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Proximal Humerus Fracture with Plating

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Abstract

Background:
Displaced proximal humerus fractures, especially in young adults or osteoporotic elderly patients, may require surgical fixation. The PHILOS locking plate provides angular stability and facilitates early mobilization.

Methods:
Thirty patients (age 18–60) with Neer type II–IV fractures were treated using the PHILOS plate between May 2020 and June 2024. A deltopectoral approach was used in all cases. Clinical and radiological follow-up averaged 24 months. Functional outcomes were assessed using the UCLA Shoulder Score.

Results:
Excellent or good outcomes were seen in 72% of cases. Mean UCLA score was 29.5. Average elevation reached 127°, with external rotation of 42°. Complications occurred in 28%, most commonly inadequate reduction (16%) and adhesive capsulitis (6%).

Conclusion:
PHILOS plate fixation is effective for displaced proximal humerus fractures, particularly when anatomic reduction is achieved. Outcomes are favorable, with a low complication rate when technical precision is maintained.

I) Introduction

These fractures have a dual age distribution occurring either in young people following low energy trauma or in those older than 50 years with low velocity injuries.

The mechanism of low-energy injury in elderly patients is usually falling from standing [3]. Approximately 85% of patients with a proximal humerus fracture are non-dislocated and treated conservatively resulting in satisfactory results [4].

Most of the proximal humerus fractures are either non-displaced or minimally displaced and can be treated non surgically [5].

Nonsurgical options focus on early functional exercises with the goal of achieving a functionally acceptable range of motion (ROM). For the 15% to 20% of displaced proximal humerus fractures that may benefit from surgery, no single approach is considered to be the standard of care.

Proximal humerus fractures are prevalent, especially among elderly populations with osteoporotic bone. Achieving stable fixation that allows early mobilization is crucial for optimal functional recovery.

The Philos locking plate system offers advantages in providing stable osteosynthesis, particularly in osteoporotic bones.
Majority of proximal humeral fractures are either nondisplaced or minimally displaced and can be treated with sling immobilization and physical therapy, approximately 20% of displaced proximal humeral fractures may benefit from operative treatment.
The proximal part of humerus is divided into 4 parts head, greater tuberosity, lesser tuberosity and proximal shaft.
Neer's classification system is based on six groups and four main fracture segments (parts) comprising the head and shaft, greater tuberosity, lesser tuberosity.
Displacement is defined as more than 1cm of translation or 45 degrees of angulation of the respective fracture part.
In young patient's proximal humerus fracture is often due to high energy trauma and is associated with severe comminution (3).
Complications following proximal humerus fracture and management can be broadly classified as ones due to the fracture itself and ones due to the management options. Complications like stiffness, avascular necrosis and secondary osteoarthritis are often related to the severity of the fracture.
Complications like malunion, implant failure and non-union are often related to the treatment option chosen. Proponents of locking plate fixation often cite better fixation, early mobilization restoration of range of movement, head preservation, and suitable function as some of the major benefits of locking plate construct.
Over the last 3 decades, various modalities of fixations have evolved for the proximal humerus fractures (transosseous suturing, percutaneous pinning, tension band wiring, plating, rush nailing, arthroplasty).
The type of fixation used depends on the patient's age, activity and bone quality, the fracture type and the surgeon's technical ability. If the fracture reduction is achieved by manipulation but cannot be maintained, percutaneous K-wire fixation is performed.
Recent advances in fracture fixation technologies have led to the development of fixed-angle locked plates that maintain angular stability under load.
In this prospective study we tried to evaluate the merits and demerits of proximal humeral locking plate system proximal locking plate (Philos, Synthes).

II) Mmaterials and Methods

We had operated 30 patients with fractures of proximal humerus from May 2020 to June 2024. The average age of patients was 38 years with male female ratio of 4:1 (19/6), with 17 dominant side and 13 non-dominant side fractures. Each patient was examined clinically and radiologically with three standard views as scapular AP view, scapular lateral views and trans-axillary views. We followed Neer's classification.

The mean follow-up time was 2 years, ranging from 7 to 44 months.

All surgeries were performed by the same trauma team involving two senior orthopaedic surgeons.

Age	18 to 60 years
Mechanism of injury	High velocity trauma, direct or indirect trauma
Neer's classification of fracture	Two, Three part and four part fractures
Management	Fixation using proximal humeral locking plate
Time period in which the fracture and management happened	mars 2014 to june 2019

Inclusion criteria Tab1

Age	Below 18 + above 60 years
Neer's classification of fracture	Type one
Management	Conservative and other type of fixation than locking plate
Cause of injury	Pathological fracture
Time period in which the fracture and management happened	Other than time of study

Exclusion criteria Tab2

Under general anesthesia was used in all patients. Deltopectoral approach was used in all patients.

