

## Prospective Study To Access The Surgical Outcome In Two- And Three- Part Fracture Of The Proximal Humerus By Using Locking Compression Plate

Tobu pertin<sup>1</sup>, S.N.Chishti<sup>2</sup>, A.M.Singh<sup>3</sup>, Snehasish Datta<sup>4</sup>, Santosha<sup>5</sup>, Dilip<sup>6</sup>

<sup>1</sup>(Post graduate resident, Department of Orthopedics, Regional Institute of Medical Sciences, Manipur University, India)

<sup>2</sup>(Prof. Department of Orthopedics, Regional Institute of Medical Sciences, Manipur University, India)

<sup>3</sup>(Prof. Department of Orthopedics, Regional Institute of Medical Sciences, Manipur University, India)

<sup>4</sup>(Post graduate resident, Department of Orthopedics, Regional Institute of Medical Sciences, Manipur University, India)

<sup>5</sup>(Post graduate resident, Department of Orthopedics, Regional Institute of Medical Sciences, Manipur University, India)

<sup>6</sup>(Post graduate resident, Department of Orthopedics, Regional Institute of Medical Sciences, Manipur University, India)

---

**Abstract:** *Background :* The displaced two- and three- part proximal humerus fractures remain a major challenge for the treating surgeons. More often the un-displaced fractures can be managed conservatively and displaced ones are treated surgically. *Objectives:* To access the efficacy, functional and anatomical outcome and complication of the locking plate in management of two parts-and three-part fractures of proximal humerus according to Neer's classification. *Methods:* This is a prospective study in which 40 patients of the proximal humerus fractures, between 18 years to 60 years of age group who provided written informed consent to participate in the study were included and treated using proximal humerus locking compression plate techniques from October 2014 to April 2016. *Outcome measured* using radiological and clinical parameters; *functional outcome* was access by Constant-Murley scoring system and DASH Score. *Result:* According to constant score, scores were excellent in 19(47.5%) patients, good in 10 patients (25%), moderate in 8(20%) patients and poor in 3(7%) patients. Mean constant score was 76(range 40-100). Excellent to good results were seen in 72.5% of patients. DASH score of 15.0 points was obtained at the final follow up. 25% of the patient's develops complications.

**Keywords:** Proximal humerus fractures, Neer's classification, locking compression plate.

---

### I. Introduction

Proximal humerus fractures are the 2<sup>nd</sup> most common fracture of upper limb after distal radius fracture and are account for 26% of all humerus fracture<sup>1</sup>. The morphology of fractures depends on the mechanism of injury, numbers of muscular forces on fracture fragments and connection of fragments to periosteum. It has been divided into avulsion and impaction fractures. For impaction fractures the mechanism are fall on the abducted arm with the glenoid consequently depressing the humeral head into the shaft thereby blowing out the minor tubercle ventrally and the greater tuberosity laterally resulting in a valgus-impacted four-part fracture. On the contrary, the avulsion fracture causes disruption of periosteum and subsequently more pronounced dislocation of affected tuberosities as well as rotational and usually varus malpositioning of the humeral head leads to two- and three-parts fractures. The term avulsion may be misleading because it generally refers to isolated avulsion fractures of the greater and lesser tuberosity. It has been observed that two- and three-part fractures often show a comminuted fracture area at the medial calcar induced by compressive forces, while tension forces are seen on the lateral side. So, in adducted arm (or neutral position), an axial forces of the humerus directed cranially to the acromion rather than to the glenoid cavity. The rotary muscles then pull the humeral head mediocaudally and the acromion additionally depresses the central and medial aspect of the humeral head caudally into varus. In contrast, a fall on the abducted arm transfers axial forces to the glenoid depressing the head into valgus. Therefore like femoral neck fractures it is reasonable to distinguish between abduction (valgus) and adduction (varus) fractures of proximal humerus and term avulsion fracture for isolated fractures of the tuberosities<sup>2</sup>. Women are affected more than men in the ratio of 3:1<sup>3</sup>. Proximal humerus fractures occur in a bimodal frequency, either in younger people following high- velocity/energy trauma or in those older than 50 years with lower- energy injuries<sup>3,4,5</sup>. In elderly with osteoporotic bone proximal humerus fracture is most common along with hip and radial fractures<sup>6,7,8</sup>. Un-displaced or minimally displaced fracture can be treated conservatively,<sup>9</sup> but for the displaced fracture different opinions including non-operation, Percutaneous fracture fixation or

