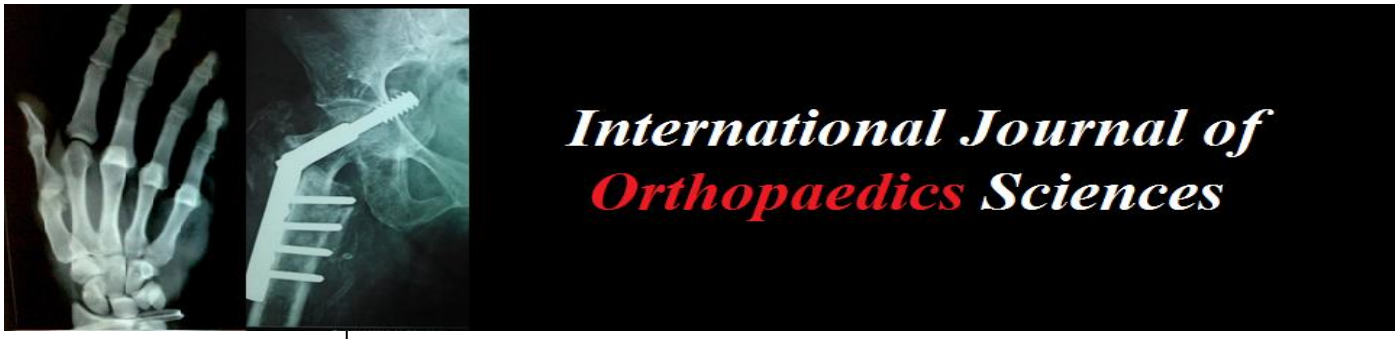

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Evaluation of management of displaced proximal humeral fracture with proximal humerus internal locking system (Philos)

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Abstract
Background: Proximal humerus fractures are one of the most common fractures occurring in upperlimbs and the third most common fractures in elderly population after hip and distal radius fractures. Previously, most of the proximal humeral fractures have been treated by non-operative methods and most are resulting in good functional outcomes. But fractures with significant displacement, especially in comminuted fractures there were poor functional outcomes. So, today's era is moving to surgical fixation for better results. However, best method of treating displaced proximal humerus fractures is still debatable where fixation with the philos plate is near ideal good technique. Aim of this study is to evaluate the outcomes after Philos plating.
Materials and Methods: The present study was a prospective study carried out from July 2016 to October 2018, on 25 cases satisfying the inclusion criteria following complete assessment. Patients were assessed for functional and radiological outcome following Philos plating.
Result: Evaluated with Constant and Murley score, Head shaft angle, Height of tuberosity to humeral head and implant position. In study, 3 (12%) of 25 patients had excellent results, 11 (44%) had good results and 10(40%) had fair results and 1(4%) had poor result out of 25.
Conclusion: PHILOS appears to be a better mode of treatment for displaced proximal humerus fracture (type 2, 3, 4 according to Neer's classification) where stable internal fixation, early mobilization and accurate anatomical restoration of the articular surface and tuberosities are crucial for the better functional outcome.

Keywords: Proximal humerus fractures, philos, neer's classification, constant and murley score

Introduction
One of the most common fractures occurring in the upper limb is proximal humerus fractures with incidence of approximately 4-5% of the fracture attendance at hospitals [1]. They are the third most common fractures in elderly population after hip and distal radius fractures. Increase in incidences due to more geriatric population with osteoporosis and increasing incidence of higher velocity injuries, increasing of road traffic accidents and industrial accidents, together with assault lead to multiple fractures and higher incidence of morbidity in young patients [1].
In the past century, most of the proximal humeral fractures have been treated by non-operative methods [2]. About 80-85% of proximal humeral fractures treated non-operatively, resulting in good functional outcomes. Whereas in the 15% to 20% of displaced proximal humerus fractures it is noted that significant displacement, especially in comminuted fractures were associated with poor functional outcome, hence moving to surgical fixation for better results [2].
However significant controversy continues regarding the best method of treating displaced proximal humerus fractures. And fixation with the philos plate is near ideal good technique with a high union rate in treatment of displaced proximal humerus fracture [3].
The Proximal Humerus Internal Locking System (Philos) plate has been introduced to early mobilization and reduces complications (adhesive capsulitis) especially in older osteoporotic individuals.

