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Functional outcome of surgical management of fracture of proximal humerus treated with proximal humerus internal locking operative system plating

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Abstract

Purpose: To study the functional outcome of proximal humerus internal locking system plating in displaced proximal humerus fractures.

Materials and Methods: Prospective interventional study a total of 30 patients admitted in VIMS, Ballari with displaced proximal humerus fractures between August 2020 and August 2022 were included in the study. Patients were treated with proximal internal locking system plating and followed up at 6 weeks, 12 weeks and 6 months and were evaluated for functional outcome using Constant and Murley shoulder scoring system.

Results: Excellent outcome was noted in 20%, Good in 47%, fair in 23% and poor in 10% cases. 90% of patients had clinical and radiological union in 3 months. The range of motion showed gradual improvement in successive follow ups.

Conclusion: PHILOS plate provides a high degree of angular and axial stability eliminating screw loosening and backout. PHILOS plate showed significantly less plastic deformation subsequent to torsional and axial forces.

Keywords: Proximal humerus, fractures, plating, PHILOS (Proximal humerus internal locking operating system)

Introduction

Proximal humerus fractures comprised of 4% of all the fractures and approximately one half of all humerus fractures ^[1]. Incidence is 300,000 per year. Most (85%) are Undisplaced. Old individuals have higher incidence secondary to osteoporosis ^[2]. Much controversy and confusion still exist and no single treatment protocol or algorithm has been proved to be universally effective ^[3]. Several reconstructive options are available like percutaneous fixation using wires, levers and screws, open reduction and internal fixation using variety of plates, closed reduction and internal fixation using intramedullary nails and Athroplasties ^[4].

The aim of this study is to achieve near anatomical reduction and stabilization of fracture and patient related functional outcomes longer than 6 months postoperatively after PHILOS plate fixation for proximal humerus fractures.

Materials and Methods

Source of Data: All the patients admitted for operative management of proximal humerus fracture in Vijayanagar Institute of Medical Sciences, Ballari.

A total of 30 patients were enrolled in the study between August 2020 to August 2022.

Inclusion criteria

- Two-part, three part and four-part fracture of proximal humerus based on Neer's classification(5) and with patients age more than 18 years and fit for surgery
- Polytrauma

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Exclusion criteria

- Children and adolescent patients less than 18 years
- Acute infections
- Compound fractures
- Pathological fractures
- Patient medically unfit for surgery

Ethical Committee clearance for the study was obtained.

Patients fulfilling the selection criteria were informed about the nature of the study and informed consent for anaesthesia and surgery were taken.

At the arrival of the patient with these fractures, a careful history was elicited about age, sex, details of injury, duration. A thorough clinical and local examination was done.

Patient was subjected Routine pre operative investigations

- X rays - Shoulder AP and lateral view, Axillary view (optional)
- CT Scan with 3-D Reconstruction in selected cases.

Fracture was stabilized temporarily by POP U-slab and arm sling. Injection tetanus toxoid and antibiotics were given 1 hour prior to the surgery. Brachial block or General anaesthesia was used in all the patients according to their medical condition. The surgery was done in beach chair position. Through delto-pectoral approach, the fracture site was exposed and reduced with minimal soft tissue dissection. The anatomical relationship between humeral head and greater tuberosity was reduced and fixed temporarily with K wires. In case of obvious rotation or displacement of the humeral head, a joystick technique was used. Then the shaft fragment was reduced by abduction, traction and rotation of the arm. The fragments will be indirectly reduced with the help of traction sutures, which are placed in the insertions of rotator cuff tendons, and by extremity rotation. When acceptable reduction was obtained, the PHILOS plate was placed at least 1 cm distal to the upper end of the greater tuberosity and fixed to the humeral shaft. An aiming device was then attached to the upper part of the plate, and the head fragments were secured with Kirschner wires, after image intensifier control. Four to six locking screws were then inserted. All proximal locking screws were placed through an external guide and confirmed to be within the humeral head with intraoperative fluoroscopy. AP (internal and external rotation) views and axillary views 90 degrees to each other were used to visualize screw placement. A minimum of three bicortical screws were used distally. Fluoroscopic images were taken to confirm satisfactory fracture reduction, plate positioning and proper length of screws in the humeral head. Range of motion of shoulder was checked on the table for impingement. After surgery the shoulder was immobilised in an universal shoulder immobiliser. Immediate post operative check radiographs were taken to determine the alignment of the bone and maintenance of reduction. Depending upon the pain, pendulum exercises were begun as soon as possible.

