

Functional Outcome of Proximal Humerus Fracture Operated with Deltopectoral Approach v/s Deltoid Splitting Approach

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PHILOS, Proximal Humerus fracture, Deltopectoral approach, Deltoid split approach, Humerus fracture

Abstract

Introduction: Upper end humerus fractures can be considered one of the common causes of morbidity. Displaced fractures do require operative stabilization. Open reduction and internal fixation are common methods used for head salvage purposes. Locking plate is the usual choice of implant for head-preserving surgeries. Proximal humerus can be operated by two basic approaches, conventional deltopectoral and lateral deltoid-split approach. **Materials and methods:** The study was conducted from May 2020 to May 2022 in tertiary care medical college hospital. The study was prospective involving 40 patients. Patients were randomly selected (20 in each group). Results were evaluated by the Constant score system. **Results:** The study showed female preponderance. Better clinical and functional outcome was observed in patients treated by deltoid split approach. **Conclusions:** Deltoid split approach is better than Deltopectoral approach for better clinical and functional outcomes in proximal humerus fractures. Deltoid split approach is better in terms of less operative time, less blood loss, less immobilization time, and early resumption of activities of daily living for a patient.

1. Introduction:

Upper-end humerus fractures can be considered one of the common causes of morbidity particularly in elderly patients. The main reason for such fracture is association with osteoporosis. Nearly 60% of such injuries are managed without operative intervention. Displaced fractures do require operative stabilization. Operative methods include percutaneous wiring, open reduction and fixation, hemi replacement arthroplasty, total shoulder arthroplasty, and reverse arthroplasty. Open reduction and internal fixation are common methods used for head salvage purposes. A locking

plate is the usual choice of implant for head-preserving surgeries^[1]. Proximal Humeral Locking Compression Plate (PHILOS) gives stable fixation with angular stability in osteoporotic bones. Various studies report good results from this implant^[2-4]. Proximal humerus can be operated by two basic approaches, conventional deltopectoral, and lateral deltoid-split approach. Neer's classification is commonly used for such fractures^[5].

Deltoid split approach involves the splitting of the anterior and middle parts of the deltoid muscle (through the median raphe), for exposure

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of the proximal humerus and upper shaft [6-11]. Displaced greater tuberosity fragments and posterior fracture-dislocations can be better managed by this approach. The incision can be extended distally for fractures involving the shaft. The Axillary nerve needs to be explored by this approach.

Deltopectoral approach [6] involves medial and lateral retraction of the Pectoralis major muscle and the Deltoid muscle respectively. This approach permits a direct approach to the fracture site and head of the humerus. It is mainly used for lesser tuberosity and calcar involving fractures and anterior fracture-dislocations [12]. In the case of greater tuberosity involvement with postero-superior displacement, this approach may not be suitable.

2. Aims and Objectives:

The aim is to study the clinical and functional outcomes of patients treated by different approaches and compare the results.

The objective is to compare clinical results by assessing the period required for immobilization and the range of post-operative shoulder movements. Another objective is to compare the incidence of complications like infection, neurovascular issues, implant-related complications, and non-union.

3. Material and methods:

The study was conducted from May 2020 to May 2022 in tertiary care medical college hospital. IRB approval and informed written consent were taken. The study was prospective involving 40 patients. The census sampling method was selected. Analysis was done by Openepi software to ensure adequate numbers are involved to prove statistically acceptable results. Patients were randomly selected (20 in each group). Randomized distribution to the surgeon was done according to

the allotted OPD (Out Patient Department) day on which the patient was first seen in the hospital. Individual surgeons selected the approach on an odd and even basis as per the patient received in the sequence. All senior surgeons in the department were involved.

All adult (age>20 years) patients with acute (injury in last 10 days) closed proximal humerus fractures requiring surgery were included in the study. All fractures were classified as per Neer's classification. A minimum follow-up of 6 months was another inclusion criterion. Patients were divided in two groups; Group I involves patients selected for the Deltopectoral approach and Group II involves patients selected for the Deltoid split approach. Patients who were medically unfit for surgery, had pathological fractures, and refused to participate in the study were excluded.

