

## **Outcome Assessment of Proximal Humeral Interlocking System Plating for Displaced Proximal Humerus Fractures**

**Abhishek Anand<sup>1</sup>, Abhinav Kumar<sup>2</sup>, Swati Singh<sup>3</sup>, Puja Sinha<sup>4</sup>**

<sup>1</sup>Assistant Professor, Department of Orthopaedics, Narayan Medical College & Hospital, Sasaram, Bihar, India

<sup>2</sup>Assistant Professor, Department of Orthopaedics, Narayan Medical College & Hospital, Sasaram, Bihar, India

<sup>3</sup>Senior Resident, General Medicine, Narayan Medical College & Hospital, Sasaram, Bihar, India

<sup>4</sup>Medical Officer, CHC, Palkot, Gumla, Jharkhand, India

Received: 06-09-2023 / Revised 22-10-2023 / Accepted 25-11-2023

Corresponding author: Dr. Abhinav Kumar

Conflict of interest: Nil

### **Abstract:**

**Aim:** The aim of the present study was to assess the functional outcome following internal fixation with the PHILOS (proximal humeral interlocking system) for displaced proximal humeral fractures.

**Methods:** The presents study was conducted in the Department of Orthopaedics, We treated 50 consecutive patients who had displaced proximal humeral fractures, with PHILOS (proximal humeral interlocking system) plating at a single large teaching hospital. The fracture was classified using Neer's classification.

**Results:** 70% were males as compared to 30% females. 66% had road traffic accidents mode of injury and 34% fell on surface. Maximum patients belonged to 56-75 years followed by 36-55 years age group. Most of the patients who were not able to do routine activity belonged to 76-95 years. 7 patients had pain in shoulder and 6 patients had stiff shoulder.

**Conclusion:** Our results show that good fracture stability was achieved, and the functional outcome was very good in younger patients and it declined with increasing age. Early mobilization of the shoulder can be achieved without compromising fracture union.

**Keywords:** Proximal Humeral Fractures, Locking Plate Fro Proximal Humeral Fractures, Philos Plating.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

### **Introduction**

The incidence of trauma related skeletal injuries have been on the rise in recent years and proximal humeral fractures alone account for approximately 4 to 5% of all bony injuries. [1] multiple factors related to patient, surgeon and fixation technique govern the outcomes of these injuries. Though locking plate technology was recommended for fixing proximal humeral fracture there are varied reports regarding functional outcomes and complication rates observed among studies. [2,3]

Proximal humerus fractures account for 4-5% of all fractures with a prevalence of 70 per 100,000, raising to 405 per 100,000 in population aged over 70 years. [4] they are the commonest fractures in elderly population, which ranks the third, the first and second being, hip and distal radius fractures respectively. [5] there are two important causes for these alarming high incidences are improved life expectancy with sedentary life style leading to senile osteoporosis which is the major cause of these fractures and increasing number of high velocity motor vehicle accidents these days. [6] the

Anand *et al.*

extent of displacement is an essential factor with regard to the choice of treatment. Non displaced or minimally displaced fractures can be treated conservatively. Displaced fractures of the humerus are preferably treated by means of surgical intervention like percutaneous or minimally invasive techniques such as pinning, osteosynthesis using cancellous screws, intra-medullary nails, open reduction and internal fixation with proximal humeral plates and hemiarthroplasty. [7,8]

The proximal humerus locking compression plate is anatomically contoured and the threaded screw heads are locked into the threaded plate holes to prevent screw toggle, slide and pull out. Because of the greater angular stability and better screw anchorage stability these devices offer, early mobilization can be achieved without the risk of screws becoming loose and/or secondary loss of reduction as seen with non-locking plates. [9]

The aim of the present study was to assess the functional outcome following internal fixation with

the philos (proximal humeral interlocking system) for displaced proximal humeral fractures.

### Materials and Methods

The presents study was conducted in the department of orthopaedics, narayan medical college & hospital, sasaram, bihar, india for one year. We treated 50 consecutive patients who had displaced proximal humeral fractures, with philos (proximal humeral interlocking system) plating at a single large teaching hospital. The fracture was classified using neer's classification.