Active range of motion was started at 2-4 weeks postoperatively, depending on stability of osteosynthesis. At fourth to sixth week immobilization was discontinued. Active assisted movements started up to 90° abduction with no forced external rotation. At sixth to eighth week-full range of movements with active exercises started.

At the end the patients were examined clinically and radiologically, assessed for range of motion and bony union and complications. The patients with shoulder stiffness were given physiotherapy for 1 to 2 weeks on outpatient basis.

Follow-up of patients was done at six weeks, three months and six months following the surgery. For all subjects, radiographs were performed at the end of six weeks, 12 weeks and six months follow-up.

Patients were evaluated based on the following parameters at the time of discharge and all the follow ups:

1. Range of motion of the Shoulder.
2. Complications.
3. Clinical union.
4. Radiological union.

The final result using Constant and Murley [6] score outcome was interpreted as follows: 86-100 – excellent; 71-85 – good; 56-70 – fair; 0-55 – poor.

Results

A total of 30 patients sustained with proximal humerus fractures were studied. Data obtained was analysed and the final results and observations were interpreted as below.

Table 1: Sex distribution

Sex	Number	Percentage
Male	22	73.33
Female	8	26.67
Total	30	100

The male to female ratio was 2.75 : 1

Table 2: Age distribution

Age	Number	Percentage
21-30	3	10
31-40	5	16.67
41-50	11	36.67
51-60	7	23.33
>60	4	13.33
Total	30	100

In this study, most patients were aged between 41 to 50 years.

Table 3: Nature of trauma

Nature of trauma	Number	Percentage
RTA	11	36.67
Fall	19	63.33
Total	30	100

In this study, 37% patients presented with Road traffic accident and 63% patients presented with history of fall as nature of trauma.

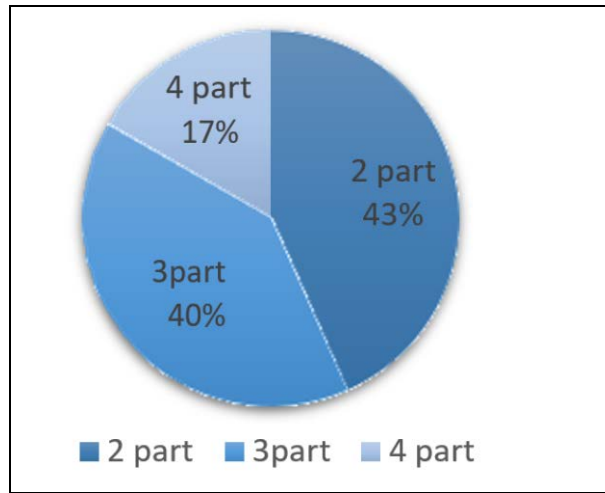
Table 4: Side involved

Side involved	Number	Percentage
Right	13	43.33
Left	17	56.67
Total	30	100

57% patients presented with left sided fractures, in our study.

Table 5: Fracture classification

Neer's Classification	Number	Percentage
2 part	13	43.33
3 part	12	40
4 part	5	16.67
Total	30	100



Graph 1: Fracture Classification

In this study, 43% patients presented with 2 part fracture, 40% with 3 part fracture and 17% with 4 part fracture according to Neer’s Classification [5].

Table 6: Complications

Complications	Number	Percentage
Varus Malunion	4	13.33
Stiffness	2	6.67
Plate impingement	3	10

In this study, 100% patients achieved clinical and radiological union by 6 months. Complications noted were varus malunion in 13%, Stiffness in 7% and Plate impingement in 10% patients.



Fig 1: Position, Deltopectoral approach, PHILOS plate fixed with screws.



Fig 2: Pre operative radiographs of case 1: 45 years old female patient with h/o self fall with Neer’s 3 part fracture of left proximal humerus.



