Functional outcome of proximal humerus fracture treated with philos plate

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Abstract
Proximal humerus fractures are the third most common nonvertebral osteoporotic fracture after proximal femur and colles fractures, accounting for >10% of fractures, above the age of 65 years. Wide arrays of techniques have been described like closed reduction and percutaneous K-wire fixation, open reduction followed by fixation with transosseous sutures, tension band wire, T plate, locking plates and screws, intramedullary nails, and prosthetic replacement. The aim of our study was to assessed the functional outcome of open reduction and internal fixation by plate osteosynthesis with proximal humeral internal locking system (PHILOS) plate for proximal humerus fractures. Prospective study conducted in our medical institution between 2015 and 2016. Open reduction and internal fixation with a PHILOS plate was done under general anesthesia in 31 patients. Male patients predominated female patients (21 males to 10 females), and the average age of patients is 39 years with the range being 25–70 years. Road traffic accident and fall from height were the commonest cause of the trauma (77.4%). Neer classification system was used to classify the fractures. During the follow-up functional parameters were assessed using Constant-Murley scoring system. The mean time for radiological union was 14 weeks (10–21 weeks). At the final follow-up the mean Constant-Murley score was 81 (57–100). The results were excellent in 15 patients, good in 7 patients, fair in 5 patients and poor in 4 patients. To conclude that PHILO plating is a safe and effective treatment for proximal humerus fractures.

Keywords: PHILOS PLATE, Proximal humerus fracture; Constant-Murley score

1. Introduction
Proximal humerus fractures always remained a challenging problem for most of the orthopaedic surgeons due to high incidence of complication. It is the commonest fracture affecting the shoulder girdle in adults. Proximal humerus fractures are the third most common nonvertebral osteoporotic fracture after proximal femur and colles fractures, accounting for >10% of fractures, above the age of 65 years [1]. In young individuals high velocity trauma is the cause of these fractures whereas simple fall can be the cause in older individuals because of osteoporosis. The majority of these fractures are stable nondisplaced or minimally displaced and can be treated nonoperatively [2]. There are different methods of surgical fixation of these fractures like closed reduction and percutaneous K-wire fixation, open reduction followed by fixation with transosseous sutures, tension band wire, T plate, locking plates and screws, intramedullary nails, and prosthetic replacement [3, 4]. Several complications such as K wire penetration, varus collapse, cut-out or back-out of the screws and plates, nonunion, avascular necrosis (AVN), nail migration, and rotator cuff impingement syndrome. Proximal humeral internal locking system (PHILOS) has been developed to solve these complications, especially to improve fracture fixation in elderly osteoporotic bones. It minimizes soft tissue dissection and gives both axial and angular stability, hence, reducing the risk of fracture displacement. Our study was to evaluate complications following proximal humerus fracture fixation using PHILOS plate and functional outcome.

2. Materials and Methods
The study was conducted in the Department of Orthopaedics, Veer Surendra Sai Institute of Medical Sciences and Researches (VIMSAR), Burla, Odisha, for a period of two years from January 2015 to December 2016.
This is a prospective study in which thirty one (31) consecutives cases of fracture of distal femur, aged 25-70 years, irrespective of sex were subjected to ORIF with PHILOS plate after obtaining written informed consent.

**Inclusion criteria**
1) Closed proximal humerus fractures (2-, 3-, 4-part according to Neer classification system)
2) Age > 18 years.

**Exclusion criteria**
1) Age < 18 years
2) Patients with failed conservative treatment
3) Open fractures
4) Pathological fractures.

There were 21 men and 10 women with a mean age of 39 years (range 25-70). Fracture was caused by trivial fall in 7 patients and caused by road traffic accidents and fall from height in the rest of the patients. Fractures were classified based on preoperative plain radiographs according to Neer classification system.

Patients were positioned supine under general anaesthesia with the patient in the beach chair position (head end of the table was elevated 35-45 degrees to the horizontal). A small bump was placed behind the patient’s back to turn the patient slightly to the opposite side with affected shoulder off the edge of the table. Skin was prepared with povidone iodine (10%) solution and draped. Fracture site was approached through a standard deltopectoral approach. K-wires were used in humeral head as joysticks and fixed temporarily with the humeral shaft. PHILOS plate was placed about 5 to 10 mm distal to the tip of greater tuberosity and just lateral to bicipital groove to avoid subacromial impingement. Place 2 proximal screw and one shaft screw. Fracture reduction and plate position were reconfirmed under image before placing other screws. Locking screws were placed in humeral head using drill guide. Drilling was done under sequential fluoroscopic imaging to prevent intraarticular penetration. Subchondral screw position was confirmed under two image views. The wound was closed over a suction drain. Arm was supported with a sling. Pendulum exercise along with passive forward flexion and external rotation was started from the 7th postoperative day followed by active assisted exercises after 3 weeks and active exercises after 6 weeks. Strengthening exercises were started 10 to 12 weeks after surgery. Standard anteroposterior, lateral and axillary views were taken immediately and then again at 6 weeks, 12 weeks, 6 months and 12 months following surgery. Functional outcome of shoulder at final followup was done using Constant-Murley score.

