



Use of Deltoid Splitting Approach for Neer's Type II and III Proximal Humerus Fractures treated with Angular Stable Locking Plate

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ABSTRACT

We studied outcomes in 35 patients having Neer's type II and III proximal humerus fractures who underwent surgery in our center. All fractures were fixed with angular stable locking plate through Deltoid splitting approach. There was no incidence of nonunion and no axillary nerve injury. Varus malunion occurred in 6% of cases. Deltoid function remained satisfactory in all patients. Overall results were excellent in 60%, good in 35%, and fair in 5%. Based on this study, we feel that the Deltoid splitting approach is associated with much better outcomes for treating Neer's type II and III proximal humerus fractures because it is less invasive, requires minimal soft tissue dissection, and lessens the chances of axillary nerve injury and Deltoid dysfunction.

Keywords: Axillary nerve injury, Proximal humerus fracture, Trans-Deltoid approach.

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INTRODUCTION

Proximal humerus fractures are the third commonest nonvertebral fractures.¹ Geriatric and osteoporotic population is particularly more vulnerable to these fractures. Conservative treatment of these fractures gives poor results. Surgery is always required for displaced fractures. Goal of surgery is anatomical reduction with stability and avoidance of usual complications like avascular necrosis (AVN) of humeral head, nonunion, impairment of rotator cuff, and malunion. Angular stable proximal humerus locking plates are ideal for fixing these fractures because these plates are precontoured, low profile, and

permit fixation by locking screws in various directions. Traditional delto-pectoral approach needs extensive soft tissue dissection and stripping, which interferes with fracture biology and may affect humeral head vascularity. Deltoid splitting approach is less invasive. It allows direct access to the area between the two tuberosities and permits easier manipulation and better fixation with minimal soft tissue dissection.²⁻⁴

MATERIALS AND METHODS

About 35 patients of proximal humerus fractures Neer's type II and III, who presented to our institute from January 2012 to February 2014, were enrolled for the study. Fractures associated with dislocation of the humeral head, and with other fractures in the ipsilateral upper limb were excluded from this study. Polytrauma patients, nonconsenting patients, and patients with serious comorbidities were also excluded. True antero-posterior and axillary views of the shoulder X-rays were obtained in all cases. The three-dimensional computed tomography scan of the shoulder was also done, if required for preoperative planning (Figs 1A and B).

All patients were operated in semireclining position, under regional or general anesthesia. Preoperatively, the patients were administered broad spectrum antibiotics and which were continued for 48 hours postoperatively. Before taking incisions, anatomical landmarks for the Deltoid splitting (trans-Deltoid) lateral approach were marked. A vertical incision was taken from the lateral

