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ORIGINAL RESEARCH

Outcome of proximal humerus fracture treated with philos plating using deltopectoral approach

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ABSTRACT

Background and Purpose: Proximal humerus fractures are the second most common fractures of the upper extremity after distal radius fracture. Proximal humeral fractures are increasingly common in aging population and are primarily linked to osteoporosis. Most of the undisplaced proximal humeral fractures can be managed with shoulder immobilizer and physical therapy. However, about 20% of displaced proximal humeral fractures require surgical intervention. Conservative treatment often leads to complications such as malunion, nonunion resulting in dysfunctional shoulder mobility. Keeping in mind the functional demand and early mobilization of the patient, surgical intervention is a better option in selective patients. Here, in our study we assess the functional and radiological outcome of the proximal humerus fracture fixed with PHILOS plate using classical Deltopectoral approach. **Methods and materials:** All the patients with proximal humerus fracture were treated with open reduction and internal fixation with PHILOS plate using classical Deltopectoral approach. A total number of 20 patients who were skeletally mature had the proximal humerus fracture were selected for the study. Neer's scoring system and DASH scoring system were used to assess the outcome. **Conclusion:** PHILOS plating using classical Deltopectoral approach gives a satisfactory functional outcome. On follow up Neer's score and DASH score were significantly increased allowing early mobilization and to perform Activity of Daily Living smoothly. However, proper selection of the patient, proper surgical technique and knowledge of thorough anatomy are pre-requisites for a successful surgery.

INTRODUCTION

Proximal humerus fractures account for 4-10 % of all fractures according to several studies performed in different countries. Fractures are particularly common in the elderly due to osteoporosis while being less common in young people which is due to high energy trauma.

About 80% of the proximal humerus fractures are stable and slightly displaced or nondisplaced in young as well as in elderly patients. Hence, these can be treated conservatively with shoulder immobilizer and physical therapy. The remaining 20% of the fractures require surgical fixation for better shoulder mobility or in cases of severe fractures. Neer's classification is used to differentiate between the number of displaced fragments of the fracture with displacement defined as greater than 45 degrees of angulation or > 1 cm of separation. Managing these fractures can be challenging due to the complexity of the anatomy, fracture pattern, and patient comorbidities. Open reduction and internal fixation (ORIF) using a locking plate, such as the Proximal Humeral Internal Locking System (PHILOS) plate, has become a widely accepted treatment method for displaced and unstable fractures. This technique aims to restore the normal anatomy of the shoulder joint and provide stability to promote early mobilization.

The classical deltopectoral approach, one of the most frequently used surgical approach for proximal humerus fracture fixation, provides direct access to the fracture site while protecting vital neurovascular structures. This study will cover the clinical

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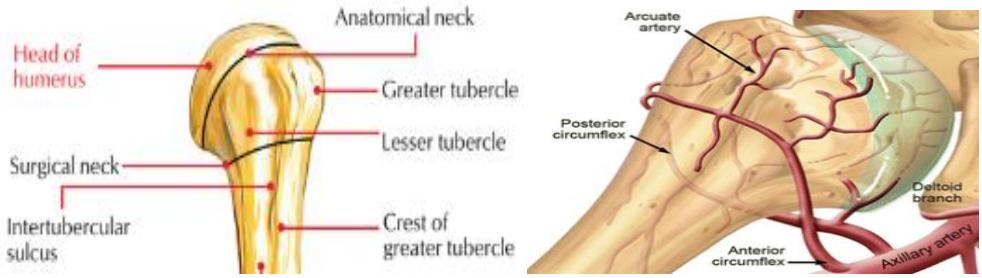
indications for using the PHILOS plate, the rationale for choosing the deltopectoral approach, and the steps involved in the surgical procedure.

ANATOMY AND BIOMECHANICS OF PROXIMAL HUMERUS

The proximal humerus consists of the humeral head, greater tuberosity, lesser tuberosity, and surgical neck. The blood supply to the humeral head is primarily from the anterior and posterior circumflex humeral arteries, with contributions from the axillary artery. The integrity of this blood supply is critical during surgical intervention, particularly in fractures involving the humeral head.

