



# PROXIMAL HUMERUS FRACTURES; RADIOLOGICAL AND FUNCTIONAL OUTCOME AS TREATED WITH THE PHILOS PLATING SYSTEM, AT A TERTIARY CARE CENTRE IN KARACHI, PAKISTAN.

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**ABSTRACT... Objectives:** The aim of our study is to study the radiological and functional outcome of proximal humerus fractures treated via open reduction and internal fixation using the proximal humerus internal locking system or PHILOS. **Study Design:** Case series study. Period 05 years duration from January 2011 to December 2015. **Setting:** Large tertiary care centre in Karachi, Pakistan. **Materials and methods:** The study population consisted of n=50 patients all of whom underwent open reduction and internal fixation utilizing the proximal humeral internal locking system or PHILOS for fractures of the proximal humerus. The inclusion criterion was all the patients with closed fractures of the proximal humerus and were belonging to 2,3 and 4 part of the Neer system of classification. Physiotherapy was started as soon as possible for the patients. Serial radiographic imaging in two views was done at 6, 12, 24 and 52 weeks postoperatively. For the functional outcome of the procedure Constant and Murley scoring system was used. Data was analyzed using IBM SPSS version 21. **Results:** The study population consisted of n= 50 patients of which n= 35 were males and n= 15 were females having a mean age of 38.50 years. The mean duration of follow up was 24 months. All the patients in the study had union of fracture both radiographically and clinically, the mean time duration for the radiographically evident union of the humerus bone was 12 weeks with a range of 8 to 20 weeks, the mean Constant Murley score for the functional outcome of the shoulder joint was 79 at the final follow up with a range of 50 to 100. Complications were found in n= 9 patients and varus malunion was the most common complication. In our case series we did not observe complications such as avascular necrosis, non union or implant failure. **Conclusion:** According to the results of our study the proximal humerus internal locking system or PHILOS is a good method for open reduction and internal fixation of the proximal humerus fractures and provides a stable fixation, and has lower incidence of complications such as avascular necrosis.

**Key words:** Humerus fractures; Open reduction internal fixation; Proximal humerus internal locking system; PHILOS; Surgical outcome.

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## INTRODUCTION

The test of any orthopedic surgeons skill is in proper treatment of a fractured bone. Fracture of bones is one of the most common reasons for visits to the accident and emergency departments worldwide, the fractures of the proximal humerus bone of the upper limb accounts for 5% of such visits, and in the geriatric population they account for a third of all fractures following the hip and distal radius fractures.<sup>1,2,3</sup> The cause of proximal humerus fracture is blunt force trauma in the young adult population and is accompanied by dislocations of the fracture, while in geriatric patients co morbidities such as osteoporosis are

the main cause. Those fractures which are stable and have lesser displacement can be managed conservatively.<sup>4</sup> Orthopedic surgeons have been using various methods for the treatment of proximal humerus fractures as described in the literature, these methods include percutaneous K wire, closed reduction, open reduction and fixation with sutures, circulating wise, intra medullary nails and plates, prosthetic replacement, T plate and tension band among others.<sup>5,6,7,8</sup> But no procedure is perfect and each one has its own set of complications such as, nonunion of bone, avascular necrosis, impingement of the rotator cuff, implant failure etc.<sup>9</sup> One of the treatment

methods is the proximal humeral internal locking system or the PHILOS system, which is especially useful in the geriatric population who have osteoporotic bones, it provides better fixation, gives stability, involves minimal disuse damage and has minimal the risk of displacement of the fractured bone. The aim of our study is to study the radiological and functional outcome of proximal humerus fractures treated via open reduction and internal fixation using the proximal humerus internal locking system or PHILOS.

## MATERIALS AND METHODS

The type of study is a case series, conducted for a period of 5 years duration from January 2011 to December 2015 at a large tertiary care centre in Karachi, Pakistan. The study population consisted of n=50 patients all of whom underwent open reduction and internal fixation utilizing the proximal humeral internal locking system or PHILOS for fractures of the proximal humerus. After due informed consent, data was collected in a pre designed proforma which included but was not limited to a complete history and physical examination, age, gender, cause of injury, co morbidities, radiological findings, past medical and surgical history.

The inclusion criterion was all the patients who presented to us through the accident and emergency department with closed fractures of the proximal humerus, those who provided consent to participate in the study, patients who were older than 18 years of age at the time of presentation, patients belonging to 2,3 and 4 part of the Neer system of classification of proximal humeral fractures. The exclusion criterion was all the patients who refused to partake in the study, were less than 18 years of age at presentation, had or pathological open fractures and all those patients in whom conservative treatment had failed. After a complete history and examination all the patients underwent a thorough radiological assessment including X rays, computer tomography scans and magnetic resonance imaging where applicable. Laboratory analysis was done for all the patients which included but was not limited to complete blood count, HbA1c, lipid profile, calcium and vitamin D levels, thyroid

profile etc. All the surgical procedures were performed at a single institute under general anesthesia with the patients lying in a beach chair position, using a deltopectoral approach.

