

Study of functional outcome of proximal humerus fractures managed by open reduction and internal fixation with locking compression plate at a tertiary hospital

Snehal Hedgire¹, Rushikesh Lonikar^{2*}

¹Consultant Orthopedician, Department of Orthopaedics, Yashodhara Superspeciality Hospital, Solapur, Maharashtra, INDIA.

²Associate Professor, Department of Orthopaedics, Ashwini Rural Medical College, Solapur, Maharashtra, INDIA.

Email: rushikeshlonikar1@gmail.com

Abstract

Background: The incidence of proximal humerus fractures is between 4% and 5% of all fractures. Proximal humeral fracture is the second most common fracture of the upper extremity, following distal forearm fracture. A variety of treatment techniques have been proposed, including Kirschner (K)-Wires, external fixation, tension band wiring, rush pins, intramedullary nails, ORIF with plates, shoulder hemiarthroplasty. Present study was taken to evaluate the functional outcome and complication rates after internal fixation of proximal humerus fractures with locking compression plate.

Material and Methods: The present study was a prospective clinical study, conducted in patients above 18 years, with closed proximal humerus fractures or open proximal humerus fractures (Gustilo and Anderson type I, Type II) underwent open reduction and internal fixation with locking compression plate. **Results:** The present study consists of 30 patients with proximal humerus fracture treated with open reduction and fixation with proximal humerus locking compression plate. Age of patients ranged from 22 years to 81 years with Mean age of 51.07 ± 17.15 years. Most common age group was 36–55 years (36.67%) followed by 56 – 75 years (30 %) age group. Majority of patients were male (76.67%), involving right side (83.33%), had road traffic accidents (63.33%). As per Neer classification, 3-part fracture was most common type (53.33%). In present study, the maximum union time observed is 16 weeks, and minimum 10 weeks. The mean union time is 12.26 ± 1.7 weeks. At the end of 6 months the mean flexion was $121.33^0 \pm 19.42$. The Mean abduction was $118^0 \pm 19.72$, mean external rotation was $53^0 \pm 11.49$ and mean internal rotation was $57.67^0 \pm 8.97$. The Mean Constant score is 75.56 ± 9.33 [Mean \pm SD]. Mean scores observed on Constant Score for its different parameters were pain 14.5, ADL 18.13, range of motion 22.93, power 20. According to the Constant score, the functional outcome of the 30 patients, 4 patients have excellent outcome (13.33%), 17 patients had good outcomes (56.67%), 8 patients had moderate outcome (26.67%) and one patient had a poor outcome (3.33%). **Conclusion:** Internal fixation of proximal humerus fractures with the use of Locking compression plate provides anatomical reduction and stable fixation which yields good functional outcome.

Keywords: proximal humerus fractures, Constant score, locking compression plate, open reduction and internal fixation

*Address for Correspondence:

Dr Rushikesh Lonikar, Associate Professor, Department of Orthopedics, Ashwini Rural Medical College, Solapur, Maharashtra, INDIA.

Email: rushikeshlonikar1@gmail.com

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INTRODUCTION

The incidence of proximal humerus fractures is between 4% and 5% of all fractures. Proximal humeral fracture is the second most common fracture of the upper extremity, following distal forearm fracture.¹ More than 70% of patients with these fractures are older than sixty years of age, and 75% of them are women.² These fractures have a dual age distribution occurring either in young people following high energy trauma or in those older than 50 years with low velocity injuries like simple fall.¹ In the elderly population, most of these fractures are related to

