

Transdeltoid Approach in Proximal Humerus Fractures: Outcome in 35 Cases and Review of Literature.

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ABSTRACT

Background: Displaced proximal humerus fractures generally result in long-term functional disability. Recently, the advances in treatment for proximal humerus fracture have involved minimally invasive plating which offer minimal soft tissue damage and rapid and improved healing of the fracture. In recent literature, there has been a shift towards the deltoid splitting approach for the fixation of proximal humeral fractures due to the increased visualization of the posterior fragments as well as the less amount of soft tissue stripping. We used the deltoid splitting approach to evaluate the feasibility and outcomes as regards to axillary nerve injury, complications and functional deficits. **Methods:** Out of a total of 35 patients included in this study, 28 were male and 7 were female; with a mean age of 44 (range 26 - 62 yrs.). **Results:** In patients, the fracture of the proximal humerus was classified as type III; while 30 % (n=6) had type II fracture, according to Neer's classification. Depending upon the fracture anatomy and the need for exposure, the skin incision was a continuous long incision in 7 cases, with complete exploration of axillary nerve in the substance of deltoid; while in 13 cases, fixation was done using two separate skin windows. The mean follow up period was 26 weeks (range 18-32 weeks). The average time to radiological union was 14 weeks (range 12-20 weeks). At final follow up, there were no cases of nonunion. There were 2 cases (10%) with varus malunion of the head fragment, and 1 case (5%) of acromial impingement. Axillary nerve palsy or deltoid dysfunction was not seen in any of the patients. The mean Constant- Murley score of shoulder function, at final follow up, was 78 (range 64-84). Graded according to the Constant shoulder score grading criteria, by calculating the difference of score between the involved shoulder and the uninvolved shoulder, 60% patients (n=12) had excellent, 35% (n=7) had good and 5% (n=1) had fair functional results. **Conclusion:** Thus deltoid splitting approach allows a feasible way to treat proximal humerus fractures with minimal axillary nerve injury, complications and functional deficits.

Keywords: Transdeltoid approach, Proximal humerus fractures.

INTRODUCTION

Fracture of the proximal humerus is the second most common fracture of the upper extremity following distal forearm fractures.^[1] In people older than age 65 years old, proximal humerus fracture is the third most common fracture, after hip fracture and Colles' fracture.^[1]

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Proximal humerus fracture present several unique problems, which must be considered in order to achieve the best treatment results. First, the proximal humerus has a complex anatomy. The rotator cuff is a critical functional structure that must be reconstructed following proximal humerus fracture.^[2] Second, the proximal humerus is vascularised by the anterior circumflex artery and arcuate artery, which are both prone to injuries, thereby increasing the risk of avascular necrosis. Third, in proximal humerus fractures, there is minimal bone stock to purchase. Regional differences in the proximal humerus must be taken into account when attempting to reduce tuberosity fragments. For instance, the cortex of the proximal humerus near the greater tuberosity becomes

progressively thicker as it proceeds distally. In fractures of the thinnest cortical bone, the fracture lines can be difficult to oppose. Fourth, proximal humerus fracture is associated with significant morbidity, leading to functional impairment lasting at least 3 months.^[3] Displaced proximal humerus fractures generally result in long-term functional disability.^[4] This type of injury is usually sustained after a moderate- energy fall in individuals with low bone density.^[3] To-date, there is no consensus on the optimal treatment of complex fractures of the proximal humerus. Management of displaced proximal humerus fractures has evolved toward humeral head preservation. Treatment should be guided by careful assessment of vascular status, bone quality, fracture pattern, and degree of comminution, as well as patient factors, such as age and activity level. Patients who are medically unstable or inactive are poor candidates for surgery and instead may be treated with sling immobilization until the fracture heals. The ultimate goal is maximum shoulder function and minimal shoulder pain.^[4] Recently, the advances in treatment for proximal humerus fracture have involved minimally invasive plating which offer minimal soft tissue damage and rapid and improved healing of the fracture.^[5,6] The surgical approaches commonly used for MIPPO in proximal humerus fractures are the transdeltoid lateral approach, anterolateral approach, and deltopectoral approach.^[7]

