

Philos Plate: Its Complications and Functional Outcome

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ABSTRACT

Aim: Locking plates are being used presently for the fixation of two, three, and four part proximal humerus fractures. The objective of this prospective study was to evaluate functional outcome and complications of proximal humeral fractures managed with proximal humerus internal locking system (PHILOS).

Methods: 8 men and 9 women aged 19 to 82 (mean 49.24) with an acute proximal humerus fracture were treated with PHILOS plate. Outcome was measured based on constant score, complications, and radiographic assessment.

Results: 7 patients had 2-part fractures, 7 patients had 3-part fractures, and 3 patients had 4-part fractures. After 6 month follow up, a mean Constant score 57.4 was achieved. Outcomes were excellent in 16%, good in 44%, fair in 16% while poor in 24%. The Constant score was poorer for Neer type IV fractures as compared to other types. The most frequently occurring complications in our patients were malreduction 29.4%, screw perforation 23.5%, infection 11.7%, avascular necrosis 5.8% and impingement 5.8%.

Conclusion: Locking plate for proximal humerus fractures has satisfactory functional outcomes in 2-part and 3-part fracture.

The incidence of complications and subsequent re-operation is relatively high. Advanced surgical skills and surgeon's experience are considered for successful outcome.

Keywords: Humerus Fracture, Philos Plating, Outcome/Complications, Constant Score, Locking Plates, Surgery.

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INTRODUCTION

Proximal humeral fractures are now recognized as 4%–5% of all fractures and 45% of all humeral fractures.^{1,2} At 65 year old and above it is the third most common fracture, after fractures of the hip and distal radius.³ They have a bimodal distribution occurring either in young people or in those older than 50 years with injuries like simple fall.³ 85% of these fractures are minimally displaced and are treated with immobilization followed by early motion. The remaining 15% of these are unstable.⁴ These fare poorly with non-operative treatment and are better treated with surgical intervention. Surgical treatment is for young patients and active elderly people in order to prevent minimal dislocations of tuberosity or articular surface.

The aim of treatment is to achieve a painless and simultaneously functional shoulder. This depends on the age, medical condition and bone quality. Earlier treatment techniques with proximal humeral plates, hemiarthroplasty, and percutaneous or minimally invasive techniques such as pinning, screw osteosynthesis, and the use of intramedullary nails. There is still no treatment that can be the golden standard in this fractures.⁵⁻⁸

PHILOS (The Proximal Humeral Internal Locking Osteosynthesis) plate (Synthes, Stratec Medical Ltd, Mezzovico Switzerland); an internal fixation system that enables angled stabilization with multiple interlocking screws. However, there are few prospective studies available that actually evaluate the results of this technique or report on the treatment-related complications.⁹⁻¹⁴ This study was planned to evaluate the outcome of proximal humerus fractures managed with PHILOS plate after approval by the Institutional Ethical Board.

MATERIALS AND METHODS

This prospective interventional study was conducted in the department of orthopedics at DR. RN Cooper Hospital and Hindu Hriday Samrat Balasaheb Thackeray Medical college, Mumbai between January 2014 and December 2015. Total 17 consecutive adult patients of either sex with displaced proximal humerus fractures that met the criteria for operative treatment as outlined by Neer¹⁵ i.e. an angulation of articular surface of more than 45 degrees, a displacement between the major fracture fragments

more than 1 cm or a fracture with valgus impaction were included in the study. Exclusion criteria included nondisplaced proximal humerus fractures, fracture dislocations and head splitting fractures, infection at the site of fracture, patients below age 18 years and pathologic fractures. All the cases were assessed clinically and treated accordingly. All routine investigations and preoperative X rays were sent. Classification of fracture was done using Neer's classification system.

Surgery in supine position on a radiolucent table under general anaesthesia using the anterior deltopectoral approach. The cephalic vein was retracted laterally or ligated. The greater and lesser tuberosity fragments were tagged with non-absorbable sutures. The tuberosity fragments were reduced to the shaft. The fracture was reduced and provisionally fixed into position using 1.5 mm Kirschner wires, sutures was passed through the rotator cuff and attached to the plate through the suture eyelet. On the anteroposterior view, the plate was ideally placed 8-10 mm distal to the superior tip of the greater tuberosity; from the lateral view, the plate was centred against the lateral aspect of the greater tuberosity. The initial screw was then placed in the elongated hole in the humeral shaft (in classic 3 or 4 part fractures), so that the height of the plate could be adjusted. The locked screws were inserted into the humeral head using the insertion guide and sleeve assembly after achieving the appropriate fracture reduction and plate position. After adequate reduction and proper medical support the rotator cuff, capsule and subscapularis muscle tears/avulsions were repaired. The wound was closed in layers and a suction drain was inserted.