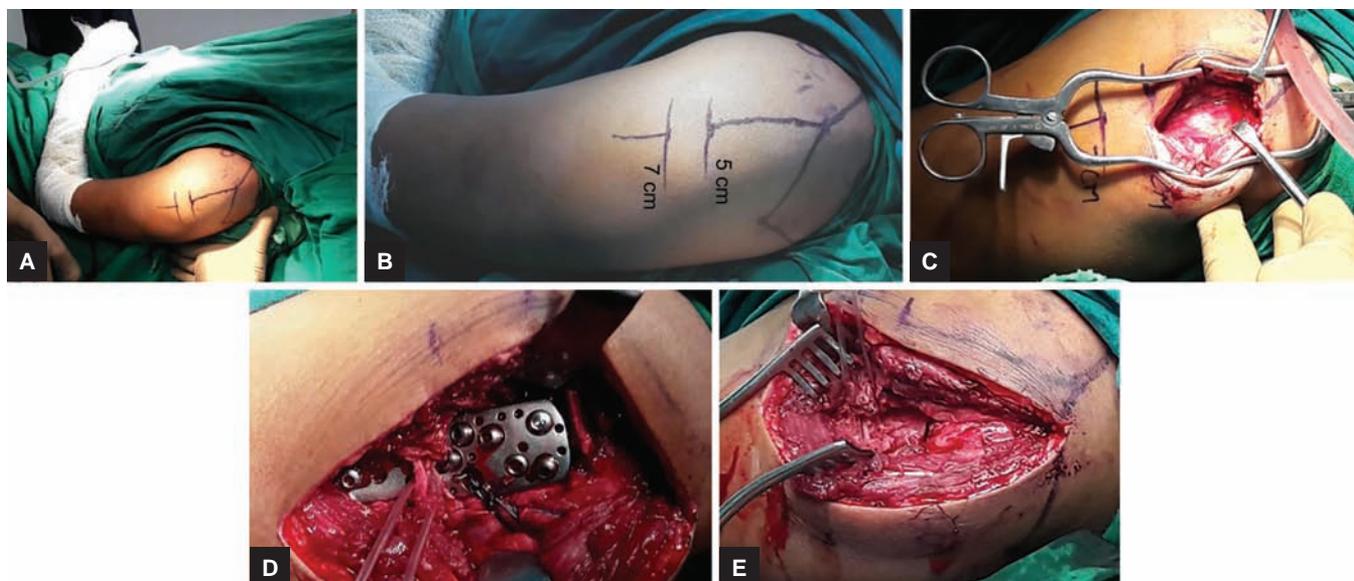


Figs 1A and B: (A) X-ray and computed tomography; and (B) scan of a patient with comminuted proximal humerus fracture

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Figs 2A to E: The trans-Deltoid approach: (A) Surface marking of bony landmarks; (B) Axillary nerve; (C) Exposure of proximal humerus; (D) Extension of approach distally, if need arises; and (E) PHILOS plate fixation

border of the acromion up to 5 cm distally along the humerus. Deltoid was split up to the margin of the acromion (Figs 2A to E).

The subacromial bursa was identified and vertically divided. A finger was inserted through the split and the axillary nerve location was identified by palpating a band-like structure along the undersurface of the Deltoid about 5 to 7 cm from acromion.^{5,6} The distal limit of the incision was then determined by the fracture characteristics and the required length of plate. After proper exposure of fracture, reduction was done under fluoroscopy guidance and maintained tentatively by wires and if required, ETHIBOND no. 2 sutures around the insertions on the tuberosities. Appropriate-sized locking plate was passed under the isolated nerve with plate tip 1 to 2 cm distal to the top of greater tuberosity and fixed with at least four screws in the head and at least two screws in the shaft fragment. Wound was repaired in layers and sterile dressing done (Figs 3A to C).

After surgery, arm was kept in arm pouch and gentle exercises were started as tolerated by the patient.

Subsequent visits in outpatient department were at 1, 3, and 6 months postoperatively. The X-rays were done on follow-up and were evaluated for union, loss of reduction, implant failure, screw back out or screw penetration, and AVN of humeral head. Complications of surgery like infection, stiffness of shoulder joint, and any impingement were looked for, noted, and treated. Axillary nerve was examined subjectively and the Constant Murley shoulder scores were evaluated for functional recovery and grading was done after comparing with normal side.⁷ The left and right shoulders were assessed separately. The subjective variables are pain and activities of daily living (sleep, work, recreation/sport), which add up to 35 points. The objective variables are range of motion and strength, which add up to 65 points.⁷

RESULTS

Out of 35 patients, 7 were females and 28 males. The mean age group was 44 years ranging from 26 to 62 years. Most of the right-handed dominant patients (65%) sustained right-side fractures. There was no patient with bilateral



Figs 3A to C: Reduction of fractures aided with C-arm (A); and PHILOS plate fixation (B and C)

humerus fracture; 6 cases (30%) had type II and 29 cases (70%) had type III Neer's fracture. Surgery was conducted at an average of 48 hours after the injury.

Dual window Deltoid splitting incision was used in 18 cases and continuous incision in 17 cases. In continuous incision patients, the axillary nerve was identified to prevent injury. Identification was done by digital palpation without anatomical nerve dissection. We followed the patients up to an average of 26 weeks ranging from 24 to 32 weeks. Signs of radiological union appeared within a mean period of 14 weeks in a range of 12 to 20 weeks. There were no cases of penetration of humeral head by the screws or screw backout or implant failure and AVN of humeral head. Initially, the range of motion of shoulder, especially abduction, was limited, but it became near normal range by 6 months. Immediate postoperative complications encountered were weeping wound discharge in two diabetic patients, which subsided in 3 weeks after starting targeted antibiotics. We did not have any cases of iatrogenic axillary nerve palsy or clinical Deltoid dysfunction postoperatively. Varus malunion (inclination angle less than 120°) was found in 6% (2 cases). Nonunion did not occur in any patient. Based on constant shoulder scoring system, overall results were graded as excellent in 60%, good in 35%, and fair in 5% patients (mean score 78, range 64 to 84) (Figs 4A and B and 5A to C).