osteoporosis. Most of proximal humerus fractures, in younger patients as well as in the elderly, are stable and minimally displaced and can be treated conservatively.³ Non operative treatment of complex (i.e., three-part and four parts) fractures often results in AVN, non-union, malunion and stiffness of the shoulder.⁴ A variety of treatment techniques have been proposed, including Kirschner (K)-Wires, external fixation, tension band wiring, rush pins, intramedullary nails, ORIF with plates, shoulder hemiarthroplasty.^{5,6} However several complications have been described in association with these techniques, including implant failure, loss of reduction, nonunion or malunion of the fracture, impingement syndrome and osteonecrosis of the humeral head.^{5,7} In order to minimize these complications, the Locking compression plate (the Locking Proximal Humeral Plate, LPHP) was developed by the A-O Foundation.⁸ It combines the principles of fixation with a conventional plate with those of locking screws. The advantage of implants with angular stability (locking plates) is better anchorage of screws in osteoporotic bone as well as their function of a locked internal fixator. Because of the good fixation there is a potential of enhanced stability that could allow early mobilization, improving range of motion. Additionally they can be inserted using a minimally invasive technique without additional trauma to the soft Tissues.⁹ Present study was taken to evaluate the functional outcome and complication rates after internal fixation of proximal humerus fractures with locking compression plate.

MATERIAL AND METHODS

The present study was a prospective clinical study, conducted in the Department of Orthopaedics, Apollo hospitals, Chennai from September 2012 to December 2013. During the study 30 patients with displaced proximal humerus fractures were treated with ORIF with proximal humerus locking compression plate.

After ethical committee clearance, and after taking informed consent, patients with proximal humerus fractures were included in the study after they have met the inclusion criteria.

Inclusion criteria

Patients above 18 years, with closed proximal humerus fractures or open proximal humerus fractures (Gustilo and Anderson type I, Type II)

Exclusion criteria

Closed proximal humerus fracture more than 4 weeks old. Open proximal humerus fracture (Gustilo and Anderson type III). Associated humerus shaft fracture. Polytrauma patients, Pathological fractures

Written informed consent was taken for participation. Detailed history was taken followed by clinical examination both local, systemic and local examination

of the skeletal system, soft tissue injuries, neurovascular examination and other associated injuries was done. Pre-operative investigations such as CBC, BT, CT, Urine routine/microscopy, Blood glucose level, Chest x-ray, shoulder X ray (AP and lateral view) were done in all patients. Electrocardiogram, Serum electrolytes, X-ray (Axillary view/Velpeau view, CT scan were assessed if required in a particular patient. The degrees of fracture comminution, displacement of the tuberosities were noted in the X-rays and CT scans obtained. Once patient's general condition stabilized, surgery was performed within 4-5 days from the day of injury. In all the patients' surgery was performed under General anaesthesia. All patients were placed in the beach-chair position, and operated either in a standard delto-pectoral approach or extended deltoid splitting approach, for open reduction and internal fixation with locking compression plate as per standard operative protocols. Immediate post operative radiographs were taken to assess the reduction of fracture and stability of the fixation. Drain removal and dressing change was done after 48 hrs on 2nd post-operative day. All patients were discharged from hospital on 3rd – 4th post-operative day. Patients were rehabilitated under supervision of physiotherapist. Patients were followed at 2 weeks, 6 weeks, 3months and 6months. During this period, in each visit clinical evaluation of wound healing, pain, shoulder function and range of movements were assessed and recorded. Fractures were assessed for clinical and radiological union. Radiologically, when callus formation and cortical continuity was observed the fracture was considered united. Functional Assessment was evaluated using Constant score¹⁰ based on pain, ADL, ROM and strength or power for each case at each follow up visit and recorded. All the statistical analysis was carried out by SPSS version 11. All the continuous variables were expressed as mean \pm standard deviation while categorical variables were represented either as percentage or proportions.

RESULTS

The present study consists of 30 patients with proximal humerus fracture treated with open reduction and fixation with proximal humerus locking compression plate. Age of patients ranged from 22 years to 81 years with Mean age of 51.07 ± 17.15 years. Most common age group was 36–55 years (36.67%) followed by 56 – 75 years (30 %) age group. Majority of patients were male (76.67%), involving right side (83.33%), had road traffic accidents (63.33%). As per Neer classification, 3-part fracture was most common type (53.33%). In present study, the maximum union time observed is 16 weeks, and minimum 10 weeks. The mean union time is 12.26 ± 1.7 weeks.

