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The functional outcome of proximal humerus fracture treated with proximal humerus internal locking osteosynthesis (PHILOS) plating

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Abstract

To assess the functional outcome of proximal humerus fractures treated with Proximal Humerus Internal Locking System (PHILOS) plating. 40 consecutive patients were treated with PHILOS plating. The inclusion criteria were skeletally matured patients with closed fracture of proximal humerus. The outcome was assessed using Neer's scoring system. As per the Neers classification system, there were 1-part, 2-part, 3 and 4-part fracture respectively. However, proper patient selection, thorough knowledge of the anatomy and biomechanical principles are the pre-requisites for a successful surgery.

Keywords: Philos plating, proximal humerus, skeletally matured patients

Introduction

The shoulder joint in general and the proximal humerus in particular is relatively less exposed to trauma and so they account for approximately 4-5% of all the fractures. But proximal humerus fractures are the most common fracture of the shoulder girdle. It is the 3rd most common fracture in elderly with male preponderance. These fractures are seen in patients of all ages, but they occur more commonly in elderly patients, after the cancellous bone of the humeral neck has been weakened by osteoporosis. Because of increasing incidence of road traffic accidents, complicated fracture patterns of proximal humerus are becoming increasingly common even in the younger age group. The fractures can be extremely disabling and their management often demands high level of surgical skills. The preferred treatment varies depending on the patient's age & bone quality, the expertise of the surgical team, the patient's expectations and needs. Although a number of reports have described the outcome of treatment of proximal humeral fractures but comparison of these reports is hampered by inconsistency in fracture classification, treatment, evaluation method and selection of operative procedure.

Material and Methods

A prospective as well as retrospective study was conducted on 40 patients with closed proximal humerus fractures treated with PHILOS. All the patient presenting to the emergency/outpatient department were included. The inclusion criteria were skeletally matured patients with closed fracture proximal humerus. All the necessary preoperative work-up for the patients will be done in the form of haematological and radiological examinations. Well written informed consent will be taken from all the patients.

Surgical technique for proximal humerus plating

Approaches

Deltopectoral: In case of the dislocation of the humeral head, this approach is preferred.

Surgical steps

- An oblique incision 15 cm long is made, starting from below the clavicle and passing over the coracoid.
- Deltopectoral interval and the cephalic vein are identified. The conjoint tendons are then retracted

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- Locate the biceps tendon and use it as a landmark to help identifying the fragments of the greater and lesser tuberosities with their attached tendons.
- Articular fractures should be anatomically reduced, and relationships of the tuberosities and their associated rotator cuff insertions should be restored.
- In case of dislocation of the humeral head, the reduction of the humeral head is achieved without further damaging soft tissue.



Fig 1: Surgical incision of Deltopectoral approach

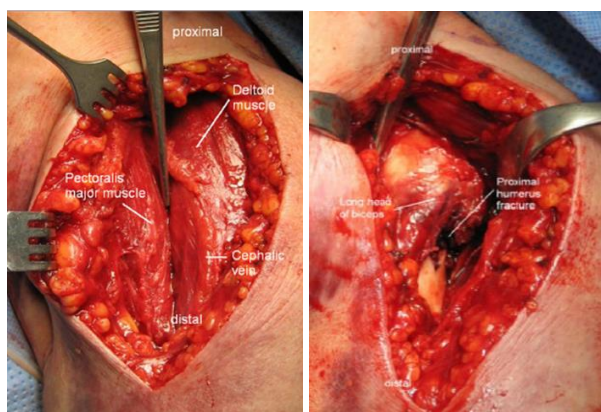


Fig 2, 3: Operative images of deltopectoral approach

Deltoid split: This approach is preferred for fractures without dislocation.

Surgical steps

- The skin incision follows the direction of the muscle fibers along the upper part of deltoid at the junction of anterior and middle raphe.
- The deltoid is split along its fibers from the acromion downwards, taking care not to injure the axillary nerve.