The rotator cuff muscles, including the supraspinatus, infraspinatus, subscapularis, and teres minor, attach around the tuberosities, influencing the biomechanics of the shoulder joint. The deltoid muscle, overlying the proximal humerus, plays a significant role in shoulder motion, which must be preserved during surgical approaches.



A B

Fig.1.A. Anatomy of proximal humerus, B. Blood supply of humeral head

Indications for PHILOS (Proximal Humeral Internal Locking System) Plate Fixation

The PHILOS plate is primarily indicated in cases where:

1. **Neer's two-, three-, or four-part fractures** are displaced.
2. **Comminuted fractures** with significant displacement of fragments.
3. **Fracture-dislocations** where the humeral head is dislocated and associated with a fracture.
4. **Fractures in osteoporotic bone**, where locking plate systems provide better anchorage and stability.
5. **Patients with high functional demands**, such as younger individuals or active elderly patients who require early mobilization.

The PHILOS Plate: Biomechanical Properties

The PHILOS plate is a locking plate specifically designed for the proximal humerus. Its multiple locking screw holes provide angular stability, especially in osteoporotic bone. The screws are inserted in a polyaxial manner, ensuring better purchase in multiple planes of the humeral head, thus reducing the risk of collapse and maintaining reduction in complex fractures. This multidirectional locking system minimizes the risk of secondary displacement, a common issue in elderly patients with poor bone quality.

The plate's design allows it to sit flush against the lateral cortex of the proximal humerus, reducing soft tissue irritation, and promoting early shoulder function. Additionally, its ability to accommodate multiple screw placements in the humeral head provides superior biomechanical strength, enhancing the stability of fracture fragments.

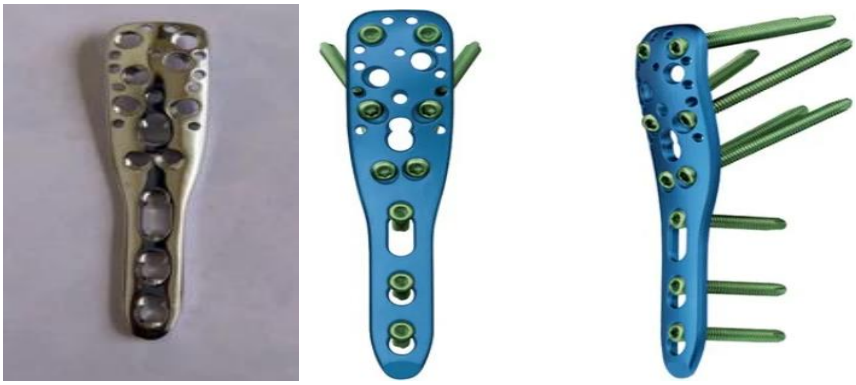


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Fig.2.PHILOS Plate; A. Stainless Steel plate and B. Titanium plate

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MATERIALS AND METHODS

A prospective study conducted on 20 patients who had sustain injury resulting in proximal humerus fracture treated with PHILOS plate. All the patients who presented to the emergency/ orthopaedic OPD between January 2023 to January 2024 in our institution were enrolled in the study.

Inclusion Criteria

- Patients of age 20 to 65 years of either sex.
- Patients who are willing for surgery.
- Neer's two- part, three- part or four- part fracture.
- Comminuted proximal humerus fractures with significant displacement.

Exclusion Criteria

- Patients < 20 years and > 65 years of age.
- Patients who are not willing for surgery.
- Patients who are not fit for the surgery.
- Patients with severely osteoporotic bone.
- Patients with pathological fractures.

Surgical Approach: The Deltopectoral Approach

The deltopectoral approach is one of the most commonly used surgical techniques for proximal humerus fractures. It offers good visualization of the fracture, allows direct manipulation of fragments, and protects vital structures such as the axillary nerve.