Group I involved 8 males and 12 females with an average follow-up of 11.3 months. Group II involved 7 males and 13 females with an average follow-up of 11.8 months. All patients were operated on as per standard protocol. Deltopectoral approach patients were operated on in a supine or beach chair position as per surgeon's choice (mostly supine). Deltoid split approach patients were operated on in a beach chair position. No mini-invasive approach was done in Group II patients. We used PHILOS or periarticular locking compression plate (LCP) in all cases. Antibiotics were given for 3 days in both groups and the average hospital stay was 7 days in Group I and 5 days in Group II patients. Sutures were removed 10-12 days after surgery. All patients were followed up at an interval of 3 weeks, 6 weeks and 12 weeks post-operatively. Later follow-ups were at 3 monthly intervals. Functional evaluation was done with a Constant scoring system (comparing both sides) [Figure 1]. Radiological evaluation was done too at each follow-up. Final evaluation was done with a minimum follow-up at 6 months or later.

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Constant Shoulder Score

Clinician's name (or ref)

Patient's name (or ref)

Answer all questions, selecting just one unless otherwise stated

During the past 4 weeks.....

<p>1. Pain</p> <p><input type="radio"/> Severe</p> <hr/> <p><input type="radio"/> Moderate</p> <hr/> <p><input type="radio"/> Mild</p> <hr/> <p><input type="radio"/> None</p>	<p>2. Activity Level (check all that apply)</p> <p><input type="checkbox"/> yes <input type="checkbox"/> no Unaffected Sleep</p> <hr/> <p><input type="checkbox"/> yes <input type="checkbox"/> no Full Recreation/Sport</p> <hr/> <p><input type="checkbox"/> yes <input type="checkbox"/> no Full Work</p>										
<p>3. Arm Positioning</p> <p><input type="radio"/> Up to Waist</p> <hr/> <p><input type="radio"/> Up to Xiphoid</p> <hr/> <p><input type="radio"/> Up to Neck</p> <hr/> <p><input type="radio"/> Up to Top of Head</p> <hr/> <p><input type="radio"/> Above Head</p>	<p>4. Strength of Abduction [Pounds]</p> <table border="0"> <tr> <td><input type="radio"/> 0</td> <td><input type="radio"/> 13-15</td> </tr> <tr> <td><input type="radio"/> 1-3</td> <td><input type="radio"/> 15-18</td> </tr> <tr> <td><input type="radio"/> 4-6</td> <td><input type="radio"/> 19-21</td> </tr> <tr> <td><input type="radio"/> 7-9</td> <td><input type="radio"/> 22-24</td> </tr> <tr> <td><input type="radio"/> 10-12</td> <td><input type="radio"/> >24</td> </tr> </table>	<input type="radio"/> 0	<input type="radio"/> 13-15	<input type="radio"/> 1-3	<input type="radio"/> 15-18	<input type="radio"/> 4-6	<input type="radio"/> 19-21	<input type="radio"/> 7-9	<input type="radio"/> 22-24	<input type="radio"/> 10-12	<input type="radio"/> >24
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<p>RANGE OF MOTION</p>											
<p>5. Forward Flexion</p> <p><input type="radio"/> 31-60 degrees</p> <hr/> <p><input type="radio"/> 61-90 degrees</p> <hr/> <p><input type="radio"/> 91-120 degrees</p> <hr/> <p><input type="radio"/> 121-150 degrees</p> <hr/> <p><input type="radio"/> 151-180 degrees</p>	<p>6. Lateral Elevation</p> <p><input type="radio"/> 31-60 degrees</p> <hr/> <p><input type="radio"/> 61-90 degrees</p> <hr/> <p><input type="radio"/> 91-120 degrees</p> <hr/> <p><input type="radio"/> 121-150 degrees</p> <hr/> <p><input type="radio"/> 151-180 degrees</p>										
<p>7. External Rotation</p> <p><input type="radio"/> Hand behind Head, Elbow forward</p> <hr/> <p><input type="radio"/> Hand behind Head, Elbow back</p> <hr/> <p><input type="radio"/> Hand to top of Head, Elbow forward</p> <hr/> <p><input type="radio"/> Hand to top of Head, Elbow back -</p> <hr/> <p><input type="radio"/> Full Elevation</p>	<p>8. Internal Rotation</p> <p><input type="radio"/> Lateral Thigh</p> <hr/> <p><input type="radio"/> Buttock</p> <hr/> <p><input type="radio"/> Lumbosacral Junction</p> <hr/> <p><input type="radio"/> Waist (L3)</p> <hr/> <p><input type="radio"/> T12 Vertebra</p> <hr/> <p><input type="radio"/> Interscapular (T7)</p>										