Fig 4: Surgical incision of deltoid split approach

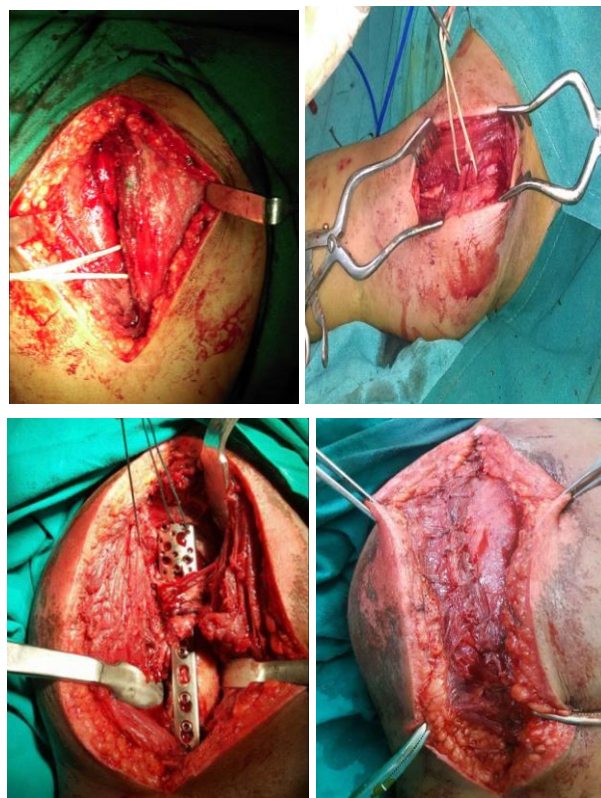


Fig 5, 6, 7, 8: Operative images of deltoid split approach

Fracture/dislocation reduction and provisional fixation

- Once adequate exposure is achieved, the humeral head dislocation if present is reduced and fracture is anatomically reduced and provisionally fixed with k-wires.
- The tuberosities are lagged to the shaft by non-absorbable sutures.

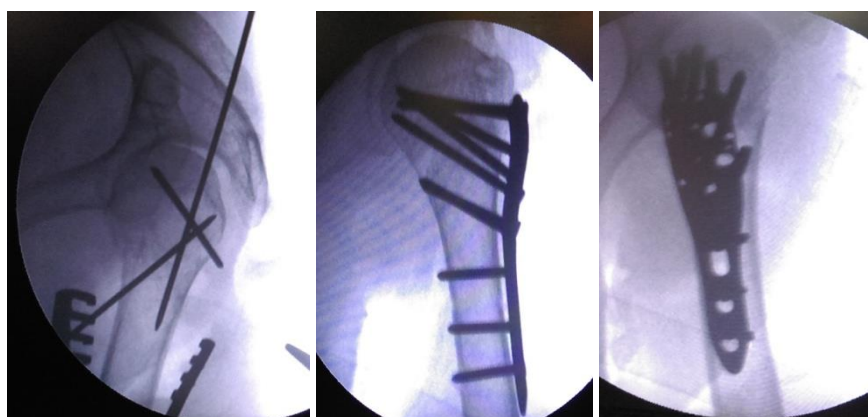


Fig 9, 10, 11: IITV image of provisional fixation of fracture with K-wires followed by fixation with plate

Plate placement

Following provisional fixation of fracture, final fixation was done using PHILOS plate.

- 1) Plate should be positioned at least 5-8 mm distal to the upper end of greater tuberosity
- 2) Plate should be in line with the shaft of humerus.
- 3) Plate should be at least 2 mm posterior to the bicipital groove thus sparing the long head of biceps.

