European Journal of Molecular & Clinical Medicine (EJMCM)
ISSN: 2515-8260 Volume 07, Issue 07, 2020

Original research article

Outcome assessment of proximal humerus fractures management using locking compression plate (LCP)

Dr. Kumar Gaurav[1], Dr.Amit Kumar[2], Dr.Abhas Kumar[3], Dr.Rajeev Anand[4]

[1]Senior Resident, Department of Orthopaedics, Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar, India.

[2]Consultant, kalyani Hospital, Patna, Bihar, India

[3]Senior Resident, Department of Orthopaedics, Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar, India.

[4]Assistant professor, Department of Orthopaedics, Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar, India.

Corresponding Author: Dr. Kumar Gaurav

Abstract

Background: Proximal humerus fractures account for 4% of all fractures. Most proximal humerus fractures can be managed conservatively, but 3-part and 4-part fractures are unstable and need internal fixation.

Aim: The aim of the present study was to evaluate the clinical and functional outcome of proximal humerus fractures treated withlocking compression plate (LCP) in adults.

Materials and Methods: This prospective observational study was carried out in the Department of Orthopaedics, Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar, India, for 12 months. Total 50 patients were included in this study. All cases of closed proximal humeral fractures (Closed two-part fracture with humeral diaphyseal extension or three or four-part fracture having a tuberosity displacement enough to cause a significant sub-acromial impingement). Constant-Murley scoring (100 point scoring system) assessment includes subjective complaints and clinical signsThe subjective complaints assessed were Pain (15 points) and activities of daily living (20 points). The clinical signs assessed were range of motion (40points) and power based on MRC grading (25 points).

Results: Motor vehicleaccidents in 35 patients, fall from height (14 patients) and electic shock (1patient) are major causes. At the end of one year, 17 patients (34%) had excellent outcome, 25 patients (50%) were functionally good and 7 patients (14%) had scores between 56-70, which according to the literature is a fair result. 1 patient (2%) had scores less than 55 points and were graded poor. The mean Constant-Murley shoulderscore was 82.91, thereby falling in the good outcome category. The average outcome after 1 year follow-up as per Neer's classification shows excellent outcome for two part fracture(mean constant score = 85.23). While three part Fractures have average outcome.

Conclusion: The proximal humeral locking plate seems to be an adequate device for the fixation of displaced proximal humerus fractures as 84% of our study population had excellent/good functional outcomes.

Keywords: Humerus, Treatment outcome, Fracture fixation

Introduction

The Incidence of trauma related skeletal injuries have been on the rise in recent years and proximal humerus fractures are one of the most common fractures occurring in the human

body. Fractures of the proximal humerus represent approximately 4% of all fractures and 26% of humerus fractures.[1,2] It is the most common type of fracture in an elderly population with osteoporotic bone, Three fourths of the fractures occur in older individuals with an occurrence three times more often in women than in men.In patients above the age of 65 years proximal humeral fractures are the second most frequent upper extremity fractures, next to distal end radius fractures. The most serious fractures and fracture dislocations are often seen in active, middle aged patients.[3-8] The management of proximal humerus fractures is a challenging task to any surgeon due to a wide variety of fracture patterns observed in these injuries. It leads to temporary disability and loss of working hours. Restoration of the function of the limb is of paramount importance. Multiple factors related to patient, surgeon and fixation technique govern the outcomes of these injuries. Patient-related factors like age, co-morbidity, fracture pattern, bone quality, arm dominance, activity level, professional demands, ability to comply with post operative rehabilitation protocol and more importantly the expectation of the patients from particular intervention were taken into account before proceeding with any appropriate intervention.[9] Reduction of displaced proximal humerus fractures is a challenging task as various fracture patterns can occur owing to the complex anatomy.10 [10]. Most of the proximal humeral fractures are non displaced or minimally displaced and stable. These can be treated conservatively with early rehabilitation.[12-17] Conservative management may result in nonunion, malunion, and avascular necrosis (AVN), which may lead to pain and dysfunction.[12] But severely displaced and comminuted fractures warrant surgical management for optimum shoulder function. The surgery should be carried out as soon as the patient's general condition permits. A delay of several days makes reduction more difficult and a significant delay results in absorption of bone, making secure internal fixation impossible.[18] Recently use of locking compression plate has been advocated. New locking plate technology was evolved to overcome complications and failure associated with older fixation technique.[19] The combination of conventional plate technology along with newly designed locking screw is the basis for new locking plate osteosynthesis.