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The Constant Shoulder Score

is

Grading the Constant Shoulder Score
 (Difference between normal and Abnormal Side)

>30 Poor

21-30 Fair

11-20 Good

<11 Excellent

Figure 1- Constant Shoulder Score chart

4. Results and Analysis:

Our study showed female preponderance. Demographic criteria were nearly matching in both groups. The mean age was 50.5 years in Group I and 53.6 in Group II. Female patients were household workers (70%) and office workers

(30%) by profession. Male patients were office workers (60%) and manual laborers (40%). The immobilization period was decided on a case basis at the discretion of the operating surgeon. Average time for shoulder immobilization (pouch arm sling) in Group I was 6.2 weeks and 3.4 weeks in Group II.

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The average surgical time in Group I and Group II was 95 minutes and 75 minutes respectively. Average blood loss in Groups I and II was 200ml and 75ml respectively. Blood loss was assessed by measuring the weight of soaked mops, and dressing material (gauze pieces) pre and post-operatively. Blood collected in the drain was measured too. Though there were three more cases of 4-part fractures in group I, an average time of surgery, and blood loss were not significantly different as

compared to other fracture patterns in the group. Average time for achieving functional movement in Group I was 14 weeks and 10 weeks in Group II. The difference in a constant score (comparing both sides considering another side as normal) was calculated. Results were interpreted from excellent to poor as per the difference (11 to 30). Results were evaluated as per the difference as below; [Table I]

Difference in Constant score	Interpretation of result
<11	Excellent
11-20	Good
21-30	Fair
>30	Poor

Table I- Interpretation of clinical outcome by Constant Scoring system

Our study showed 15% excellent, 25% good, 40% fair, and 20% poor results in group I. Study showed 40% excellent, 30% good, 25% fair, and 5% poor results in group II [Table II].

Result	Group I (n=20)	Group II (n=20)
Excellent	3 (15%)	8 (40%)
Good	5 (25%)	6 (30%)
Fair	8 (40%)	5 (25%)
Poor	4 (20%)	1 (5%)

Table II- Results as per Constant Scoring system

We assessed results with fracture patterns in both groups.

In group I; we found excellent results in 3 patients (2 were of 2-part, and 1 was 3-part fracture), good results in 5 patients (2 were of 2-part, 1 was 3-part, and 2 were 4-part fracture), fair results in 8 patients (3 were 3-part, and 5 were 3-part fracture), and poor results in 4 patients (1 was 3-part, and 3-were 4-part fracture).

In group II; we found excellent results in 8 patients (3 were of 2-part, 3 were of 3-part, and 2 were of 4-part fracture), good results were found in 6 patients (3 were of 2-part, 1 was 3-part, and 2-were 4-part fracture), and poor result in 1 patient (4-part fracture).

Our results at the final follow-up because of type of the fractures are as below in both groups as per [Table III, IV].