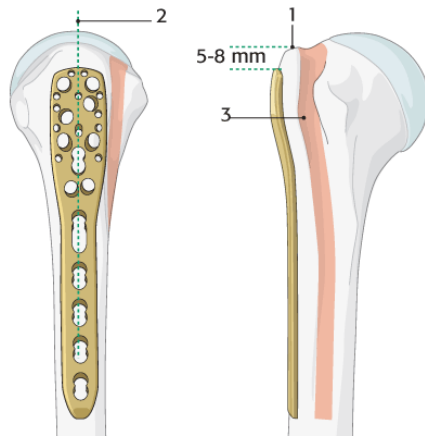


Fig 12: Ideal position for placement of PHILOS

Screw insertion

Head of the plate consists of 9 holes which are arranged in five Rows as follows;

- 4 holes aligned in centre at 95°
- 2 holes that are convergent
- 2 holes that are divergent
- one hole in the centre aligned at 45°

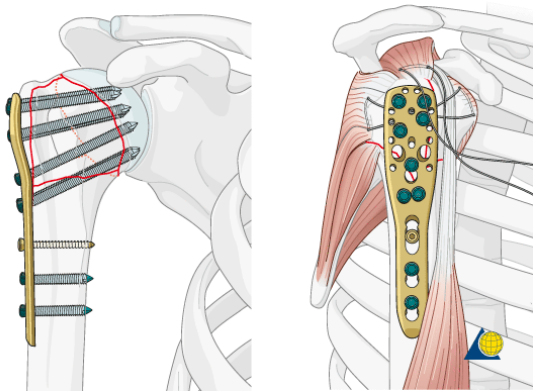


Fig 13: Arrangement of screws in PHILOS plate

- Distal shaft consists of three or five locking compression holes in the shaft, including one elongated hole to aid in plate positioning. These holes accept 3.5 mm Locking Screws in the threaded portion, and 3.5 mm Cortex Screws, 4.0 mm Cortex Screws, and 4.0 mm Cancellous Screws in the compression portion.
- Reduction is checked and confirmed under IITV.

Closure

- Closure of the wound was done in layers over drain as and when needed.

Instruments and plates (Fig 14, 15)

- 1) Screw Driver
- 2) Locking Sleeve

- 3) PHILOS Plate
- 4) LPHP Plate
- 5) Drill Bit (locking & simple)
- 6) Depth Gauge
- 7) Sleeve
- 8) Tap
- 9) Cortical and cancellous screw



Fig 14.



Fig 15: Reduction clamps used for fixation of proximal humerus fractures

5. Results

This is prospective study of 40 patients of proximal humerus fracture treated surgically with PHILOS plating. Following results were found on observation.

Table 1: Age Distribution

Age Group (In Years)	Number	Percentage
26-35	05	12.5%
36-45	04	10%
46-55	10	25%
56-65	10	25%
66-75	05	12.5%
>75	06	15%
Total	40	100%

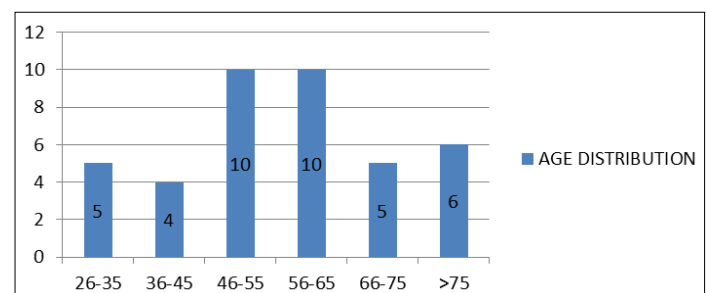
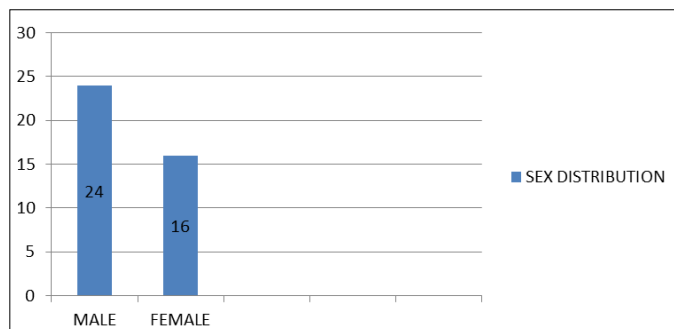


Fig 16: Age Distribution

In present study there are 05(32.5%) patients in 26-35 years, 04(10%) patients in 36-45 years, 10(27.5%) patients in 46-55 years, 10 patients in 55-65 years age group with a total of 70% patients between 25-65 years of age.

