

# PHILOS Plating: Outcome and Complications In Humerus Fracture Fixation

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## ABSTRACT

**Objective** To assess the use, union rate and complications with proximal humerus interlocking osteosynthesis (PHILOS).

**Study design** Descriptive study.

**Place & Duration of study** Department of Orthopaedic surgery, Dow University of Health Sciences / Dr Ruth K M Pfau Civil Hospital Karachi, from January 2018 to February 2020.

**Methodology** Patients with proximal humerus fracture Neer II, III, IV and with fracture dislocation, proximal humerus nonunion and tumor were included in the study. Type I, neglected proximal humerus fractures were excluded.

**Results** Twenty-one patients were included in the study with age of 18 years - 65 years and mean age of 45 year. There were 12 (57.14%) male and 9 (42.85%) female patients. Ten (47.6%) patients had history of road traffic accident, 8 (38%) had fall and 3 (14.2%) with tumor. Ten (47.6%) were with type III Neer and two (10%) type IV, type II noted in two (10%) patients, tumor in three (14%), two (10%) with fracture dislocation, one (5%) with proximal humerus and ipsilateral shaft fracture, one (5%) patient with nonunion humerus. Three (14.2%) patients had hypertension. In nine (42.8%) patients fracture united in 15 weeks, in six (28.4%) in 14 weeks, in three (14.2%) in 16 weeks and one united in 13 weeks. One patient with pathological fracture had bone cementation with PHILOS plate and other had plate after recycled bone re-implantation. Osteotomy site united in 13 weeks. One patient had curettage and bone cement fixed with PHILOS. Complications noted included screw out of bone in one (5%) patient, varus deformity in four (21%), reduction problem in one (5%), impingement in one (5%), stiffness in three (14.2%), two of them having varus as well, and infection in one (5%) patient. A patient died of tumor. Maximum follow-up was of 15 months and minimum seven months.

**Conclusions** Proximal humerus interlocking osteosynthesis is excellent implant with variable angle in plate for screws to be placed in multiple directions that provides good bone purchase. With this it provides good union rate. Complications were also noted in number of patients.

**Key words** PHILOS, Proximal humerus fracture, Bone union, Osteosynthesis.

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## INTRODUCTION:

Proximal humerus fracture accounts for 4% to 5% of all fractures and 45% of humerus fractures. It is more common in old age patients.<sup>1</sup> Proximal humerus fracture fixation with plate is mostly done through deltopectoral approach.<sup>2</sup> Most of the proximal humerus fractures are treated conservatively but evolving surgical methods of fixation are increasingly used. Methods of fixation for the proximal humerus fracture start from close reduction and K-wire

application helical plating, tension band wiring, T-plate, intramedullary nails, proximal humerus locking osteosynthesis, shoulder hemiarthroplasty to total shoulder replacement.<sup>3-5</sup>

Proximal humerus fracture classically are classified by Neer system that depends on fracture parts according to proximal humerus anatomy. Head split fracture are often associated with avascular necrosis. Proximal humerus plate osteosynthesis has variable angle screw holes to purchase the head in multiple areas. Increase in the purchase especially in osteoporotic bone provides angular stability and works as internal fixator.<sup>6-8</sup> Proximal humerus locking plates are single beam constructs with no motion between the plate, screw and the bone. This construct is four times stronger than load sharing construct.<sup>9</sup> Objective of this study was to determine the outcome of proximal humerus locking plate in humerus fractures.

**METHODOLOGY:**

This descriptive study was conducted at the Department of Orthopaedic Surgery, Dow University of Health Sciences / Dr Ruth K M Pfau Civil Hospital Karachi, from January 2018 to February 2020. Patients with proximal humerus fracture Neer II, III, IV and with fracture dislocation, proximal humerus nonunion and tumor were included in the study. Open fractures, Neer type I, and neglected proximal humerus fractures were excluded from the study. After counselling and taking consent patients were enrolled for the surgery. All patients were treated through delto-pectoral approach. In between deltoid and pectoralis major plane was made, then coracobrachialis, pectoralis minor were detached from coracoids process. Fracture was then identified and temporarily held with K-wires.

Proximal humerus plate osteosynthesis was used in all cases with proper placement one cm lateral to the bicipital groove and one cm below greater tuberosity tip. Plate was fixed with screws (Figure I). Postoperatively as pain tolerated, patients were allowed gradual shoulder movements. Elbow and hand exercise were encouraged in all patients.