Description of Procedure:

A) Positioning and Preparation:

The patient was placed in a beach chair position under general anesthesia. The operative site was prepped and draped in sterile fashion.

B) Approach:

A deltopectoral approach was utilized. A skin incision was made along the deltopectoral interval, and the cephalic vein was identified and preserved or ligated as appropriate.

C) Exposure:

The deltopectoral interval was developed, and the deltoid and pectoralis major muscles were retracted to expose the anterior aspect of the proximal humerus. The fracture site was identified and carefully exposed.

D) Fracture Reduction:

The fracture fragments were reduced anatomically under direct visualization. Temporary fixation with K-wires was used to hold reduction.

E) Implant Placement:

A Philos locking plate was selected and positioned along the lateral aspect of the proximal humerus. The plate was temporarily held in place, and fluoroscopy confirmed proper alignment and hardware positioning.

F) Fixation:

Locking screws were inserted into the humeral head, ensuring appropriate depth and position under fluoroscopic guidance.
Distal locking screws were placed into the diaphyseal segment to secure the construct. Care was taken to avoid injury to neurovascular structures.

G) Final Inspection and Closure:

The reduction was confirmed with fluoroscopy. Hemostasis was achieved, and the wound was irrigated. The deltopectoral interval was closed in layers, and the skin was approximated with sutures or staples.
The patients remained immobilized with a simple sling for a period three week but were already submitted to assisted passive gain of movements with the physiotherapist's help.
After three weeks they were started on isometric strengthening and active gain of movements.
The average duration of the rehabilitation was four months

Follow-up radiographs were also obtained at one month, three months and at six months on all patients.

III) Results:

The patients of the study group were assessed by the UCLA score after a minimum period of seven months, with radiographic confirmation of consolidation. The mean follow-up period was 24 months. According to the UCLA score, we obtained 18 patients with excellent and three with good results (72 %) and three case with fair and four poor results (28%). (Table 2) The patients with results considered poor exhibited pain, limited range of motion and dissatisfaction.

mode of injury	*Number of Patients*	*Percentage*
Road traffic accident	15	50%
domestic falls	8	26%
Assaults	7	23%
Total	30	100%

Mode of injury Tab 3

The mean UCLA score was 29.5 points, with a range from 12 to35 points,
The mean elevation of the operated shoulder was127°, with a range from 70 to 160°. The mean lateral rotation was 42°, with a range from 10 to 70°.

No. of patients	Pre operative	Post operative
Pain (mean)	2	4
Function	2	5
Active forward flexion	1	5
Strength of forward flexion (manual muscle testing)	2	4
Satisfaction of patient	no	yes

Our mean result according to UCLA Shoulder Score Neer type l Tab 4

No. of patients	Pre operative	Post operative
Pain (mean)	2	4
Function	2	4
Active forward flexion	1	4
Strength of forward flexion (manual muscle testing)	2	4
Satisfaction of patient	no	yes

Our mean result according to UCLA Shoulder Score Neer type Ill Tab 5

No. of patients	Pre operative	Post operative
Pain (mean)	2	3
Function	1	3
Active forward flexion	1	3
Strength of forward flexion (manual muscle testing)	2	3
Satisfaction of patient	no	yes

Our mean result according to UCLA Shoulder Score Neer type IV Tab 6

Seven complications occurred in 25 patients (28%) and these are presented in three patients (12%) had more than one complication.