**3. Results**

A total number of 31 patients were taken up for study. The maximum age of the patient in the present study was 70 years and the minimum being 21 years, with a mean age of 39 years. All fractures were united clinically and radiologically. The mean time for radiological union was 14 weeks (10-21 weeks). At the final follow-up, the mean Constant-Murley score was 81 (57-100). The results were excellent in 15 patients, good in 7 patients, fair in 5 patients and poor in 4 patients. During the follow-up, 2 cases of varus malunion, one case of subacromial impingement, one case of deep infection, one case of intraarticular screw penetration and one case of failure of fixation were noted. Deep infection was treated with multiple debridements and intravenous antibiotics. Radiological union was noted after 18 weeks. Infection was resolved completely. Failure of fixation due to articular collapse underwent re-fixation with bone grafting and the fracture healed. Other complications were not symptomatic enough to undergo additional surgery. No cases of AVN, hardware failure, locking screw loosening or nonunion were noted.
during open reduction and internal fixation since damage to these soft tissues may disturb the vascularity of fracture fragments.

In our study, we used the standard deltopectoral approach in all the patients. Important aspects of the surgical technique include placement of the plate in strict adherence to the technique, determination of appropriate length and placement of the screws with fluoroscopy, insertion of screws to the head in adequate number and position, providing medial cortex support for the prevention of varus displacement. Egol et al. [7] observed only one case of acute infection in their series of 51 patients who mainly had 3- and 4-part fractures. Moonot et al. [6] reported one superficial infection that healed with oral antibiotic treatment. Low incidence of infection in our study was attributed to meticulous surgical techniques and the special attention paid to soft tissue preservation.

Osteonecrosis of humeral head occurs as a consequence of impaired blood supply of articular surface and sub chondral bone, which undergo involutions change, leading to articular collapse and fibrosis. Incidences of AVN have been reported in a wide range, 4%-75% of cases [5,7]. Hertel et al. [10] evaluated risk factors for humeral head ischemia following intracapsular proximal humerus fracture and found that the most relevant predictors were the length of the dorsomedial metaphyseal extension (<8 mm), the integrity of the medial hinge (defined by greater than 2-mm shaft displacement in any direction), and fracture with an anatomic neck component (types 2, 9, 10, 11 and 12 in their binary description system). When three of these criteria were present, the positive predictive value for ischemia was 97%. We did CT scans in 17 proximal humerus fractures and measured dorsomedial metaphyseal bony extension of humeral head along with integrity of medial hinge. In 3 patients, dorsomedial metaphyseal bony extension was <8 mm and medial hinge integrity was lost in 3 patients. Both these parameters along with intracapsular fracture extension were present in 2 patients. In our study we did not notice a single case. However our follow-up was short term. More cases of AVN could potentially arise with longer observation [9]. We believe that a majority of humeral heads are quickly revascularised through creeping substitution. However we need a much longer follow-up period to come to any strong conclusions.

Implant failure and loss of primary fixation of the implants occur in 2.7% to 13.7% of cases following open reduction and internal fixation with locking plates in proximal humeral fractures [6,7]. In our study we noted one case of fixation failure in the early postoperative period, which was revised with bone grafting. Varus malunion is one of the potential complications following fixation of proximal humeral fractures. It is defined as a head shaft angle of less than 120 degrees. Moonot et al. [6] reported the incidence of malunion in 3- and 4-part proximal humeral fractures. Agudelo et al. [8] considered primary varus reduction to be an important risk factor which may cause poor results.

In our study we observed 2 (6.4%) cases of varus malunion. We did not notice nonunion and heterotopic ossification in our series. According to Constant-Murley score, excellent/good results accounted for 70.96%, and only

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**4. Discussion**

Treatment of proximal humerus fractures are challenging, especially in the elderly. Different techniques have been described for the fixation of comminuted and displaced proximal humerus fractures. All these techniques have been associated with a varying rate of complications such as cut-out or back-out of the screws and plates, nonunion, AVN, and fracture distal to the plate. Locking periarticular plate fixation offers more advantages compared to many implants and have been shown to be superior to non-locking plates. Meticulous care must be taken to preserve the overlying soft tissues.
29.03% had fair/poor results. These results are comparable to those previously reported [11].

Conclusion

PHILOS plate for proximal humerus fracture is a safe alternative. It provides stable fixation, early mobilization with excellent radiographic and functional results with minimal complications. Our study had some limitations. The sample size of our study is limited to one center and is small to conclude very effective. Meticulous surgical dissection to preserve vascularity of humeral head is necessary to prevent potential complications such as AVN.

References