Treatment type is primarily determined by examining the radiographs of the proximal humerus and then classifying the injury according to the Neer's classification. An anteroposterior (AP) view of the shoulder in the plane of the scapula, a lateral view of the scapula (Yview), and a supine axillary view are necessary to initially assess a proximal humerus fracture. If the degree of displacement of the humeral head or tuberosity fragments is uncertain, an axial CT study with 2-mm sections is obtained.^[8]

Displaced complex proximal humeral fractures are commonly treated by open reduction and internal fixation. Most of the surgeons are familiar with the traditional deltopectoral approach^[9-11] which utilizes the inter-nervous plane between the pectoralis major and the deltoid; and hence this is the most commonly used approach for proximal humerus fracture fixation. However, this approach causes extensive soft tissue stripping and in fractures in which the fragments especially the greater tuberosity fragment is displaced, usually posterolaterally, reduction through this approach is difficult. In addition, the application of plates on the lateral surface of proximal humerus requires a lot of soft tissue dissection and retraction. Prolonged retraction during surgery may cause ischemia to the deltoid muscle as well as extensive damage to the soft tissue may increase the risk of

avascular necrosis of the already injured bone fragments. Hence, an access from the lateral aspect would be far more convenient in certain circumstances. The transdeltoid or the deltoid splitting approach obviates some of the disadvantages of the deltopectoral approach and provides convenient access to the lateral surface of the proximal humerus.^[12-14] But there have been concerns regarding the use of deltoid splitting approach due to the potential of injury to the axillary nerve that traverses around the surgical neck of humerus, through the substance of the deltoid; and also because of the fact that splitting the deltoid could result in weakening of this muscle and resultant difficulty in shoulder movements, particularly abduction.

In recent literature there has been a shift towards the deltoid splitting approach for the fixation of proximal humeral fractures due to the increased visualization of the posterior fragments as well as the less amount of soft tissue stripping.^[15] We used the deltoid splitting approach to evaluate the feasibility and outcomes as regards to axillary nerve injury, complications and functional deficits.

MATERIALS AND METHODS

This prospective study on 35 patients of proximal humerus fractures, from January 2012 to February 2014. Two, three and four part Fractures of the proximal humerus according to the Neer's four-segment classification system for proximal humerus fractures, were included in this study. Fractures associated with dislocation of the humeral head, and with other fractures in the ipsilateral upper limb were excluded from this study.

The fractures were evaluated by radiographs in minimal two planes antero-posterior and axillary view of the shoulder; and in some cases, 3D CT scan of the shoulder was also done. Pre-anaesthetic assessment was done.

All patients were operated in semi sitting position, under regional or general anaesthesia. Preoperatively, the patients were administered broad spectrum antibiotics before induction and which were continued for 48hrs post-operatively. Before taking incisions anatomical landmarks for the transdeltoid lateral approach were marked; Lateral border of the acromion, and lateral side of the proximal humeral shaft. A vertical incision in line with the humeral shaft was put from the lateral border of the acromion to the distal limit of the approach which is marked 5cm below the acromion, the middle third (acromial) part of the deltoid muscle is split in line with its fibres.



Figure 1: X-rays and CT scan of a patient with comminuted proximal humerus fracture.



(d)



(e)

Figure 2: The transdeltoid approach for proximal humerus fractures. Surface marking of bony landmarks (a) and axillary nerve (b). Exposure of proximal humerus (c). Extension of approach distally if need arises (d). Philos plate fixation (e).



