

A Study on Surgical Outcome of Proximal Humeral Locking Compression Plate for Displaced Proximal Humeral Fractures

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ABSTRACT

Management of displaced fracture of the proximal humerus is still a controversial subject in orthopaedics. 30 patients with proximal humerus fractures were treated with open reduction and internal fixation with locking compression plates to study the surgical outcome and functional recovery of shoulder. The average time taken for union in our study was 14 weeks. All fractures remained united. Adults between 20-50 years had better functional results with respect to older age group. In the present study, 3 patients had malunited fracture, 3 had plate impingement, and 2 each had screw cut out and superficial post-operative infection, and one each had avascular necrosis and transient axillary nerve palsy. 24% (6 patients) had excellent outcome, 32% (8 patients) had good outcome, 40% (10 patients) had moderate outcome and 4% (1 patient) had poor outcome at the end of 1 year follow up. Open reduction and internal fixation with locking compression plates had favourable outcome in displaced fracture of the proximal humerus (Constant and Murley score 74.56 at 1 year follow up), but in view of complications related to incorrect surgical technique, it is important for the surgeon to perform the operation correctly to avoid iatrogenic errors.

Keywords: Locking compression plate, displaced proximal humeral fracture

INTRODUCTION

The current fracture epidemiology shows proximal humeral fractures account

for almost 7% of all fractures & make up 80% of all humeral fractures. ⁽¹⁾ Due to increasing incidence of high velocity trauma, the fracture pattern in proximal humerus fracture is becoming complicated. Management of such fractures has always been an enigma because of numerous muscles attachment and paucity of space for fixing implant. A review of published results suggests that there is no universally accepted form of treatment for displaced proximal humerus fracture. Conservative management may be associated with non-union or malunion resulting in painful dysfunction. The object of the osteosynthesis is to reduce the displacement (usually rotation) of each fragment and hold it in place with an implant; the greater tuberosity fragment which has usually been displaced proximally and rotated upward by rotator cuff muscles inserted into it is fixed to the major humeral head fragment, lesser tuberosity fragment similarly displaced by subscapularis is fixed. ⁽²⁾ Various modalities of fixation have evolved for achieving this (transosseous suturing, percutaneous pinning, tension band wiring, plating, rush nailing, arthroplasty, etc). Out of these, proximal humerus locking compression plate is the implant of choice nowadays for treatment of displaced proximal humerus fractures since they provide rigid anatomical fixation and more angular stability; hence it permits early mobilization and a good functional limb.

So, the authors aimed to study the surgical outcome following proximal humeral locking compression plating for displaced proximal humeral fractures by evaluating pain, range of motion & muscle power as well as radiological parameters, neurological deficit & infection.

MATERIALS AND METHODS

This study was a hospital-based prospective study conducted in the department of Orthopedics in a tertiary care hospital of West Bengal. The study was approved by the local ethical committee and all patients gave their informed consent to take part in this investigation. The study duration was 18 months and included 30 patients, above the age of 18 years & below 75 years, attending the Orthopaedic emergency and Out Patient Department, with symptoms/imaging finding suggestive of proximal humerus fracture.

Inclusion Criteria: 1.All skeletally mature patients between 18 and 75 years of age presenting with Neer two, three and four part displaced proximal humerus fractures.⁽³⁾ 2.Patients with associated dislocation of the shoulder 3 Recent fracture, surgery done within 3 weeks.

Exclusion Criteria: 1. Pathologic fractures from primary or metastatic tumours 2. Patients age less than 18 years and more than 75 years. 3. Open fractures 4. Polytrauma 5.Failure of conservative treatment 6.Patients with medical comorbidity. 7. Fractures associated with neurovascular deficits.

After admission of cases, careful clinical examination of skeletal system, neurovascular status and soft tissue injuries was done. Radiographs were done. Arm was immobilized in a U/ coaptation splint and arm sling. Once patient's general condition stabilized, operative fixation was planned. 25 cases were operated by deltopectoral approach (DP) and 5 cases operated by deltoid splitting (DS) approach. Fracture was anatomically reduced and fixed with locking compression plate. Fixation rigidity was checked on table and post-operative

check radiographs taken. Patients were mobilized in the arm pouch; all patients were encouraged for pendulum exercises as early as possible. Sutures were removed on the 14th postoperative day.