Key Steps of the Surgical Procedure:

1. Patient Positioning: The patient is placed in a beach-chair or supine position. The affected arm is prepped and draped, allowing free movement.
2. Incision: A skin incision is made along the deltopectoral groove, starting from the coracoid process and extending distally. This incision is favoured because it provides an easy and familiar route for exposure.
3. Deltopectoral Interval: The deltopectoral interval is identified between the deltoid and pectoralis major muscles. The cephalic vein is protected, usually by retracting it laterally along with deltoid muscle while the conjoint tendon is retracted medially.
4. Fracture Site Exposure: Once the interval is developed, the proximal humerus is exposed. Adequate care is taken to avoid damaging the axillary nerve, which runs inferior to the surgical site.
5. Fracture Reduction: Direct manipulation and reduction of fracture fragments are performed. In more complex cases, Kirschner wires (K-wires) may be used to temporarily stabilize the fragments before definitive fixation.
6. PHILOS Plate Placement: The PHILOS plate is positioned on the lateral aspect of the humerus. It was applied about 5-8 mm distal to the greater tuberosity and around 2-4 mm posterior to the bicepital groove. Locking screws are inserted into the humeral head through pre-drilled holes in the plate. These screws secure the humeral head fragments to the shaft, providing angular stability.
7. Wound Closure: After the plate is secured, the wound is closed in layers. Special care is taken to minimize tension on the skin and soft tissues around the plate.

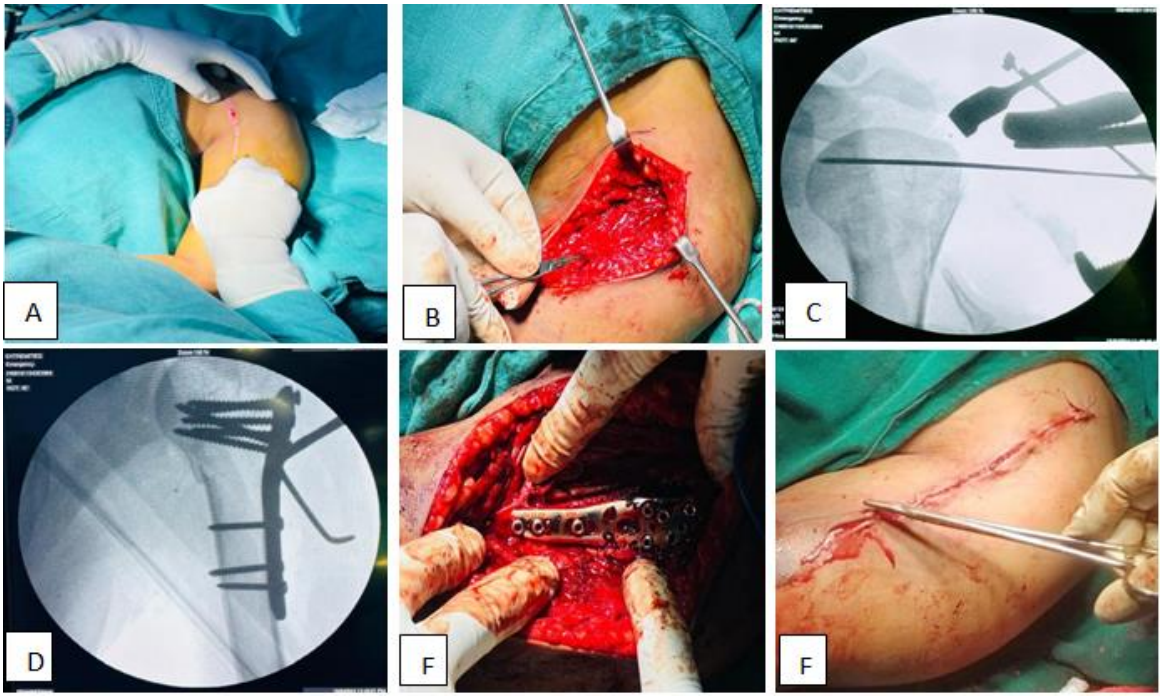

Fig.3. Intraoperative pictures using Deltopectoral approach A & B are skin incision and deep dissection. C & D. are the C-arm images taken intraoperatively. E & F. Final PHILOS plate fixation and closure.