Active assisted and passive exercises were used during the first two weeks, and 3 weeks later active motion was started. On the 8th postoperative week, daily activities were allowed. Patients were followed up on OPD basis at 2 weeks at first postoperatively then after every month till 6 months then every 3 monthly till 2 years. At every follow up, patients were assessed clinically for shoulder stability and range of motion and radio graphically checked for the progress of fracture healing. Radiographic union

was defined as bridging trabeculation across the fracture site in the absence of hardware breakage or cut-out. The complications were also documented. Evaluation of results were done on basis of scoring system given by Constant and Murley score, the scoring system of which comprises four parts: pain, power, activities of daily living and range of movement. The Constant score was graded as poor (0-39 points), fair (40-59), good (60-79) or excellent (80-100).

RESULTS

The mean age of our seventeen patients was 49.24 (19-82), with a female to male ratio of 1.125:1 (9:8). 10 patients belong to age group more than 50 years suggesting a strong relation of proximal humerus with age related osteoporosis. Majority of patients' sustained injury due to road traffic accident (68%) followed by fall on out stretched hand (20%) and other causes (12%). Twelve cases involved the dominant side. 11 (44%) had 2-part fractures, 11 (44%) had 3-part fractures and 3 (12%) had 4-part fractures according to Neer.

Function

Fractures united at an average of 11.2 weeks (range, 8-17 weeks). Three patients developed nonunion due to avascular necrosis in two patients and plate pulled out in one patient. Overall the functional outcome was found to be good to excellent in 60% of our patients however almost 24% patients had poor outcome. The mean Constant score achieved was 57.4 (range, 17-80). We found that patients with Neer type III fractures had the highest Constant scores while patients with Type IV had the lowest Constant scores. Patients less than 60 years of age group showed better response.

Complications

Various complications seen in our study have been shown in table 1. In this study, we found 10 (58%) patients complications (Figure 2, 3, 4, 5), requiring a total of 3 (17.6%) revision surgeries. Complications like suprascapular or axillary nerve injury or deltoid weakness were not encountered.

Fig 1: Post-operative complication in percentage after treatment with PHILOS plate

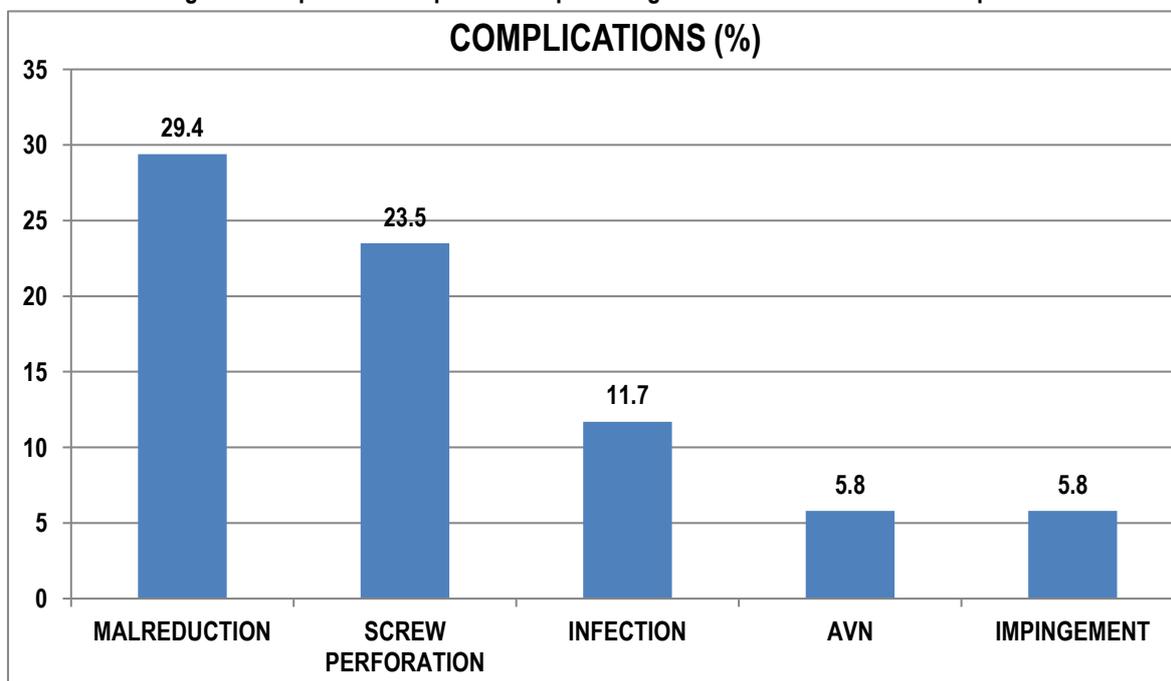


Table 1: Post-operative complication after treatment with PHILOS plate

COMPLICATIONS	No. of Patients
Malreduction	5 (29.4%)
Screw perforation	4 (23.5%)
Infection	2 (11.7%)
AVN	1 (5.8%)
Impingement	1 (5.8%)