Fig 3: Immediate post operative radiograph of Case 1



Fig 4: Radiographs of Case 1 at 6 months follow up





Fig 5: Range of motion of case 1 after 6 months

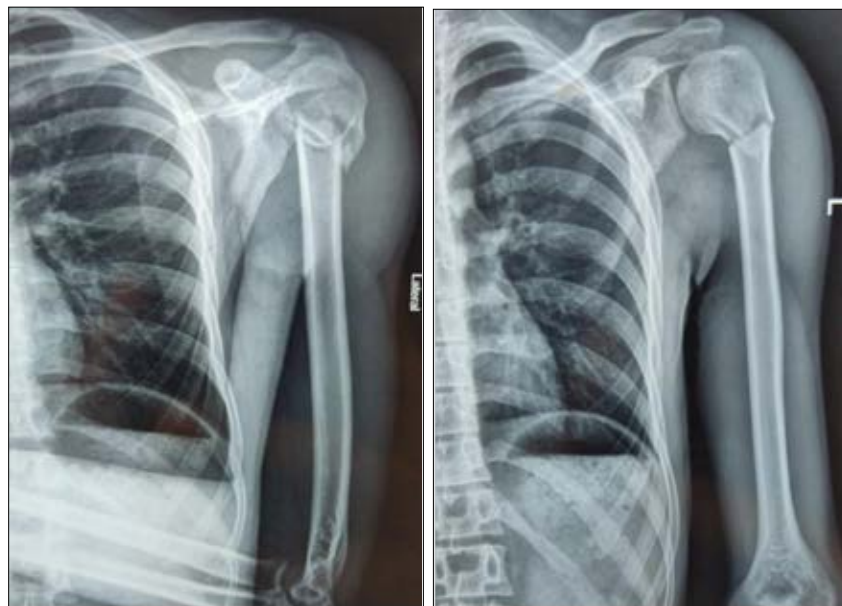


Fig 6: Pre operative radiographs of case 2: 23 year old male with left 2 part proximal humeral fracture.



Fig 7: Immediate post operative radiographs of case 2



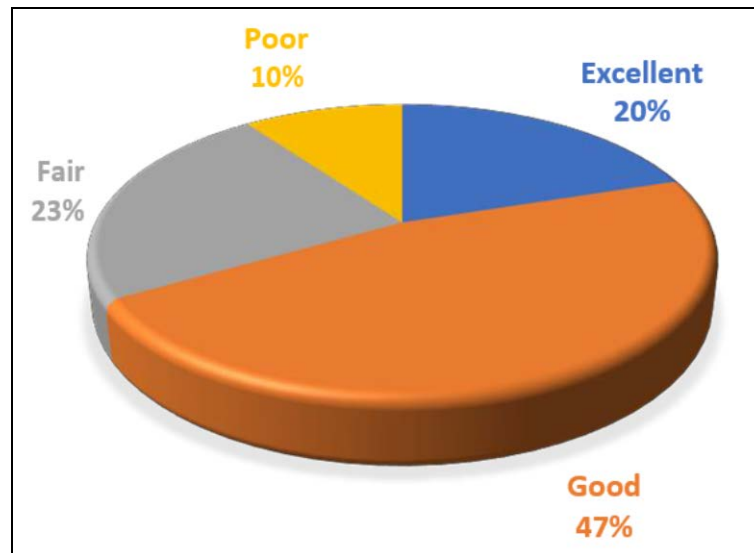
Fig 8: Radiographs of case 2 at 6 months follow up



Fig 9: Range of motion of Case 2 at 6 months follow up

Table 7: Final outcome

Outcome	Number	Percentage
Excellent	6	20
Good	14	47
Fair	7	23
Poor	3	10
Total	30	100



Graph 2: Final Outcome

Discussion

The treatment of complex humeral 3- or 4-part fractures represents a challenge. The surgeon must obtain an exact anatomical reduction and stable fixation, and at the same time minimise the iatrogenic risk of screw penetration and avascular necrosis of humeral head by maximal protection of the periarticular soft tissues.

Poor results in these complex fractures are due to following causes

- Inadequate fracture reduction especially medial cortex
- Unstable fixation
- Incorrect positioning of the fixation devices.

There is consensus in the literature that, regardless of the procedure and the implant chosen, a good functional final result depends mainly on anatomical reduction of the fracture combined with a stable fixation, and early initiation of functional rehabilitation of the shoulder. But in this study, age of the patient, minimal part of fractures and early fixation of fracture, directly increase the functional outcome.

In recent decade, rigid internal fixation of fracture have been increasingly used in the operative care of proximal humeral fractures.