Table 2: Sex Distribution

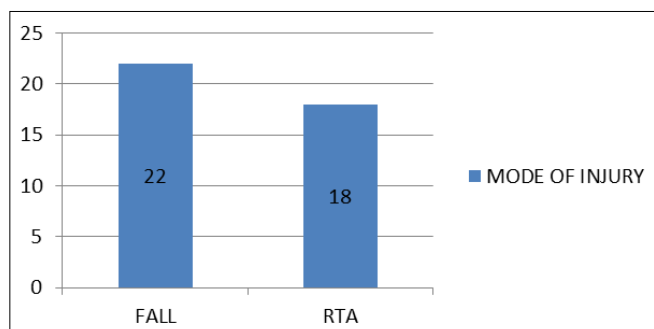
Sex	Number	Percentage
Male	24	60%
Female	16	40%
Total	40	100%

**Fig 17:** Sex Distribution

In present study, there are 23(58%) males having fracture of proximal humerus in comparison to only 17(42%) females. Thus there is male preponderance.

Table 3: Mode of Injury

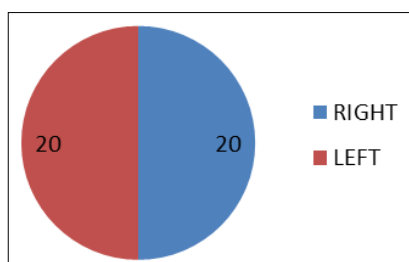
Site	Number	Percentage
Fall	22	55%
Rta	18	45%
Total	40	100%

**Fig 18:** Mode of Injury

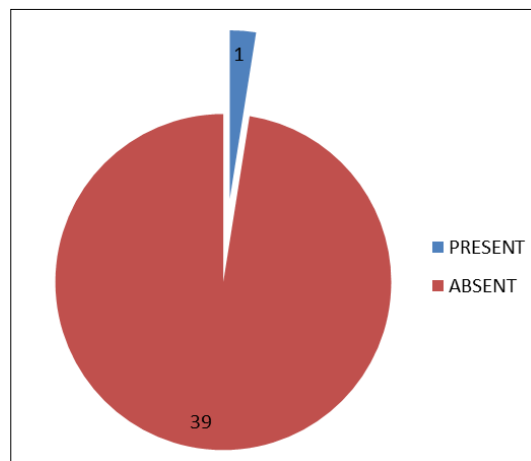
In present study, 22(58%) patients had fall down injuries. Fractures of proximal humerus also occur due to road traffic accident. Fractures in young age groups are mainly due to high velocity trauma.

Table 4: Fracture Side

Side	Number	Percentage
Right	20	50%
Left	20	50%
Total	40	100%

**Fig 19:** Fracture Side**Table 5:** Fracture with dislocation

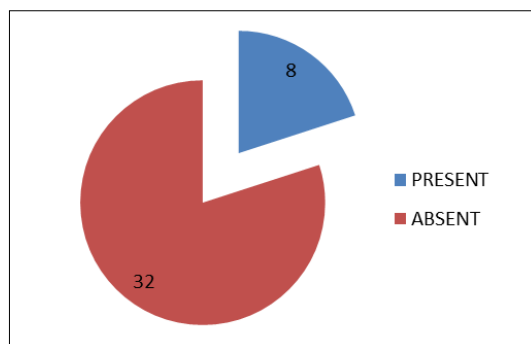
Fracture with Dislocation	Number	Percentage
Present	01	2.5
Absent	39	97.5
Total	40	100%

**Fig 20:** Fracture with Dislocation

In present study, 39 (97.5%) patients did not have Fracture with dislocation.

Table 6: Head Split

Head split	Number	Percent
Present	8	20%
Absent	32	80%
Total	40	100%

**Fig 21:** Head Split

In present study 8 (20%) patients had head split which was reconstructed on table and appropriately fixed.