DISCUSSION

This study evaluated the Neer's type II and III fractures in 35 patients treated with locked angular stable plate via Deltoid splitting approach. To achieve good results, bony and soft tissue anatomy must be restored and maintained until healing has occurred. The realization that a poor result after primary treatment is difficult to readdress or reconstruct adds to significance of initial treatment selected. Malunion, nonunion, and AVN are common complications of conservative treatment, which result in stiffness with pain and shoulder dysfunction. These complications can be minimized, if not prevented with successful operative treatment. Most of the displaced Neer's



Figs 4A and B: X-rays showing bony union at 6 months

two-part, three-part, and some four-part fractures should be managed by open reduction and internal fixation.

The anterior delto-pectoral approach is traditionally used for most of the proximal humerus fractures.^{8,9} This approach is unable to address two-part greater tuberosity fractures with fragment displaced posteriorly. Placement of the plate on the lateral surface of proximal humerus via anterior approach requires excessive retraction of Deltoid, thereby causing more soft tissue dissection and stripping increasing chances of AVN and decreasing biology for plate fixation.

Thus, in order to make surgery easier, reproducible, and to preserve biology, the lateral approach becomes a boon.^{9,10} Practical aspects of addressing the posteriorly displaced fracture fragments and direct lateral plate fixation have also been proven by many studies to give better results with no incidence of axillary nerve palsies.^{11,14} Better functional results and better constant shoulder scores have been documented by many authors.¹⁰⁻¹³ Gardner et al¹¹ and Korkmaz et al¹⁰ have also stated that trans-Deltoid approach is easier and more practical as compared with anterior delto-pectoral approach, as it avoids axillary nerve trauma and provides good access to posteriorly displaced fractures. Our constant shoulder score



Figs 5A to C: Clinical outcomes at 6 months

Table 1: Comparison of various studies with present study

Sl. no.	Study	Constant score	Overall complication rate (%)	Complications					
				Screw penetration (%)	Subacromial impingement (%)	Deltoid dysfunction (%)	Infection (%)	Varus malunion (%)	Avascular necrosis (%)
1	Sproul et al ¹⁷	73.6	48.8	7.5	4.8	0	3.5	16.3	10.8
2	Sudkamp et al ¹⁶	85.1	34	14	–	–	–	–	8
3	Egol et al ¹⁸		23.5	16	0	0	2	0	4
4	Owsley et al ¹⁹		36	23	0	0	0	25	4
5	Hepp et al ²⁰	84	31.3	14.4	2.4	0	1.2	3.6	4.8
6	Koukakis et al ²¹		15	0	0	0	5	0	5
7	Agudelo et al ²²		19	0	2	0	4.5	0	4.5
8	Present study	78	12	0	0	0	5.71	6	0

of 78 is comparable to many studies, which had utilized similar Deltoid splitting approach.¹⁵ Liu et al,¹³ in his study of 91 patient cohort, concluded that type II and III Neer's fractures are better approached via trans-Deltoid route, whereas delto-pectoral approach is satisfactory for type IV Neer's fractures.

Sudkamp et al¹⁶ reported a mean constant score of 70.6 points 1 year after Proximal Humerus Internal Locking System locking plate fixation corresponding to an intra-individual constant score of 85.1%. Complications were found in 34% of patients. The most common complication (14% of patients) was intraoperative screw perforation of the humeral head (Table 1).

Sproul et al¹⁷ conducted a systematic review of mid- and long-term results. Average constant score was 73.6 points after a mean follow-up of 29.2 months. The overall complication rate was 48.8%. The most common complications were varus malunion (16.3%), AVN (10.8%), intra-articular screw perforation (7.5%), subacromial impingement (4.8%), and infection (3.5%). The present study had a complication rate of 12% mostly in the form of superficial infection (diabetic patients) and varus malunion.

Our study has shown much better constant scores in 95% patients, without any presence of axillary nerve palsy or Deltoid dehiscence or weakness. Patients with an inclination angle (head diaphysis angle) of less than 120° on immediate postoperative radiographs were accepted as having varus inclination.²³ Our study had a varus malunion of 6% (2 patients with 114° and 110° of head diaphysis angle), whereas various other studies had results of varus malunion ranging from 3.6 to 25%.^{17,19,20} Varus malunion was more common in cases who were aged above 60 years, which indicates that factors like osteoporosis and higher fracture comminution may have a role in its causation.

CONCLUSION

Deltoid splitting approach allows good access to treat proximal humerus fractures with minimal risk of axillary

nerve injury, less complications, and better functional results. Approach can be by a single incision or by two-window technique to provide good visualization of the proximal humerus fracture fragments. We recommend the trans-Deltoid approach based on our outcome to be more practical than other approaches for proximal humerus fractures.

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