

## Functional outcomes of locking plate fixation in complex proximal humerus fractures

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**Objective:** To assess the functional outcome of proximal Humerus fractures after fixation with the PHILOS (Proximal Humerus Interlocking System) plating system in Sindh, Pakistan.

**Methodology:** This systematic case series was conducted at the Department of Trauma and Orthopedics, JPMC Karachi Pakistan from December 2017 to November 2019. A total of 81 patients of age 20 years and above of either sex presented with 3-part fracture, 4-part fracture or fracture-dislocation (according to the Neer classification system) with angulations of  $>45^\circ$  or displacement of  $>1\text{cm}$  and fracture duration of less than two weeks were enrolled. Patients with pathological fractures secondary to tumors, infection and connective tissue disorders were excluded from the study. Passive elevation and

rotation exercises were started on day 3<sup>rd</sup> day of operation. Active range-of-movement exercises were started at week 6. Final outcome was assessed on 24<sup>th</sup> week in terms of range of motion

**Results:** There were 25 (30%) patients with 3-part fracture, 41 (50%) with 4-part fracture and 15 (18%) patients had fracture dislocation. Right limb was involved in 55 (67%) patients and left limb was involved in 26 (32%) patients. Overall satisfactory outcome was found in 70 (86%) patients.

**Conclusion:** The functional outcome of PHILOS plate system in displaced proximal humerus fractures was found satisfactory. (Rawal Med J 202;45:633-636).

**Keywords:** Fracture proximal Humerus, Functional outcome, PHILOS plate.

## INTRODUCTION

Fractures of the proximal humerus (FPH) are the third most common fractures, after hip and Colles' fractures in the elderly people.<sup>1</sup> Proximal humeral fractures account for 5-6% of all fractures and the incidence is higher among older age women.<sup>1-3</sup> Nearly 85% of these fractures occur in people over the age of 50 years with the peak incidence in 60 to 90 years of age.<sup>4</sup> These fractures are usually caused by low-energy trauma in osteoporotic elderly individuals or by high-energy trauma in young patients leading to more displacement of the fracture fragments.<sup>5</sup> The treatment goal is to achieve a painless shoulder with normal range of motion.<sup>6</sup>

The main approach of uni-displaced, stable or minimally displaced proximal humeral fractures is conservative and more than 80% of these injuries heal without any surgical intervention.<sup>7,8</sup> However in nearly 20% of the cases, these fractures are moderate to severely displaced and treatment regime for such kind of fractures is not fully defined.<sup>8</sup> Surgical fixation is indicated for displaced

and unstable fractures since early reduction and fixation leads to faster rehabilitation and improved functional status.<sup>9</sup> However, certain factors which affect the outcome in these fractures are increasing age, co morbidities such as diabetes and hypertension, weak osteoporotic bones, displaced and comminuted fracture fragments.<sup>10,11</sup>

To overcome these problems and to achieve treatment goals improved surgical techniques, fixation methods and better implants have been designed.<sup>6,8</sup> Out of these, locking plates which are contoured anatomically according to the shape of proximal humerus known as Proximal Humeral Internal Locking System PHILOS (Synthes, Solothurn, Switzerland) has been developed by AO/ASIF foundation.<sup>12,13</sup> PHILOS provides rotational, angular and axial stability. It has better screw fixation in old osteoporotic bone with minimum soft tissue stripping.<sup>13-15</sup>

Despite better implant designs, there are still chances of complications such as avascular necrosis of humeral head, subacromial impingement, varus

collapse, non-union, rotator cuff tears and adhesive capsulitis which are related to open reduction of the fracture, improper placement of the plate and screws and fracture of the medial calcar.<sup>16-18</sup> The purpose of our study was to determine the functional outcome of proximal humerus fractures using PHILOS, and to compare our results with other studies.

## METHODOLOGY

This descriptive case series was conducted at the Department of Orthopedic and Trauma Surgery, JPMC Karachi from Dec 2017 to Nov 2019. A total of 81 patients of 20 years and above of either sex with 3-part, 4-part fractures and fracture dislocations (according to the Neer classification system).<sup>19</sup> With angulations of  $>45^\circ$  and displacement of  $>1$  cm, who presented within 2 weeks of injury were enrolled. Pathological fractures secondary to tumors, infection, connective tissue disorders and open fractures were ruled out from the study.

Surgery was performed by a senior consultant with at least 5 years post-fellowship experience using PHILOS plate in proximal humerus fracture. Fracture was reduced anatomically and provisionally fixed with k-wires and PHILOS plate was applied. Post operatively, patient arm was kept in a broad arm sling, drain was removed after 24-48 hours and passive elevation and rotation exercises were started on day 3. Active range-of-movement exercises were started at week 6.

Patients were followed at 2<sup>nd</sup>, 6<sup>th</sup>, 12<sup>th</sup> and 24<sup>th</sup> week for radiological union of the fracture and functional assessment according to the Constant-Murley shoulder outcome score. This scoring system has maximum 100 points with four parameters: 1) Range of movements: 40 points, 2) Pain: 15 points, 3) ADL (activities of daily living: 20 points, and 4) Strength: 35 points. The Constant scores of 86 and above are considered excellent, 71 to 85 as good, from 56 to 70 as fair and below 55 were graded as poor.<sup>21</sup> Final outcome was assessed at 24 weeks.

**Statistical Analysis:** The data were analyzed with SPSS Version 11. Effect modifier was controlled by stratification of age, gender, and fracture type through Chi-Square test.  $p < 0.05$  was taken as significance.

