restore the medial calcar of the proximal humerus, an elevator was inserted to disimpact the head fragment. If required, the fracture was reduced and provisionally fixed into position using 1.5 mm K- wires, sutures was passed through the rotator cuff and attached to the plate through the suture eyelets before permanent fixation with the contoured proximal humerus locking plate will be performed. On the anteroposterior view, the plate was ideally placed 8-10 mm distal to the superior tip of the greater tuberosity; from the lateral view, the plate was centred against the lateral aspect of the greater tuberosity. An adequate gap was left between the plate and the biceps tendon to prevent disruption of the anterior humeral circumflex artery or entrapment of the tendon. The initial screw was then placed in the elongated hole in the humeral shaft (in classic 3 or 4 part fractures), so that the height of the plate could be adjusted. After achieving the appropriate fracture reduction and plate position, the locked screws were inserted into the humeral head using the insertion guide and sleeve assembly. At least three distal shaft screws were inserted. A final fluoroscopic image was taken to ensure adequate reduction and proper medical support. Rotator cuff, capsule and subscapularis muscle tears/avulsions were repaired meticulously. The wound was closed in layers and a suction drain will be inserted. After the procedure, for pain

relief paracetamol or paracetamol with tramadol was used in all the patients post operatively third generation cephalosporin was used intravenously as recommended by the institutions antibiotic protocol policy. Each operated patient was given a universal shoulder immobilizer immediate post- operatively. The dressing was done accordingly at third and seventh day and the sutures were removed by 12 day. The patient was also encouraged to exercise the hand, wrist and elbow. This is continued for six weeks. Post treatment physiotherapy was also given, gentle passive forward flexion and internal and external rotation exercises were started by the third or fourth week. Active or resistive exercises were permitted by 4 to 6 weeks. The follow up was done post-operatively at 1 month, 3 months and 6 months intervals and the functional outcome was assessed by radiography as shown in Figure 1 and the DASH (disability of arm, shoulder and hand) scoring system. The data collected and recorded in the appropriate proforma.

Statistical Analysis

The collected data was analyzed using SPSS software version 23.0. A 'p' value less than 0.05 was considered significant.

RESULTS

The study consists of 20 cases of proximal humerus fractures in adult treated surgically at Narayana Medical College Hospital for a period of two years from April 2024 to March 2026. Proximal humerus fractures were found to have high incidence in the 40 to 45 age group which had 37% of the study population. Males predominated over females in our study. Ratio of males to female was 3:1. Right sided fractures are more in the present study in both the sexes. None of them had fractures in both the sides. Most of the injuries (57%) were caused by road accidents. The most common mechanism of injury in the present study was fall on the outstretched hand from a standing height or less with minor trauma seen in 34% of patients. High energy trauma was more frequently involved in younger patients (30%). Excessive rotation of the arm, especially in the abducted position was seen in older patients (23%) and direct blow was seen in 13% of patients. According to Neer's classification two part fractures constituted the most common type 16 (54%) in this study. In our study patients were treated by open reduction and plate fixation, in one patient loss of reduction was seen and none of them had shown complications post-surgically.

The outcome of the surgery was assessed using DASH scoring system. In our study there was a significant difference in the pre-operative and the post-operative DASH scoring with a p value of <0.001. But there was no statistically significant difference in the post-operative DASH scoring between the months 1 and 6 (p >0.005) suggesting that the maximum recovery occurs in the immediate post-operative period as shown in Table 1.

Table 1: DASH scoring Among 20 Patients Pre and Post-operatively.

Timepoint	DASH Score			Friedman Test	
	Mean (SD)	Median (IQR)	Range	$\chi2$	P Value
Pre-Operative	36.91 (4.95)	36.00 (7.00)	28.00-48.00	60.0	<0.001
1 Month	26.26 (4.90)	25.00 (4.50)	21.00-40.00		
6 Months	23.71 (1.38)	24.00 (2.00)	21.00-25.00		

Non-parametric tests (Friedman test) were used to make statistical inference as data were not normally distributed. Friedman test was used to explore whether the DASH Score changed significantly over time.

The mean DASH Score decreased from a maximum of 36.91 at the Pre-Operative timepoint to a minimum of 23.71 at the 6 Months timepoint. This change was statistically significant (Friedman Test: $\chi2 = 60.0$, $p = <0.001$).

The Figure 1 is a line diagram depicting the change in DASH Score over time.

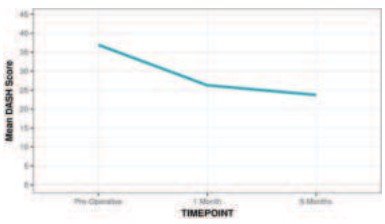

Figure 1: Change in DASH Score Over Time

The Figure 2 is a bar diagram depicting the change in DASH Score over time.

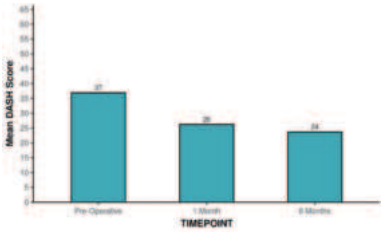

Figure 2: Change in DASH Score Over Time

The Box-and-Whisker plot below depicts the distribution of DASH Score over different timepoints. In each box, the middle horizontal line represents the median DASH Score, the upper and lower bounds of the box represent the 75th and the 25th centile of DASH Score respectively, and the upper and lower extent of the whiskers represent the Tukey limits for DASH Score at each of the timepoints respectively.

