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## Functional outcome of locking anatomical plate in extra articular fracture of distal humerus

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### Abstract

**Background:** The complex anatomy of distal humerus with proximity of radial nerve makes the exposure and fixation of these fractures difficult. The standard technique of plate osteosynthesis considers to hold at least eight cortices in both distal and proximal ends. Following these principles becomes difficult in distal humerus fractures. These difficulties have been overcome with the use of anatomical extra-articular distal humerus plate which has more hole density in the distal part with 3.5 mm screws for greater hold in distal part.

**Methods:** A prospective study was carried out at SMIMER Medical College and Hospital, Surat for 25 cases of distal third fracture excluding open fractures of patients between 18-60 years who attended our OPD or Emergency from June 2022 to November 2023. All patients were operated with the triceps-reflecting modified posterior approach. Regular clinical and radiological follow-up was done to evaluate functionality of elbow, union status of fracture, non-union, secondary displacement, implant failure and any complications.

**Results:** Out of 25 patients, 6 had AO type A1 fracture, 14 patients had type B1 fractures and remaining 5 had type C1 fractures. Mean DASH score at final follow up was 18.3; range being 12.6 to 35.7 points. The mean elbow range of motion was 130 degrees (range: 120 to 140 degrees). The mean duration for complete radiological fracture union was 14 weeks, range being 10 to 18 weeks.

**Conclusion:** The distal humerus extraarticular plate is choice of implant for the fixation of distal humerus fractures since it offers good stability of fracture and enables early return of functionality.

**Keywords:** Distal humerus fracture, extraarticular locking distal humerus plate

### Introduction

Distal one third fracture of humerus are difficult to manage due to their complex regional anatomy. These fractures are most often displaced and rotational misalignment so proper anatomical reduction is of primary importance for the management.

Both non operative and operative methods have been proposed for the management but in recent times surgical intervention has taken a lead [1-4]. Traditional Plaster of Paris cast or Sarmiento's functional brace have been used to conserve these fractures but the distal third humerus fractures are very difficult to treat with cast or brace due to rotational forces acting on it which leads to mal-alignment [2, 5].

Operative management of these fractures with stable internal fixation is also a tough task owing to proximity of elbow joint and restoration of functional elbow movement.

These operative techniques include intra medullary nail, 4.5 mm DCP and bi-columnar distal humerus plates. The intramedullary nail is difficult to insert due to the small size of medullary canal and small distal fragment. Similarly, difficulty to achieve 8 cortical hold in the distal fragment poses restriction on use of the 4.5 mm DCP. Bi-columnar plating, despite being a good option, involves excessive stripping of soft tissues.

Hence, to overcome the disadvantages of these two plates, the extra articular distal humerus plate (EADHP) was invented. This plate is a locking compression plate specifically pre-contoured to be fixed in the center of the diaphysis of the humerus in the proximal fragment and the distal part of the plate is pre-contoured to be fixed on the lateral supracondylar ridge in the distal fragment. Also, it has a tapered end which fits on lateral condyle so it reduces soft tissue irritation. This study was conducted to evaluate the outcome of extra-articular distal

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humerus plate for fixation of distal humerus fractures.

### Methodology

Demographics, mode of trauma, related injuries, hospitalization details, as well as operative management description, were collected from the hospital data. Patients with at least follow-up of 1 year were called telephonically or by letter for clinical and radiological assessment. Only 25 patients were eligible for given inclusion criteria, and therefore, included for retrospective evaluation.

### Inclusion criteria

Both male and female patients 18 to 60 years of age with isolated, closed, metaphyseal extra articular distal humerus fractures treated with open reduction and internal fixation with the EADHP were included in the present study, conducted at the Department of Orthopaedics, Smimer Medical College and Hospital, Surat between June 2022 to November 2023. The fractures were then classified according to the AO/OTA classification.

### Exclusion criteria

Pathologic fractures, fractures in skeletally immature patients, old neglected fractures, refusal to provide informed consent, fractures with neuromuscular disorders / neurovascular insufficiencies.

### Operative protocol

All patients were operated under general anesthesia and/or brachial block. Operative site was approached through the midline posterior incision and triceps-reflecting approach.

Radial nerve was identified and protected both at lateral intermuscular septum as well as at spiral groove; status of radial nerve was documented in each & every case. Distally, the triceps was lifted off the bone only on the lateral side to visualize the lateral epicondylar ridge. Reduction of fracture was done under vision and temporarily held with Kirschner's wire or bone holding clamps; depending upon the fracture pattern, fragments were lagged, whenever appropriate.

Appropriate length of plate was chosen and slid under the radial nerve, its proximal end was placed on diaphysis of humerus, and the distal end of the plate was placed over posterolateral aspect of distal humerus just lateral to olecranon fossa and inferior to it till capitellum. Final position was checked under C-arm and fixation done according to it.