Patient were seen for follow up at 6 weeks ,12 weeks, 6 months and 1 year for functional assessment and also AP and lateral radiographs of the shoulder were obtained to confirm fracture reduction and to assess fracture healing with each follow up. Statistical analysis was done for functional outcomes for pain, motion and muscle power, and functions of shoulder were assessed using the Constant and Murley (CM) scoring system.⁽⁴⁾ Interpretation of CM scoring system is as follows- excellent: score between 86 and 100, good: score between 71 and 85, moderate: score between 56 and 70,poor: score less than 56.

RESULTS

Table 1. Age distribution of patients

Age group (years)	No. of patients	Percentage
21-30	7	23.33
31-40	6	20
41-50	8	26.66
51-60	5	16.66
61-70	3	10
71-80	1	3.33
Total	30	100

19 patients were male and 11 were female.

The most common mode of injury observed in our series was road traffic accident (RTA). It accounted for 15 patients (50%). The next common cause was fall from standing height (domestic fall) accounting for 8 patients (26.7%) followed by fall from height accounting for 4 patients (13.3%). 2 patients had a history of assault (7%) and 1 patient had history of animal attack (3%).

Table 2.Outcome on basis of fracture pattern at 1 year

Neer part fracture	No. of patients	Mean score (range)
2 part	9	82.11 (70-92)
3 part	14	70.71 (47-86)
4 part	2	66.5 (65-68)
Total	25	74.56

In our study series the most common type of fracture according to Neer criteria observed was 2 part fracture accounting for

13 of 30 patients (43%), the next common being 3 part fracture accounting for 15 of 30 patients (50%); 2 patients had 4 part fracture (7%). No fracture dislocation was observed.

Functional score measurement based on CM scoring system was done at 3 months, 6th months and 1 year post operative during follow up. 2 patients were lost in follow up within 6 months. A total of 25 patients were followed up at 1 year. Abduction strength was measured only when a patient was able to do pain-free abduction \ lateral elevation at least up to 90 degrees.

Mean score at 3 months: 50.86(poor)

Mean score at 6 months: 65.78(moderate)

Mean score at 1 year: 74.56 (good)

Table 3. Outcome of CM score at 1 year

Outcome	No. of patients	Percentage
Excellent (86-100)	6	24 %
Good (71-85)	8	32 %
Moderate (56-70)	10	40 %
Poor (<56)	1	4 %

Table 4. Outcome on basis of age group at 1 year follow up

Age group	No. of patients	Mean score	Outcome
20-50	17	77.7	Good
51-75	8	67.63	Moderate

Radiological union time: All fractures had united. No non-union noted. Delayed union (>3 months) noted in five cases.

Table 5. Complications in cases

Complications	No. of patients	Occurrence
Screw cut out	2	6.67%
Plate impingement	3	10%
Malunion	3	10%
Nonunion	0	0%
Superficial infection	2	6.67%
Deep infection	0	0%
Osteonecrosis (avascular necrosis)	1	3.33%
Axillary nerve palsy (transient)	1	3.33%

DISCUSSION

Incidence of proximal humeral fractures is increasing because of increase in geriatric population with osteoporosis and increased RTA in young population. Most of these fractures are amenable to conservative treatment; the remaining few fractures are significantly displaced and require some type of internal fixation. The main principle of fixation is reconstruction

of articular surface including restoration of anatomy and stable fixation with minimal injury to soft tissues preserving the vascular supply. Poor results in these complex fractures are due to following causes: 1) Inadequate fracture reduction especially medial cortex 2) Unstable fixation, and 3) Incorrect positioning of the fixation devices. Regardless of the procedure and the implant chosen, a good functional final result depends mainly on anatomical reduction of the fracture combined with a stable fixation, and early initiation of functional rehabilitation of the shoulder. Precontoured locking compression plates work on the principle of angular stability, less disruption of vascularity and less change of plate failure. Improved fixation by locking plates is attributed to angular stability of the screws locking the plate and their three dimensional distribution in the humeral head.