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- There are two other approaches that can also be used for proximal humerus fracture fixation. These are:

a) Anterolateral or Mackenzie approach: The incision is placed between acromial part and clavicular part of the deltoid muscle. It is mainly useful for nailing and osteosynthesis of fracture of greater tuberosity. It is also recommended for minimally invasive plate osteosynthesis.

b) Transdeltoid lateral approach: The incision is placed between acromial and spinal part of the deltoid muscle. It is especially useful for osteosynthesis of fracture of greater tuberosity.

- Both of the above mentioned anterolateral and transdeltoid approaches to proximal humerus have the advantage of utilizing a relatively avascular plane, away from the anterior and posterior circumflex humeral arteries. But have the limitation in extending the incision beyond 5 cm distally from lateral border of acromion as there is a risk of damaging the anterior motor branch of axillary nerve as it crosses the humerus horizontally at about 6 cm distal to lateral border of acromion.

- **Advantages of using Deltopectoral approach**

It provides an excellent exposure of the proximal humerus, including the humeral head and medial calcar, without detaching the deltoid muscle, thereby preserving deltoid function and minimizing the risk of axillary nerve injury. This approach allows for more anatomic reduction and fixation, especially in complex fractures involving the articular surface or the medial cortex. Additionally, it facilitates easier extension proximally or distally if needed and avoids splitting the deltoid, which is particularly beneficial in elderly patients or those with poor soft tissue quality.

Post-operative Protocol

Early rehabilitation is crucial for achieving good functional outcomes. The shoulder was immobilized with an arm pouch. Gentle passive flexion and rotation exercises were initiated from the **second week** after the surgery to avoid shoulder stiffness**. Active range of motion** exercises and resistive exercises were started by **3-5 weeks**. In cases of fractures of the greater tuberosity (eg, in three- and four-part fractures), only limited assisted abduction up to 90◦ was allowed for the first 6 weeks after surgery.

Follow-up

Patients were followed up at 3 weeks, 6 weeksand 6 months. The range of motion was monitored along with physiotherapy to assess functional recovery. Check radiographs were taken at 3 weeks, 6 weeks and 6 months. Neer's Scoring System and DASH scoring system were used to assess the functional outcome.

Neer's Scoring System

It assesses pain, functionality (strength, daily activity), range of motion and anatomy in the X-ray image. It is used to evaluate the shoulder function after conservative or surgical management of proximal humerus fracture.

Functional	
Pain	**Scores**
No pain	35
Slight, occasional, no compromise in activity	30
Mild, no effect on ordinary activity	25
Moderate, tolerable, makes concessions	15
Marked, serious limitations	5
Totally disabled	0
Function	
Strength- normal	10
Good	8
Fair	6
Poor	4
Trace	2
Zero	0
Reaching- Top of Head	2
Mouth	2
Belt buckle	2
Opposite axilla	2
Brassiere hook	2
Stability- lifting	2
Throwing	2
Pounding	2
Pushing	2
Hold overhead	2

DOI: 10.69605/ijlbpr_14.5.2025.46

Range of Motion	
Flexion- 180^0	6
170^0	5
130^0	4
100^0	3
80^0	2
$<80^0$	1
Abduction- 180^0	6
170^0	5
140^0	4
100^0	3
80^0	2
$<80^0$	1
Extension 45^0	3
30^0	2
15^0	1
$<15^0$	0
External rotation 60^0	5
30^0	3
10^0	1
$<10^0$	0
Internal Rotation 90^0	5
70^0	4
50^0	3
30^0	2
$<30^0$	0
Anatomy (Rotation, Angulation)	
None	10
Mild	8
Moderate	4
Marked	0-2
Results	
90-100 points	Excellent
80-89 points	Satisfactory
70-79	Unsatisfactory
<70	Failure

Disability of the Arm, Shoulder and Hand (DASH Score)

The DASH questionnaire consists of 30 questions on daily disabilities with a minimum of 24 and maximum of 100 points. It helps to describe the disability experienced by people with upper-limb disorders and also helps monitor changes in symptoms and function over time.