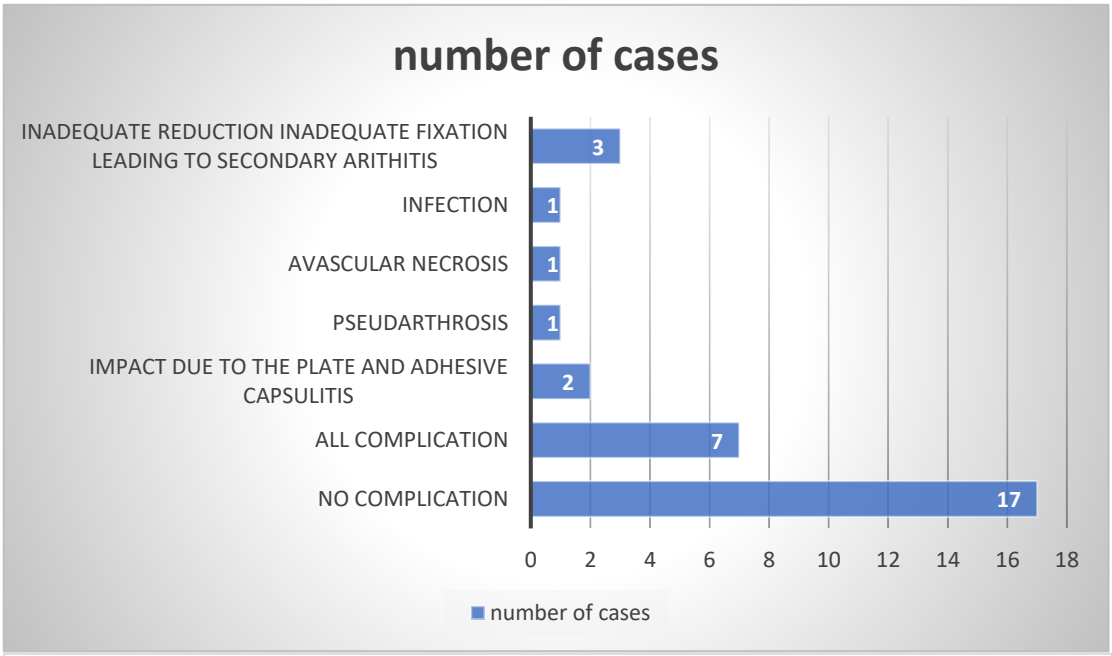
Among the three cases of inadequate reduction of the fracture, Inadequate reduction was the most frequent complication, with a statistically significant difference in occurrence between this complication and the others Among the two cases of complications from the subacromial plate caused by the plate, leading to (Impact due to the plate and Adhesive capsulitis) .

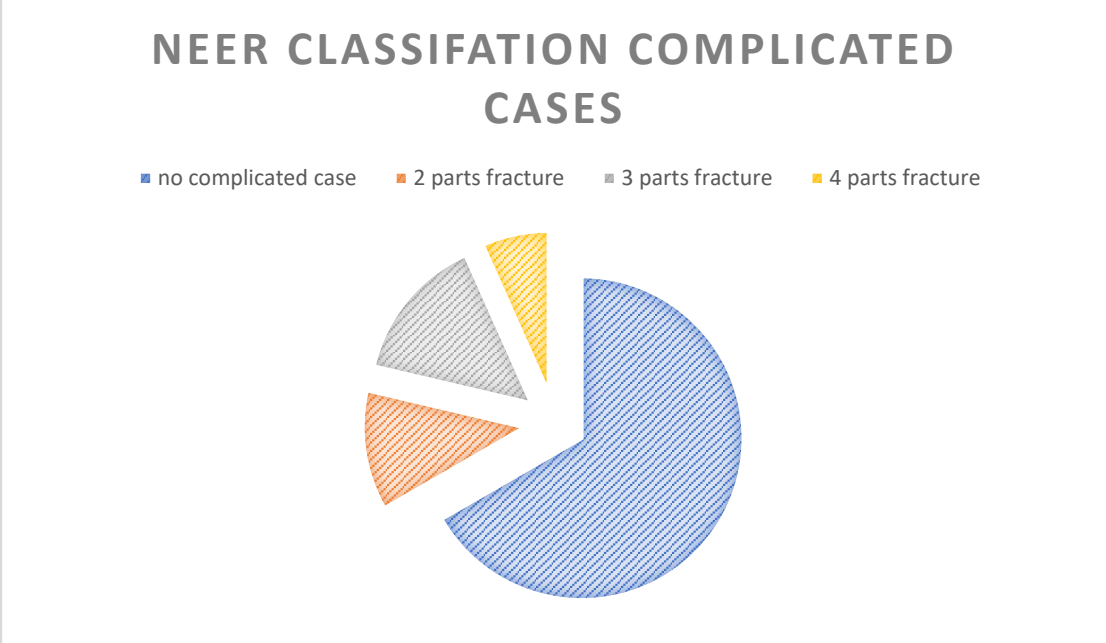
One case complicated by AVN, One case complicated by pseudo arthrosis one case complicated by infection

Complications Cases

Inadequate reduction Inadequate fixation leading to secondary arithitis	5	16%
Impact due to the plate and Adhesive capsulitis	2	6%
Infection	1	3%
Avascular necrosis	1	3%
Pseudarthrosis	1	3%

•Complications relating to fixation of fractures in the proximal third of the humerus using Philos plates tab 7





According to our study, a total of 9 patients were classified with Neer Type II fractures (see Pic 2). Out of these, 8 patients achieved excellent or good outcomes, while one patient was classified as having a fair result. For Neer Type III fractures, 11 patients were identified (see Pic 3), with 8 patients obtaining excellent or good outcomes, and the remaining 3 classified as having fair or poor results. In the group with Neer Type IV fractures, which included 5 patients, 2 achieved excellent or good outcomes, whereas 3 patients had fair or poor results.