The classification is based on the degree of displacement and angulations of the anatomical segments regardless of the level of fracture or the mechanism of injury. [10] the criteria used to select these patients for surgery were the amount of displacement of the fracture fragments (45 degrees of angulation and 1 cm of displacement) and the quality of function of the shoulder preoperatively. The operations were carried out by 2 specialist shoulder surgeons. The mean age of the patients was 58 years (range, 19-92 years). The cause of injury was mainly a simple fall, but other causes were road traffic accidents, skiing and fall from a ladder. The surgery was carried out within 10 days of the injury and within 2 weeks. Postoperatively the patients were assessed clinically and radiologically. The average follow-up period was 9 months (range, 4-12 months). Functional shoulder

assessment was done using the ases [11] score and constant scoring system. [12]

### Physiotherapy Regime

Our physiotherapy regime consisted of polysling for 3 weeks with pendulum exercises, followed by active assisted external rotation to neutral and active assisted flexion. At 6 weeks they were allowed full range of movements.

### Surgical Technique

Through a deltopectoral approach, the fracture site is exposed taking care of the soft tissue envelope to maintain a good vascular supply. The anterolateral branch of the anterior humeral circumflex artery, which is the primary blood supply to the proximal humerus, can be damaged while exposing the tendon in the bicipital groove, and care should be taken to avoid this complication as this may jeopardize the blood supply to the humeral head and increase the risk of avascular necrosis. [13] the fracture is then reduced anatomically, and the locking plate is applied onto the proximal humerus. The technically demanding part of the operation is to get the correct version of the humerus while applying the plate. The height of the implant is set by inserting the guide wire. It cannot be too high due to risk of impingement, and it cannot be too low as there will be insufficient holes to put the screws into the head of humerus.

### Results

**Table 1: Base line characteristics of the study**

|                             | Number | Percentage (%) |
|-----------------------------|--------|----------------|
| <b>Sex</b>                  |        |                |
| Male                        | 35     | 70             |
| Female                      | 15     | 30             |
| <b>Occupation</b>           |        |                |
| Labourer                    | 33     | 66             |
| Agriculture                 | 7      | 14             |
| Professional                | 4      | 8              |
| Housewife                   | 4      | 8              |
| Students                    | 2      | 4              |
| <b>Comorbidity</b>          |        |                |
| None                        | 30     | 60             |
| Diabetes mellitus           | 6      | 12             |
| Hypertension                | 6      | 12             |
| Others                      | 5      | 10             |
| Chronic kidney disease      | 3      | 6              |
| <b>Mechanism of injury</b>  |        |                |
| Road traffic accident       | 33     | 66             |
| Fall on surface             | 17     | 34             |
| <b>Limb involved</b>        |        |                |
| Right                       | 28     | 56             |
| Left                        | 22     | 44             |
| <b>Neer's fracture type</b> |        |                |
| Two-part                    | 26     | 52             |
| Three-part                  | 14     | 28             |
| Four-part                   | 10     | 20             |

| <b>Head-shaft angle</b>        |    |    |
|--------------------------------|----|----|
| Normal (125-145)               | 6  | 12 |
| Varus (<125)                   | 20 | 40 |
| Valgus (>145)                  | 24 | 48 |
| <b>Metaphyseal comminution</b> |    |    |
| Yes                            | 17 | 34 |
| No                             | 33 | 66 |

70% were males as compared to 30% females. 66% had road traffic accidents mode of injury and 34% fell on surface.

**Table 2: Age groups of patients and averages of the American Shoulder and Elbow Society and Constant Scores, respectively**

| Age in years | Total no. of patientsN (%) | ASES score | Constant score |
|--------------|----------------------------|------------|----------------|
| 15-35        | 10 (20)                    | 80/100     | 74/100         |
| 36-55        | 14 (28)                    | 72/100     | 73/100         |
| 56-75        | 17 (34)                    | 58/100     | 55/100         |
| 76-95        | 9 (18)                     | 54/100     | 36/100         |

Maximum patients belonged to 56-75 years followed by 36-55 years age group.

**Table 3: American shoulder and elbow society objective assessments (average)**

| Age   | Forward elevation % range of movements achieved | External rotation at 0° | External rotation at 90° abduction | Internal rotation | Strength |
|-------|---|-------------------------|------------------------------------|-------------------|----------|
| 15-35 | 85-95   | 558-648                 | 558-648                            | Level of T12      | 18/20    |
| 36-55 | 85-95   | 358-448                 | 558-648                            | Level of L3       | 15/20    |
| 56-75 | 65-74   | 358-448                 | 358-448                            | Level of sacrum   | 14/20    |
| 76-95 | 55-64   | 358-448                 | 258-348                            | Level of sacrum   | 12/20    |

**Table 4: American Shoulder and Elbow Society subjective assessments (average)**

| Age   | Pain score 0= no pain | Activity of daily living, e.g., put on a coat, comb hair, toileting, etc. |
|-------|-----------------------|---|
| 15-35 | 5/10                  | 27/30   |
| 36-55 | 6/10                  | 23/30   |
| 56-75 | 7/10                  | 18/30   |
| 76-95 | 8/10                  | 17/30   |

Most of the patients who were not able to do routine activity belonged to 76-95 years.