minimally invasive techniques such as pins, screw osteosynthesis, use of intramedullary nails, LPHP and hemiarthroplasty<sup>10</sup>. Decision of the fracture treatment should take into account of patient's individual needs and characteristics, such as his/her biological age, accompanying illness, bone quality and morphology of the fracture<sup>11</sup>. Excellent outcome have been obtained with advent of locking compression plates technology<sup>12, 13</sup>. It preserves the biological integrity of the humeral head and secures an anatomical reduction with multiple screws and angular stability<sup>14</sup>.

## **II. Materials and Method**

After due approval from the institution ethical committee and obtaining written informed consent, of the individual patients, were taken. All patients with Proximal humerus fractures who came to the department of orthopedics from emergency services and Out-patient Department(OPD), were admitted between October 2014 to April 2016. They were assessed by antero-posterior, lateral view X-rays and CT-scan with 3D reconstruction of the affected limb. Routine Investigations were done in all patients.

The study was an intervention experimental without control, hospital based and patient with mental and physical inability to cooperate and presence of complicating medical condition and patient's who refuses to give consent for operation were excluded. Data collected were analyzed by using descriptive statistics like mean and percentages.

### **1.1 Inclusion Criteria**

1. All adult patients aged 18-60 years with closed displaced proximal humerus fractures. [Neer's classification: 2- and 3-part fractures].
2. Closed two part fracture with a major displacement of the humeral diaphysis or three part fracture having a tuberosity displacement enough to cause a significant subacromial impingement.
3. Age of the fracture maximum within 14 days of injury.

### **1.2 Exclusion Criteria**

1. Patients under 18 years and above 60 years.
2. Patients with Polytrauma and open fractures.
3. Pathological fractures.
4. Patients with distal neurovascular deficit.
5. Concomitant ipsilateral fracture of distal humerus or elbow joint.
6. Medically unfit patients.

**1.3 Surgical techniques:** All the patients in this study were operated upon under regional or general anesthesia. Position the patient in either the beach chair or supine semi lateral position on an operation table. After preparing and draping the limb, the fracture site was approached through either by the anterolateral deltoid-splitting approach and the deltopectoral approach. The incision is centered between the anterior and middle heads of the deltoid, with the proximal extent of the incision approximately one fingerbreadth proximal to the anterolateral border of the acromion. This incision is extended as far distal as necessary to adequately expose the fracture and facilitate plate placement, while aiming toward the lateral epicondyle of the humerus. Proximally, the interval between the anterior and middle heads of the deltoid is entered using sharp dissection. The axillary nerve needs only to be identified and protected, which should be approximately 5cm distal to the acromion. The fracture is reduced carefully and fixed with k-wires temporarily; placement of tagging sutures within the rotator cuff tendons to help gain control of tuberosity fragments. The plate is position on the bare spot on the lateral cortex posterior to the bicipital groove, which then fixed with angle stable screws on the humeral head and shaft. Incision wound is closed in three layers with a negative suction drain and pressure bandage is applied. Fixation may be confirmed by C-Arm in AP and Lateral views.

The operative limb will be kept elevated with both the shoulder and elbow extended. During this time, passive and active movements of the fingers will be encouraged to promote circulation, avoid stiff shoulder and edema.

**1.4 Post-Operative Rehabilitation:** Shoulder and Elbow exercises were encouraged and postoperative check x-rays were taken in both antero-posterior & lateral views on the next day of operation. For first 3 weeks passive assisted stretching done, followed by 4-6 weeks of active range of motion exercises with terminal stretching exercises until maximum active range was achieved. At 10 weeks resisted strengthening exercises were given. Second check x-ray was taken on follow up at 6th week; the fracture union was assessed clinically by absence of tenderness and radiographically by bridging callus formation. Patients were followed up at 3 weeks, 6 weeks, 3 months, 6 months, 1 year. At each visit, functional evaluation was done according to Constant-Murley scoring system and DASH score.