Materials and Methods

This prospective observational study was carried out in the Department of Orthopaedics, Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar, India, for 12 months. Total 50 patients were included in this study. They were followed for minimum period of 1 year.

Inclusion criteria

- Patients in the age group of 20-65 years.
- All cases of closed proximal humeral fractures (Closed two-part fracture with humeral diaphyseal extension or three or four-part fracture having a tuberosity displacement enough to cause a significant sub-acromial impingement).

Exclusion criteria

- Skeletally immature patients.
- Age > 65 yrs.
- Patients with distal neurovascular deficits.
- Patients with open fractures.
- Pathological fractures.
- Terminally ill patients with multiple medical co-morbidities.

The selected patients were distributed into NEER 2 part, 3 parts and 4 part grades according to radiological analysis. Patients' consent obtained for participation in the study. Patients operated by 4 orthopaedic consultants at our tertiary care hospital with open reduction and internal fixation by proximal humerus locking compression plate through standard Delto-pectoral

approach with patient in beach chair position. Provisional fixation of fracture done by K-wires under C-Arm guidance, over which the LCP is fixed and closure of surgical wound done after assessing that there isno screw penetration into sub-chondral bone. Patients weredischarged on 2nd post operative day, on oral antibiotics for4 days and asked to follow standardized supervised OPD based physiotherapy at hospital as per protocol. Patients were regularly followed up after 2 weeks, 6 weeks, 3 months, 6 months and 1 year.

Constant-Murley scoring (100 point scoring system)assessment includes subjective complaints and clinical signsThe subjective complaints assessed were Pain(15 points) and activities of daily living(20 points). The clinical signs assessed were range of motion(40points) and power based on MRC grading(25 points).

Results

Motor vehicleaccidents in 35 patients, fall from height (14 patients) and electic shock (1patient) are major causes.

Table 1: Demographic profile of the patients

Age groups (in years)	**Number of patients**	**Percentage**
Below 35 years	27	54
35 -65 years	23	46
Sex		
Male	37	74
Female	13	26
Mechanism of injury		
Road traffic accident	35	70
Fall on surface	14	28
Electic shock	1	2
Limb involved		
Right	30	60
Left	20	40

Table 2: Grading based on Constant- Murley score

Grading	**Constantscore**	**Patientsnumber**	**Percentage**
Excellent	86-100 points	17	34%
Good	71-85 points	25	50%
Moderate	56-70 points	7	14%
Poor	0-55 points	1	2%

At the end of one year, 17 patients (34%) had excellent outcome, 25 patients (50%) were functionally good and 7 patients (14%) had scores between 56-70, which according to the literature is a fair result. 1 patient (2%) had scores less than 55 points and were graded poor. The mean Constant-Murley shoulderscore was 82.91, thereby falling in the good outcome category.