Materials and method

This prospective study was conducted in Dr. Bhim Rao Ambedkar Memorial Hospital, Raipur, Chhattisgarh between July 2016 and October 2018. The study included 25 (male 14 & female 11) patients with displaced proximal humerus fracture who underwent open reduction and internal fixation (ORIF) with PHILOS (proximal humerus internal locking system) plate by deltopectoral approach. Follow up of patients and evaluation done clinically and radiologically at 3 weeks, 6 week, 12 weeks and 6months.

We studied 25 adult patients of proximal humeral fracture of which most of the patients were brought to the causality or admitted through outpatient department basis, clinical history was elicited. Careful clinical examination of skeletal system and soft tissue injuries was recorded. Radiographs were done. Arm was immobilized in a "U' Slab and arm sling. Once patient's general condition stabilized then we planned operative fixation.

Inclusion criteria

- Age > 18 year
- Any sex male/ female
- Displaced fracture of proximal humerus according to Neer's classification4 (type 2, 3, 4) displacement >1cm. and angulations >45°.
- Fractures less than 1 month old.

Exclusion criteria

- Pathological fractures (sickle cell disease, secondary to neoplasm, bone cyst etc.)
- Open fracture
- Fracture associated post-traumatic brachial plexus injury or peripheral nerve palsy, bilateral fractures and fracture dislocation
- Fracture associated with vascular injury

Methodology

Position-After proper an aesthetic assessment scalene block or GA was given, patient put on operation table in beach chair position or sand bag under scapula

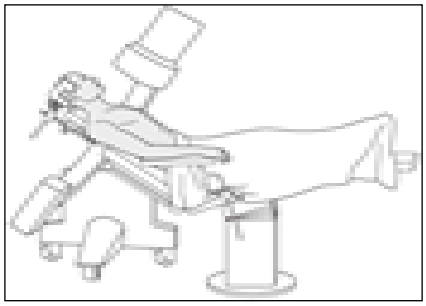

Fig 1: Beach chair position

Fig 2: Patient position

Fig 3: Basic instrument used in surgery

Fig 4: Deltopectoral approach

Approach-Deltopectoral approach 4

Landmarks: Coracoid Process. Palpate the coracoid process by dropping your finger distally about 2.5 cm from the anterior edge of the clavicle at the deepest point in the clavicular concavity. Press laterally and posteriorly in an oblique line until the coracoid process is felt [5].

Deltopectoral Groove: The deltopectoral groove is easier to see than to feel, especially in thin patients. The cephalic vein, which runs in thegroove [5].

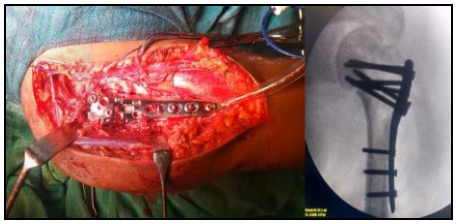

Fig 5: Intraoperative implant position

Results

Age distribution: In our series of twenty five patients 7 are in the age group of l8 to 40 (28%), 15 are in the age group of 40-60 (60%) and 3 are in the age group of more than 60 year (12%).

Table 1: Age distribution

Age	No. of patients	Percentage (%)
18-40	07	28
40-60	15	60
>60	03	12
Total	25	100

Type of fracture: In our study the most common type of fracture observed was 2 part fracture accounting for 16 of 25 patients (64%). The next common being 3 part fracture accounting for 8 of 25 patients (32%), and one patient, it is 4 part fracture (4%).

Table 2: Pattern of fracture

Two part	16	64%
Three part	8	32%
Four part	1	4%
Total	25	100%

Functional outcome by Constant and Murley Scoring System: In our study, final functional outcome is assessed with Constant and Murley score. 3 (12%) of 25 patients had excellent results, 11 (44%) had good results and 10(40%) had fair results and 1(4%) had poor result out of [25].

Table 3: Functional outcome

Result	No. of patient	Percentage
Excellent	3	12
Good	11	44
Fair	10	40
Poor	1	4
Total	25	100

Fig 6: After 6 month follow up

Head shaft angle: In our study, head shaft angle of humerus for normal limb range in between 133° to 136°, mean is 134.23° with standard devation of 0.863 and standard error is 0.169. For operated limb, head shaft angle range in between 133° to 137°, average is 134.54° with standard deviation of 0.706 and standard error is 0.138.

Height of the tuberosity in relation to the top of the humeral head: In our study for normal upper limb, normal range is 8.0mm to 9.0mm, mean value 8.54mm, standard deviation 0.02596 and standard error is 0.00509. For operated limb, range is 8.4mm to 8.9mm, mean value 8.64mm standard deviation 0.01835 and standard error is 0.00360.