**III. figures**



**Fig.1:** Pre operative X-Ray



**Fig.2:** Plating



**Fig.3:** Checked in IITV



**Fig.4:** Post operative X-Ray



**Fig.5:** Post operative ROM



**Fig. 6:** After union

#### IV. Results

In our study 40 consecutive patients of proximal humerus fractures between 18 years to 60 years of age group were treated with proximal humerus locking compression plates. Mean age of the patients was 40.8(range 18 years to 60 years). (Table 1) There were 12 male and 28 female. The mean time from injury to operation was 7 days (range from 2 to 12 days). Fractures were classified according to Neers classification, 12 two- part and 28 three- part fractures were operated. The patients were followed up for a period of 1 year at 3 months, 6 months and 12 months. Average union time was 13(11-14) weeks. (Table 3) Clinical evaluation was done using Constant score. According to constant score, scores were excellent in 19(47.5%) patients, good in 10 patients (25%), moderate in 8(20%) patients and poor in 3(7%) patients. Mean constant score was 76(range 40-100). Excellent to good results were seen in 72.5% of patients. DASH score of 15.0 points was obtained at the final follow up. 25% of the patient's develops complications. (Table 4)

**TABLE 1:** Age and sex:

Sl.no.	Sex	Age in years			
		18-30	31-40	41-50	51-60
1	Male	2	4	3	3
2	Female	1	3	6	18

**TABLE 2:** Types of fracture:

Sl.no.	Sex	2-parts fracture	3-parts fracture
1	Female	4	8
2	Male	8	20

**TABLE 3:** Clinical and Radiological union:

Type of union	DURATION OF UNION(WEEKS)	MEAN DURATION TO UNION(WEEKS)
Clinical	8-32	18
Radiological	9-20	13.5

**TABLE 4:** Complications:

Complications	Number of patients	Percentage (%)
Hypertrophic scar	8	20
Sub-acromian impingement	5	12.5
Stiffness	3	7.5
Superficial wound Infection	1	2.5

**TABLE 5:** Assessment of outcome compare with other studies:

Sl.no.	Studies	Outcome			
		Poor (%)	Moderate (%)	Good (%)	Excellent (%)
1	Present study	7	20	10	47.5
2	Chandan Kumar et al	14.67	19.5	65.8	65.8
3	Aggarwal et al	10.5	34	38.5	17
4	Raghvendra raghuvanshi et al	12.12	9.09	33.33	45.45
5	Neil Rohra et al	3.33	13.3	26.6	50.6
6	Dr.G.Kishore Roy et al	10	0	43.33	46.66
7	Felix Brunnel et al	0	0	45	55
8	Parmaksizoğlu et al	0	68.7% excellent to good results		
9	Siebler et al	0	Poor outcome due to complex fracture in elderly		

**TABLE 6:** Final constant-murley score after 12 months in points:

Sl.no.	Study	Constant-Murley score
1	Present study	72.5
2	Lill H	77.6
3	Robert C. Sproul	74
4	Koukakis, Athanasios MD	76.1 % (range, 30-100%).
5	Ben Ockert	78.7

#### V. Discussion

For the displaced fracture of the proximal humerus non-operative treatment leads to poor outcome due to inherent instability of fragments and intra-articular nature of injury.<sup>15, 16</sup> ORIF with conventional plates and screws associated with higher complication rate like AVN, Subacromial impingement, head perforation and screw loosening in osteoporotic bone.<sup>17-20</sup> The biomechanical studies has demonstrate significant benefits of the standard plating by using locked implants which maintain the angular stability in the face of axial loading.<sup>21,22</sup> The locking compression plates provides high resistance to back out of screws even in patients with poor bone