All patients were subjected to regular clinical and radiological follow-up in OPD. At the latest follow-up visit, patients were assessed clinically for ROM, activity level.

A supervised physiotherapy session of active assisted and passive exercises was started for all patients from the first post-operative day. Clinically, the outcome was evaluated by the disability of arm, shoulder and hand (DASH) score as well as elbow range of motion.

Fracture union was examined clinically by absence of tenderness on palpation and the absence of pain on performing regular activities.

Radiologically, union was assessed on anteroposterior and lateral radiographic view. Bridging of the fracture site in minimum 3 of the 4 cortices on AP and lateral views was identified as definitive sign of union [1, 3, 4].

### Result

A prospective study of 25 patients with extra articular distal third shaft of humerus fracture treated with EADHP was carried out in our institution.

The study group comprised of 19 males and 06 females indicating higher incidence of these injuries in males (Figure 1).

The mean duration of follow up was 10.8 weeks (range: 4 to 12 weeks). Out of 25 patients, 6 had AO type A1 fracture, 14 patients had type B1 fracture and remaining 5 had type C1 fractures 9 (figure 2). Surgical fixation was performed within a mean delay of 3.7 days from the date of injury utilizing the triceps reflecting modified posterior approach.

The study group comprised of 16 males and 9 females indicating higher incidence of these injuries in males. Patients ranged from 18 to 60 years with average age being 42 years. Most patients (11 patients) had history of road traffic accident like fall from two-wheeler whereas others had history of fall from height (14 patients).

1 patient had pre-operative radial nerve palsy which was found to be neurapraxia as intra operatively the nerve was found to be intact without any visible anatomical damage and the nerve function recovered after 4 -6 weeks (mean: 5.8 weeks). 15 patients were operated 2 days after trauma, 10 patients after 6 days.

Plate was selected in a way that 8 cortical purchase was possible in the proximal fragment. Hence, the 8-hole plate was used in the majority of cases (20 patients). In the remaining 5 patients, owing to a long spiral oblique fracture or extensive comminution, 10-hole plate was chosen (Figure 3).

Mean DASH score at final follow-up i.e. after radiological union was 18.3; range being 12.6 to 35.7 points (DASH in normal individuals is  $10 \pm 14.68$ ). The mean elbow range of motion was 130 degrees (range: 90 to 140 degrees). One patient had 5-degree deformity and another had 10-degree deformity at the elbow. No incidence of iatrogenic radial nerve palsy was found in our study. The mean time duration for complete radiological fracture union was 14 weeks, range being 10 to 18 weeks. No complications like non-union, superficial or deep infection and plate failure and no intra-operative complications were noted in relation to implant application.

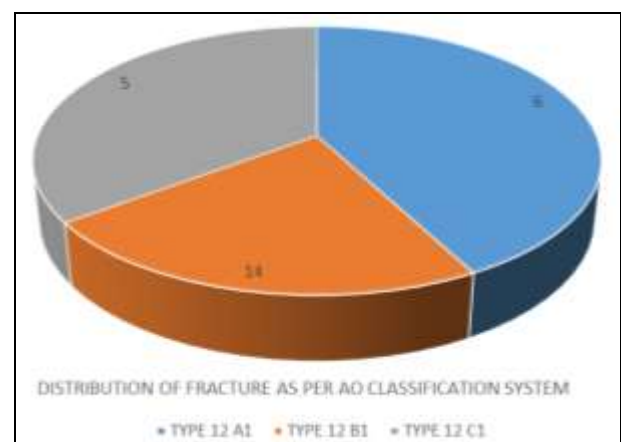
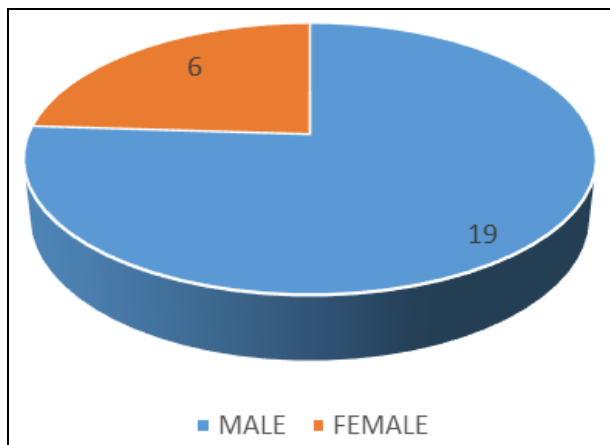