**Table 5: Complications in patients**

| Complications                   | No. of cases |
|---------------------------------|--------------|
| Sub acromial impingement        | 1            |
| Screw perforation               | 1            |
| Infection                       | 1            |
| Varus malreduction              | 4            |
| Restricted ROM (Stiff shoulder) | 6            |
| Pain in shoulder                | 7            |

7 patients had pain in shoulder and 6 patients had stiff shoulder.

**Discussion**

Most of the proximal humerus fractures which are undisplaced can be treated conservatively. [14] However, displaced fractures require surgical treatment for better outcomes. [15] The treatment goal is to achieve a painless shoulder with full range of motion. Fixation of proximal humeral fractures with plates and screws has been associated with complications such as pullout of screws in osteoporotic bone, subacromial impingement and avascular necrosis of the humeral head due to excessive periosteal stripping. [16,17]

70% were males as compared to 30% females. 66% had road traffic accidents mode of injury and 34%

fell on surface. This is in contrast to the earlier epidemiological studies which state accidental fall as the most common mode of injury. [18,19] Vijayvargiya et al study also reported fall (53.8%) as the predominant mode of injury followed by road traffic accidents (46.2%). [20] Maximum patients belonged to 56-75 years followed by 36-55 years age group. Most of the patients who were not able to do routine activity belonged to 76-95 years. 7 patients had pain in shoulder and 6 patients had stiff shoulder. The use of PHILOS plates and screws to fix proximal humeral fractures has been linked to problems such as subacromial impingement, screw pull-out in osteoporotic bone, and avascular necrosis due to severe periosteal stripping. The use of T-buttress plates in fixing proximal humeral fractures has been linked to a significant rate of fixation failure, according to

Kristiansen and Christensen. [21] Wijnman et al [22] found that 87 percent of patients with three- and four-part fractures treated with T-buttress plates had good intermediate and long-term results. The participants in their study had an average age of 48 years. Fractures of the Proximal humerus have lately been treated with novel implants such as the plan tan, humerus fixator plate, Polaris nail, and PHILOS plate. Two cancellous compression screws in the head of the humerus are combined with a plate on the shaft of the humerus to form the humerus fixator plate. According to Sadowski et al [23], the use of this device in older patients results in a 100% failure rate. Polaris nails have been demonstrated to be effective in both older and younger patients with 2 part fractures.

In this work, a new surgical strategy for the treatment of displaced proximal humerus fractures was presented. It combines the ideas of traditional plate fixation with the principles of locking screws. For the proximal humerus, the plate is pre-shaped and contoured. [24] The advantages of this implant include the improved purchase in osteopenic bone, no loss of reduction or varus/valgus angulations, and angular and axial stability of the construct provided by the locking screws in the plate. We obtained preliminary results in terms of functional outcomes using locking plates. The procedure's main technically problematic part is acquiring the correct version of the humerus for proper plate positioning. We had some impingement concerns with the early sample of patients due to the relatively newer implant and the novel technique used. Because this plate does not affect the envelope of the soft tissue, it causes less injury to the vascular supply of the fracture, lowering the likelihood of osteonecrosis. [25]

### Conclusion

Our results show that good fracture stability was achieved, and the functional outcome was very good in younger patients and it declined with increasing age. Early mobilization of the shoulder can be achieved without compromising fracture union.