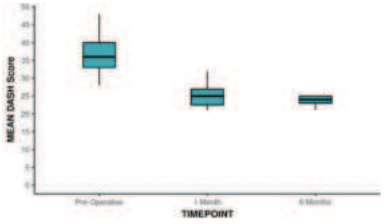

Figure 3: Change in DASH Score Over Time

Post-hoc pairwise analysis was performed to explore at which timepoints the DASH Score differed significantly from the Pre-Operative timepoint. The table 2 summarizes this analysis:

Table 2: DASH Scoring Over Time

Comparison of DASH Score at Various Timepoints vs Pre-Operative	Mean (SD) of Difference	Median (IQR) of Difference	Range of Difference	p value
1 Month - Pre-Operative	-10.66 (2.53)	-11.00 (2.00)	-14.00 - -3.00	<0.001
6 Months - Pre-Operative	-13.20 (4.41)	-12.00 (4.00)	-23.00 - -5.00	<0.001

Post-Hoc pairwise tests for Friedman test performed using Nemenyi Test method for p value correction. Green background denotes statistically significant difference at $p < 0.05$.

The DASH Score differed significantly from the Pre-Operative timepoint at the following timepoints: 1 Month, 6 Months. The maximum change from the Pre-Operative timepoint was observed at the 6 Months timepoint.

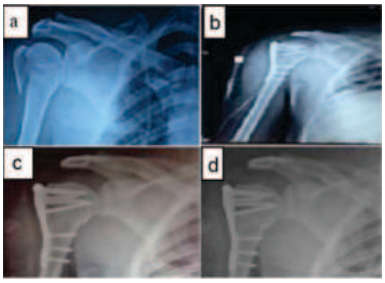

Figure 4: Proximal Humerus Fracture Fixed with Proximal Humerus Locking Plate. a) Preoperatively b) Postoperatively c) 1 Month Follow-up d) 6 Month Follow-up.

DISCUSSION

Treatment for proximal humerus fracture can be done by both non-operative and operative methods. Non-operative management was preferred for common two-part fracture. However displaced two-part fracture and more comminuted three or four-part fracture requires operative management to correct the position of fracture.[10] Various methods were available to treat these fractures. But the treatment with proximal humerus locking plate fixation had met varying degree of success.[11,12] Generally in young people this method of treatment is

successful because of good quality of bone but in elderly due to osteoporosis poor results may be seen.[10]

The incidence of fractures was more common in the people with the mean age group of 49.3 years. And this observation in the present study was comparable with the studies of Jakob et al, Roolker et al and Sohal et al.[13-15] In our study males are more affected compared to females in the ratio of 3:1 and this higher in ratio can be explained by a higher involvement of male in day to day activities than females and this gender related issue in this study was similar with the studies of Kumar et al in which the male:female ratio was 2.19:1.[16]

Vehicular accidents are the most common cause of skeletal injury globally. In our study this act remains as most common cause of proximal humerus fracture with high energy trauma (57%) followed by domestic fall (43%). The major mechanism concerned with fracture was fall on outstretch hand (34%), followed by high energy trauma (30%), excessive rotation of arm in abduction (23%) and direct blow (4%). This observation of the present study was in accordance with the observations of Sohal et al in which 20% of fractures are due to fall on outstretch hand and 68% of fractures are related to high energy trauma.[15]

In this study 22 (73%) patients were affected with proximal humerus fracture on right handed side and remaining 7 (33%) on left handed side. None of them had fracture on both the sides. This feature was similar with the observations of Geiger et al.[7]

According to Neer's classification, two-part fractures were seen in 16 (53%) cases, three-part fractures in 13 (43%) patients and four-part fractures in 4 (3%) cases. Similar reports were observed in a study conducted by Bansal et al in which 11 patients had 2-part fractures, 11 patients had 3-part fractures, and 3 patients had 4-part fractures.[15]

In this study the mean time of union was 11.8 weeks. Complications occurred only in 1 (3%) case. In a study conducted by Kumar et al and Vander et al, the mean time of union observed was 12 and 16 weeks respectively.[16,17] In contrast to our findings, Kumar et al in his study reported complications in 4 cases with varus malunion, 1 case of subacromial impingement, 1 case of deep infection, 1 case of intraarticular screw penetration and 1 case of failure of fixation.[16]

In study of Atalar et al, 10 patients treated with minimally invasive bone grafting and suturing had an average of DASH score 23.18 This was comparable to DASH score of our study in 29 patients after 6 months of follow up.

Thyagarajan et al recommend the use of the proximal humerus locking plate as a surgical option in the management of displaced proximal humeral fractures.19 According to Shahid et al management of proximal humeral fractures with the proximal humerus locking plate were equally good in all the patients but the functional outcome was better in younger patients.[20] Patil et al confirms proximal humerus locking plate produces promising functional outcomes by giving proper anatomical reduction.[21]

CONCLUSION

Our study concludes that the proximal humerus locking plate method appears to be safe, effective, reliable and provides stable fixation for the treatment of proximal humerus fractures in patients with poor bone quality. Number of fracture fragments did not affect the outcome.

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Conflict of Interest: None declared
Ethical Approval: The study was approved by the institutional ethics committee

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