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Original Research

Functional Evaluation of Proximal Humerus Fractures Managed by Locking Plates

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Abstract

Background: Proximal humerus fractures are common orthopedic injuries, particularly in elderly patients. Locking plates have emerged as a preferred fixation method, offering stable fixation and promoting early mobilization. This study aims to evaluate the functional outcomes of proximal humerus fractures treated with locking plates and functional evaluation using the Constant Murley Score (CMS).

Methods: The study utilized 60 cases of displaced proximal humerus fractures classified by Neer's system. All patients underwent open reduction and internal fixation with a (Proximal Humerus Internal Locking System)PHILOS plate. The Constant score assessed functional performance by evaluating three aspects: pain levels combined with motion range restriction and muscle strength and activities of daily life.

Results: This study analyzed 60 cases of proximal humerus fractures. The highest incidence was in the 41-50 age group (40%), with males (65%) more affected. Road traffic accidents were the leading cause (60%). Two-part fractures were most common (50%), and the right humerus was more frequently involved (65%). Most patients (65%) reported to the hospital on the same day. Functional evaluation showed that 40% had excellent outcomes, while 90% achieved union by nine weeks. Complications included osteonecrosis and screw cut-out in isolated cases, but no additional surgeries were required.

Conclusion: Locking plate fixation for proximal humerus fractures demonstrated favorable functional and radiological outcomes. Most patients (90%) achieved fracture union within nine weeks, with excellent to good shoulder function observed in 70% of cases. Two-part and three-part fractures had better functional recovery, while four-part fractures showed higher complication rates.

Keywords: Proximal Humeurs fractures, Unstable humerus Fractures, Locking plate, Functional outcome.

Introduction

Proximal humerus fractures account for 4 – 5% of all fractures. It is the common fracture of the upper extremity especially, in the elderly population due to the presence of osteoporosis and low-energy trauma, such as falls. [1] These fractures tend to impair shoulder functions leading to pain, and reduced range of motion. Treatment options for the management of proximal humerus fractures remain a topic of contention. The treatment options range from conservative management to surgical intervention including open reduction and internal fixation using locking plates. [2] Recently the evolution of locking plate technology has revolutionized the treatment of proximal humerus fractures. These plates provide angular stability and improved fixation in osteoporotic bone in the elderly population. Since locking plates create a fixed angle construct that minimizes screw loosening, they are more suitable for cases of comminuted or unstable fractures. [3] However, despite the advantages there are certain challenges in the use of locking plates which include complications such as varus malunion, screw perforation into the joint, and avascular necrosis of the humeral head therefore, requires a careful surgical technique and patient selection [4]. The results of function following locking plate treatment of proximal humerus fractures depend on fracture anatomy type and bone quality and the surgical approach as well as postoperative recovery protocols. Treatment options rely on the Neer classification system which analyzes the number of displaced fragments to make informed treatment decisions [5]. Multiple studies show varying correlations between fracture classification and

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functional recovery because some research finds locking plates deliver excellent outcomes for complex fractures but others stress that patient-dependent variables like age and medical conditions together with commitment to therapy determine final results [6]. The functional evaluation of proximal humerus fractures requires assessments of the range of motion together with strength evaluation which combines with patient-reported outcomes using the Constant-Murley Score and Disabilities of the Arm, Shoulder, Hand (DASH) questionnaire and Visual Analog Scale (VAS) for pain measurement [7]. The combination of assessment tools gives an extensive perspective regarding patient healing and surgical treatment effectiveness. Researchers are now investigating the benefits of using 3D computed tomography (CT) imaging both before surgery and after procedures to enhance treatment results [8]. The current study aimed to evaluate the functional outcomes of proximal humerus fractures managed by locking plates.

Material and methods

This prospective study was done in the Department of Orthopedics, Medical College and Hospital. Institutional Ethical approval was obtained for the study. Written consent was obtained from all the participants of the study after explaining the nature of the study in vernacular language. A total of 60 cases of displaced proximal humerus fractures classified by Neer's system were utilized in the study. All patients underwent open reduction and internal fixation with a PHILOS plate.

