

## Original Research Article

# Clinico-radiological and functional outcome of surgical management of displaced two part, three part and four part proximal humeral fractures in adults treated by PHILOS plate in a tertiary care hospital in North India: a prospective study of 30 patients

Pankaj Spolia\*, Abdul Ghani, Sakib Arfee

Department of Orthopaedics, Govt. Medical College, Jammu. Jammu and Kashmir, India

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### \*Correspondence:

Dr. Pankaj Spolia,

E-mail: [pankajspolia13@gmail.com](mailto:pankajspolia13@gmail.com)

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## ABSTRACT

**Background:** Treatment of proximal humeral fractures is challenging. In the past, the fractures were treated conservatively which compromised the functional results. PHILOS plate provides a good functional outcome with context to the early joint mobilization and rigid fixation of the fracture.

**Methods:** This was the prospective study of 30 patients aged 20 to 60 years (mean age 48.4 years) with proximal humeral fractures including two part, three part and four part fractures based on Neer's classification, treated by open reduction internal fixation with PHILOS plating. Functional outcome was assessed using Constant-Murley Score.

**Results:** The final outcome was observed at 6 months follow up. The results were comparable with the existing literature. The Mean Constant Score at 6 month follow up was 79.4, range (38 to 92). Out of 30, (n = 12, 40%) had excellent outcome, (n = 9, 30%) had good functional outcome, 6 (20%) had moderate outcome, 3 (10 %) had poor outcome. Out of 30 patients, one patient with four part fracture had a lowest CS of 38. Complications were observed in 5, (16.7%) patients. Varus malunion in one patient, avascular necrosis in one patient, stiffness in one patient.

**Conclusions:** PHILOS plate gives stable fixation, enables early range of motion and minimizes complications with good functional outcome if done with expert hands.

**Keywords:** Proximal humeral fracture, Proximal humerus interlocking system, Visual analogue scale, Constant score

## INTRODUCTION

Proximal humeral fractures account for 5% to 6% of all adult fractures.<sup>1</sup> It is the third most common fracture in people above 65 years of age, after fractures of hip and distal radius.<sup>2</sup> About 85% of these fractures are minimally displaced and are treated conservatively. The remaining 15% are displaced and unstable, and are treated operatively.<sup>3</sup> Displaced three part and four part fractures alter the articular congruity and disruption of blood supply, leading to osteonecrosis. Many operative techniques are available for treatment. Percutaneous pinning and

intramedullary nailing are also done which give satisfactory results and have less chance of infection, soft tissue disruption and blood loss. However, these are less stable than Open Reduction and Internal Fixation (ORIF) with locking plates.<sup>4,5</sup>

The benefits of ORIF with locking plate include more fracture angular stability in comminuted fractures and in osteoporotic bone, and early rehabilitation.<sup>6</sup> With advancing age and osteoporosis, irrespective of modality of treatment, the risk of poor results increases.<sup>7-9</sup>

The aim of this study was to evaluate the clinico-radiological and functional outcome of Neer's two, three and four part displaced humeral fractures treated with PHILOS plate.

## METHODS

An observational prospective study of 30 patients (n = 30) satisfying the inclusion criteria treated by open reduction and internal fixation from January 2020 to May 2021 was done at the Post graduate Department of Orthopaedics, Government Medical College, Jammu.

Patients satisfying the selection criteria were included in the study after proper history, clinical examination, written informed consent for the surgery and anaesthesia, and explaining their possible complications prior to the surgery. The indication of surgery was based on Neer's classification.<sup>10,11</sup> The data was analysed by appropriate statistical methods. Functional outcome was evaluated by Constant Score at 6 month follow up and was compared with the existing literature.<sup>12</sup> Pain was evaluated by Visual Analogue scale.<sup>13</sup>

### Inclusion criteria

Patients with closed proximal humeral fracture including two, three and four part fractures within 3 weeks, with age 20 to 60 years, were included in the study.

### Exclusion criteria

Fractures presenting after 3 weeks, minimally displaced fractures, isolated greater tuberosity fractures paediatric fractures, open fractures, pathological fractures.

### Investigations

Appropriate radiological investigations were done in the form of antero-posterior and axillary views, and fractures were classified according to Neer's classification. In doubtful and complex fractures, CT scan was also done.

All baseline blood investigations, Chest X-rays and ECG was done. Informed written consent was taken and antibiotic prophylaxis was given.

### Operative technique

With the patient positioned supine on radiolucent table in beach chair position, standard deltopectoral approach was used.