Table 4: Distribution of HSA & HTAA

	Normal limb	Operated limb	p value	Remark
HSA (degree)	134.23±0.863	134.54±0.706	0.166	Not significant
HTHH (cm)	0.8546±0.02596	0.8638±0.01835	0.145	Not significant

Table 5: T-Test: Group Statistics

	Group	N	Mean	S.D	S.E. Mean
HSA (degree)	Normal	25	134.23	.863	.169
	Fracture	25	134.54	.706	.138
HTHH (cm)	Normal	25	0.8546	.02596	.00509
	Fracture	25	0.8638	.01835	.00360

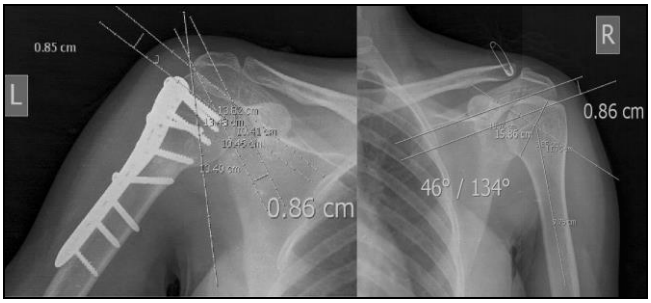

Fig 7: Radiological outcome

Discussion

Proximal humeral fractures make up 4-5% of the entire fractures of long bones. Now a days, its occurrence is increasing because of rise in geriatric population with osteoporosis and increased RTA in young population. 80-85% of these fractures are manage by conservative treatment, remaining 15-20% are displaced and require open reduction and internal fixation.

In recent years, rigid internal fixation has been ever more used in the operative cases of proximal humerus fractures by diverse implants. In spite of early post-operative mobilization, these implants would lessen the risk of secondary reduction loss, particularly in osteoporotic bone.

Proximal humerus internal locking system is the most frequently used implant at present for these fractures. It also allows direct and indirect reduction of the articular fragments using image intensifier, thus lowering the possibility of osteoarthritis particularly in four part fractures

The results of our study are comparable with the various prospective studies conducted in our country and other parts of the world and results are shown below.

Age Incidence: The average age incidence in our series of 25 patients analyzed, ranging between 18 to 70 years and mean was 52.8 years, which was constant with the age. Incidence in research done by Kenneth A. Egol *et al.* [6] was 61 years and the mean age incidence in C. Gerber *et al.* [7] study was 44.9 years. In our series 13 out of 25 Patients were above the age of 50 years.

Table 6: Age comparison

Study	Average Age (in years)
Kenneth A. EGOL *et al.* [6]	61
Gerber C *et al.* [7]	44.9
Our Study	52.8

Type of Fracture: The study of type of fracture in our series revealed 16 (64%) were 2 part fractures, 8 (32%) were 3 part fractures and 01 (4%) was a 4 part fracture (3.84%). In studies done by Rizwan Shahid *et al.* [8] in a series of 50 patients studied 11 (22%) were 2 part fractures, 21 (42%) were 3 part fractures and 18 (36%) were 4 part fractures. In another study by MA Fazal *et al*. 9 of 27 cases, 13 (48%) were 2 part fractures, 12 (44.5%) were 3 part fractures and 2 (7.5%) were 4part fractures indicating that the incidence of type of fracture is nearly consistent with the studies in literature.

Table 7: Pattern of fracture in various study

Study	2 Part #	3 Part #	4 Part#
Rizwan Shahid *et al.* [8]	11(22%)	21(42%)	18(36%)
MA Fazal *et al.* [9]	13(48%)	12(45.5%)	02(7.5%)
Our Study	16(64%)	8(32%)	01(4%)

Functional Outcome: In our study final functional outcome is assessed with Constant and Murley score. 3 (12%) of 25 patients have excellent results, 11 (44%) have good results and 10(40%) have fair results and 1(4%) have poor result out of 25. All cases of poor results had complication of shoulder stiffness in elderly patients. None of patients in our study were failure. These results are consistent with these other studies too. So, according to various studies PHILOS plate is better fixation option for proximal humeral fracture.

