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An analysis of functional outcome and complications of proximal humeral interlocking system plating for displaced proximal humeral fractures a prospective study

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Abstract
Background: The study was conducted to assess functional outcome and complications of Proximal Humerus Inter Locking System (PHILOS). Plating in displaced proximal humeral fractures by Constant-Murley (Subjective and Objective) score.
Materials and Methods: The study was conducted on 60 patients with displaced proximal humeral fractures operated with Proximal Humerus Inter Locking System. Among 60 patients 24 females, 36 males; mean age 50.64 years range (26-70yrs). All patients were put on same physiotherapy program following internal fixation with the PHILOS plate. The patients were assessed clinically and radio graphically at regular intervals of 6 weeks, 12 weeks and 6 months. Functional outcome was assessed using the Constant- Murley score. Complications during the follow-up period were recorded.
Results: In our series of 30 patients 2-part fractures were more common accounting 60 % compared to 3-part (20%) and 4-part (20%). Fractures united in all patients. The most frequent complication seen was shoulder stiffness in 6 patients. Excellent functional outcome seen in 18 (30%) cases, good 24 (40%) cases, fair 12(20%) cases, poor 6(10%) cases
Conclusion: Fixation of proximal humerus fractures with proximal humerus locking plates is associated with satisfactory functional outcomes in 2-part and 3-part and 4 part fracture. The complications are high in four part fractures and old age. Good surgical skills and surgeon's experience are of utmost importance for successful operative treatment.

Keywords: Fractures a prospective, plating, assessed, proximal humeral

Introduction
Proximal humerus fracture accounts for approximately 5% of all fractures [1]. Fractures occurring at or proximal to the surgical neck of humerus are considered as proximal humerus fractures. These fractures occur primarily in older populations, many of them being osteoporotic. In younger population high velocity injury is the most common cause. As the age increases complications and morbidity following fracture increases [2]. Numerous modalities of management for proximal humeral fractures have been described which includes conservative and operative. The invasive methods mainly include closed reduction with percutaneous k wire fixation, open reduction and internal fixation, humerus head replacement, reverse shoulder arthroplasty, external fixation with K wire, intramedullary nailing and plating and rush nails [3]. Depending on displacement and angulation of fracture fragments management is planned.
There are many causes for failure of implant like osteoporotic bone, angular instability, implant impingement, bone loss, loss of reduction and backing out of screws [4]. The indication for fixing such a fracture depends on the fracture pattern, quality of bone and the age and activity of the patient. Thus the goal of this study was to assess the results of PHILOS in fracture of proximal humerus both clinically and radiologically and come to conclusion about functional outcome and complications of PHILOS in proximal humerus fractures according to the pattern of fracture and patient selection.

Materials and Methods
Type of study
A prospective study

Inclusion Criteria
1. Patients age more than 18 years.
2. Failure of conservative management.

Exclusion Criteria:
1. Pathologic fractures from primary or metastatic tumours.
2. Patients age less than 18 years.
3. Open fractures.
4. Ipsilateral humerus shaft and distal humerus fractures

60 patients both male and female with fresh closed displaced fractures of proximal humerus with Neer 2 part, 3 part and 4 part fractures were randomly selected and included in study. All cases of displaced proximal humerus fractures were treated using proximal humerus interlocking system plating. Approach- Deltopectoral Approach was used. In the Proximal holes of the philos [proximal humerus interlocking osteosynthesis] plate, the holes are drilled into the proximal humerus (head) up to the subchondral bone and are fixed with appropriate length locking screw. Shoulder immobilizer was used after surgery till 4 weeks. Sutures were removed at 10th day post operatively. Patients were discharged after 10 days were advised to follow up after 4 weeks. Passive and assisted passive range of movements were advised at 4th week and active range of movements were encouraged at 6 weeks and should be able to achieve 90 degrees of forward elevation and rotation from the hand placed on the chest to neutral with the hand pointing straight forward. During the follow up radiological and functional outcome were assessed. In our study monthly follow up was done every month for three months and then final at 6th month. On every follow up check X-rays (AP and Lateral view).
Functional outcome was assessed using Constant Murley scoring system This scoring system consists of four variables that are used to assess the function of the shoulder. The right and left shoulders are assessed separately. The subjective variables are pain and ADL (sleep, work, recreation / sport) which give a total of 35 points. The objective variables are range of motion and strength which give a total of 65 points. Altogether there are a total of 100 points
Interpreting constant and murley scoring system
Excellent: Score between 86 and 100
Good: Score between 71 and 85
Moderate: Score between 56 and 70
Poor: Score less than 55