The incision was started at the tip of coracoid process, and extended distally along the deltopectoral groove to the deltoid insertion. The fascia over the deltopectoral groove was opened with blunt scissors, looking for the cephalic vein. The vein was retracted laterally. Bluntly this interval was developed after retracting the deltoid laterally and the pectoralis major medially. The anterior circumflex artery

was isolated, clamped, and coagulated. Plate was placed onto the greater tuberosity, and temporarily fixed with Kirschner wires; confirmed correct plate position in C-Arm both in AP view in adduction and abduction. Once fixation was confirmed, the wound was irrigated and drain was placed. Suturing and dressing was done.

### Post-operative treatment

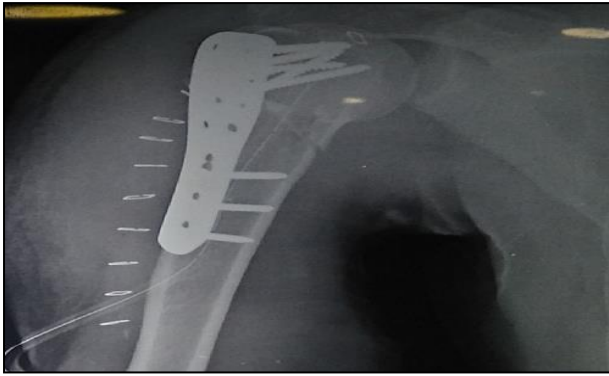
Postoperatively, the arm was immobilized in a shoulder immobilizer. Adequate analgesia was given. Intravenous antibiotics (cefuroxime) were given. Drain was removed on 2nd to 3rd post operative day. Sutures were removed on 14th post operative day. Passive ROM exercises (Pendulum exercises, passive forward flexion and external rotation) were started in immediate post operative period. Active ROM of elbow wrist and hand were started immediately after surgery. Depending upon the stability on fixation, active shoulder isometric exercises were started at 3 weeks, followed by isotonic strengthening and stretching exercises at 8 to 12 weeks only after bony consolidation was confirmed on plain radiographs. The patient was followed up for a period of 6 months to 1 year.



Figure 1: Intraoperative picture showing PHILOS plate.



Figure 2: Radiograph showing Neer's two part fracture.



**Figure 3: Postoperative radiograph at 2 weeks showing PHILOS plate.**

**Follow up**

Patients were assessed clinically and radiologically at 2 weeks, 6 weeks, 3 months, 6 months, 12 months. Fracture healing was judged by both clinical (pain and motion at fracture site) and radiological (bridging callus filling the fracture site or trabeculations across the fracture site). At each follow up, functional evaluation of the patient was done to note the range of movements, at the shoulder and elbow, any pain, deformities, and any residual complaint. The occurrence of the complications in treatment like shoulder pain, elbow pain, stiffness, swelling of the shoulder and elbow was noted. After two weeks, X-rays were taken again to check for position of the fracture, head, neck and shaft, and evidence of radiological union. After 3 months, patients were assessed by Constant score which include severity of pain, activities of daily living, range of motion in terms of forward elevation, lateral elevation, internal rotation and strength. Subsequently, the patients were followed at above mentioned time intervals till one year.

**Post operative assessment**

Post-operative patients were assessed by Constant-Murley Score. The Constant-Murley Score (CMS) is a 100 point scale composed of number of score parameters. These parameters define the level of pain and the ability to carry out the normal daily activities of the patient. The score was introduced to determine the functionality after the treatment of a shoulder injury. The test is divided into four subscales: pain (15 points), activities of daily living (20 points), strength (25 points), and range of motion: forward elevation, external rotation, abduction and internal rotation of the shoulder (40 points). The higher the score, the higher the quality of the function.

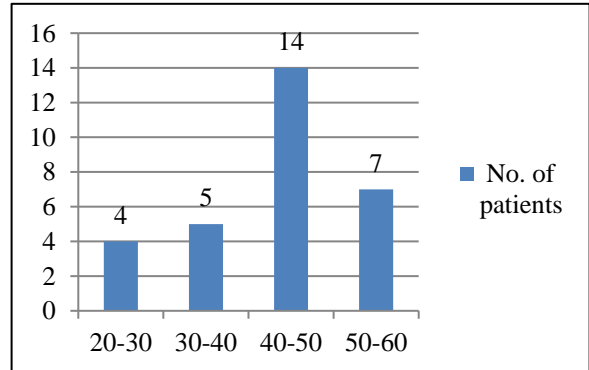
Constant score was categorized as; Excellent (86 to 100), good (71 to 85), moderate (56 to 70), poor (0 to 55).