The imaging unit was at the head end of the table and trial images were taken prior to draping and scrubbing. Local anesthetic was applied in the skin around the area of procedure. Midway between the clavicle and coracoid process an incision was made which was extended till the insertion of the deltoid muscle. The cephalic vein was retracted laterally while the conjoint tendon was retracted medially. For fragmented tuberosity of the humerus traction sutures with Ticron number 5 and K wires were fixed to the humeral shaft temporarily. Distal to the greater tuberosity at a distance of 5 to 10mm and lateral to the bicipital groove the PHILOS plate was placed, the initial cortical screw was placed and the subsequent screws were placed after confirming the position of the PHILOS plate system, all the drilling to place the locking screws was done under fluoroscopic imaging. At least 5 head screws and 3 bicortical screws were used in the procedures. The tuberosity sutures that were applied earlier were fixed with the PHILOS plate, as doing this provides better functional outcome.<sup>10,11</sup>

Suction drain was used when closing the wound which was removed on the first or second post operative day accordingly. A Sling was used to support the arm. Physiotherapy was started as soon as possible for the patients and it was started with passive forward flexion, pendulum and external rotation exercises (usually from the first post operative day) these exercises were gradually increased up to assisted active exercises starting from the third week of procedure and full active exercises starting from the sixth week of procedure, while the muscular strengthening exercises were started from twelfth week of procedure respectively. Serial radiographic imaging in two views was done at 6, 12, 24 and 52 weeks postoperatively. The surgeons assessed the radiological union of bone by assessing the appropriate formation of Callus and observing the bridging of the trabecular bone. For the functional outcome of the procedure Constant and Murley

scoring system was used, which consists of various variables such as pain, activities of daily living with a total of 35 points and range of motion and strength with a total of 65 points.<sup>12</sup> Data was analyzed using IBM SPSS version 21 for windows. Continuous variable like age are expressed as mean and standard deviation while categorical variables like gender are given in frequency and percentage.

**RESULTS**

The study population consisted of n= 50 patients of which n= 35 were males and n= 15 were females having a mean age of 38.50 years with a range between 22 and 65 years. The mean duration of follow up was 24 months. All the patients in the study had union of fracture both radiographically and clinically, the mean time duration for the radiographically evident union of the humerus bone was 12 weeks with a range of 8 to 20 weeks, the mean Constant Murley score for the functional outcome of the shoulder joint was 79 at the final follow up with a range of 50 to 100. For the various other demographic variables refer to Table-I.

Following complications were noted at follow up, n= 5 cases of malunion (varus type), n= 1 patient had impingement at the subacromial location, n= 1 patient had wound infection, n= 1 patient had penetration of the screw in the joint cavity, n= 1 patient had failure of fixation of the bone respectively. For the patient who had infection debridement and intravenous antibiotics were utilized for treatment, in the patient union was observed at 20 weeks and implant was removed at 24 weeks, the infection resolved completely. In our case series we did not observe complications such as avascular necrosis, non union or implant failure.

**DISCUSSION**

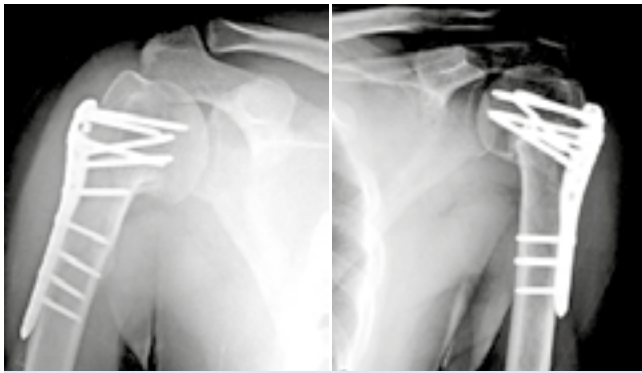
According to the results of our study the proximal humerus internal locking system or PHILOS is an excellent mode of treatment with good functional and radiological outcome post operatively for patients who have fractures of the proximal humerus.

Characteristics	Frequency	Percentage
Age in years	38.50 +/- 12.55	
Less than 60 years	43	86%
More than 60 years	7	14%
Gender		
Male	35	70%
Female	15	30%
Neer Classification		
2 Part	9	18%
3 Part	14	28%
4 Part	23	46%
4 Part with dislocation	4	8%
Cause of fractures		
Fall from height	14	28%
Road traffic accidents	17	34%
Trivial fall	8	16%
Assault	6	12%
Other causes	5	10%
Post operative outcome		
Excellent	27	54%
Good	12	24%
Fair	7	14%
Poor	4	8%

**Table-I. Characteristics of the patient population undergoing PHILOS plate for treatment of proximal humerus fractures.**



**Figure-1. Preoperative radiographs of a patient with 4 part fracture of the humerus.**



**Figure-2 and 3. Postoperative radiographs of patients after treatment of proximal humerus fracture with the PHILOS plate system.**