stock due to combination of fixed angular screws plate locking and 3D placement of the screws in the humeral head and provides early exercise in short period of immobilization because of the high initial stability achieved.<sup>23,24</sup> It has been advice to bring the fragments near anatomical reduction before application of multi directional screws since plate doesn't helps in reduction of proximal fragments.<sup>25</sup> In our study 72.5 % (n=29) of the patients had excellent to good outcome as compare to Chandan Kumar et al in their study 66% (n=27) of the patients had excellent to good outcome. Aggarwal et al found moderate to excellent outcome in 90% of patients and mean constant score for 4-part fracture was 66±12.6 % and was significantly inferior to 2-part and 3-part fractures. G.Kishore et al in their study found 44.6% and Felix Brunel et al reports excellent to good results in 50% of the patient. In our study the overall mean Constant score was 76 (range 40-100). The mean age of the patient is 40.8 with female dominant. Similar findings were reported by Raghavendra Raghuvanshi et al.<sup>27</sup> Solberg et al<sup>26</sup> in their retrospective study of near 3-part and 4-part fractures shows constant scores of 64.7 in 4-part fractures. The mean age of the patient in locking plate group was 66.5±8.6. Parmaksizoglu *et al*<sup>28</sup> in their study showed 68.7% excellent to good results. Mean age was 63 years (range 29-82 years) and fractures were Neers, 3-part, and 4-part 31.8% (n=10). Patients have not achieved optimal results. Hypertrophic scar was the major complication in 8(20%) of the patients followed by subacromial impingement 12.5%, stiff shoulder in 7.5% and superficial wound infection in 2.5% of the patient. Based on our result we can say that the proximal humerus compression plate fixation is a suitable choice for two- part and three-part proximal humeral fractures. Its complication rates are low, probably because these patients were relatively young and both the bone quality and the surgical technique were good. But during dissection and head penetration with the proximal interlocking screws, care had to be taken to avoid damage of the anterior humeral circumflex artery and the axillary nerve. The screw position has to be checked intraoperatively with image intensification. The only limitation of our study is that we did not compare our results with other alternative treatment modalities.

## VI. Conclusion

We conclude that proximal humerus locking compression plate's fixation for 2-part and 3-part fractures has good functional and anatomical outcome and is associated with low to minimum complication rate. Use of this implant needs technical expertise and most of the complications occur because of intraoperative technical errors.

## References

- [1]. Manjappa CN, Mahendra Kumar GL, Vijay C, Deepak CD. Study of Functional Outcome of Surgical Management of Proximal Humerus Fractures. *ijhr* 2013 october 3; 3(10):41-7.
- [2]. Fakler JKM, Hogan C, Heyde CE, John T. Current Concepts in the Treatment of Proximal Humeral Fractures. *Ortho* 2008 Jan; 31(1):1-10
- [3]. Aggarwal S, Bali K, Dhillon MS, Kumar V, Mootha AK. Displaced proximal humeral fractures: an Indian experience with locking plates. *Journal of Orthopaedic Surgery and Research* 2010 Aug 23; 2-8
- [4]. Jones CB, Sietsema DL, Williams DK. Locked Plating of Proximal Humeral Fractures: Is Function Affected by Age, Time, and Fracture Patterns? *Clin Orthop Relat Res* 2011 June 21; 469:3307-3316.
- [5]. Kumar C, Gupta AK, Nath R, Ahmad J. Open reduction and locking plate fixation of displaced proximal humerus fractures. *Indian J Orthop* 2013 March 16; 47(2):156-160.
- [6]. Bell JE, Leung BC, Spratt KF, Koval KJ, Weinstein JD, Goodman DC et al. Trends and Variation in Incidence, Surgical Treatment, and Repeat Surgery of Proximal Humeral Fractures in the Elderly. *J Bone Joint Surg Am.* 2011 Jan 19; 93:121-31.
- [7]. Siwach R, Singh R, Rohilla RK, Kadian VS, Sangwan SS, Dhanda M. Internal fixation of proximal humeral fractures with locking proximal humeral plate (LPHP) in elderly patients with osteoporosis. *J Orthopaed Traumatol* 2008 July 16; 9:149-153
- [8]. Kruijff MD, Vroemen JPAM, Leur KD, van der Voort EAM, Vos DI, Van der Laan L. Proximal fractures of the humerus in patients older than 75 years of age: should we consider operative treatment? *J Orthopaed Traumatol* 2013 Nov 15; 15:111-5.
- [9]. Maddah M, Prall WC, Geyer L, Wirth S, Mutschler W, Ockert B. Is loss of fixation following locked plating of proximal humeral fractures related to the number of screws and their positions in the humeral head? *Orthopedic Reviews* 2014; 6:85-9
- [10]. Plecko M, Kraus A. Internal fixation of proximal humerus fractures using the locking proximal humerus plate. *Europe PubMed Central* 2005; 17(1):25-50.
- [11]. Burkhart KJ, Dietz SO, Bastian L, Thelen U, Hoffmann R, Müller LP. The treatment of proximal humeral fracture in adults. *Dtsch Arztebl Int* 2013; 110(35-36):591-7.
- [12]. Strohm PC, Helwig P, Konrad G, Südkamp NP. Locking Plates in Proximal Humerus Fractures. *Acta chirurgiae orthopaedicae et Traumatologiae tchecoslovaca* 74<sup>th</sup>. Germany: In-service training.
- [13]. Berkes MB, Little MTM, Lorich DG. Open reduction internal fixation of proximal humerus fractures. *Curr Rev Musculoskelet Med* 2013 Jan 16; 6:47-56
- [14]. Patil MY, Patil AB, Balemane S. A prospective study to assess the surgical outcome in three- and four-part proximal humerus fractures with PHILOS plate. *J Sci Soc* 2012; 39:12-6.
- [15]. Nho SJ, Brophy RH, Barker JU, Cornell SJ, MacGillivray JD (2007) Management of Proximal Humeral Fractures Based on Current Literature. *J Bone Joint Surg Am* 89(Suppl 3): 44-58.
- [16]. Friess DM, Attia A (2008) Locking plate fixation for proximal humerus fractures: a comparison with other fixation techniques. *Orthopedics* 31(12).
- [17]. Esser RD. Open reduction and internal fixation of three- and four-part fractures of the proximal humerus. *Clin Orthop Relat Res* 1994; 299:244-51.