Table 7: Associated Injuries

Associated injuries	Number	Percentage
Head injury	1	10%
Head injury+ Proximaltibia #	1	10%
Mid shaft tibia & mid shaft ulna #	1	10%
Olecranon #	1	10%
Supracondylarfemur # + d7 #	1	10%
Supracondylar Humerus #	1	10%
Scaphoid #	1	10%
Superior+Inferior pubic rami # +12 #	1	10%
Proximal tibia #	2	20%
Total	10	100%

Complex proximal humerus fractures are usually high velocity injuries and as a result of this high velocity trauma, injury to

other limbs and systems is not uncommon. As a result, in present study 10(25%) patients had associated injuries to other limbs and systems.

Table 8: Union Frequency

Weeks	Radiological union		Clinical union	
	Number	Percentage	Number	Percentage
8	0	0%	31	77.5%
9	28	70%	5	12.5%
10	8	20%	3	7.5%
11	2	5%	0	0%
12	1	2.5%	0	0%

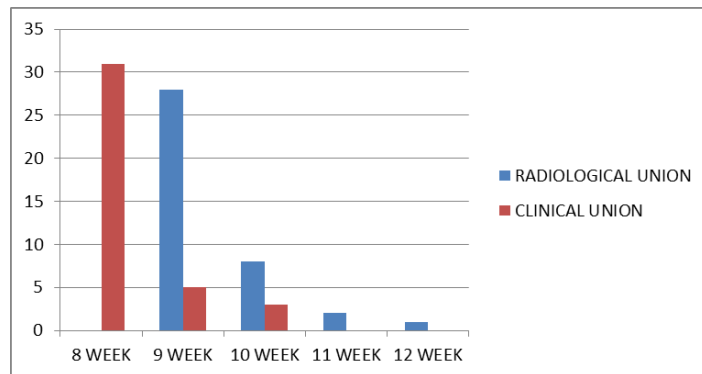


Fig 22: Union Frequency

In present study, all the fractures except one united. Clinical union always precedes radiological union. That's why, 31(77.5%) patients had clinical union at 8 weeks follow up whereas no patients had radiological union at the same follow up. On an average, clinical and radiological union was seen at 9 weeks and 10 weeks respectively.

Table 9: Complications

Complication	Number	Percentage
Infection	1	2.5%
Malunion	3	7.5%
Nonunion	1	2.5%
Total	5	12.5%

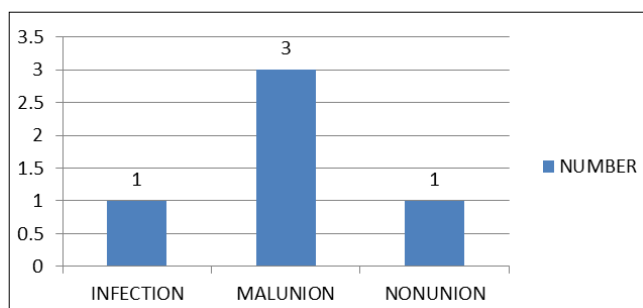


Fig 23: Complications

In present study, 1 patient had early infection which was treated by antibiotics and regular dressing. This patient required delayed suture removal. In same patient fracture had head split and showed nonunion on follow up. This patient was lost at follow

up.

In 3 patients there was malunion, in all the patients the head was fixed in varus. These complex patterns of fractures could be the reason for these complications. These patients had restriction in movements and overhead abduction above 90° was not possible.

Table 10: Head Shaft Angle

Head shaft angle on	Total	
Follow up	Number	Percentage
Good	23	57.5%
Fair	13	32.5%
Poor	4	10%
Total	40	100%

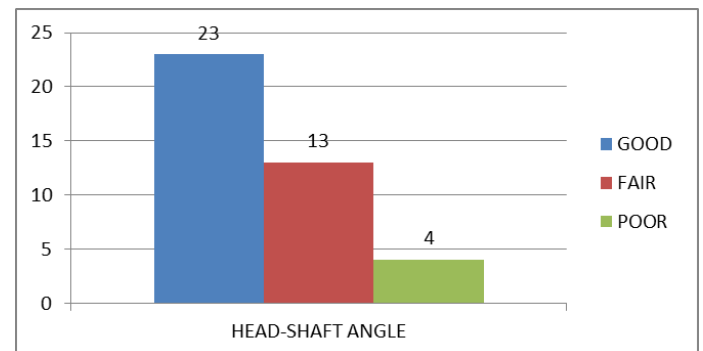


Fig 24: Head-Shaft Angle

Good 130°-150°

Fair 115°-130° or 150°-175°

Poor <115° or >175°

In present study, 4 (10%) patients operated by PHILOS show poor radiological result as calculated by head shaft angle on x-ray.