Stitches were removed after two weeks. Patients were followed regularly every month for three months and then every three till fracture united. In Patients with tumor (one with pathological fracture secondary to renal cell carcinoma, and other from metastasis of carcinoma breast) curettage was done and fixed with bone cement. In third patient who was a known case of Ewing’s sarcoma osteotomy at anatomical neck of humerus was done and the pedicle frozen into liquid nitrogen for 20 minutes was reimplanted and fixed with PHILOS plate (Figure II).

**RESULTS:**

Twenty-one patients were included in the study with age distribution of 18 years - 65 years. The mean age was 45 year. There were 12 (57.14%) males and 9 (42.85%) females in the study. Ten (47.6%) patients had road traffic accident, eight (38%) had fall and three (14.2%) patients had tumors. Ten (47.6%) had type III Neer and two (10%) type IV fracture. Type II was found in two (10%) patients, and tumors in three (14%). In two (10%) there was fracture dislocation, one (5%) with proximal humerus and ipsilateral shaft fracture, and one (5%) patient with nonunion humerus. Three (14.2%) patients had hypertension.

Maximum follow-up was of 15 months and minimum of seven months. Time to union assessed in fracture patients is shown in table I. In nine (42.8%) patients fracture united in 15 weeks. One patients with pathological fracture had bone cementation with PHILOS plate and other had plate after recycled bone re-implantation. Osteotomy site united in 13 weeks. One patient had curettage and bone cement fixed with PHILOS. Complications noted included screw out of bone in one (5%), varus deformity in four (21%), reduction problem in one (5%), impingement one (5%), stiffness in three (14.2%) patients, two of them having varus deformity as well, and infection in one (5%) patient. One patient died of tumor.

**Table I: Time To Fracture Union**

Number of Patients - n (%)	Union (Weeks)
9 (42.8%)	15 weeks
6 (28.4%)	14 weeks
3 (14.2%)	16 weeks
1 (5%)	13 weeks



Fig I A: Segmental humerus fracture

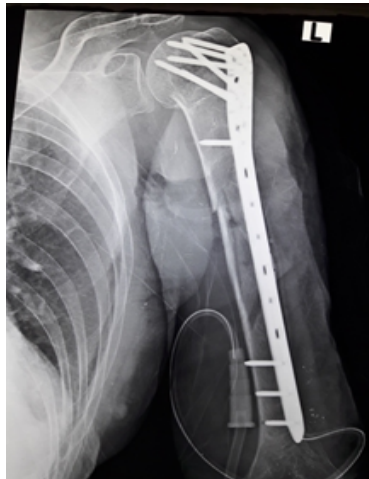


Fig I B: After fixation PHILOS plate AP view



Fig I C: Postoperative lateral view

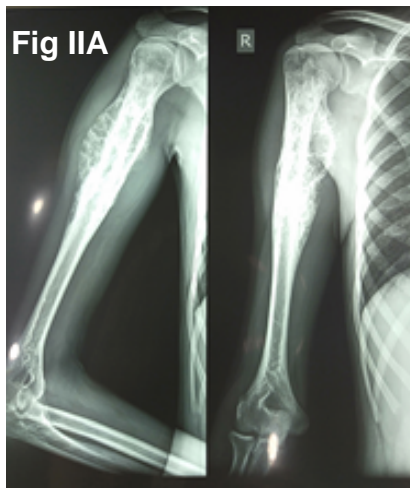


Fig II A: Patinet II: Preoperative Humerus Ewing's Sarcoma



Fig II B: Incision



Fig II C: Proximal Humerus Osteotomy



Fig II D: Freezing in Liquid Nitrogen

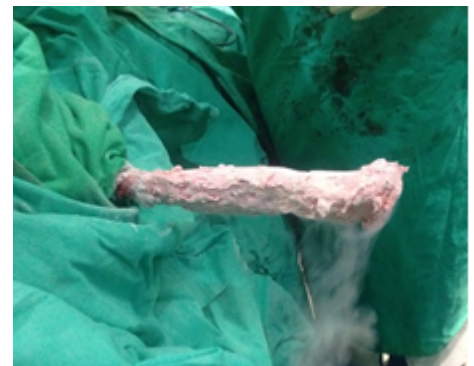


Fig II E: After Freezing

#### DISCUSSION:

For proximal humerus fractures gliding plate made as of PHILOS plate but with four short barrels for 3.5mm gliding screws in spite of locking screw to achieve dynamic compression at the fracture site.<sup>10</sup> In a study of 25 patients treated with PHILOS showed

excellent results in 48%, good and moderate in 40% of patients with loss of fixation in one, screw out of bone in one and delayed union in one.<sup>9</sup> We treated 21 patients of whom 19 showed union during variable time. In one patient screw came out, and reduction problem noted in in one patient which is