Inclusion criteria

1. All the cases of displaced proximal humerus fractures
2. Males and females
3. Aged 18 years and above
4. Closed fractures
5. Failure of conservative treatment

Exclusion criteria

1. Pathological fractures
2. Pediatric cases
3. Undisplaced fractures

On admission patients' data was recorded which included demographic profiles, injury details, and functional demands. Radiographic evaluations, including standard views and CT scans when necessary for confirmation of diagnosis. Preoperatively, patients were managed with analgesics, immobilization, and treatment for comorbidities. The preoperative evaluation included a detailed history and assessment of the injury mechanism. Radiographic evaluation included anteroposterior (Grashey's), lateral (Neer's-Y), and axillary views. CT scans were utilized when needed to assess intra-articular involvement.

Surgical technique in brief: The patient was positioned supine with a 30-45° head tilting angle with a sandbag placed under the scapula. Two approaches were available for the procedure: deltopectoral and deltoid-splitting. For the deltopectoral approach medical staff needed to find the cephalic vein and then move muscles aside to expose the anterior circumflex artery. Blood supply remained intact throughout the dissection process to prevent devascularization. The reduction process was supported using either K-wire fixation or rotator cuff suturing techniques. The PHILOS plate needed installation on the greater tuberosity in a position that would prevent both vascular damage and impingement. Screw fixation achieved stability in all cases but provided utmost security when dealing with medial comminution. C-arm imaging was used to verify that the procedures had the correct reduction positioning along with proper screw location.

Arm treatment included sling immobilization together with drain removal on the second postoperative day. The rehabilitation plans included starting passive ROM exercises before active ROM exercises and muscle strengthening exercises after stability achievement at week 6 followed by week 10 to week 12. X-ray evaluation through anterior-posterior and scapular-Y views with axillary views was performed at three weekly intervals then six weeks, three months, six months, and twelve months for monitoring fracture healing. We recordedall intraoperative complications during the procedure. The patient received follow-up assessments through radiological tests along with clinical examinations performed at 3 weeks and then at 6 weeks and again at 3 months and 6 months up until 12 months postoperatively. Medical personnel used the Constant score to conduct both functional and radiological final evaluations. Shoulder function assessments through radiographic examinations and clinical tests assessed joint mobility as well as recovery together with the detection of malunion or avascular necrosis as post-operative complications. The Constant score assessed functional performance by evaluating three aspects: pain levels combined with motion range restriction and both muscle strength and activities of daily life. The strength evaluation required patients to maintain a 1 kg weight at 90° abduction or their personal maximum reachable position.

Statistical analysis: All the available data was segregated, refined, and uploaded to an MS Excel spreadsheet and analyzed by SPSS version 21 in Windows format. The continuous variables were denoted as mean, standard deviation, and percentages. The categorical variables were calculated by Pearson's Chi-square test for analysis of p values. The values of ($p<0.05$) were considered as significant.