Table 3: Number of patients in each Neer's grade and mean Constant Murley score as per Neer's class at 1 year follow up

Neers fracture class	**Number of patients**	**Constant score**
2 part fracture	16	85.23
3 part fracture	25	82.91
4 part fracture	9	79.88

The average outcome after 1 year follow-up as per Neer'sclassification shows excellent outcome for two part fracture(mean constant score = 85.23). While three part Fractures have average outcome. (mean constant score = 82.91). The 4 part fractures have poor outcome (mean constant score = 79.88). However, the difference in outcomes is minimal andnot statistically significant

Table 4: Time delay between fracture and surgery and comparing its outcome at end of 1 year follow-up

Fracture to surgery delay	No. of patients	Percentage	Constant Murley score at 1 year followup
1 day	3	6	86.79
2 days	13	26	81.96
3 days	16	32	79.89
4 days	9	18	83.93
5 days	4	8	78.41
6 days	4	8	82.12
7 days	1	2	74.13

The mean outcome at the end of 1year follow-up shows that there is decrease in the mean Constant-Murley score gradually towards the longer interval between fracture to surgery delay. Complications encountered in this study include varus collapse in 2 patients (4%), sub acromial impingement in 2 patient (4%), AVN humeral head In 1 patient (2%), persistent shoulder stiffness in 2 (4%), and deltoid atrophyin 4 patients (8%), screw penetration in one patient, late onset infection in 2 diabetic patient (4%). Penetrated screw has been removed after two weeks post op percutaneously, Implant removal was done in infected diabetic patient in view of failed and exposed implant at 1 year follow up.

Complications like nonunion were not reported in our study of patients, because only limited number of cases formed the study.

Table 5: Incidence of complications over 1 year follow-up

Complications	No. of patients	Percentage
varus collapse	2	4
sub acromial impingement	2	4
AVN humeral head	1	2
persistent shoulder stiffness	2	4
deltoid atrophy	4	8
screw penetration	1	2
Infection	2	4

Fig. 1: Implants and instruments used for fracture fixation

Fig. 2: Beach chair position for hand to lie on arm rest

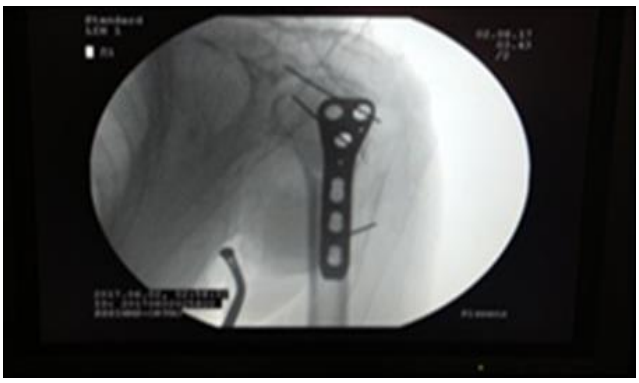

Fig. 3: Positioning of the plate using image intensifier with K wires

Fig. 4: Fracture fixation with plate in-situ

Fig. 5: After final fixation of plate with K wires removed

Discussion

Beate Hanson et al.[20] in their study of 160 patients, 65 patients (40.6%) had sustained fractures following slip and fall on their outstretched hand or on their shoulderand 10 patients (6.3%) had sustained fractures due to high velocity road traffic accidents. In our study of 50 patients, Motor vehicleaccidents in 35(70%) patients, fall from height 14 patients (28%) and electic shock 1(2%) patient are major causes.

Neer et al.[21] in their study of 43 patients treated with open reduction and internal fixation with plate and screws showed good to excellent results in 48% of cases. Forpatients with 3-part fractures, plating techniques resulted inthe best outcomes, as measured by the Neer pain scoring systems. In our study of 50 operative patients, majority of the patients (84%) had fair to good results. Excellent outcome was registered in sixteen (34%) patients and only one patient (2%) having poor results. Poor results were mainly due to poor patient compliance and failure to attend regular physiotherapy. Three-part fractures were the most common (25 patients). 84% of our patients had moderate to excellent results following LCP plate fixation. Patients were followedup for a mean duration of 12 months. The average time taken for fracture healing was 16 weeks. The mean Constant- Murley shoulder score was 82.91 points after 1 year followup and was categorized as having good outcome. Our patients were able to achieve a good functional range of movement, averaging 110.5° flexion, 81.75° abduction and rotations (internal and external) ranged between 30° and 45°.

