

Evaluation Of Outcomes Of Proximal Humerus Fractures In Adults Treated With Locking Compression Plate

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Abstract

Objective: To evaluate the clinical and functional outcome of proximal humerus fractures in adults treated with locking compression plate.

Methods: Range of motion, time to radiological sign of union, and validated outcome measures-i.e., Oxford, UCLA and NEER'S score-were assessed in a prospective study of fifty patients (thirty-eight men and twelve women with a mean age of 42.44 years) of proximal humerus fractures treated with open reduction internal fixation with locking compression plate. The duration of follow-up was 6 months and standardized radiographs of the shoulder were evaluated.

Results: All fractures went for union clinically and radio-logically. The average time for union was 12.76 weeks (average 10.58 weeks for two-part fractures, 12.78 weeks and in three-part fractures and 14.28 weeks in four-part fractures). The average NEER's score out of 100 was 81.1 (minimum score 48, maximum score 95) with excellent results (score 90-100) in 5 patients (10%), 30 patients (60%) showing satisfactory results (score 80-89), 12 patients (24%) with unsatisfactory results (score 70-79) and 3 patients (6%) had a poor result (score <70). As per the UCLA Score out of 35, the average score was 27.48 (minimum score 15 and maximum of 34) showing good/excellent results (score >27) in 31 patients (62%) and fair/poor results (score <27) in 19 patients (38%). Post-operative shoulder arthritis was assessed by using Oxford score. The average score out of 48 was 40.02 (minimum score 18, maximum score 47) showing satisfactory joint function and no signs of arthritis (score 40-48) in 36 patients (72%), mild to moderate shoulder arthritis (score 30-39) 10 patients (20%), moderate to severe arthritis (score 20-29) in 2 patients (4%) and severe arthritis (score 0-19) in 2 patients (4%). The complications observed were, shoulder stiffness in 5 patients (10%), radiological features of avascular necrosis of head of humerus in 3 patients (6%), plate impingement in 1 patient (2%) and infection in 1 patient (2%) which resolved uneventfully with help of antibiotics. No patient suffered non-union or varus malunion.

Conclusion: Observations of fifty cases of proximal humerus fractures treated with locking compression plate shows the advantages of stable internal fixation, early mobilization, and functional restoration, combined with unlikely secondary loss of reduction. Accurate

anatomical restoration of the articular surface and tuberosities appear to be more important for the better functional outcome. An adequate surgical technique will minimize complications and an aggressive rehabilitation regime (active physiotherapy) will ensure the best possible result. The superior functional and radiological outcomes in patients with proximal humerus fractures are observed in our study.

Keywords: Proximal humerus fracture, PHILOS plate

Introduction

Proximal humerus fractures are common injuries accounting for about 5% of all injuries to appendicular skeleton ^[1]. Increased incidence is due to more geriatric population with osteoporosis in and increasing incidence of higher velocity injuries, road traffic accidents, natural disasters, industrial accidents and assault in young patients. Most of the proximal humeral fractures have been treated by non-operative methods ^[2]. Whereas in the 15% to 20% of significantly displaced and comminuted proximal humerus fractures were associated with poor functional outcome, hence opting for surgical fixation for better results ^[3]. However, significant controversy continues regarding the best methods of treating displaced proximal humerus fractures ^[4]. Of the various modalities of fixations that have evolved for the treatment of proximal humerus fractures, proximal humerus locking plate has become a well-accepted implant. In this study we will evaluate the results and outcomes of open reduction internal fixation of proximal humerus fractures with locking compression plate in adults.

Materials and Method

This prospective study was conducted between November 2019 and June 2021 at a tertiary rural hospital. A total of 50 patients between the age group of more than 18 years to less than 65 years presenting with closed proximal humerus fractures were included in this study and treated by open reduction and internal fixation with PHILOS plate. Patients not within this age group and patients presenting with open fractures or pathological fractures or fractures with neurovascular deficit were excluded out of the study. Relevant clinical and radiological findings were noted and the fractures were classified as per NEER's classification ^[5].