The procedure thought technical and requiring some level of surgical proficiency provides a stable fixation and early mobilization for the patients. In the literature there have been various methods that surgeons have used for fixation of comminuted or displaced fractures of the humerus, and these techniques have their own complications such as avascular necrosis, treatment induced fractures, non union etc.<sup>5,6,7,8,10,13</sup> Various studies have shown that locking plate fixation (peri articular) have a better outcome and lesser rate of complications as compared to the non locking plates.<sup>13,14</sup>

However the locking plate fixation type of fixation requires more surgical proficiency and care especially regarding the preservation of the soft tissue structures and blood supply and vascularity of the fractured segments during this open reduction and internal fixation technique.<sup>15,16,17</sup> In our study we utilized the deltopectoral approach in the patients of the proximal humerus fractures, the important points that must be taken care of are the placement of the plate of proper length, using the fluoroscopic imaging when placing the screws in the correct position and avoiding the varus displacement by ensuring support to the medial side of the cortex.<sup>18,19,20</sup>

The overall complication rate in our study was found to be 18% and 10% of the patients had varus malunion, while the remainder of the complications were impingement, infection, failure of fixation and intra articular screw, revision surgeries were performed for the patients with deep infection and failure of fixation. In the study

by Egol et al they had an infection rate of 1.61% in their case series and similar rate of observed in a study by Moonot et al and Gardner et al, in which the patients of infection were treated with antibiotics only.<sup>16,20,21</sup>

The lower rates of infections observed are due to proper aseptic technique, with special care taken to minimize the soft tissue injury. One of the complications of the procedure is the penetration of the screw inside the joint cavity (intra articular screw) which is observed at a rate of 0 to 23% according to various studies.<sup>21,22,23</sup> In our series we encountered this complication in one patient, even though we had employed fluoroscopic monitoring during the procedure, monitored the drilling and monitored the position of the screw, to avoid such complication. We did not observe any incidences of avascular necrosis in our series, however the literature reports an incidence rate of 4% to 75%, this could be due to the smaller duration of follow up in our study, a longer follow up time may yield incidence of this complication.<sup>17,21,24</sup>

The most important factors in humeral head ischemia post fracture according to Hertel et al, are the dorsomedial extension at the metaphysic (less than 8mm), medial hinge integrity (a displacement of more than 2mm of the shaft) and fracture with the 2,9,10,11 and 12 (binary description system) components of the anatomic neck of the humerus. The positive predictive value of the ischemia is 97%, upon the presence of all three of the afore mentioned criterion.<sup>25</sup> In our series, we had performed computer tomographic CT scanning of all the patients, we found that in n=9 patients the metaphyseal bone extension was less than 8mm dorso medially, and integrity of the medial hinge was compromised in the n= 8 patients. We did not observe any avascular necrosis in these patients, which could be explained by the fact that humeral head is revascularised promptly through the phenomenon of creeping substitution (bone remodeling and formation of new vascular channels via reabsorption of bone by osteoclasts), however a longer duration of follow up might reveal more complications. In our study we had n=1 case of implant failure



(fixation failure), which needed revision with bone grafting. According to various studies the rate of incidence of implant failure is from 2.7% to 13.7% in the PHILOS system. Varus malunion is a common complication that occurs after fixation of the proximal humerus shaft fractures. Varus malunion is considered to occur when the head to shaft angle of the humerus bone is <120 degrees. In our study we had 5 patients who had varus malunion post operatively. Agudelo et al observed that primary varus reduction is related to poor outcome for the patients and Bjorkernheim et al observed an incidence of 26.3% on varus malunion in the fractures of 2,3 and 4 part of the humerus.<sup>9,23</sup> The Constant Murley scores on the final follow up of patients in our study were found to be excellent and good in n= 39 patients (78%) and fair and poor in n= 11 (22%) of the cases, which are similar to the results reported by Kettler M et al in their report of 225 cases treated with the PHILOS plate system.<sup>26</sup> In our series we did not observe any cases of heterotopic ossification and non union, there were some limitations to our study, the main limitation was a small sample size, and the second limitation was a shorter duration of follow up. We recommend further studies be done with longer duration of follow up and larger sample size to further strengthen the use of PHILOS plate as a good treatment option.

## CONCLUSION

According to the results of our study the proximal humerus internal locking system or PHILOS is a good method for open reduction and internal fixation of the proximal humerus fractures and provides a stable fixation, and has lower incidence of complications such as avascular necrosis.

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*“If you're giving someone your best and it's not enough, Then you are giving to the wrong person.”*

Unknown

**AUTHORSHIP AND CONTRIBUTION DECLARATION**

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1	Faisal Abdul Jabbar	Corresponding author, Write up, Data collection, Data analysis, Literature review.	
2	Rehana Ali Shah	Write up, Data collection definition of intellectual content, Literature review final draft, Proof reading.	