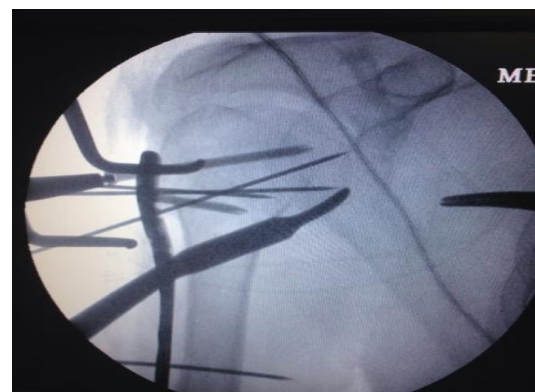
(a)



(b)



(c)



(a)



(b)



(c)

Figure 3: Reduction of fractures aided with C-arm (a) and Philos plate fixation (b),(c).

For maximum exposure the deltoid was split up to the margin of the acromion, but distally not more than 5 cm from its origin to avoid damaging the axillary nerve and paralyzing the anterior part of the deltoid. The subacromial bursa was identified and vertically divided. A finger was inserted along the under surface of the deltoid through the split and the axillary nerve location was identified by palpating along the under surface of the deltoid. It is felt as a circumferential band on the under surface of the deltoid. The axillary nerve is located generally at a distance of 5-7 cm from the tip.^[16-19] The length of the incision depended upon the type of fracture and the length of plate needed to fix it.

The fracture fragments were maneuvered and reduced under image intensifier guidance; and provisionally fixed with k-wires in some cases, and ethibond sutures around the tendon insertion on tuberosities as necessary. After feeling for the axillary nerve, or under direct vision in cases where the incision was single, a Philos plate was then slid beneath this nerve on the lateral surface of humerus. Internal fixation was done after checking the reduction of fracture fragments under image intensifier. Wound was repaired in layers and sterile dressing done.

Post operatively, patient was advised an arm sling pouch and pendulum shoulder exercises were started the next day. Patients were followed up in Orthopaedic OPD at 7-post op day, 15th post op day, 6 weeks, 3 months and 6 months post-operatively.

They were evaluated for any axillary nerve dysfunction and their shoulder functions were evaluated using the Constant shoulder scoring system.^[20] The functional results were graded as excellent, good, and fair or poor by assessing the difference of the Constant shoulder score between the affected and the normal shoulder.^[22]

RESULTS

Out of a total of 35 patients included in this study, 28 were male and 7 were female; with a mean age of 44 (range 26 – 62 yrs.). In patients, the fracture of the proximal humerus was classified as type III; while 30% (n=6) had type II fracture, according to Neer's classification. The dominant limb was involved in 65% of the cases. The mean duration from admission to surgery was 2 days. Depending upon the fracture anatomy and the need for exposure, the skin incision was a continuous long incision in 7 cases, with complete exploration of axillary nerve in the substance of deltoid; while in 13 cases, fixation was done using two separate skin windows. Axillary nerve was digitally palpated on the under surface of deltoid in the latter group and was not completely explored under vision.

The mean follow up period was 26 weeks (range 18-32 weeks). The average time to radiological union was 14 weeks (range 12-20 weeks).

In the early postoperative period, in two cases who were diabetic, with poor control of sugar, there was serosanguinous wound discharge for which cultures were obtained and appropriate antibiotics started; and it resolved in around 3 weeks.

At final follow-up, there were no cases of nonunion. There were 2 cases (10%) with varus malunion of the head fragment, and 1 case (5%) of acromial impingement Axillary nerve palsy or deltoid dysfunction was not seen in any of the patients. The mean Constant- Murley score of shoulder function, at final follow up, was 78 (range 64-84). Graded according to the Constant shoulder score grading criteria, by calculating the difference of score between the involved shoulder and the uninvolved shoulder, 60% patients (n=12) had excellent, 35% (n=7) had good and 5% (n=1) had fair functional results.

DISCUSSION

There is no consensus as to the optimal treatment of complex fractures of the proximal humerus. The best results are obtained if the fractures are well reduced and reduction is maintained until healing has occurred.