Undisplaced		Displaced Fractures				
	1 Part	2 Part	3 Part	4 Part	Articular Surface	
Anatomical Neck						
Surgical Neck						
Greater Tuberosity						
Greater Tuberosity or Lesser Tuberosity Surgical Neck						
Lesser Tuberosity						
Lesser Tuberosity Surgical Neck						
Anatomical Neck Greater Tuberosity Lesser Tuberosity Surgical Neck						
		Anterior Dislocation				
		Posterior Dislocation				
		Head Splitting				

Fig 1: NEER's Classification ^[5] of proximal humerus fracture

Surgical technique

All surgeries were performed by a consultant orthopaedic surgeon under general anaesthesia with the patient in the beach chair position (supine position in fracture table with 30-45° angulation at head end, with a sandbag behind the operating scapula). A deltopectoral approach ⁽⁶⁾ was used for all patients to reach the fracture site and achieve reduction and the plate was placed onto the greater tuberosity, just posterior to the biceps tendon, at least 8 mm distal to the tip of the greater tubercle and temporarily fixed with Kirschner wires. After confirming correct plate position under image intensifier in various views, it was fixed to the humeral shaft with screws. In fractures with medial comminution, first we fixed the plate to the head with screws, and reduced the shaft segment to the plate to avoid varus malposition. Screw insertion into the inferomedial humeral head adds stability for fractures without medial calcar support. Confirmation with image intensifier on anteroposterior and lateral views is necessary for reduction confirmation and implant placement. The wound was closed over a suction drain, which was removed after 24 hours.



Fig 2: Cephalic vein in deltopectoral groove



Fig 3: Fracture fixed with screws proximally and distally



Fig 4: Wound closure in layers

Post-operative care

Post-operatively the arm was supported in a sling. The time for commencement of shoulder rehabilitation was determined by stability of fixation, quality of bone, and compliance of patient. Passive ROM exercises (i.e., pendulums, passive forward elevation, external rotation) generally were begun on the first postoperative day provided that a stable reduction was achieved along with active ROM of the elbow, wrist, and hand. The patient then progressed through a three-phase rehabilitation program, consisting of passive assisted exercises, early active exercises starting at approximately 6 weeks postoperatively, and strengthening or resisted exercises beginning 10 to 12 weeks after surgery. Early passive assisted exercises help to avoid adhesion formation. No limitation of exercises within the pain-free ROM was necessary during this time provided that bone stock was good and medial buttressing adequate. Shoulder strengthening and resistance exercises were initiated only after bony consolidation was confirmed on plain radiographs and adequate coordination of the extremity had been achieved.

Advice on discharge

Patient is advised to continue adequate physiotherapy. Suture removal done at 14 days after surgery and oral antibiotic and analgesic is given for 14 days till sutures removal. All patients were followed up at 2 weeks, 6 weeks, 3 months & 6 months postoperatively and standard anteroposterior, axillary and scapular Y radiographic views were taken to ensure that no pin has migrated, no loss of reduction has occurred, evidence of callus formation and consolidation of fracture. Plate removal was generally not necessary. The functional outcome

was assessed with the use of Oxford ^[7], UCLA ^[8] and NEER'S score at the end of the study.