Table 1: General characteristics

Age group (in years)	No. of Patients	Percentage (%)
18-35	7	23.33
36-55	11	36.67
56-75	9	30
>75	3	10
Sex		
Male	23	76.67
Female	7	23.33
Side involved		
Right	25	83.33
Left	5	16.67
Mode of injury		
Road traffic accident (RTA)	19	63.33
Simple fall	11	36.67
Fracture type	No of patients	Percentage (%)
2- Part	11	36.67
3 –Part	16	53.33
4 –Part	3	10

At the end of 6 months the mean flexion was $121.33^{\circ} \pm 19.42$. The Mean abduction was $118^{\circ} \pm 19.72$, mean external rotation was $53^{\circ} \pm 11.49$ and mean internal rotation was $57.67^{\circ} \pm 8.97$. 2 (6.67%) of the patient had flexion between 150° to 180° . 14 patients (46.67%) had flexion between 120° to 150° . 13 patients (43.33%) had flexion between 90° to 120° . 1 patient (3.33%) had Flexion of less than 90° .

Table 2: Assessment at the end of 6 months the

Movement	Mean + SD
Flexion	$121.33^{\circ} \pm 19.42$
abduction	$118^{\circ} \pm 19.72$
External Rotation	$53^{\circ} \pm 11.49$
Internal Rotation	$57.67^{\circ} \pm 8.97$

2 patients had post-traumatic shoulder stiffness. 2 patients showed mal-union, out 2 patients with malunion, 1 patient is in young age group and showed excellent range of movements. One patient developed superficial infection with delayed wound healing. The functional assessment of all the patients is done by Constant – Murley score. The Mean Constant score is 75.56 ± 9.33 [Mean \pm SD]. Mean scores observed on Constant Score for its different parameters were pain 14.5, ADL 18.13, range of motion 22.93, power 20.

Table 3: Mean scores for parameters of constant scoring system.

Parameters	Maximum score	Mean score
Pain	15	14.5
Activity of daily living (ADL)	20	18.13
Range of movement (ROM)	40	22.93
Power	25	20
Total	100	75.56

According to the Constant score, the functional outcome of the 30 patients, 4 patients have excellent outcome (13.33%), 17 patients had good outcomes (56.67%), 8 patients had moderate outcome (26.67%) and one patient had a poor outcome (3.33%).

Table 4: Outcome of Constant – Murley score.

Outcome (Score)	No. of patients	Percentage (%)
Excellent (>85)	4	13.33
Good (71-85)	17	56.67
Moderate (55-70)	8	26.67
Poor (<55)	1	3.33

DISCUSSION

The incidence of proximal humerus fractures has increased in last few years due to changes in life style and

increase in road traffic accidents. The best management in these injuries is still uncertain. Most of the proximal humerus fracture which are un-displaced can be treated