Table 11: Neer Score

Score rating	Patients	Percentage
Excellent(>95)	11	27.5%
Good(>75)	22	55%
Fair(>60)	3	7.5%
Poor(<60)	4	10%
Total	40	100%

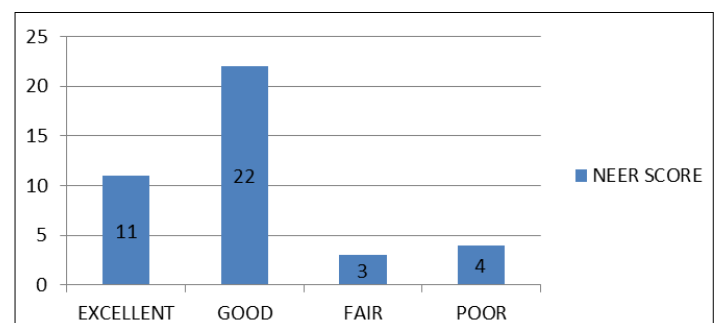


Fig 25: Neer Score

6. Discussion

Table 12: Age / sex distribution / mode of injury

	Average age	Sex predominance	M.O.I
Present study	52	M	57.5% domestic, 37.5% rta
Irenberger <i>a et al.</i>	50	M	67% rta, 21% domestic
Mohamed M.H. El-Sayed	42	M	Rta> domestic

In present study the average age was found to be 52 years which is comparable with other studies.

The male predominance was mainly observed due to the predominant outdoor activity and active professional life in male patients. Female patients being mainly involved in household activities are less prone to such injuries.

In present study 45% patients had vehicular accident. This was especially in younger age group who sustained a high velocity injury leading to more complex fractures. In the aged trivial injuries like domestic fall is commonly the reason for fracture. This must be due to osteoporosis which is more common in this age group.

Thus in present study, we observed that proximal humerus fractures were more common in young males with road traffic accidents due to their active outdoor life.

In present study, all the fractures except one united. Clinical union always precedes radiological union. That's why, 31(77.5%) patients had clinical union at 8 weeks follow up whereas no patients had radiological union at the same follow up. As proximal humerus is a cancellous bone, usually union is not a problem but malunion is more common. On an average, clinical and radiological union was seen at 12 weeks.

In present study, 1 patient had early infection which was treated by antibiotics and regular dressing. This patient required delayed suture removal. In this patient fracture had head split and showed nonunion on follow up. This patient was lost at follow up.

7. Conclusion

In this study, 40 cases of proximal humerus fractures were managed surgically by PHILOS. All of them were followed up regularly and evaluated with NEER'S Score

There is a paradigm shift in proximal humeral fracture epidemiology, with reduction in average age group and increase in frequency of high grade fractures.

Male preponderance in present study is due to the pre-dominant outdoor activity and active professional behaviour. Female patients being mainly involved in household activities are less prone to such injuries.

As there is a substantial increase in the number of motor vehicles; there is increased frequency of road traffic accidents in younger active population, which has lead to complex patterns of fracture.

Associated injuries may affect the functional outcome despite satisfactory shoulder function.

Though radiological outcome does not always correlate with the clinical outcome, most of the radiological results are comparable with the clinical results.

Varus collapse is associated with restriction of range of motion and poor functional results. Complication rates with this technique are low in present study.

Early mobilization exercises and physiotherapy yielded better movements of operated shoulder.

In conclusion, Proximal humerus fractures and fracture dislocations treated by Open Reduction and Internal Fixation by PHILOS plate give gratifying results with low complication rates.

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