

Original Research Article

A prospective study to evaluate functional results of PHILOS locking plate system in management of proximal humerus fractures in adults

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ABSTRACT

Background: Various management options are available for management of proximal humerus fractures where PHILOS plating is one of them. But data available in literature on its use and efficacy in management of all types of proximal humerus fractures is still dicey. So, we through our study attempted to grow our knowledge regarding its functional results, complication rates, etc. for use in coming future.

Methods: 30 patients with proximal humerus fractures classified on the basis of Neer's classification were included in study who were operated from 2018 to 2020 at our institute. These patients were operated by PHILOS locking plate system with either delto-pectoral or trans-deltoid approach and they are followed up at regular intervals to assess them clinicoradiologically and functionally by Neer's criteria.

Results: In our study we found maximum incidence of these fracture between age group of 40-80 years (66.66%) with male to female ratio of 2:1 with 19 patients having left sided and 11 patients having right sided proximal humerus fracture. Complications were found in 11 patients (36.67%). Functional evaluation was carried out using Neer's criteria at final follow up which came to excellent results in 3, satisfactory in 18, unsatisfactory in 7 and failure in 2 patients. Average time of fracture union was 12.62 weeks.

Conclusions: PHILOS locking plate system serves good purpose in management of fractures of proximal humerus but requires trained faculty to do this operation who has detailed knowledge about shoulder anatomy and mechanism of injury to reduce complications associated with this type of modality.

Keywords: PHILOS locking plate, Delto-pectoral approach, Trans-deltoid approach, Neer's classification, Neer's criteria

INTRODUCTION

Shoulder joint is a ball and socket joint come under synovial joint class. Rounded articular surface of head of humerus and shallow glenoid cavity of scapula forms shoulder joint with 4:1 disproportion. The harmonious arrangement of joints around shoulder girdle, muscles and ligaments of shoulder girdle allows significant range of movements which are essential for day-to-day activities.

Trauma to shoulder may lead to functional limitation, which in turn challenges independent living and quality of

life of patient. These fractures occur at incidence of 4% to 5%.^{1,2} Incidence of these fractures found more in aged population with female predominance which is contributed by increased life expectancy, low bone mineral density (osteoporosis) and increased risks of fall in these patients. High energy trauma can cause fractures of proximal humerus in young patients. Mechanism of injury which is commonly associated with these fractures in elderly population is fall from standing height onto an outstretched upper extremity. 80-85% of proximal humerus fractures comes under undisplaced category as described by Neer's classification criteria which can be managed non-

operatively with good functional results. Only 15-20% comes under displaced category for which operative procedures are required for better results.² Operative technique selection mostly depends on age of patient, expectation of clinical outcome by patients and ability of patient to carried out rehabilitation program. Following treatment options are available since last 3 decades for proximal humerus fracture management such as trans osseous suturing, percutaneous pinning, tension band wiring, plating with PHILOS locking plates, rush nailing, arthroplasty. But selection of best operative treatment for given patient is still questionable.³ These fractures should be managed as early as possible when patients' general conditions improve. A delay in operative procedure is enemy of surgeons as obtaining reduction becomes more difficult and there can be absorption of cancellous bone.⁴ So, if not treated and reduced properly well in time, it can give rise to malalignment of fracture fragments, change in the movement axis and lever actions of shoulder.

Proper implant selection and management with proper operative techniques has greatest influence on prognosis.⁵ Achieving necessary stability in patients with low bone mineral density is a major issue.⁶ Chosen operative management should provide adequate stability and early mobilization.⁷ Different complications observed in different modalities of management are infections, non-union, malunion, loss of reduction, neurovascular injury, osteonecrosis, adhesive capsulitis, and residual pain and reoperation.⁷

Conservative treatment requires prolonged immobilization which causes joint stiffness and atrophy of muscles, may have secondary loss of reduction.⁷ Same scenario is there with closed reduction and percutaneous k-wire fixation where we need postoperative immobilization for 4 to 6 weeks. Along with this k-wire fixation can have following problems or complications such as small fracture fragments cannot be engaged and reduced, secondary loss of reduction, k-wire migration, loosening and backout, breakage of k-wire, pin tract infection.⁸

PHILOS locking plate by open reduction and internal fixation techniques gives a great chance of reducing complications associated with conservative or k-wire fixation management options. PHILOS locking plate designed with locking as well as non-locking 3.5 mm screws. Head screws are arranged in various angles to get purchase in different sections of humeral head and small holes present at proximal portion of plates gives access to pass anchor sutures to strengthen rotator cuff and small fracture fragments so that rigid anatomical fixation, angular stability can be provided to allow early mobilization and functional limb.

Aim of this study is that to observe results PHILOS locking plate in management of proximal humerus fractures in >18 years old patients. Other purpose of this study is to assess the efficacy and advantage of PHILOS

locking plate system and to note intraoperative and postoperative complication.