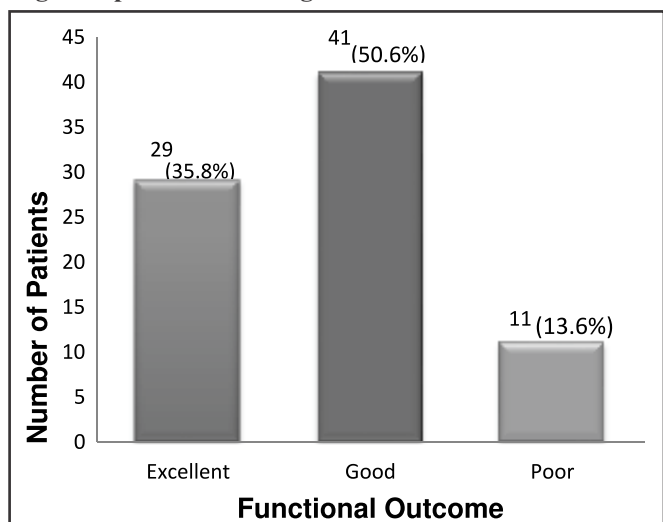
## RESULTS

In a total of 81 patients, mean age was  $46.85 \pm 10.69$  (range 32-56) years with most of the patients above 40 years ( $n=51$ , 63%). There were 63 (77.8%) male and 18 (21.2%) females (Table). Regarding mechanism of injury, 22 (27.2%) patients had falls from different levels of height whereas vehicular trauma was found in 59 (72.8%) patients. Right limb was affected in 55 (67.9%) patients and left limb in 26 (31.1%) patients. Excellent functional outcome was found in 29 (35.8%) patients, Good in 41 (50.6%) patients and fair in four (5%) and poor in seven (8.6%) patients. Overall satisfactory outcome (good and excellent) was found in 70 (86.4%) patients. radiological union was achieved in 78 (96%) of the patients whereas three (4%) fractures remain un-united (Figure).

**Table. Outcome with respect to age, gender and fracture type ( $n=5$ ).**

Variable		Outcome		P-value
		Satisfactory	Non satisfactory	
Age	<40y	30	00	0.006
	>40y	40	11	
Gender	Male	60	03	0.001
	Female	10	08	
Fracture type	3-part	25	00	0.001
	4-part	36	05	
	Frac dislocation	09	06	

**Fig. Comparison of scoring in Functional outcome.**



Stratification of age group showed that patients with age  $\leq 40$  years were more likely ( $n=30$ , 37%) to have

satisfactory outcome as compared to those of age >40, (n=51, 63%). Significant relationship was found for age and satisfactory outcome ( $p=0.006$ ). Stratification of gender showed that male patients (n=60, 95.2%) had better outcome as compared to females (n=10, 55.6%). Statistically significant relationship was found for gender and satisfactory outcome ( $p=0.001$ ).

Patients with 3-part fracture were more satisfied (n=25, 100%) with outcome as compared to patients with 4-part fracture or fracture dislocation (n=36, 97.8%) and (n=9, 60%), respectively. Chi-square test showed a significant relationship for type of fracture and satisfactory outcome ( $p=0.001$ ).

## DISCUSSION

Most important observations of our study included: (1) all patients in age group of  $\leq 40$  years had satisfactory outcome compared to those age >40 years; (2) male patients had better results than female patients; (3) 3-part fractures had better results than other fracture patterns; (4) incidence of complications such as non-union, varus collapse and avascular necrosis was low. These findings suggest better results with PHILOS in proximal humerus fractures, since it provides greater angular stability than do conventional implants.<sup>22,23</sup> It works as a locked internal fixator and provides better anchorage of screws in comminuted as well as osteoporotic bone with good functional results.<sup>22</sup>

Age is an important decisive factor in surgical fixation of displaced proximal humerus fractures since elderly population have low functional demands, poor bone quality and presence of multiple comorbidities.<sup>4,11</sup> In fact most of studies have been done on elderly women because of preponderance of these fractures in this population age group.<sup>3,9,11</sup> Similar to these studies, most of our patients were also older than 40 years (n=51, 63%). Our findings are similar to study by Koukakis et al who found that increasing age frequently leads to failure of fixation and poor results.<sup>24</sup> Another important finding of our study was that majority of our patients were males in contrast to other studies<sup>3,11,13</sup> and results were better in males as compared to females.

Fracture geometry also influences the outcome of proximal humerus fractures. Better results can be found in two and three part fractures in contrast to four part and fracture dislocations.<sup>24</sup> Gavaskar et al<sup>12</sup> and Martinez et al<sup>21</sup> found no difference in results of three and four part proximal humerus fractures treated with PHILOS plate system.

Various complications have been reported with this procedure including infection, failure of fixation, axillary nerve damage, avascular necrosis and penetration of screws into humeral head.<sup>14,17,18</sup> Gavaskar et al reported complications in three out of 26 patients requiring revision surgery and arthroplasty.<sup>12</sup> Sudkamp et al noted highest complication rate, where they found sixty two complications in 52 (34%) out of 155 patients during the follow up of one year.<sup>14</sup> We found superficial wound infection in one patient which healed with antibiotics, one patient developed avascular necrosis of humeral head and two had intraarticular screw penetration requiring removal. Main limitation of our study was that there was no control group in the current study; therefore we were unable to determine if other treatment methods have different results.

## CONCLUSION

The use of PHILOS plate system had satisfactory functional outcome in the fractures of proximal humerus. Results were particularly better in male patients younger than 40 years. The functional outcome of Proximal Humerus Interlocking System provided better rotational and angular stability.

### Author Contributions:

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