Item	Scoring categories
<i>During the past four weeks</i>	
1) How would you describe the worst pain you had from your shoulder?	1 None 2 Mild 3 Moderate 4 Severe 5 Unbearable
2) Have you had any trouble dressing yourself because of your shoulder?	1 No trouble at all 2 Little trouble 3 Moderate trouble 4 Extreme difficulty 5 Impossible to do
3) Have you had any trouble getting in and out of a car or using public transport because of your shoulder? (whichever you tend to use)	1 No trouble at all 2 Very little trouble 3 Moderate trouble 4 Extreme difficulty 5 Impossible to do
4) Have you been able to use a knife and fork - at the same time?	1 Yes, easily 2 With little difficulty 3 With moderate difficulty 4 With extreme difficulty 5 No, impossible
5) Could you do the household shopping on your own?	1 Yes, easily 2 With little difficulty 3 With moderate difficulty 4 With extreme difficulty 5 No, impossible
6) Could you carry a tray containing a plate of food across a room?	1 Yes, easily 2 With little difficulty 3 With moderate difficulty 4 With extreme difficulty 5 No, impossible
7) Could you brush/comb your hair with the affected arm?	1 Yes, easily 2 With little difficulty 3 With moderate difficulty 4 With extreme difficulty 5 No, impossible
8) How would you describe the pain you usually had from your shoulder?	1 None 2 Very mild 3 Mild 4 Moderate 5 Severe
9) Could you hang your clothes up in a wardrobe, using the affected arm?	1 Yes, easily 2 With little difficulty 3 With moderate difficulty 4 With great difficulty 5 No, impossible
10) Have you been able to wash and dry yourself under both arms?	1 Yes, easily 2 With little difficulty 3 With moderate difficulty 4 With great difficulty 5 No, impossible
11) How much has pain from your shoulder interfered with your usual work (including housework)?	1 Not at all 2 A little bit 3 Moderately 4 Greatly 5 Totally
12) Have you been troubled by pain from your shoulder in bed at night?	1 No nights 2 Only 1 or 2 nights 3 Some nights 4 Most nights 5 Every night

Fig 5: Oxford Shoulder Score

Observation and Results

In our series 42 (84%) out of 50 Patients were below the age of 50 years and hence the average age incidence was 42.44 years. Thirty-eight were male patients and twelve were female patients (M: F=3.16:1). 31 patients (62%) had right sided fracture and 19 patients (38%) had left sided fracture. The mode of injury commonly observed in our series was fall (including self-fall and fall from height) accounting for 24 patients combined (48%), 21 patients (42%) had a history of RTA and 5 patients (10%) had a history of animal attack. 21 patients (42%) had a four-part fracture, 14 patients (28%) had a three-part fracture and 15 patients (35%) had a two-part fracture and none had fracture dislocation.

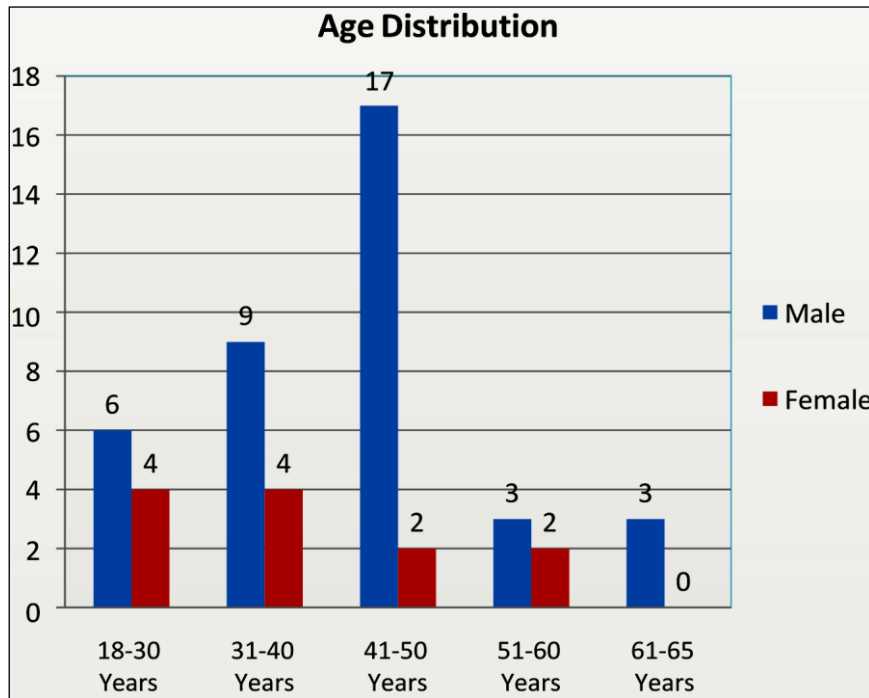


Chart 1: Age distribution

Table 1: Sex distribution

Sex distribution	Number	Percentage
Male	38	76%
Female	12	24%
Total	50	100%

Table 2: Modes of injury

Mode of injury	Number	Percentage
Fall injury	15	30%
Road traffic accidents	21	42%
Fall from height	9	18%
Animal attack	5	10%
Total	50	100%