Misra A et al.[22] in their study of patients treated with internal fixation, 76% had better pain relief and 67% patients had good functional range. In our study of 50 operative patients, 84% had excellent pain relief and rest 14% have average outcome. 2% had poor functional outcome.

Lu et al.[23] treated 39 proximal humerus fracturesincluding isolated 2-part GT fractures with ORIF after a delay of 21-120 days from initial injury, ROM were improved except for internal rotation and all of the evaluatedscores including visual analogue score, Constant – Murley score , university of California Los Angeles(UCLA) scoring system and Simple Shoulder score demonstrated great reconstruction. In our study patients were operated within a week and delay within a week does not affect the shoulderoutcome to a statistically significant value, although a trend towards decrease in long term outcome was noted with increasing preoperative surgical delay. To the best of our knowledge, there are few studies discussing delayed treatments of GT fractures and we did not find enough evidence to help surgeons to decide whether late surgery canachieve satisfactory outcome or not.

Sameer Aggarwal, Mandeep Dhillon et al.[24] also noted varus malalignment and collapse in 5 out of 56 patients in their study, of which three underwent revision surgery withimplant removal and new PHILOS plate; and two underwent shoulder hemi arthroplasty at a later date.

Koval et al.[25] in their study of cases pointed out that theuse of plates required more extensive soft tissue stripping, which may increase the risk of osteonecrosis. In our study, operative patients treated with plate fixation had one case (2%) with features suggestive of osteonecrosis at the endof one year, though our study had a small number of cases in exclusion criteria.

In our study, we encountered 2 patients with varus collapse during post-operative follow-ups. No revision surgeries were performed in both cases, were treated with U-cast application for 6 weeks, and both patientsattained adequate functional outcomes after one year and were able to resume doing their daily household activities satisfactorily. In conjunction with this complication, we would like to highlight the critical importance of placingan inferomedial, strut or kickstand screw for fractures withmetaphysical comminution and a missing medial calcar portion which were available with newer implants like PHILOS, a lagging feature of locking compression screws.

In our study 1 case of screw perforation with severe pain in the shoulder was noted at 2 weeks post op. Issue addressed with screw removal in operation theatre percutaneously, leaving implant in situ followed bymobilization of the joint. we realized that the best way to avoid this was to get confirmatory radiographs throughout the arc of rotation (maximum internal to maximum externalrotation) after the hole has been drilled (with drill bit in- situ) to get the exact length of the screw and we preferred toput a smaller sized screw whenever the length measured fellbetween the two screw sizes.
Subacromial impingement occurred in 2 patient with painful restriction of abduction at 60˚. However, with time,the patient improved and plate removal was done afterthe fracture had united at 12 months. Shoulder stiffnesswas noted in 2 patients at 8 weeks post operatively, which improved with regular, intensive physiotherapy. There was no incidence of Nonunion of humeral head. Nonehad axillary nerve palsy pre or post-operatively and no secondary bone grafting was required. The results obtainedin our study are comparable with the results obtained by other authors.

Conclusion

In Proximal humerus locking compression plate system, locking of the threaded heads of the screws in the plate itself provides for a construct with angular and axial stability, eliminating the possibility of screw toggling (windscreen wiper effect), or sliding of the screws in the plate holes. Coupled with a divergent or convergent screw orientation to head of humerus provide improved resistance to pull out and failure of fixation. Results are best when the operative method results in stable fixation. Fixation should be followed by early physiotherapy. The rehabilitation programme plays important role in functional outcome of surgical management of proximal humerus fracture. In conclusion, locking compression plate mechanically and biologically an advantageous implant in proximal humeral fractures particularly in comminuted fracture and in Osteoporotic bones in elderly patients, thus allowing early mobilization.

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Received: 07-06-2020 || Revised: 06-07-2020 || Accepted: 22-07-2020