Results
The following observations were made from the data collected during this study of the functional outcome following fixation using PHILOS for proximal humerus fractures

Table 1: Type of fracture

Neer's classification	Total number of fracture	Percentage
Two Part	36	60%
Three Part	12	20%
Four Part	12	20%

Table 2: Functional outcome of proximal humerus fixation using PHILOS

Constant Murley Score	Number of patients	Percentage
Excellent	18	30%
Good	24	40%
Fair	12	20%
Poor	6	10%

Table 3: Complications of PHILOS fixation

Complication	Number of patients	Percentage
Stiffness	12	20%
Impingement	4	7%
Malreduction	4	7%

In our study Mean Constant and Murley score at the end of 6 weeks was 36.12±7.15 SD
Mean Constant and Murley score at the end of 12 weeks was 50.25±7.25 SD
Mean Constant and Murley score at the end of 6 months was 70.81±10.35 SD

Discussion
Most of the un-displaced proximal humeral fractures can be treated conservatively. However, displaced fractures require surgical treatment for better outcomes. The treatment goal was to achieve a painless shoulder with full ROM. Commenuted and displaced proximal humerus fractures are very difficult to treat especially in older osteoporotic individuals.
Various techniques have been described for fixation of commenuted and displaced proximal humeral fractures and all these techniques have a varied rate of complications like cut-out or back-out of the screws and plates, non-union, avascular necrosis, and fractures distal to the plate [5]. In PHILOS plate, all forces are transmitted from the bone via the locking head screws to the blade, and vice versa. Hence, the principle of fixed angle plates enables a gain in torsional stiffness and stability, so gives a better outcome
In our study, the average age of patients was 50.64% years (ranging from 26-70yrs), stating osteoporosis is the most common cause of theses fractures, which is also told by these authors [6, 7].

Fracture union has never been a problem in proximal humeral fracture management as had been mentioned in many studies [8, 9, 10, 11] due to cancellous nature of bone unless anatomical neck or articular part of humerus is involved, compromising bone of its blood supply. In our study, all fractures united successfully

We had a mean Constant Murley score of 70.81at the end of 6 months. Various studies had reported varying results. Thiyagarajan *et al*. in their study on 30 patients showed an overall average Constant score of 57.5. [12] The mean age in their series was 58 years (range 19-92 years) and fractures were Neer's 2-part, 3-part, and 4-part fractures. Rizwan Shahid *et al*. in their study reported that the results of PHILOS plating were equally good in all patients but functional outcome was better in younger age group [13]. They reported that with associated dislocation the results were deteriorated. These results were comparable to our study. In one prospective study, mean constant score was 68.31 in 19 patients [14]. Kettler *et al*. reported a Constant Murley score between 52 to 72 points after ORIF with the PHILOS plate. Hente *et al*. reached a mean Constant Murley score of 55 points in these specific fracture types, which was lower than for fractures without dislocation [15]. However, the systematic review by Thanasi's *et al*. reported an overall Constant score of 74.3 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 [16].

By this we can conclude that the use of the locking plate technology has a steep learning curve and appropriate surgical technique is very important for achieving good functional outcome. Severely commenuted fractures and improper implant positioning may lead to decreased functional outcome.

Hence, to improve functional results, we consider plate positioning and anatomical reduction of fracture were to be of utmost importance when using PHILOS plate fixation.

Conclusion

The proximal humeral interlocking system plating for displaced proximal humeral fractures has almost good functional outcome. In cases of commenuted fractures and severely osteoporotic fractures, proper positioning of the plate along with bone grafting can improve the functional outcome. There is no substitute to the proper positioning of implant as improper positioning leads to impingement and implant failure. The advantage of this fixation is it allows early postoperative mobilization of the affected shoulder, and better functional outcome of the affected shoulder, as compared to conservative management, where patient's affected shoulder is immobilized for long periods. However study of large sample size, longer follow up is worthwhile pursuing.

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