- [18]. Hawkins RJ, Bell RH, Gurr K. The three-part fracture of the proximal part of the humerus- Operative treatment. *J Bone Joint Surg Am* 1986; 68:1410-4.
- [19]. Kristiansen B, Christensen SW. Plate fixation of proximal humeral fractures. *Acta Orthop Scand* 1986; 57:320-3.
- [20]. Wijnman AJ, Roolker W, Patt TW, Raaymakers EL, Marti RK. Open reduction and internal fixation of three and four-part fractures of the proximal part of the humerus. *J Bone Joint Surg Am* 2002; 84:1919-25.
- [21]. Hessmann MH, Hansen WSM, Krummenauer F, et al. Locked plate fixation and intramedullary nailing for proximal humerus fractures: a biomechanical evaluation. *J Trauma*. 2005; 58:1194-1201.
- [22]. Siffri PC, Peindl RD, Coley ER, et al. Biomechanical analysis of blade plate versus locking plate fixation for a proximal humerus fracture: comparison using cadaveric and synthetic humeri. *J Orthop Trauma*. 2006; 20:547-554.
- [23]. O'Toole RV, Andersen RC, Vesnovsky O, Alexander M, Topoleski LD, et al. (2008) Are locking screws advantageous with plate fixation of humeral shaft fractures? A biomechanical analysis of synthetic and cadaveric bone. *J Orthop Trauma* 22(10): 709-715.
- [24]. Thalhammer G, Platzer P, Oberleitner G, Fialka C, Greitbauer M, et al. (2009) Angular stable fixation of proximal humeral fractures. *J Orthop Trauma* 66(1): 204-210.
- [25]. Siwach R, Singh R, Rohilla RK, Kadian VS, Sangwan SS, Dhanda M. Internal fixation of proximal humeral fractures with locking proximal humeral plate (LPHP) in elderly patients with osteoporosis. *J Orthopaed Traumatol* 2008 July 16; 9:149-153
- [26]. Solberg BD, Moon CN, Franco DP, Paiement GD. Surgical treatment of three and four part proximal humeral fractures. *J Bone Joint Surg Am* 2009; 91:1689-97.
- [27]. Raghuvanshi R, Waikhom S, Singh AM, Singh Ch AK, Datta S, Marbaniang GB et al. Internal fixation of displaced proximal humerus fracture using PHILOS: A prospective study. *International journal of Science and Research [IJSR]* 2013, March 2015; 4(3):437-41.
- [28]. Parmaksizolu AS, Sökücü S, Ozkaya U, Kabukçuoğlu Y, Gül M. Locking plate fixation of three and four part proximal humeral fractures. *Acta Orthop Traumatol Turc* 2010; 44:97104.