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DISABILITIES OF THE ARM, SHOULDER AND HAND

Please rate your ability to do the following activities in the last week by circling the number below the appropriate response.

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1. Open a tight or new jar.	1	2	3	4	5
2. Write.	1	2	3	4	5
3. Turn a key.	1	2	3	4	5
4. Prepare a meal.	1	2	3	4	5
5. Push open a heavy door.	1	2	3	4	5
6. Place an object on a shelf above your head.	1	2	3	4	5
7. Do heavy household chores (e.g., wash walls, wash floors).	1	2	3	4	5
8. Garden or do yard work.	1	2	3	4	5
9. Make a bed.	1	2	3	4	5
10. Carry a shopping bag or briefcase.	1	2	3	4	5
11. Carry a heavy object (over 10 lbs).	1	2	3	4	5
12. Change a lightbulb overhead.	1	2	3	4	5
13. Wash or blow dry your hair.	1	2	3	4	5
14. Wash your back.	1	2	3	4	5
15. Put on a pullover sweater.	1	2	3	4	5
16. Use a knife to cut food.	1	2	3	4	5
17. Recreational activities which require little effort (e.g., cardplaying, knitting, etc.).	1	2	3	4	5
18. Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.).	1	2	3	4	5
19. Recreational activities in which you move your arm freely (e.g., playing frisbee, badminton, etc.).	1	2	3	4	5
20. Manage transportation needs (getting from one place to another).	1	2	3	4	5
21. Sexual activities.	1	2	3	4	5

DOI: 10.69605/ijlbpr_14.5.2025.46

DISABILITIES OF THE ARM, SHOULDER AND HAND

	NOT AT ALL	SLIGHTLY	MODERATELY	QUITE A BIT	EXTREMELY
22. During the past week, *to what extent* has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups? *(circle number)*	1	2	3	4	5

	NOT LIMITED AT ALL	SLIGHTLY LIMITED	MODERATELY LIMITED	VERY LIMITED	UNABLE
23. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem? *(circle number)*	1	2	3	4	5

Please rate the severity of the following symptoms in the last week. *(circle number)*

	NONE	MILD	MODERATE	SEVERE	EXTREME
24. Arm, shoulder or hand pain.	1	2	3	4	5
25. Arm, shoulder or hand pain when you performed any specific activity.	1	2	3	4	5
26. Tingling (pins and needles) in your arm, shoulder or hand.	1	2	3	4	5
27. Weakness in your arm, shoulder or hand.	1	2	3	4	5
28. Stiffness in your arm, shoulder or hand.	1	2	3	4	5

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	SO MUCH DIFFICULTY THAT I CAN'T SLEEP
29. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand? *(circle number)*	1	2	3	4	5

	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
30. I feel less capable, less confident or less useful because of my arm, shoulder or hand problem. *(circle number)*	1	2	3	4	5

DASH DISABILITY/SYMPTOM SCORE = ____ ([(sum of n responses / n) - 1] x 25, where n is the number of completed responses.)

A DASH score may <u>not</u> be calculated if there are greater than 3 missing items.

RESULTS

A total number of 22 patients who underwent open reduction and internal fixation with PHILOS plate for proximal humerus fracture from January 2023 to January 2024 in RKDF Medical College Hospital & Research Centre, Bhopal Madhya Pradesh. Out of 25 patients, 20 patients were available for the follow-up, as2 patients were lost to follow-up after 3 weeks. Among the 20 patients, 1 patient had a complication as superficial infection at the suture line which was managed with intravenous antibiotics and regular sterile dressing.