The traditional delto-pectoral approach serves as the "work-horse" for most of the proximal humerus fractures due to the familiarity with this approach but there are certain limitations of this approach. In cases of fractures involving the greater tuberosity, the access to the posteriorly displaced tuberosity fragment is very limited through the deltopectoral approach.^[13] In addition, the soft tissues need to be retracted quite a lot; and the already comminuted fracture fragments need to be stripped of their attachments, in order to enable fixation of the plate on to the lateral surface in comminuted proximal humerus fractures. In contrast, an approach from the lateral side provides a convenient access to the displaced fragments and also for plate fixation on

the lateral surface.^[23] Many recent studies have shown excellent functional results with the lateral approach, whether extended or minimal, with no incidence of any axillary nerve palsy or any other significant complications.^[14,24] In fact, most studies involving comparison of the functional results between the deltopectoral and deltoid splitting approaches have come out with better functional scores using the deltoid splitting approach. Gardner et al used this approach in 16 patients of proximal humerus fractures and found it to be safe and very useful in the treatment of such fractures.^[24] Isiklar et al in their comparative study on 42 patients of proximal humerus fractures demonstrated significantly better constant scores at an earlier time, in patients operated with the deltoid splitting approach than those operated using the deltopectoral access.^[12] They were of the view that the transdeltoid approach enabled better control and hence better reduction of the head and tuberosity fragments in comminuted proximal humerus fractures. No case of axillary nerve palsy was encountered with lateral approach in their series. Robinson et al. were of the view that deltopectoral approach provided a limited access to the posterior aspect of the shoulder; and hence recommended the deltoid splitting approach for the internal fixation of comminuted proximal humerus fractures.^[13] A study by Liu et al on 91 patients of proximal humerus fractures demonstrated greater range of motion in 2 part and 3 part fractures with the minimally invasive lateral approach, while the conventional deltopectoral approach gave better results in 4 part fractures; and they declared minimally invasive lateral approach as the “optimal alternative” in Neer’s type 2 and 3 fractures.^[25] In this study, the deltoid splitting approach was used as an extended one in some cases, while in others, it was used in a minimally invasive manner using two windows, depending upon the need of exposure to reduce and fix the fragments. In the extended deltoid split, the axillary nerve was secured by exploring the nerve directly under vision. In case of minimally invasive or a “two window” approach, the area traversed by the axillary nerve was secured by leaving a bridge of skin in between. Most of the studies suggest that the axillary nerve lies at a distance of 5-7cm from the tip of acromion.^[16-19] Abhinav et al, in cadaveric dissection of thirty shoulders, calculated the mean acromion-axillary distance as 6.0 cm with a range of 4.5-6.5 cm. Therefore, they recommended that the maximum deltoid split in the proximal window should not be more than 4.2cm; and that splitting the deltoid should be avoided in abduction since the nerve comes closer to acromion by 1.5cm in this position.^[16] The present study also shows excellent or good functional results in 95% of the patients, as determined by the Constant shoulder score grading; and no postoperative

axillary nerve palsy or deltoid muscle dysfunction was encountered in any of the cases. Since similar results have been reported in the literature without any significant complications, it can reasonably be concluded that the lateral transdeltoid approach to proximal humerus is a very useful approach without any clinically significant adverse effects. The findings of this study can be further validated by a comparative study with other surgical approaches, using a larger sample.

CONCLUSION

Deltoid splitting approach allows a feasible way to treat proximal humerus fractures with minimal axillary nerve injury, complications and functional deficits.

The approach can be single incision or two window technique can be utilized providing ideal visualization of the proximal humerus fracture fragments. We recommended trans-deltoid approach based on our outcome to be more practical than other approaches for proximal humerus fractures.

Ethical Clearance:

All patients gave informed consent before inclusion into the study. The study was permitted by the university ethical committee and was carried with the ethical standards of the revised Helsinki declaration.

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