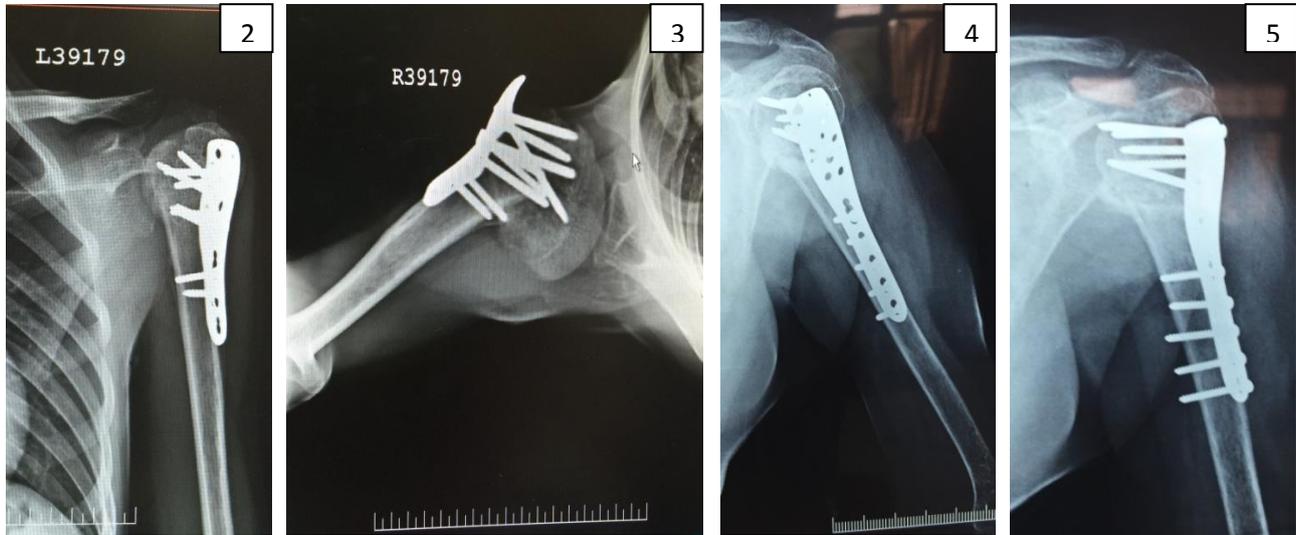


Fig 2,3: Antero-posterior and Axillary view of Malreduction

Fig 4,5: Anteroposterior and Axillary views of Screw perforation

DISCUSSION

In our study men suffered more complex fractures because they are venerable to more high-energy trauma. The ratio of high energy to low energy injury in our study was 1.27:1. India, as reported by world health organization, has the worst road traffic accident rate worldwide. Moreover our hospital being a tertiary care hospital had a greater proportion of patients with high-energy polytrauma as compared to low energy isolated fractures of the proximal humerus.

We could achieve a mean Constant Murley score of 57.4 due to various complications encountered with plates. Our results were somehow inferior to those reported in the western literature. Various studies had reported varying results. Thyagarajan et al in their study on 30 patients showed an overall average Constant score of 57.5. The mean age in this series was 58 years (range 19-92 years) and fractures were Neer's 2-part, 3-part, and 4-part fractures.¹⁶ In one prospective study, mean constant score was 68.31 in 19 patients.¹³ Kettler et al¹¹ reported a Constant-Murley score between 52 to 72 points after ORIF with the PHILOS plate. Hente et al¹⁷ reached a mean Constant-Murley score of 55 points in these specific fracture types, which was lower than for fractures without dislocation. These results match ours, knowing that the Constant-Murley score of different studies are difficult to compare. However, the systematic review by Thanasis et al reported an overall Constant score of 74.3.¹⁸ and most of other studies have reported good functional outcomes and recommended the use of locking plates for proximal humerus fractures especially in elderly patients with poor bone quality. This leads us to believe that application of locking plate technology for proximal humerus fractures has a steep learning curve and appropriate surgical technique is very important for achieve good functional outcome.