Table 1: Age frequency distribution of patients studied

Age	No. of patients
20-35 years	4 (20%)
36-50 years	5 (25%)
51-65years	11 (55%)
Total	20

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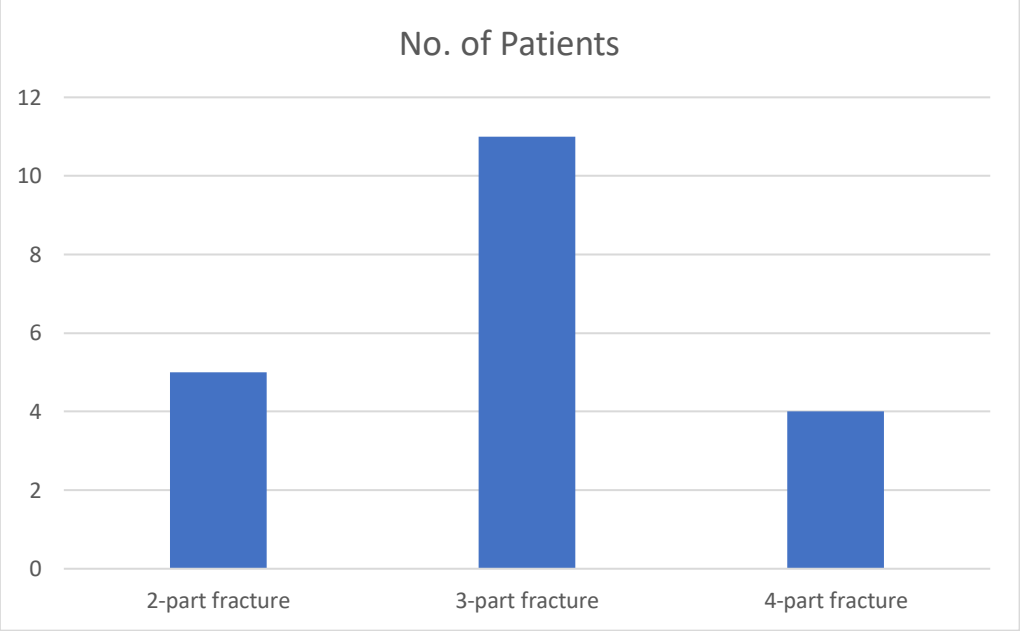
- Average age – 47.2±5.3 years

Table 2: Demographic and perioperative data

DEMOGRAPHIC AND PERIOPERATIVE DATA	NO. OF PATIENTS
SEX	
FEMALE	8
MALE	12
FRACTURE	
2-PART	5
3-PART	11
4-PART	4
HOSPITAL STAY (IN DAYS)	7 (5 -9)
OPERATION TIME (IN MINUTES)	70 (65-75)

- Eleven (55%) cases had road traffic accident while nine (45%) cases sustained fracture due to fall.
- All the fractures were classified as per the Neer's Classification system.
- Average duration of surgery is 70 minutes.
- Average duration of hospital stay is 7 days.
- Functional outcome was assessed using Neer's Scoring system and DASH scoring system.
- Radiological union was seen at 7 weeks ± 6days

Fracture Fragments	Neer's Score	DASH Score
2-part fracture	94.5 (92-97)	34 (31-37)
3-part fracture	86 (83-89)	53 (51-55)
4-part fracture	83.5 (81-86)	55 (51-59)