### References

- Kristiansen B, Barfod G, Bredesen J, Erin-Madsen J, Grum B, Horsnaes MW, et al. Epidemiology of proximal humeral fractures. *Acta Orthop Scand.* 1987;58(1):75-7.
- Burkhardt KJ, Dietz SO, Bastian L, Thelen U, Hoffmann R, Müller LP. The treatment of proximal humeral fracture in adults. *Dtsch Arzteblatt Int.* 2013;110(35-36):591-7.
- Thanasas C, Kontakis G, Angoules A, Limb D, Giannoudis P. Treatment of proximal humerus fractures with locking plates: a systematic review. *J Shoulder Elbow Surg.* 2009;18(6):837-44.
- Court-Brown CM, Garg A, McQueen MM. The epidemiology of proximal humeral fractures. *Acta Orthop Scand.* 2001;72(4):365-71.
- Neer CS, Rockwood CA. Fractures and dislocations of the shoulder, In: Rockwood CA, Green DP (eds). *Fracture in adults.* Philadelphia, PA: Lippincott; 1984: 675-721.
- Calvo E, Morcillo D, Foruria AM, Redondo-Santamaría E, Osorio-Picorne F, Caeiro JR. Nondisplaced proximal humeral fractures: high incidence among outpatient-treated osteoporotic fractures and severe impact on upper extremity function and patient subjective health perception. *Journal of shoulder and elbow surgery.* 2011 Jul 1;20(5):795-801.
- Resch H, Povacz P, Frohlich R, Wambacher M. Percutaneous fixation of three- and four-part fractures of the proximal humerus. *J Bone Joint Surg Br.* 1997;79(2):295-300.
- Fankhauser F, Boldin C, Schippinger G, Haunschmid C, Szyszkowitz R. A new locking plate for unstable fractures of the proximal humerus. *Clin Orthop Relat Res.* 2005; 430:176-81.
- Storhm PC, Helwig P, Konrad G, Sudkamp NP. Locking plate in proximal humerus fractures. *Acta chirurgiaeorthopaedicae et traumatologiae.* 2007; 74:410-5.
- Charles S Neer II. Displaced proximal humeral fractures: Part I. Classification and evaluation. *JBJS.* 1970 Sep 1;52(6):1077-89.
- Richards RR, An KN, Bigliani LU, Friedman RJ, Gartsman GM, Gristina AG, Iannotti JP, Mow VC, Sidles JA, Zuckerman JD. A standardized method for the assessment of shoulder function. *Journal of shoulder and elbow surgery.* 1994 Nov 1;3(6):347-52.
- Constant CR. Age related recovery of shoulder function after injury. Thesis, University College. 1986.
- Hintermann B, Trouillier HH, Schäfer D. Rigid internal fixation of fractures of the proximal humerus in older patients. *The Journal of Bone & Joint Surgery British Volume.* 2000 Nov 1; 82(8):1107-12.
- Warriner AH, Patkar NM, Curtis JR, Delzell E, Gary L, Kilgore M, et al. Which fractures are most attributable to osteoporosis? *J Clin Epidemiol.* 2011; 64:46-53.
- Young TB, Wallace WA. Conservative treatment of fractures and fracture-dislocations of the upper end of humerus. *J Bone Joint Surg Br.* 1985;67(3):373-7.
- Kristiansen B, Christensen SW. Plate fixation of proximal humeral fractures. *Acta Orthopaedica Scandinavica.* 1986 Jan 1;57(4):320-3.
- Lind T, Krøner K, Jensen J. The epidemiology of fractures of the proximal humerus. *Archives of orthopaedic and trauma surgery.* 1989 Sep; 108:285-7.

18. Court-Brown CM, Caesar B. Epidemiology of adult fractures: A review. *Injury*. 2006;37 (8) :691-7.
19. Roux A, Decroocq L, El Batti S, Bonneville N, Moineau G, Trojani C, et al. Epidemiology of proximal humerus fractures managed in a trauma center. *Orthop Traumatol Surg Res OTSR*. 2012;98(6):715-9.
20. Vijayvargiya M, Pathak A, Gaur S. Outcome Analysis of Locking Plate Fixation in Proximal Humerus Fracture. *J Clin Diagn Res JC DR*. 2016 ;10(8):RC01-05.
21. 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.
22. Hawkins RJ, Kiefer GN: Internal fixation techniques for proximal humeral fractures. *Clin Orthop Relat Res*. 1987, 77-85.
23. Sadowski C, Riand N, Stern R, Hoffmeyer P: Fixation of fractures of the proximal humerus with the PlantTan Humerus Fixator Plate: early experience with a new implant. *J Shoulder Elbow Surg*. 2003, 12:148-51.
24. Goldman RT, Koval KJ, Cuomo F, Gallagher MA, Zuckerman JD. Functional outcome after humeral head replacement for acute three-and four-part proximal humeral fractures. *Journal of shoulder and elbow surgery*. 1995 Mar 1;4 (2):81-6.
25. Moeckel BH, Dines DM, Warren RF, Altchek DW. Modular hemiarthroplasty for fractures of the proximal part of the humerus. *JBJS*. 1992 Jul 1;74(6):884-9.