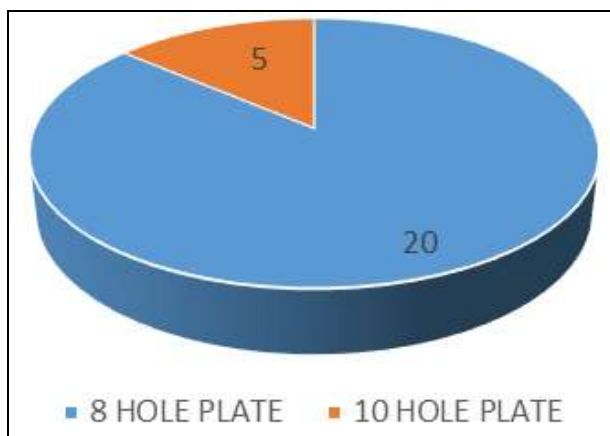
Fig 1: Distribution of fracture as per AO classification system

**Table 1:** Distribution of fracture as per AO classification system

Patient's characteristics	Mean	Range	
		From	To
Age	42	18	60
Elbow rom (Degree)	130	120	140
Fracture union (Weeks)	14	10	18
Blood loss (ml)	280	220	350
Delay in surgery (days)	3.7	1	7
Operative time (min)	110	90	120
DASH Score	18.3	12.6	35.7



**Fig 2:** Sex distribution



**Fig 3:** Plate used

**Discussion**

Traditionally shaft humerus fractures were treated satisfactorily with functional braces. The problems associated are predictability of outcome, technicality, loss of functional movement of shoulder and elbow and long waiting time [7, 8].

The main goal of treatment is to achieve proper alignment with stable reconstruction so as to start early elbow ROM. Hence, surgical intervention is favored over conservative treatment [6].

Surgical management of extra-articular distal humerus fractures is challenging because of its complex anatomy, vicinity to neurovascular structures, short distal fragment with relatively flat metaphyseal part [6].

Plate osteosynthesis with 4.5 mm dynamic compression plate gives excellent outcome for diaphyseal fractures but in distal third fractures usual principle of engaging 8 cortices are not achieved. Many modifications of plates have been tried to overcome this difficulty [6, 11]. Also, the plate can occupy olecranon fossa distally causing mechanical block to extension. To circumvent these problems with the conventional DCP, numerous modifications to this plate were

devised [6, 11].

Moran MC described modified lateral approach with use of conventional straight 4.5 mm DCP in an oblique plane orientation which was 5-8 degree off center from the long axis of the humerus also angled the most distal screw proximally with goal of improving the fixation of the distal fragment [17]. while in oblique plate, fractures requiring long plate length were difficult to manage. Also, patients had complaints of implant prominence with this fixation method [9].

Levy, in 2005 described plating with a modified lateral tibial buttress plate (Synthes) which had an angular offset of 22 degrees which allows the plate to match the contour of the lateral column, while at the same time allowing to extend proximally at the shaft.

Other plate designs like the Lambda plate and metaphyseal locking plate have also been described, but none of them are as efficient as the EADHP in terms of biomechanical stability and lesser complications [14-17].

Dual plating provides stable construct and facilitates early range of motion but the risk of infection and non-union are associated with it owing to soft tissue stripping and long operative time [12, 13].

In all our patients, we used EADHP to fix the fracture. Adequate plate length was chosen as to ensure at least 4 cortical screws in the proximal fragment. We have used triceps sparing a modified posterior approach. This approach also decreases the healing potential as the triceps muscle is not split or incised and thus there is hardly any adhesion formation or elbow contracture associated with another approach.

In our study, 25 patients were males which indicates the higher incidence of distal humerus fractures in males than in females. Most of the fractures occurred due to high energy trauma i.e. road traffic accidents. Also, the association of these fractures with other injuries and the complex fracture patterns (AO type 12 B1 and C1) in majority patients point out the high energy mode of trauma that predispose to these fractures. The mean age of the patients was 45 years. All these correlates with other similar studies conducted earlier.

One problem noted during application of plate on posterior aspect was offset of plate away from bone in proximal aspect which demanded pre-bending of plate so anterior opening of fracture site on application of cortical screws be avoided specially in transverse fracture patterns.

The limitations of our study are relatively small sample size and unavailability of a control group to compare the results. Large randomized controlled trials may be more effective to shed more light on the subject.

**Conclusion**

The extraarticular distal humerus plate is a better implant for the fixation of distal humerus fractures because it matches the contour of the distal humerus and provides rigid stability by due to availability of locking screws distally which enhances

fixation and also ensures timely union of the fracture and early return of elbow function.

We found excellent results of extraarticular distal humerus plate both in terms of union rates as well as functional scores.

#### Conflict of Interest

Not available

#### Financial Support

Not available

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