Result	2 part fracture	3 part fracture	4 part fracture
Excellent (3)	2 (66.6%)	1 (33.3%)	-

Good (5)	2 (40%)	1 (20%)	2 (40%)
Fair (8)	-	3 (37.5%)	5 (62.5%)
Poor (4)	-	1 (25%)	3 (75%)

Table III- Results in Group I with respect to type of fracture

Result	2 part fracture	3 part fracture	4 part fracture
Excellent (8)	3 (37.5%)	3 (37.5%)	2 (25%)
Good (6)	3 (50%)	1 (16.66%)	2 (33.33%)
Fair (5)	-	3 (60%)	2 (40%)
Poor (1)	-	-	1 (100%)

Table IV- Results in Group II with respect to type of fracture

The statistical analysis was done by chi square test and t-test. The mean of difference in the Constant score in group I was 21.7, and 14.9 in group II. The Deltoid split approach was found better than the Deltopectoral approach, and the result was statistically significant ($p=0.0001$).

Superficial infection was found in one patient in Group I, which was treated with dressings and antibiotics for a period of 2 weeks. No implant-related or neurovascular complication was found in the study.

5. Discussion:

Operative methods for proximal humerus include percutaneous wiring, open reduction and fixation,

and hemi replacement arthroplasty. Open reduction and internal fixation are common methods used for head salvage purposes. Various studies show different results for such a common problem. We have tried to randomize patient selection, used nearly the same type of implant, and analyzed the results of the outcome by two different approaches.

The Deltopectoral approach involves retraction of the deltoid and the pectoralis major muscles. An incision is downwards from the coracoid process [Figure 2]. Sometimes we need to cut a few fibers of the deltoid muscle for better exposure (so, need to immobilize for a bit longer period in a pouch arm sling). We can achieve direct reduction under vision and approach shoulder joint if required.



Figure 2- Deltopectoral approach

The Deltoid split approach involves incision vertically downwards from the angle of the acromion process [Figure 3]. Deltoid fibers are split in the median raphe (which is avascular, so bleeding is less) at the junction of anterior and middle fibers. Axillary nerve with vessels can be isolated and the plate is passed underneath the

same [Figure 4]. Correction of varus collapse can be done by joystick [Figure 5] using Kirschner wire (k-wire). A bigger fragment of greater tuberosity needs a periarticular plate [Figure 6]. Usually, calcar screw is at the level of the Axillary nerve and needs extra precaution when inserting the calcar screw.