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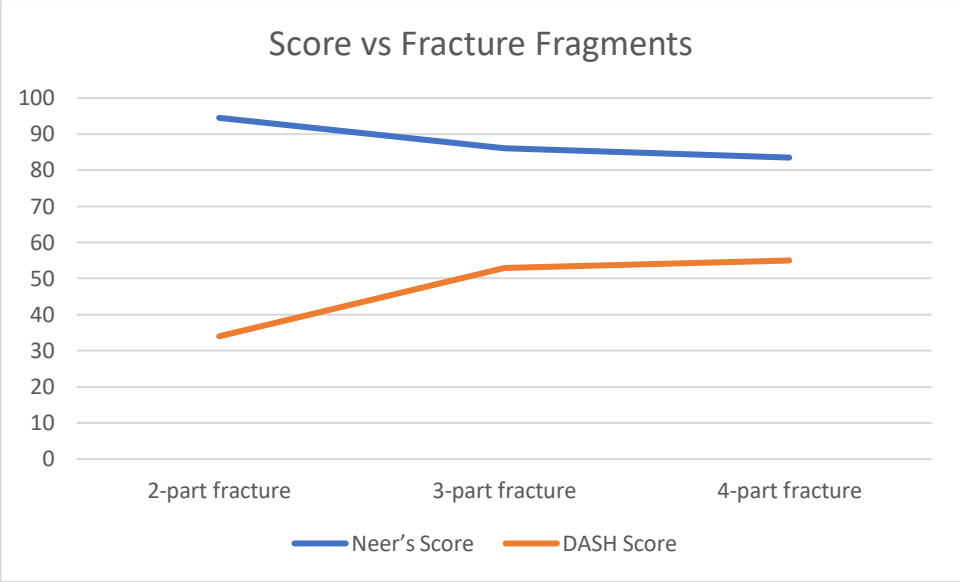

DISCUSSION

The present study aimed to evaluate the outcomes of proximal humerus fractures treated with the PHILOS plate using the deltopectoral approach. Proximal humerus fractures are prevalent in both the elderly due to osteoporosis and younger patients due to high-energy trauma. Surgical intervention, particularly with the PHILOS plate, is essential in cases of displaced and unstable fractures, as well as in patients who demand early mobilization. The study observed that using the deltopectoral approach allows for clear visualization and direct reduction of the fracture, while minimizing damage to surrounding structures like the axillary nerve.

In our cohort of 20 patients, the age range was broad, with most patients falling within the 51-65 years age group (55%), which is consistent with literature highlighting increased incidence in older adults due to osteoporosis and fragility. The most common mechanism of injury was road traffic accidents (55%), which is typical in younger individuals, while falls were responsible for a significant portion of fractures in the elderly (45%). Surgical outcomes, including operation time and hospital stay, were within the expected range for this type of intervention, with a mean surgical duration of 70 minutes and an average hospital stay of 7 days. These results support the PHILOS plate's efficiency in managing complex fractures.

Functional outcomes, assessed by Neer's scoring system and DASH scores, demonstrated favourable results for the majority of patients. The average Neer's score was 94.5 for two-part fractures, 86 for three-part fractures, and 83.5 for four-part fractures, indicating that the PHILOS plate provides good to excellent functional recovery in patients with less complicated fractures, while maintaining satisfactory outcomes even in more complex fracture patterns. This is supported by previous studies highlighting the effectiveness of the PHILOS plate in achieving stable fixation and good functional results, even in osteoporotic bone. However, it is noteworthy that patients with more complex fractures (three-part and four-part) had slightly lower scores, which could be attributed to the increased difficulty in restoring full anatomic alignment in these fractures.

Post-operative rehabilitation, initiated early in the second week, played a crucial role in preventing shoulder stiffness and ensuring functional recovery. The relatively short time to radiological union (mean of 7 weeks) further emphasizes the efficacy of the PHILOS plate in achieving fracture healing and early mobilization.

CONCLUSION

In conclusion, the treatment of proximal humerus fractures with the PHILOS plate via the deltopectoral approach is an effective surgical option, yielding excellent to satisfactory outcomes. This technique provides adequate fracture fixation, particularly in complex fractures and osteoporotic bone, while allowing for early mobilization and functional rehabilitation. The favourable results, including good functional scores and early radiological union, highlight the utility of this method in managing proximal humerus fractures. While the study primarily supports the use of PHILOS plating using Deltopectoral approach for displaced fractures, further research with larger cohorts and long-term follow-up would be valuable to confirm the durability of these outcomes and to explore potential complications and their management in this patient population.