**Statistical tool**

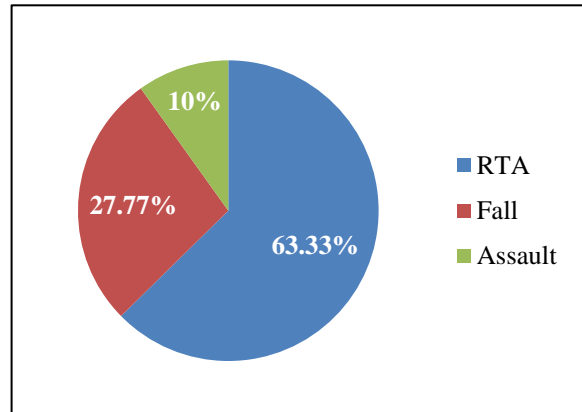
As this study was not a comparative study, simple statistical methods of mean and percentage were used.

**RESULTS**

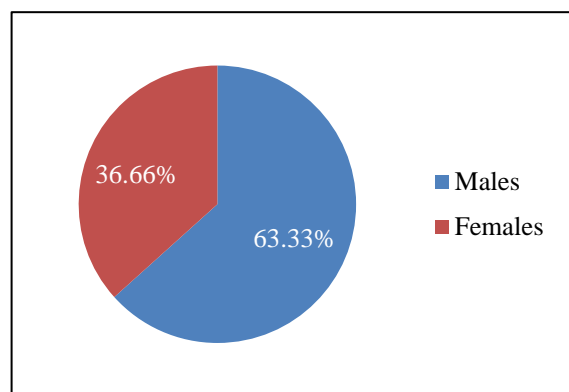
The total number of cases in our study were 30, out of which, 19 were male and 11 were females, with mean age of 48.4 years ranging from 20 to 60 years.



**Figure 4: Age distribution of proximal humerus fractures.**



**Figure 5: Mode of trauma.**



**Figure 6: Sex distribution.**

In the present study, the majority of the mode of trauma was road traffic accidents in 63.3 % of cases, followed by fall in 26.7% cases and assault in 10% of the cases.

Out of 30 patients, 18 had trauma of the right side and 12 had trauma of the left side. On the basis of Neer’s

classification, 14 patients had 2 part fracture, 10 patients had 3 part fracture and 6 patients had 4 part fracture.

**Table 1: Following parameters studied.**

Parameter	No. of patients	Percentage
<b>Mode of injury</b>		
RTA	19	63.33
Fall	8	26.7
Assault	3	10
<b>Neer's type</b>		
Two part	14	46.7
Three part	10	33.3
Four part	6	20
<b>Occupation</b>		
Sedentary	5	16.7
Light work	21	70
Heavy work	4	13.3
<b>Delay in surgery</b>		
Less than 1 week	18	60
More than 1 week	12	40

**Table 2: Functional outcome in terms of constant score.**

Constant score	No. of patients (n, %)	two part*	three part*	four part*
Excellent (86 to 100)	12 (40%)	8	4	0
Good (71 to 85)	9 (30%)	5	3	1
Moderate/fair (56 to 70)	6 (20%)	1	2	3
Poor (0 to 55)	3 (10%)	0	1	2
Total	30 (100%)	14	10	6

\*fracture types

**Table 3**

Complication	No. of patients	Percentage
<b>Superficial infection</b>	2	6.67
<b>Varus malunion</b>	1	3.33
<b>Avascular necrosis</b>	1	3.33
<b>Stiffness</b>	1	3.33
<b>Total</b>	5	16.7

In the present study, 18 patients reported on the same day of injury, 7 patients reported after one day, 3 patients after 2 days, 2 patients reported after 2 weeks. Mean delay in reporting was 2.2 days. 5 patients were sedentary, 21 patients were light workers, 4 patients were heavy workers. 20% of the patients were found to be associated with other injuries (head 4%, chest 8%, fracture intertrochanteric 2%, fracture lateral malleolus 2%, blunt trauma abdomen 2%, fracture radius 2%). In the present study, 18 patients were operated within first week, 12 patients were operated after first week.

### Clinico-radiological consolidation

Fractures were assessed clinically when painless, unaided movements were possible and there was no tenderness.

**Table 4: Time of radiological union.**

Study	Average time of union
<b>Kilic et al<sup>29</sup></b>	10 weeks
<b>Monga et al<sup>30</sup></b>	11 weeks
<b>Bansal et al<sup>20</sup></b>	11.2 weeks
<b>Nabil et al<sup>25</sup></b>	12 weeks for 97% of patients
<b>Vijay et al<sup>26</sup></b>	12.3 weeks
<b>Present study</b>	12.6 weeks

**Table 5: Comparison of functional outcome in terms of constant score.**

Study Score	No. of patients	Percentage
<b>Vijay et al<sup>26</sup></b>		
Excellent	20	50
Good	08	20
Moderate	08	20
Poor	04	10
<b>Zeigler et al<sup>27</sup></b>		
Excellent	36	46.8
Good	24	31.2
Moderate	07	9.1
Poor	10	13
<b>Patel et al<sup>21</sup></b>		
Excellent	34	56.7
Good	11	18.3
Moderate	08	13.3
Poor	07	11.7
<b>Present study</b>		
Excellent	12	40
Good	09	30
Moderate	06	20
Poor	03	10

Out of 30 patients, in 8 patients the fracture was united within 11.5 weeks. In 18 patients, the fracture was united at 13 weeks, and in 4 patients, the fracture was united at 16.2 weeks in the present study. The average union time was 12.6 weeks. The union time was more in four part fractures.