In our study also the mean Constant score for 4-part fractures was 48.3 which were inferior as compared to 2-part and 3-part fractures (57.60 and 60 respectively). This result is comparable to the one prospective study in which the mean Constant score for 4-part fractures was significantly inferior to other types.¹³ The results of two studies indicated an advantage in functional outcomes favoring shoulder hemiarthroplasty compared with ORIF with a locking plate in 4-part fracture.¹⁸ These results are expected as these fractures are more complex and open reduction and internal fixation is tougher. We found difference in outcome between patients of age group less than or more than 60 years of age. Patients less than 60 years of age group showed better response. Similar findings have been reported by Aggarwal et al who found the Constant scores to be higher in younger patients as compared to older patients (>65).¹³

Post operatively, various complications were observed. A varus malunion was observed in 5 patients (29.4%) and was found to be the commonest complication in our study. Varus malunion was found in five out of 17 patients in one study.¹³ Two patients had only malreduction who had fair outcome in one patient and poor outcome in other patient which lost to follow up after that. Two of these patients had also screw perforation leading to implant loosening. These patients had been fixed in a varus position and had an insufficient medial buttressing leading to poor outcome. We did not observe any valgus malunion in our study. We thus found that a varus malalignment was causing loss of fixation with poor outcome in four patients in similar to one prospective study¹³ and must be avoided intra-operatively.

Within our patient population, screw perforation occurred in 4 patients (23.5%). An early implant removal was done in one of

these patients who had poor outcome while three were lost to follow up. Yang et al¹⁵ found an overall complication rate of 35.9 with a screw cut-out rate of 7.6%. Helwig et al¹⁶ reported screw penetration of the humeral head in 11 of 87 patients (12.6%) and Thanasas et al. showed a screw cut-out rate of 11.6% in their review of 791 patients.¹³ These previous studies agree that screw perforation of fixed-angle implants has replaced the complications of secondary displacement and implant loosening as the main implant related complication of non-fixed-angle implants.

Postoperatively, impingement was observed in 1 patient (5.88%). This patient with impingement had severe limitation of overhead abduction initially associated with severe pain in his operated shoulder. The systematic review of twelve studies by Thanasas et al reported an impingement rate of 5.5%.¹⁵ We in our patients placed the plate in such a way that, proximal most part of the plate was in line with the tip of the greater tuberosity. Plate was fix with k-wires through the proximal most hole and check under C-arm throughout the arc of abduction.

Avascular necrosis (AVN) is one of the most dramatic complications requiring re-operation. 1 patient (5.8%) in our study was reported to have developed osteonecrosis of the humeral head and poor results. Hemiarthroplasty was done after the removal of implant and the result was found to be good. As per the published literature, the chances of AVN of the shoulder are directly proportional to the severity of the injury. The risk of osteonecrosis increases if the anterolateral branch of the anterior humeral circumflex artery is damaged. Utmost care should be taken while exposing the biceps tendon in the bicipital groove.

Deep wound infection was seen in 1 patient. Implant removal was done in this patient who was reoperated later; repeat plating being done 7 months after the infection had settled. However superficial wound infection, not requiring a formal debridement, was seen in 1 of our patients. The patients with superficial infection were treated with oral antibiotics.

Postoperatively, 3 patients (17.6%) in our study got their plate removed. One patient got his plate removed because of deep infection with distal screw and plate pullout, one patient got his plate removed because of AVN and implant loosening, one patient got his plate removed due to screw perforation, malreduction and implant loosening.

In our study, we did not encounter any implant breakage consistent with systematic review who reported this complication to be rare with an incidence of 0.7%.¹⁸ It has been declared that for patients having low Constant - Murley scores removal of the plate may lead to a better performance.

A high rate of complications was found in our study in early cases but later on with surgeon's experience, further less complications were encountered. In one recent systematic review the overall rate of complications was 49% including varus malunion, 33% excluding varus malunion, and reoperation rate was 14%. The most common complications included varus malunion 16%, AVN 10%, screw perforation of the humeral head into the joint 8%, subacromial impingement 6%, and infection 4%.¹⁶ Various studies have stressed out the association of high rate of complications and need for reoperation.^{18,19}

The limitation of this study is lack of a control group and less follow up period and we do not evaluate any patient characteristics which can be risk factors for failure of this now common fixation technique.

CONCLUSION

PHILOS plating gives a satisfactory functional outcome in management of 2-part and 3-part fracture. Complications and subsequent re-operation rate is relatively high. Inadequate positioning of the implant resulted in reduced functional outcome. Hence, to improve functional results, we consider plate positioning to be of utmost importance when using PHILOS plate fixation. Adequate surgical skills and surgeon's experiences with the surgical technique are necessary to achieve correct implant fixation and avoid these intraoperative errors.

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