REFERENCES

1. Borer J, Schwarz J, Potthast S, Jakob M, Lenzlinger P, Zingg U, Babians A. Mid-term results of minimally invasive deltoid-split versus standard open deltopectoral approach for PHILOS™ (proximal humeral internal locking system) osteosynthesis in proximal humeral fractures. Eur J Trauma Emerg Surg.

DOI: 10.69605/ijlbpr_14.5.2025.46

2020 Aug;46(4):825-834. doi: 10.1007/s00068-019-01076-7. Epub 2019 Jan 14. PMID: 30643920.

2. Aliuddin AM, Idrees Z, Rahim Najjad MK, Ali Shah SA. Functional Outcome Of Proximal Humeral Fractures Treated WithPhilos Plate In Adults. J Ayub Med Coll Abbottabad. 2016 Apr-Jun;28(2):337-340. PMID: 28718565.
3. Chiewchantanakit S, Tangsripong P. Locking plate fixation of proximal humeral fracture: minimally invasive vs. standard delto-pectoral approach. J Med Assoc Thai. 2015 Feb;98(2):196-200. PMID: 25842801.
4. Kim YG, Park KH, Kim JW, Oh JK, Yoon JP, Kim HJ, Oh CW. Is minimally invasive plate osteosynthesis superior to open plating for fixation of two-part fracture of the proximal humerus? J OrthopSurg (Hong Kong). 2019 May-Aug;27(2):2309499019836156. doi: 10.1177/2309499019836156. PMID: 30885047.
5. Rechsteiner J, Grieb M, Zdravkovic V, Spross C, Jost B. Complications and morbidity of the extended delto-pectoral approach in treating complex humeral shaft fractures with proximal metaphyseal extension using a long locking plate for internal fixation. BMC MusculoskeletDisord. 2024 Oct 10;25(1):801. doi: 10.1186/s12891-024-07915-y. PMID: 39390553; PMCID: PMC11465748.
6. Oldrini LM, Sangiorgio A, Feltri P, Marbach F, Filardo G, Candrian C. Proximal humerus fractures: deltopectoral open reduction and internal fixation vs deltosplit minimally invasive plate osteosynthesis: which surgical approach provides superior results? EFORT Open Rev. 2023 Aug 1;8(8):662-671. doi: 10.1530/EOR-22-0110. PMID: 37526265; PMCID: PMC10441256.
7. Rancan M, Dietrich M, Lamdark T, Can U, Platz A. Minimal invasive long PHILOS®-plate osteosynthesis in metadiaphyseal fractures of the proximal humerus. Injury. 2010 Dec;41(12):1277-83. doi: 10.1016/j.injury.2010.07.235. Epub 2010 Aug 9. PMID: 20696426.
8. Zhao JP, Hu WK, Zhang QL, Lin J, Zhou Q, He JJ, Zhuge TY. [Application of PHILOS plate through mini-open deltoid-splitting approach for the treatment of proximal humeral fractures]. Zhongguo Gu Shang. 2012 Feb;25(2):155-7. Chinese. PMID: 22577723.
9. Vijayvargiya M, Pathak A, Gaur S. Outcome Analysis of Locking Plate Fixation in Proximal Humerus Fracture. J Clin Diagn Res. 2016 Aug;10(8):RC01-5. doi: 10.7860/JCDR/2016/18122.8281. Epub 2016 Aug 1. PMID: 27656515; PMCID: PMC5028477.
10. Chiewchantanakit S, Tangsripong P. Locking plate fixation of proximal humeral fracture: minimally invasive vs. standard delto-pectoral approach. J Med Assoc Thai. 2015 Feb;98(2):196-200. PMID: 25842801.