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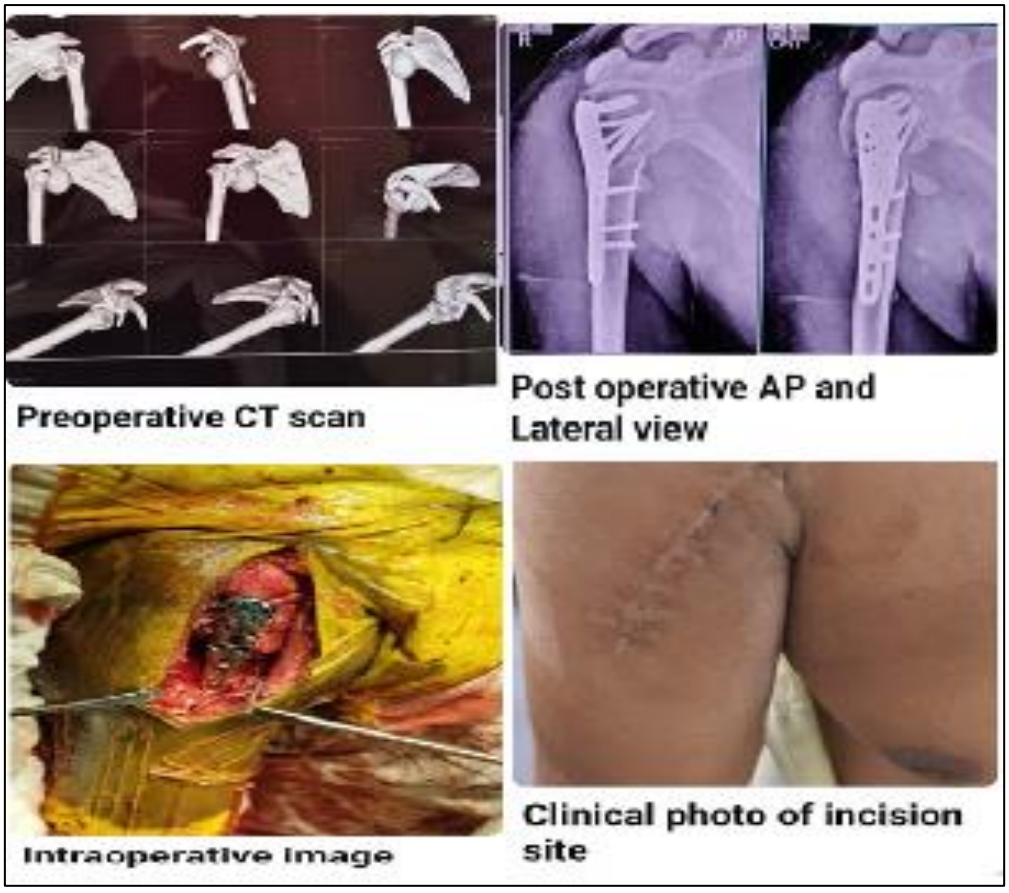

Results

A total of 60 cases of proximal humerus fractures were included in the study based on the inclusion and exclusion criteria. The highest incidence of proximal humerus fractures is observed in the 41-50 age group (40% of cases). The 31-40 age group also shows a significant proportion (30%). Males constitute a significantly larger proportion of the cases (65%) compared to females (35%). This shows a higher risk of proximal humerus fractures in males within this cohort. Mode of Trauma: Road Traffic Accidents (RTAs) are the most common cause of these fractures, accounting for 60% of cases. Falls are the second most frequent cause (30%). Assaults represent a smaller proportion (10%).

Table 1: showing the demographic profile of cases of proximal humerus fractures

	Frequency	Percentage
Age group		
20 - 30	9	15
31 - 40	18	30
41 - 50	24	40
51 - 60	6	10
61 - 70	3	5
Total	60	100
Sex		
Male	39	65
Female	21	35
Mode of trauma		
RTA	36	60
Fall	18	30
Assault	6	10

In this study we found 2-part fractures are the most common (50%), indicating that in half of the cases, the fracture involved two displaced parts (Table 2). 3-part fractures represent 30% of the cases. 4-part fractures are the least frequent (20%). The right humerus is more frequently affected (65%) than the left humerus (35%). This may be because of right-handedness, and the natural protective reactions of

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people. The majority of patients (65%) reported to the hospital on the same day as the injury. 20% reported the next day. 10% after 2 days. 5% after 3 days. Associated injuries were relatively less which included Head injuries, chest injuries, and radius fractures which occurred in 5% of cases (3 patients each).

Table 2: Showing the characteristics of proximal humerus fractures in the cases of the study

	Frequency	Percentage
Neer's Classification		
2-part fractures	30	50
3-part fractures	18	30
4-part fractures	12	20
Side involved		
Left hand	21	35
Right hand	39	65
Delay in reporting to the Hospital		
On the same day	39	65
Next day	12	20
After 2 days	6	10
3 – days	3	5
Associated injuries		
Head	3	5
Chest	3	5
Intertrochanteric	0	0
Lateral malleolus	0	0
Fracture radius	3	5

Table 3 shows the functional evaluation of unstable proximal humerus fractures using the (CMS). Excellent Function: Twenty Four patients (40%) had excellent shoulder function. Good Function: Eighteen patients (30%) had good shoulder function. Moderate Function: Fifteen (25 %) patients achieved moderate shoulder function. Poor Function: Three patients (5%) had a poor shoulder function. Moderate shoulder function was observed in three of five cases. This shows that three of the five patients with moderate shoulder function had 4-part fractures. 3-part and 2-part fractures achieved good and excellent functions because less complex fractures (2-part and 3-part) generally resulted in better outcomes.