METHODS

Our study was observational based prospective study. We included total 30 patients fulfilling decided inclusion criteria, of which 20 were male and 10 were female patients operated with PHILOS locking plate for fracture proximal humerus fractures from May 2018 to December 2020 in our hospital. Written, informed, valid consent has been taken from each patient. Ethical approval not required as we used standard known operative procedures.

Inclusion criterions were as follows, age group >18 years, radiologically diagnosed proximal humerus fractures, and consent to participate in the study whereas exclusion criterions were as follows, age group less than 18 years, open fractures in Gustilo-Anderson type III B and C, refusal to provide informed consent, patients with significant other comorbidities such as psychiatric disorders, uncontrolled diabetes mellitus (DM), hypertension (HTN), end stage liver or kidney diseases, sever cardiac conditions, etc., and fractures with neurovascular injury.

We have selected a standard PHILOS locking plate for the management of various proximal humerus fractures classified according to Neer's classification.⁸ Patients were managed either through deltopectoral or deltoid-split approach in our study we have not interfered in selection of approach by surgeon.

We preoperatively evaluated patient haemato-radiologically to get anaesthetic fitness for surgery. Once anaesthetic fitness has been obtained, we carried out operative procedure by use of either standard deltopectoral approach or lateral/deltoid-split/trans-deltoid approach (Figures 1 and 2).⁹⁻¹⁰

Postoperatively, immediate radiographs were taken, patients were immobilized in universal shoulder immobilizer (USI) belt. Appropriate IV antibiotics started, and immediate postoperative radiographs were taken. Pendulum exercises started from day 5 after subsidence of pain. First check dressing done averagely at 4th day postoperatively and Sutures removed by 14th day. Active range of motions started from second week onwards by advising patient to not to do external rotation. Until 6th week, immobilization in USI continued. Patients were assessed at regular intervals by Neer's score and clinicoradiological parameters. Range of motions of shoulder joint are also documented at final follow up.

The statistical software statistical package for the social sciences (SPSS) version 24 was used for analysis of the data. Microsoft word and excel have been used to generate graphs, tables etc. We also applied geometric mean, percentage tests.

RESULTS

Following observations are made from our study. Our study showed higher incidence of fractures among 40 to 80 years age group (66.66%). Left sided fractures were common in our study (63.33%). Male patients were more than female patients in our study (66.67%). Road traffic accident (RTA) was the common mode of injury in patients (60%). 2-part (40%) and 3-part (40%) fractures were common. Heavy workers and alcoholic (43.33%) had higher incidence of these fractures. HTN (26.67%) was the common associated illness in patients of our study (Table 1).

In our study, average operative time was 85±17.46 min, average blood loss was 197±63.78 ml and average hospital stay was 13.07±7.01. Average time of fracture union found in our study was 12.62 weeks with standard deviation (SD) of 2.17. Average operative time was 85 min with SD of 17.46. Average blood loss in our study was 197 ml. Average hospital stay was 13.07 days with SD of 7.01.

36.67% (11) patients had complications in our study. Varus collapse or malunion was in 4 cases, subacromial impingement in 4 cases, Reoperation was done in 3 cases who were having screw penetration and avascular necrosis (AVN), 1 case with AVN, 2 cases with screw penetration, 1 case with implant loosening with infection, 1 case with non-union and 1 with deltoid wasting (Table 2).

Average functional results by applying Neer’s criteria in our study was 80.33 which comes under satisfactory result category. Functional results according to Neer’s criteria score observed in our study are, 3 (10%) cases with excellent results, 18 (60%) cases with satisfactory results,

7 (23.33%) cases with unsatisfactory results, and 2 (6.67%) cases with failures (Table 3).

Table 1: Demographic data of patients.

Criteria	Number of patients (%)
Age (years)	
21-40	9 (30)
41-60	12 (40)
61-80	8 (26.66)
81-100	1 (3.33)
Sex	
Male	20 (66.67)
Female	10 (33.33)
Side of injury	
Right	11 (36.67)
Left	19 (63.33)
Mode of injury	
Road traffic accidents	18 (60)
Fall	11 (36.67)
Physical assault	1 (3.33)
Type of fracture	
Two-part	12 (40)
Three-part	12 (40)
Four-part	1 (3.33)
Two-part with dislocation	2 (6.67)
Three-part with dislocation	1 (3.33)
Four-part with dislocation	2 (6.67)
Surgical approach	
Delto-pectoral	23 (76.67)
Trans-deltoid	7 (23.33)

Table 2: Complications.

Complications	Male	Female	Total	Percentage of patients with complications
AVN	0	1	1	36.67
Varus collapse/varus malunion	4	0	4	
Subacromial impingement	3	1	4	
Implant loosening/screw backout	1	0	1	
Screw penetration/perforation	2	0	2	
Infection	1	0	1	
Osteoarthritis/stiffness	2	0	2	
Subluxation/dislocation	1	0	1	
Non-union	0	1	1	
Nerve injury/deltoid wasting	1	0	1	
Reoperation	2	1	3	
None	11	8	19	63.33

*More than one complication can be present in one patient

Table 3: Results from Neer’s criteria.