Table 3: Types of fractures

Type of fracture	Number	Percentage
Two-part surgical neck	7	14%
Two-part greater tuberosity	8	16%

Three-part	14	28%
Four-part	21	42%
Total	50	100%

Table 4: Complications

Complication	Number	Percentage
Stiffness	5	10%
Avascular necrosis	3	6%
Plate impingement	1	2%
Post-operative infection	1	2%

No patients were lost to follow-up. All fractures went for union clinically and radio logically. The average time for union was 12.76 weeks (average 10.58 weeks for two-part fractures, 12.78 weeks and in three-part fractures and 14.28 weeks in four-part fractures). The average NEER's score out of 100 was 81.1 (minimum score 48, maximum score 95) with excellent results (score 90-100) in 5 patients (10%), 30 patients (60%) showing satisfactory results (score 80-89), 12 patients (24%) with unsatisfactory results (score 70-79) and 3 patients (6%) had a poor result (score <70). As per the UCLA Score out of 35, the average score was 27.48 (minimum score 15 and maximum of 34) showing good/ excellent results (score >27) in 31 patients (62%) and fair/poor results (score <27) in 19 patients (38%). Post-operative shoulder arthritis was assessed by using Oxford score. The average score out of 48 was 40.02 (minimum score 18, maximum score 47) showing satisfactory joint function and no signs of arthritis (score 40-48) in 36 patients (72%), mild to moderate shoulder arthritis (score 30-39) 10 patients (20%), moderate to severe arthritis (score 20-29) in 2 patients (4%) and severe arthritis (score 0-19) in 2 patients (4%).

The complications observed were, shoulder stiffness in 5 patients (10%), radiological features of avascular necrosis of head of humerus in 3 patients (6%), plate impingement in 1 patient (2%) and infection in 1 patient (2%) which resolved uneventfully with help of antibiotics. No patient suffered non-union or varus malunion.

Discussion

In our study of fifty patients of proximal humerus fracture treated with locking plate we observed a mean age of 42.44 years consistent with the study by C. Gerber *et al.* [9]. In our series the male to female ratio is 3.16:1 with 38 males and only 12 females. The mode of injury commonly observed in our series was fall (including self-fall and fall from height) accounting for 24 patients combined (48%), 21 (42%) patients had a history of road traffic accident and 5(10%) had a history of animal attack. These observations were found to be consistent with the studies in literature [10]. The most common mode of injury in young patients is road traffic accident and in elderly it is domestic fall, which is consistent with world literature. The study of type of fracture in our series revealed 15 (35%) were 2-part fractures, 14 (28%) were 3-part fractures, 21 (42%) was a 4-part fracture and none had fracture dislocation which is consistent with the studies done by Rizwan Shahid *et al.* [11]. Avascular necrosis occurred in three cases mostly seen in three- and four-part fractures. One patient had plate impingement and limitation of abduction, its hardware related complication, and improper plate positioning may have led to impingement. Five patients had shoulder stiffness leading to unsatisfactory results stiffness is more of surgical complication than implant. One patient had postoperative infection which subsided with the use of antibiotics. None of them had malunion and non-union. These results are consistent with other studies too.

Limitations

Our study with limitations of small sample size, short duration of follow up with requirement of experience in surgical procedure.

Conclusion

The locking compression plate gives the advantages of stable internal fixation, early mobilization, functional restoration of the tuberosity can be combined indirect reduction of the articular fragments using image intensifier, and unlikely secondary loss of reduction. Accurate anatomical restoration of the articular surface and tuberosities appear to be more important for the better functional outcome. An adequate surgical technique will minimize complications and an aggressive rehabilitation regime (active physiotherapy) will ensure the best possible result.

Conflict of interest: There is no conflict of interest among all authors.

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