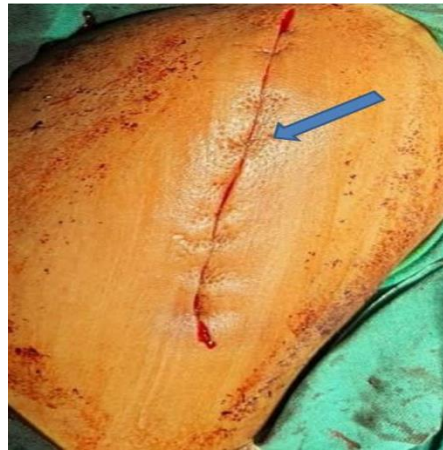


Figure 3- Deltoid split approach



Figure 4- Axillary nerve and vessels in deltoid split approach



Figure 5- Showing k-wire for correction of varus of humerus head

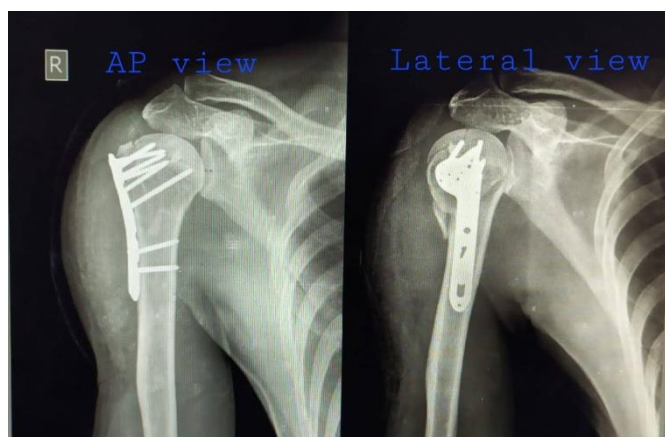


Figure 6- Showing Periarticular plate fixation by Deltoid split approach

Wu CH, Ma CH, Yeh JJ, Yen CY, Yu SW, and Tu YK ^[13] studied 63 patients and showed no significant difference in clinical, radiological, and electrophysiological outcomes in patients treated by the Deltopectoral and Deltoid split approach. Better functional results were reported by Hepp P, Theopold J, Voigt C, Engel T, Josten C, and Lill H in their study in patients treated by the Deltopectoral approach ^[14]. They noted that the choice of approach affects the outcome in the management of upper humeral fractures ^[15].

Isiklar Z, Kormaz F, Gogus A, and Kara A showed better functional and radiological outcomes in patients operated by the deltoid split approach ^[16]. He recommended a split approach for the treatment of AO (Arbeitsgemeinschaft für Osteosynthesefragen) type B and C upper-end humerus fractures. Robinson CM, Khan L, Akhtar A, Whittaker R; Robinson CM, Akhtar A, Mitchell M, Beavis C; and Gardner MJ, Boraiah S, Helfet

DL, Lorich DG in their study showed better results with a deltoid split approach for the treatment of complex upper humerus fractures and posterior fracture dislocation of shoulder joint ^[10-12]. ^[17].

Rouleau DM, Balg F, Benoit B, Leduc S, Malo M, Vézina F, and Laflamme GY, in their study of 85 patients showed better results with the deltopectoral approach ^[18]. The mean follow-up was 26 months in their study. Xie L, Zhang Y, Chen C, Zheng W, Chen H, and Cai L, in their systemic review and meta-analysis of three RCTs and three prospective comparative studies, showed less operative time, and less humeral head necrosis rate with deltoid split approach ^[19]. They observed no difference in intra-operative parameters, functional outcome, and complications in both methods.

Our experience showed that the deltoid split approach is better because of less blood loss, less operative time, less immobilization period, and better functional outcome [Figure 7, 8].



Figure 7- Showing excellent result in Group II

(a -full abduction, b-full internal rotation, c-well healed scar)



Figure 8- Showing fair result in Group I

(a- restricted abduction, b-external rotation, c-restricted internal rotation, d-forward flexion)

Prospective study, randomized selection of patients, long-term follow-up (for early post operative evaluation) and reasonable number can be considered strength of our study. Single- centric study can be considered our weakness. Though no case of avascular necrosis was detected in either group on the last follow-up in our study, long-term follow-up for 5 years or more is required for better assessment and to reach to a final conclusion. Multicentre study with more number of patients can give more information for such problem.

6. Conclusion:

We conclude that the Deltoid split approach is better than the Deltopectoral approach for better clinical and functional outcomes in proximal humerus fractures.

ROLE OF AUTHORS

The Deltopectoral approach involves more soft tissue dissection and more blood loss. It requires more immobilization period to allow the healing of soft tissues. The Deltoid split approach is better in terms of less operative time, less blood loss, less immobilization time, and early resumption of activities of daily living for a patient. All types of fractures can be operated by the deltoid split approach. This approach allows indirect manipulation of displaced fragments, so soft tissue damage is less. Soft tissue healing is considerably faster by the deltoid split approach. However surgeon`s experience and choice do play role in the final results.

SR. NO.	NAME OF AUTHOR	CONTRIBUTION
1	DR. MANISH R. SHAH (First author and Corresponding author))	MANUSCRIPT PREPARATION, DATA ACQUISITION, DATA ANALYSIS, STATISTICAL ANALYSIS, CONCEPT, DESIGN, MANUSCRIPT REVIEW
2	DR. MANISHA M. SHAH	MANUSCRIPT PREPARATION, DATA ACQUISITION, LITERATUR SEARCH, CLINICAL STUDIES
3	ISHA M. SHAH	DATA ACQUISITION, DATA ANALYSIS, STATISTICAL ANALYSIS

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