Table 3: Functional evaluation using Constant-Murley Score (CMS)

Constant-Murley Score (CMS)	Shoulder function	Frequency (%)
90 – 100	Excellent shoulder function	24 (40%)
80 – 89	Good shoulder function	18 (30%)
70 – 79	Moderate shoulder function	15 (25%)
60 – 69	Poor shoulder function	3 (5%)
< 60	Very Poor shoulder function	0(0.0%)

54 out of the 60 patients achieved union at approximately 9 weeks of follow-up, accounting for 90% of the total cases. The exceptions were 6 cases complicated by osteonecrosis. In 3 cases with a four-part fracture, there was a screw cut out. Although the patient underwent implant removal, follow-up radiological assessments revealed evidence of successful union, therefore no additional surgical interventions were necessary.

Discussion

The current study aimed to evaluate the functional outcomes of proximal humerus fractures managed by locking plates. The cohort of the study was of 60 patients with unstable proximal humerus fractures. In this study, we found that the highest incidence of proximal humerus fractures was in 4th decade with 40% of the total cases in the study. These findings align with other similar studies suggesting that middle-aged individuals particularly males are at a higher risk due to occupational hazards and also involved in Road traffic accidents [1, 9, 10]. The results of this study showed that RTAs were the most important cause of injuries in 60% of all cases. This shows that high-energy trauma on the proximal humerus leads to fractures. Other causes were falls in 30% of cases which were found in older adults and a small proportion of cases were due to assaults (10%). In this study, we had 50% of cases of 2-part fractures followed by 3-part fractures in (30%) cases and 4-part fractures in (20%) cases. This distribution is consistent with the Neer classification system, which emphasizes the importance of fracture complexity in determining treatment outcomes [5]. We found that the right humerus fractures were more frequently occurring in 65% of cases due to the dominant arm in

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most cases and could initiate protective reflex on exposure to trauma. Most of the cases in this study (65%) sought medical attention on the same day, which is important for timely intervention and optimal outcomes. We evaluated the treatment outcomes by the Constant-Murley Score (CMS) score [7]. The CMS scores revealed excellent outcomes in 40% of cases and good outcomes in 30% of cases. These results are comparable to studies by Südkamp et al. [6], who reported that favorable outcomes can be achieved in less complex 2-part and 3-part fractures. However, we found moderate outcomes in 25% of cases which mostly included the cases of 4-part fractures. Three patients had a poor outcome which was due to a complication of osteonecrosis which is the known risk in these types of fractures [4]. The results of this study showed that radiological union was achieved in 90% of cases by 9-week follow-up, demonstrating the efficacy of locking plates in promoting bone healing. However, in six cases 4-part fracture complication occurred. The osteonecrosis occurred in three cases which was due to compromised blood supply to the humeral head [8]. In three cases screw cutout occurred which required implant removal but ultimately resulted in successful union without any surgical intervention. The limitation of the study was the small sample size and cases were taken from one center. This should be kept in mind for the generalized applicability of the results of this study.

Conclusion

Within the limitation of the current study, we found Locking plate fixation for proximal humerus fractures demonstrated favorable functional and radiological outcomes. The majority of patients (90%) achieved fracture union within nine weeks, with excellent to good shoulder function observed in 70% of cases. Two-part and three-part fractures had better functional recovery, while four-part fractures showed higher complication rates. Early hospital reporting and prompt surgical intervention contributed to improved outcomes. Locking plates remain an effective treatment, offering stability and facilitating early mobilization for better recovery.

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