Table 8: Constant score in various study

Study	Constant Score	Neer's Classification
Vivek Bansal [10]	58.4	3&4 part fracture
Mayank vijayvargi *et al*. [11]	74.0	2,3&4 part fracture
Sameer aggarwal *et al*. [12]	74.6	2,3&4 part fracture
Dr. Goutam *et al*. [13]	81	2,3&4 part fracture
Srivatasav *et al*. [14]	73.10	2,3&4 part fracture
Our study	82.30	2,3&4 part fracture

Radiological outcome

Head shaft angle: In our study, we observed that, there is no significant difference in the Head shaft angle of humerus post operatively between the operated limb and normal upper limbs. In operated limb head shaft angle range in between 133° to 137°, average is 134.54°with standard devation of 0.706 and for normal limb range in between 133° to 136°, means is 134.23° with standard deviation of 0.863.

In study of Shrivatsav *et al*. 14 head shaft angle for operated limb, average is 133.23° with standard deviation of 4.6 and for normal limb, mean is 133.33°with standard deviation of 3.9 which is helpful in early mobilization and also provide rigid fixation.

In study of Georgios Touloupakis *et al*. [15] post-operative mean HSA was 131.5° with deviation of 9.4 and head shaft angle is crucial prognostic factor for quality level of the orthopaedic reduction (insufficient, sufficient and good) based on a radiograph and presence of calcar screws through the PHILOS plate, restoring an optimal head- shaft angle which is of crucial importance for a successful treatment, as, missing an optimal head-shaft angle could lead to early failure, despite an otherwise good reduction.

In study of Aditya C Pawaskar16, MD, the mean neck shaft angles were 133.6° (range, 100 to 116) at immediate postoperative, 129.8° (range, 99 to 150) at 3 months postoperative and 128.4° (range, 97 to 145) at final follow-up. The mean loss in the neck-shaft angle in the first 3 months was 3.8 as compared to 1.3 in the period between 3 months and final follow-up.

Implant position (greater tuberosity to top of plate): In our study, average implant position is 0.88 cm with 0.02 cm standard deviation.

In study of Dr. Arun pal singh17 the average implant position is 0.84 cm and it must be more than 0.8cm.

Complications

In our study, 2 of 25patient (8%) developed shoulder stiffness due to post-operative fibrosis on healing and poor patient compliance. Also, 2 of 25(8%) patient developed superficial infection due to poor personal hygiene which was treated by daily dressing and appropriate antibiotic according to pus culture and healed eventually.

Study of Ramchander, Siwach *et al*. [18] shows superficial infection in 1 of 25(4%), plate impingment in 1 of 25(4%), mal-union 1 of 25(4%), non-union in 2 of 25(8%) and AVN in 2 of 25 (8%) of patient Study of RICHARD J *et al*. 19 shows plate impingment in 2 of 15(13.3%) and AVN in 2 of 15(13.3%) patients.

Study of N. Sudkamp *et al*. [20] shows superficial infection in 6 of 187(3.2%), plate impingement in 4 of 187(2.1%), nonunion 4 of 187(2.1%) and AVN in 6 of 187(3.2%) patients.

Table 9: Complication in various study

	Ramchander Siwach [18]	Richard j [19]	N. Sudkamp, md *et al*.	Our study
Stiffness	00	00	00	02
Post Op Infection	01	00	6	02
Plate impingement	01	02	4	00
Mal union	01	00	00	00
Non union	02	00	4	00
AVN	02	02	6	00
Total	25	15	187	25

Conclusion

Proximal humerus fractures demand careful evaluation of type of fracture and surgical skills to restore three-dimensional anatomy of the gleno-humeral joint. Clinical evaluation, obtaining appropriate radiological views, age of the patient and movement levels hold the key for realistic approach and appropriate surgical management of these complex fractures.

The common mode of injury in these fractures is fall on shoulder in elderly and RTA in young population. Anatomical reduction is essential and determines the outcome in surgical treatment of these fractures. Open reduction and internal fixation with proximal humerus internal locking system has given good results and it is the implant of choice now a days.

The advantages of PHILOS are: Stable internal fixation, early mobilization and accurate anatomical restoration of the articular surface and tuberosities, appear to be more important for the better functional outcome. An adequate surgical technique will minimize complications and an aggressive rehabilitation regime (active physiotherapy) will ensure the best possible result.

Corrected neck-shaft angle and height of tuberosity to height of humeral head has been associated with better functional outcome as it prevents lengthening of lever arm of the deltoid and supra-spinatus muscles, abductor muscle dysfunction and subsequent sub-acromial impingement and which provides early restoration of range of motion especially abduction.

Correct implant placement is associated with better useful outcome as it promotes rotator cuff mechanism and prevents impingement of plate to supra glenoid structures.

Hence, PHILOS appears to be a better mode of treatment for displaced proximal humerus fracture (type 2,3,4 according to Neer's classification)

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