Total patients in this study group were 30. All patients were followed up at 3 months, 28 patients appeared in follow up at 6 months. As this was a 18 months study, we were able to follow up 25 patients at 1 year. Sex distribution in study population showed male predominance (Male: Female = 1.5 : 1). This higher ratio can be explained by higher involvement of males in outside day to day activities compared to females. Mean age of the patients in this studies was 41.25 (ranging from 20 to 74 years), which was consistent with the age incidence in studies done by Gerber et al. ⁽⁵⁾

All patients aged more than 50 years (9 patients) in the study group sustained fracture after domestic fall (fall from standing height), whereas 13 out of 15 patients who sustained fracture after RTA in the study group were aged below 40 years. No bilateral fracture of proximal humerus was found. Thus the most common mode of injury in young patients is RTA and in elderly it is domestic fall, which is consistent with world literature. ⁽⁶⁾

In studies done by Fazal et al, of 27 cases, 13 (48%) were 2 part fractures, 12 (44.5%) were 3 part fractures and 2 (7.5%)

were 4part fractures; in another study by Siwach et al, of 25 cases, 12(48%) were 2 part fractures, 13 (52%) were 3 part fractures, and there were no 4 part fractures, indicating that the incidence of type of fracture in the present study was nearly consistent with other studies in literature. (7,8)

After surgery, every patient went through a post operative exercise regimen and periodic follow up. Surgical outcome of patients based on CM score at 3 months (30 patients), 6 months (28 patients) and at 1 year (25 patients) were assessed. The mean average CM scores at 3 months, 6 months and 1 year were 50.86, 65.78 and 74.56 respectively. Thus, between 3 months and one year, the mean range of motion and the mean CM score for the injured shoulders improved substantially. This outcome in the study was consistent with other studies in literature, where the mean average CM scores at 3 months, 6 months and 1 year were respectively 69,75 and 80. (7)

In our study we observed that more fracture parts (2 part<3part<4 part) resulted in more unfavourable outcomes. At 1 year follow up, mean outcome of 2 part,3 part and 4 part fractures were 82.11, 70.71 and 66.5 respectively (table 2). This outcome in our study was consistent with other studies in literature, where mean outcome of 2 part,3 part and 4 part fractures were 80,75,69. (7)

Complications: No nonunion occurred in the present study but malunion occurred in 3 cases. Impingement was seen in 3 patients, one was a case of 3 part fracture and two were cases of four part fractures. All patients were elderly (more than 58 years). These patients had limitation

on abduction; improper plate positioning might have led to impingement. Screw cut out occurred in 2 patients, in one patient due to avascular necrosis of head, in case of the other patient it might have been due to osteoporotic collapse. Deep infection occurred in no cases, but in 2 cases superficial infection was noted which was adequately controlled by debridement. Osteonecrosis developed in a 49 year old male patient who had a 3 part fracture. Transient axillary nerve palsy was noted post surgically in one patient; the palsy recovered gradually. Overall complication rate seen in the present study was about 40%, which was comparable to what found was in literature. Incidence of screw cut out/ loosening of implant, osteonecrosis, plate impingement, infection and overall incidence were 7.6%, 3.1%, 3.1%,1.6% and 35.9% respectively as per Yang et al, (9) 4%,8%,4%, 4% and 32% respectively as per Siwach et al, (7) and 6.67%, 3.33%, 10%, 6.67% (superficial) and 40% respectively in the present study (table 5).

Average union time was 14 weeks, which was comparable to other studies. (7)

Surgical outcome in younger age group (20- 50 years) was better than older (51 -75 years) age group (77.7 vs 67.6 CM Score) in the present study (table 4); it might be explained by more associated morbid conditions in older age group, lower bone quality; also in older age group mean shoulder functional score before injury had been lower (measured by measuring contra lateral side); 81.3 in older vs 94.4 in younger age group.

CM score of the present study was comparable to other studies stated in literature (table 6).

Table 6.CM score of various studies at 1 year

Study	Excellent (86-100)	Good (71-85)	Moderate (56-70)	Poor (<56)
Kumar et al (10)	51%	26.5%	12.3%	10.2%
Siwach et al (7)	28%	64%	8%	0%
Jagiasi et al (11)	40%	36.66%	20%	3.33%
Present study	24%	32%	40%	4%

CONCLUSION

Although the present study was relatively short and was not a randomized

controlled study, the results were comparable with other published journals. An adequate surgical technique will

minimize complications and an aggressive rehabilitation regime (active physiotherapy) might ensure better possible results. Surgical treatment of displaced proximal humeral fractures with the use of the locking proximal humeral plate that was evaluated in the present study can lead to a good functional outcome (CM score 74.56 at 1 year follow up) provided that the correct surgical technique is used. However, incidence of complications were high, with an overall complication rate of 40%. Since many of the complications were related to incorrect surgical technique, it is important for the surgeon to perform the operation correctly to avoid iatrogenic errors.

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