conservatively. Fractures of proximal humerus have a bimodal presentation with adolescents and younger middle age who are more prone for high velocity injuries, most common among males forming one group and later these fractures are seen in elderly (>60 years) in which cases, they are osteoporosis related and most often seen in females.^{3,11} Mean age of 51.07 ± 17.15 years and majority were male (76.67%) in present study. Other researchers Moonot P *et al.*,¹² Sameer Aggarwal *et al.*¹³ noted similar findings. In the present study, fractures are classified as per Neer classification. In the study, there were 11 (36.67%) two-part fractures, 16 (53.33%) three-part and 3 (10%) four-part fractures. Fazal and Haddad,¹⁴ David S Thyagarajan, *et al.*¹⁵ and Sameer Aggarwal *et al.*¹³ noted similar findings. All the fractures were united within 6 months (range 10 – 16 weeks) with mean union time 12.26 ± 1.7 weeks which is consistent with the previous studies. In the study by P. Moonot *et al.*¹², mean fracture union time was 10 weeks. In the study by Michael Leonard *et al.*¹⁶, mean fracture union time was 12 weeks (9–20). In the study by David S Thyagarajan *et al.*¹⁵, radiological union was 12 weeks. In a series of 72 patients of proximal humerus fractures treated with locking compression plate studied by Bjorkenheim *et al.*,¹⁷ 27 (37.5%) complications were occurred with 19 fractures healed in varus malunion, 2 fractures failed to unite and were reoperated, AVN was observed in 3 fractures and they had no deep wound infections, neural or vascular injury and 3 patients had loss of fixation. In a study by Sudkamp N *et al.*¹⁸ they encountered 62 (34%) complications during the one year follow up period. Of these 62 complications, 34 complications (55%) were directly related to the surgical procedure and were could be potentially avoidable. The incidence of complications in the study is 16.67% which is less compared to other studies in literature – Bjorkenheim¹⁷ (37.5%); Sudkamp *et al.*¹² (34%), Michael Leonard, Leibo Mokotedi¹⁶ (29%). The functional outcomes in present study were assessed with the use of Constant – Murley score. In our series of 30 patients, 4 patients (13.33%) had excellent outcome, 17 (56.67%) patients had good outcome, 8 patients had moderate outcome (26.67%), and one patient had a poor outcome (3.33%). In other study of 27 patients by MA Fazal and FS Haddad¹⁵ treated with locking plate for displaced proximal humerus fractures 11 patients had good outcome (40.7%), 13 patients had moderate outcome (48%) and 3 patients had poor outcome (11%). Literature reveals that four part fractures in general have worse outcomes compared to 2 part fractures especially in older patients and osteosynthesis should be tried in case of young patients even though the risk of osteonecrosis is high in these fractures as anatomical restoration of proximal humerus results in good outcomes even though

osteonecrosis may supervene.¹⁹ David S Thyagarajan *et al.*⁹⁰, in his study, stated that following proximal humerus interlocking system for displaced proximal humerus fracture gives good functional scores in young patients. Michael Leonard *et al.*⁸⁹, found inferior functional outcome in patients over 65 years. However Moonot P *et al.*⁵⁷, in their study, showed no statically significant difference in functional outcome in different age group. The mean score in patients < 60 years was 67.1 and in >60 years it was 66.1 years. Although the locking plate technology has revolutionized the surgical fixation of proximal humerus fractures in recent years, typical failure patterns occur with locking plates whenever basic concepts and technical principles are not respected. Secondary loss of reduction with varus collapse can occur as a result of use of screws of inadequate length in the humeral head fragment and inappropriate fixation of locking head screws in the plate. The interface between the locking head screws and the threaded plate holes should not fail if the screws are inserted at the perfect angle and attached with a torque limiting screw driver. Even if the injury is thoroughly analyzed and the literature is understood, treatment of displaced fracture or fracture dislocation is difficult. However, with the aim of getting anatomically accurate reductions, rapid healing and early restoration of function, which is a demand of today's life, open reduction and internal fixation, is the preferred modality of treatment. There have been only a limited number of clinical studies investigating the results after ORIF of proximal humerus with locking compression plates. In those studies, the average Constant score ranged from 72 to 76 points. Complications included osteonecrosis, loss of reduction, plate breakage, and non-union of the fracture. Most authors have concluded that the locking compression plate design provides stable fixation with a good clinical outcome and have recommended the use of locking plates for the treatment of proximal humerus fractures with poor bone quality. Limitations of present study were short term follow up and small sample size. Long term follow up might have improved the functional outcome and might have revealed chances of developing AVN. The study was not randomized and the total number of patients in the study was small.

CONCLUSION

Internal fixation of proximal humerus fractures with the use of Locking compression plate provides anatomical reduction and stable fixation which yields good functional outcome. Rehabilitation to achieve good

functional recovery of the shoulder is very essential especially in middle aged and elderly individuals.

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