In spite of an early and secure functional postoperative therapy, it was believed that these implants would reduce the risk of secondary reduction loss in osteoporotic patients.

Open reduction and internal fixation (ORIF) provided the features of anatomical fracture reduction, rigid fixation and the possibility of bone grafting. In proximal humerus fractures, PHILOS plate offers good functional outcome with context to the early joint mobilization and rigid fixation of the fracture. The present study was undertaken to assess the efficacy and the functional outcome following internal fixation with PHILOS plate for displaced proximal humerus fractures. The present two year prospective study was conducted from August 2020 to August 2022. A total of 30 patients who sustained proximal humerus fractures were included. Patients underwent Open reduction and internal fixation with PHILOS plate through deltopectoral approach. In this study, patients with only 2 part, 3 part and 4 part fracture of proximal humerus were included based on Neer's classification. Accordingly, 2 part fractures were noted in most of the cases (43%) followed by 3 part (40%) and 4 part (17%) fractures.

Kristiansen and Christensen^[7] have reported a high incidence of fixation failure following use of T-buttress plates in fixation of proximal humerus fractures. Wijnman *et al.*^[8] have reported good intermediate and long-term results in 87% of patients who had three-and four-part fractures fixed with T-buttress plate. In the very old age group with osteoporosis, functional outcome after conventional plate osteosynthesis was poor^[9].

In order to obtain better and reproducible results, the AO/ASIF has developed a special locking compression plate (Philos) for fractures of the proximal humerus^[10].

The plate is pre-shaped and contoured for the proximal humerus. The benefits of this implant are that it gives enhanced purchase in osteopenic bone, there is no loss of reduction or varus/valgus angulations, the locking screws into the plate provide angular and axial stability of the construct. With regard to functional outcome following use of locking plates (PHILOS) early benefits can be gained. The other demanding aspect is to avoid placing the plate too proximally on the humerus with resulting impingement of the top of the plate on the acromion. This can be avoided by using a K wire inserted through a hole at the top of the plate, which should line up with the tip of the greater tuberosity. This is done during initial positioning of the plate. Positioning the plate too high can also lead to incorrect placement of the divergent screws in the humeral head. Care should be taken to avoid penetration of the head and subsequent chondrolysis with proximal interlocking screws^[11].

In the present study, open reduction internal fixation of displaced proximal humeral fractures using deltopectoral approach with PHILOS plate, almost half the study population had good outcome (47%). Fair and poor outcomes were noted in 23% and 10% respectively, while excellent outcome was noted in 20% of the patients.

Majority of the patients had clinical and radiological union by second follow up i.e. by 12 weeks.

The range of motion at first, second and third follow ups showed gradual increase in mean flexion, abduction, external rotation and internal rotation during subsequent follow ups. These findings suggest that internal fixation with PHILOS (proximal humeral internal locking system) plate for displaced proximal humerus fractures results in overall good results that is nearly 67% of the patients had excellent and good results.

In 2014, Kumar GN *et al.*^[12], 51 patients who underwent

ORIF with PHILOS plate between 2007 to 2012 were studied and excellent results were noted in 25 patients, 13 patients had good, fair in 6 patients while poor results were noted in 5 patients. 2 patients were lost to follow up.

Elgohary HS *et al.* [13] in 2013 evaluated 26 osteoporotic and osteopenic patients with three part or four part proximal humeral fractures who underwent surgical fixation with locked plates. The clinical outcome was evaluated and all 26 fractures healed with a mean time of 11.5 weeks (8-16 weeks) and it was concluded that locked plate fixation for three or four part proximal humeral fractures in osteopenic or osteoporotic bones is a good and reliable method of fixation with limited complications.

Proximal humerus fractures, remain a challenging problem for the surgeon because the complication rate for these fractures still remains high. The internal locked system (PHILOS) plate is a new device used for proximal humerus fracture fixation is designed to decrease the high complication rate. In the present study, following complications were noted: Varus malunion in 13%, joint stiffness in 7% and plate impingement in 10% of the study population.

In conclusion, PHILOS plating is an ideal internal fixation material for the osteosynthesis of proximal humerus fractures in patients of all ages, particularly in osteoporotic bones in elderly patients and in comminuted fractures and thus allows early mobilization of the shoulder without compromising fracture union.

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