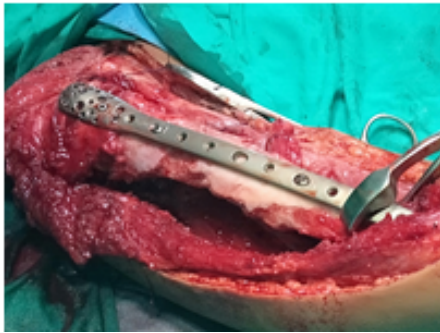


Fig II F: After Reimplantation and Fixation with PHILoS

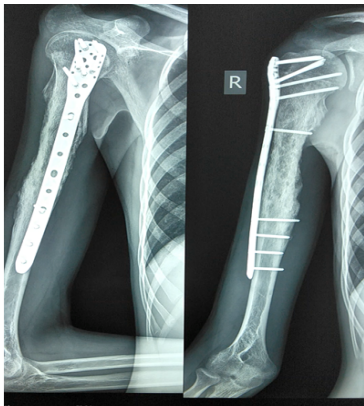


Fig II H: After union of osteotomy site

comparable to results of other studies.

In another study of 278 patients with two-part fracture treated with PHILoS by 22 different surgeons showed less number of complications and less revision rate when experienced surgeons operated.<sup>11</sup> PHILoS plates are associated with more than 10% problems like fixation loss, head perforation, shoulder impingement etc.<sup>12</sup> In our study shoulder impingement noted in one case, and stiffness in three patients. The support of the inferio-medial cortex is the key to prevent varus and screw penetration. Plate placement is the key in proximal humerus to prevent proximal migration and impingement.<sup>13</sup> We put calcar screw to prevent varus in case with comminuted fractures of proximal humerus still we had varus in four patients.

A study evaluated 71 patients for the head shaft angle (HAS) following fixation. The aim should be 125 degree head shaft angle. Varus with HSA >10° loss indicate poor shoulder function.<sup>14</sup> In another study 25 patients operated with proximal humerus locking plate, 20% patients developed superficial and deep infection, 20% had malreduction and 16% screw perforation.<sup>15</sup> Infection occurred in one patient in our series. A prospective study of 30 cases showed

union in all cases but with malunion in one case and shoulder stiffness in four patients after treatment with proximal humerus locking plate.<sup>16</sup> Another study conducted at Karachi showed excellent results in 54%, good in 24%, fair 14% and poor in 8%. They concluded that PHILoS is good tool for fixation of proximal humerus fixation though the results are not convincing.<sup>17</sup> A retrospective study conducted in China emphasized that medial screw prevent the varus and fixation failure and maintains humerus rotation angle.<sup>18</sup> This is a key step while operating upon these patients.

A comparative study for Neer III or IV part humerus fracture in the elderly patients treated with PHILoS fixation with fibular allograft showed satisfactory short-term results with respect to humeral head support and maintenance of reduction. This may reduce the incidence of complications associated with fixation using a PHILoS alone.<sup>19</sup> The limitations of our study included all patients being treated with proximal humerus interlocking osteosynthesis plate. No comparison is made with different types of NEER classification. The sample size is small and patients with tumors are also included which is a different group in comparison with trauma patients.

#### CONCLUSIONS:

Proximal humerus interlocking osteosynthesis is a good implant with variable angle in plate for screws to be placed in multiple directions to provide good bone purchase. This provided good union rate but complications are also noted which may be reduced with more experience.

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Arsalan Khalil Ayoub: Data collection.

Badaruddin Sahito: Conception, design of work & agreement to be accountable for all aspects.

Dileep Kumar: Critically revised for important intellectual content.

Nusrat Rasheed: References & data interpretation.

Sunel Kumar: Drafting of work.

Maratib Ali: Final approval of manuscript.

Conflict of Interest:

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