### Functional evaluation

Patients were functionally evaluated based on subjective (35 points) and objective (65 points) parameters as per Constant Scoring System.

In the present study, at 6 month follow up, 23 patients had no pain, 4 patients had pain at extreme of movements and 3 patients had significant pain evaluated by Visual



Analogue Scale. Pain severity was more with four part fractures.

The Mean Constant Score at 6 month follow up was 79.4, range (38 to 92). The Constant Score was higher in the younger patients and patients with two part fractures as compared to the complex fractures in the present study. Out of 30 patients, one patient with four part fracture had a lowest CS of 38. Out of 30, (n = 12, 40%) had excellent outcome, (n = 9, 30%) had good functional outcome, 6 (20%) had moderate outcome, 3 (10 %) had poor outcome.

### **Complications**

In the present study, complications were observed in 5, (16.7%) patients. Varus malunion in one patient, avascular necrosis in one patient, stiffness in one patient. No neurovascular complications were observed. There was no incidence of articular surface perforation or breakage of plate or screw. Superficial infection was observed in two patients at 2 weeks follow up which was managed with sterile dressings and antibiotics.

### **DISCUSSION**

The operative treatment for proximal humeral fractures is controversial and a challenge for the surgeon. The treatment of displaced fractures with conventional plates have reported unsatisfactory outcomes and complications.<sup>14</sup>

Locking plates are angular stable plates and thus provide secure fixation in metaphyseal region which resist physiological loads more effectively.<sup>15,16</sup> Suture holes are useful to repair rotator cuff and provide stabilization of tuberosity fragments.<sup>17</sup>

In the present study, maximum incidence was observed in 5th decade with mean age of trauma was 48.4 years, which has similar results as compared to Gerber et al (44.9 years) and Jagiasi et al (47.1 years), Bansal et al (49.24).<sup>18-20</sup>

In the present study, 19 (63.33%) were males and 11(36.6%) were females, with M:F ratio of 1.73:1. Similar observations were made by Jagiasi et al and Bansal et al.<sup>19,20</sup>

In our study, the most common cause of proximal humeral fracture was road traffic accident (64%), followed by fall from standing height (28%), which was similar to previous studies Patel et al and Bansal et al.<sup>20,21</sup>

Fractures were more common on the right side (60%), than on left side (40%) which were in agreement with previous studies Gerber et al and Iglesias-Rodriguez et al.<sup>18,22</sup>

In the present study, on the basis of Neer's classification, most common fracture type was two part (46.6%), followed by three part (33.3%) and 4 part (20%). Similar

observations were reported by Bjorkenheim et al, Rangan et al and Jagiasi et al.<sup>19,23,24</sup>

Radiological union was achieved within 10 to 18 weeks, with an average of 12.6 weeks. Similar observations were made by Bansal et al, Nabil et al and Vijay et al.<sup>20,25,26</sup> Delayed union was observed in two patients in whom the union occurred within 18 weeks without any intervention.

The functional outcome was assessed on the basis of Constant Score. 12 Out of 30, (n = 12, 40%) had excellent outcome, (n = 9, 30%) had good functional outcome, 6 (20%) had moderate outcome, 3 (10 %) had poor outcome. The mean Constant Score was 79.4. Our results were similar to Zeigler et al and Vijay et al.<sup>26,27</sup>

Out of 30 patients, complications were observed in 3, (10%) patients. Varus malunion in one patient with two part fracture, avascular necrosis of humeral head in one patient with four part fracture, stiffness in one patient. Our results were comparable with the existing literature, Sudkamp et al, Kilic et al and Sharma Vijay et al.<sup>26,28,29</sup> No neurovascular complications were observed in the present study.

### **Limitation of the present study**

The present study had limitations. It was not randomised, and the sample size was lesser which can lead to bias. The Constant scoring system is based on both subjective and objective parameters. The subjective components can lead to bias in the study.

### **CONCLUSION**

The treatment of proximal humeral fractures remains challenging. Adequate surgical skills and surgeons experience are needed to achieve good results. The present study reveals the preference towards the proximal humerus locking plates which are pre-contoured and can hold firmly on the bone, provide a buttress effect laterally and provides inferomedial support by locking screws which prevents varus displacement of proximal fragment. PHILOS plate gives stable fixation, enables early range of motion and minimizes complications with good functional outcome.

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*Ethical approval: The study was approved by the Institutional Ethics Committee*

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