Result	Male	Female	Total	Percentage
Excellent	3	0	3	10
Satisfactory	11	7	18	60

Continued.

Result	Male	Female	Total	Percentage
Unsatisfactory	6	1	7	23.33
Failure	1	1	2	6.67
Average Neer's score	80.33 (satisfactory)			



Figure 1: Clinical photographs of deltopectoral approach (a) deltopectoral incision, (b) superficial dissection, (c) deep dissection with exposed fracture site, (d) plate fixed, and (e) closure of wound with drain in situ.



Figure 2: X-rays of one of the cases operated with PHILOS plate (a) preoperative X-ray right shoulder AP view, (b) immediate postoperative X-ray right shoulder lateral view, (c) immediate postoperative X-ray right shoulder oblique view, (d) 6 months postoperative X-ray right shoulder axillary view showing fracture union, and (e) 6 months postoperative X-ray right shoulder AP view showing fracture union.

DISCUSSION

We as orthopaedic surgeons constantly facing challenge on how to manage proximal humerus fractures as epidemiologically these fractures mostly occur in osteoporotic bones and there is not a single modality of treatment available which gives well to excellent results without causing many complications. Still in our study we managed to get satisfactory results by using PHILOS

locking plate as a modality of management which is comparable to other studies conducted across the world.

44.9 years and 54.3 years was the average age of patients in Gerber et al study and Doshi et al study, respectively.^{11,12} Whereas in our study patients had average age of 49. 5 years. Doshi et al study reported 12±4.6 weeks as average time of fracture union.¹² Whereas, our study reported 12.62±2.17 weeks as the

average time of fracture union. Gerber et al in their study mentioned 1.42:1 as the male to female sex ratio.¹² Whereas, in our study it was 2.1. Duralde et al and Geiger et al both in their study reported 57.14 % right sided fractures and 42.86% left sided fractures.^{13,14} In our study, 36.67% patients had right sided, and 63.33% patients had left sided fractures of proximal humerus.

Patients of proximal humerus fractures routinely come with history of either self-fall from standing height or with RTA. In studies conducted by Fazal et al and Geiger et al, 6 patients (22.22%) had RTA, 21 patients (77.78%) had fall and zero patients had RTA, 21 patients (75%) had fall, respectively.^{13,14} Whereas, in our study 18 patients (60%) had RTA and 11 patients (36.67%) had fall. Most of the cases in our study had 2-part and 3-part fractures with 40% patients in each group. Whereas Fazal et al study reported highest cases in 2-part fracture group with 13 patients (48.15%) and Shahid et al. study reported highest cases in 4-part fracture group with 18 patients (45%).^{15,16}

Average intraoperative blood loss reported in studies conducted by Chiewchantanakit et al and Chen et al was 128±65.8 and 187.1 ml, respectively.^{17,18} Whereas, in our study it was 197±63.78. Konigshausen et al in their study reported 85 min with SD of 25 as the average operative time required and Chiewchantanakit et al in their study reported 110 min as average operative time required.^{18,19} Whereas, in our study it was 85 min with SD of 17.46. Konigshausen et al reported 8±3 days of average hospitalization in their study.¹⁹ Whereas, in our study it was 13.07±7.01 days. Konigshausen et al study showed 23.1% patients with complications.¹⁹

Total 36.67% (11 patients) patients had various complications in our study. Among these patients, some patients were having combined 2 or 3 complications. Varus malunion and subacromial impingement were the commonest complications reported in our study accounting for 4 patients in each. Konigshausen et al study showed complication rate of 23.1%.¹⁹ Erasmo et al study showed 28% of complication rate.²⁰ We proceeded with reoperation in 3 cases where patients required better outcome. Some patients adjusted their life with complications and does not provided consent for reoperation.

Sharma et al and Srinivas et al assessed their patients with Neer's criteria for functional results after management of patients with PHILOS locking plate.^{21,22} They found 3 patients (15.8%) and 4 patients (34%) with excellent results, respectively. 14 patients (73.7%) and seven patients (58%) with satisfactory results, respectively. 2 patients (13.3%) and one patient (8%) with unsatisfactory result, respectively. Whereas, in our study of 30 patients we found 3 patients (10%) with excellent results, 18 patients (60%) with satisfactory results, 7 patients (23.33%) with unsatisfactory results, and 2 patients (6.67%) with failures.

CONCLUSION

From our study of 30 patients operated with PHILOS locking plate for proximal humerus fractures with mean follow up period of 1 year, we can conclude that PHILOS locking plate system serves very good purpose in the management of proximal humerus fracture considering stability of construct and postoperative functional outcome, but it is not totally free from some serious complications. So, PHILOS locking plate surgery in hands of well-trained surgeons who knows all anatomical aspects of proximal humerus, mechanisms of injury patterns, proper techniques of reduction and at the end a good rehabilitation program give a successful outcome both radiologically and functionally. Whereas studies with a greater number of patients and larger time duration of follow up needed to observe clinicoradiological and functional gain from PHILOS locking plate.

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