Results %	Number of patients	
Excellent	19	63%
Good	4	13%
Fair	3	10%
Poor	4	13%
Total	30	100%

Evaluation of the results according to the UCLA score. tab8

IV) Discussion

The proximal humerus Fractures were first described by Hippocrates in 420 B.C.
In 1970, Neer categorized proximal humerus fractures built on number of fracture fragments that are displaced (11). AO/OTA group came with an alternative classification based on the location of fracture and the status of the surgical neck of humerus which mirror the blood supply to the humeral head (12).
Majority of patients, 80 - 85%, with proximal humerus fractures can be managed without surgery. Most of these fractures are minimally displaced ones and had high union rates (13)
Biomechanical studies comparing locking plates versus non locking plates for open reduction and internal fixation of displaced proximal humerus fractures reported many biomechanical advantages, increased torsional and pull-out strength, and less complication rate to locking plates as compared to non-locking plates (16, 17).
Proponents of locking plate fixation often cite better fixation, early mobilization, head preservation, restoration of range of motion and satisfactory function as some of the major benefits of locking plate construct (18-25).
The outcome of the intramedullary nailing for the treatment of proximal humerus fractures was quite unpredictable. The choice of site of entry can be difficult and it may cause lateral metaphyseal comminution (19).
The main aim of management is the restoration of limb function. Open reduction, in spite of the morbidity of surgical access, allows a more anatomical reduction of the fracture, Rigid fixation with locking plate favors immediate assisted mobility, avoiding stiffness and pain as sequela of the fracture. Since the mean age of the patients that present this type of fracture is high,
Rose et al. encountered 75% of consolidation and excellent results in their casuistry, considering the fixations stable and performing early rehabilitation. (11)
It is important to highlight that the locking plate did not contribute towards reduction of the fracture: fixation of the implant should be done with the fractured already reduced, and this is one of the biggest difficulties with treatments using this type of implant (9).
Several thin metal wires are placed to maintain the reduction while the plate is being positioned. Since the plate is positioned laterally to the bone, there is often great difficulty in maintaining this.

Koukakis et al (6) considered that the greatest challenge in this surgery was to reach anatomical reduction of the fracture, especially in three and four-part fractures.
Sudkamp et al (19), prospective study was observed that 33.5% of the patients evolved with complication, Among the complications observed by those authors, the following were seen: migration of the screws, subacromial impact, pseudarthrosis, loss of reduction, avascular necrosis, neurological lesions, breakage of the implant, inadequate fixation and infection 19).
It is important to emphasize that the functional results from fractures of the proximal extremity of the humerus are less dependent on the choice of implant; rather, they depend on correct anatomical reduction of the fracture and stable fixation of the implant (22).
It is believed that in elderly patients with osteoporosis and in cases of comminutive fractures, "locking plates" ensure greater stability of fixation and fewer risks of loss of reduction. (8)
It has been noted that there is some difficulty in achieving adequate reduction of the fracture in association with good positioning of the plate on the bone, even considering the different fractures dealt with. Correct reduction and fixation of fractures of the proximal extremity of the humerus using this type of synthesis requires technical skills from the surgeon and this, in turn, implies a long learning curve.
Südkamp et al (13) concluded that 55% of the complications encountered were already present at the end of the surgical procedure, and related to incorrect surgical technique.
In our study, this occurred in 46.7% of the complications.
To avoid complications with the implant, some technical precautions should be detected in using this fixation method. It is important to position the plate at the correct height since the plate positioned "high" can provoke mechanical impact in the acromion when the shoulder is abducted
The frequent complication in our study was Inadequate reduction Inadequate fixation leading to secondary arithitis in three cases
our results showed that the use of this fixation method is efficacious even in severe fractures. Good and excellent results were found in 80% of the patients with Neer type II simple fractures, and in with Neer type IV severe fractures. However, it is necessary to observe that the group with severe fractures was small, with only Five patients, and this can be considered a bias when we compare these groups. according to our experience.

V) Conclusion

The Philos plate is an effective and reliable option for proximal humerus fracture fixation, resulting in good union rates and favorable UCLA scores over a long-term follow-up. Its use is particularly advantageous in osteoporotic fractures, facilitating early rehabilitation and functional recovery.

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