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# A distal third extra-articular humerus fractures treated with precontoured single anatomical locking plates: A retrospective study of 11 cases

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**Abstract**
**Background:** Distal third humerus shaft fractures are difficult entity to manage with. Regional Anatomy and acting forces at the region makes its management tricky to have a good functional results. Conventional platting when used have a limited distal fragment purchased. we used anatomical precontoured single 3.5 mm locking plates in 11 patients with distal third extra articular humerus fractures.
**Materials and methods:** We have studied a retrospective study of 11 patients presented to our institute with an extra articular distal third of humerus fracture between January 2017 to June 2018. All patients were approached through posterior midline incision. Osteosynthesis had been achieved with precontoured 3.5 mm anatomical locking plates. Minimum follow up of 6 months had been taken. (range 6-24 months).all patients had been evaluated according to mayo elbow performance score at final follow up.
**Results:** We have evaluated 11 cases of closed distal third extraarticular humerus fractures. We have included patients with mean age of 39 years in our study. There were 8 male patients (72.73%) and 3 feamale patients (27.27%). In our study maximum numbers of patients had injuries due to road traffic accidents 8 cases (72.7%) followed by domestic fall in 3 cases. Mean Range of motion at elbow was 122.27. We found excellent results in 9 cases (81%) and good to fair results in 2 cases. None of the patient had undergone for any revision surgery.
**Conclusion:** In the management of the extra articular distal third fracture of humerus optimal osteosynthesis with rigid fixation is required to achieve good functional outcome. Use of precontoured 3.5 mm anatomical locking plates in such fractures gives rigid fixation and allows early mobilization.

**Keywords:** Extraarticular distal third humerus fracture, anatomical precontoured locking plate, single column plate, MEPS

## Introduction
Humerus shaft fracture is one of the common injury where 7% of the fractures involved at distal third of diaphysis [1]. Most studies recommended treating these fractures using a 4.5-mm low-contoured dynamic compression plate (LC-DCP) with 4.5-mm diameter screws and obtaining 6 to 8 cortices of purchase on either side of the fracture [2, 3].
In the past many studies noted high union rate and fewer complications by treating diaphyseal humerus shaft fractures by conservative methods. Distal one third extraarticular shaft fractures are often challenging and difficult to treat than their middle third counterparts. These may be due to change in anatomic region where humerus become rounding to flat, force provided by action of various muscles, shorter fractured segment of distal part with limited area for osteosynthesis.
Primary goal of treatment to provide stable internal fixation which allows early functional range of motion which prevents complications from prolonged immobilization and elbow stiffness.
Choice of implant must be based on fragment geometry of fracture. Use of Conventional 4.5 mm plates for these fractures arise some problems like short working length due to lesser number of distal cortical purchases, impingement at olecranon fossa. These factors renders fracture relatively less stable, mechanical and soft tissue related complications and decreased range at elbow.

Levy *et al*. [4] used 3.5 mm precontoured anatomical locking plate which would be used posteriorly and had an added flare which gives more purchase of cortex with an additional fixation.
We presented a study of distal third extraarticular fractures of 11 patients treated with open reduction and internal fixation with 3.5mm anatomical precontoured single column plate and its functional outcomes.

**Materials and methods**
We have studied a retrospective study of 11 patients presented to our institute with an extra articular distal third of humerus fracture between January 2017 to June 2018.

**Our criteria for inclusion were**
i. Adult patients with age > 18 years
ii. Closed fractures
iii. Extra articular distal 1/3 rd diaphyseal humerus shaft fractures.

**Our exclusion criteria were**
i. Age less than 18 years
ii. Open fractures
iii. Intra-articular extension of distal humerus fractures
iv. Previous history of surgical intervention about humerus and elbow

All patients were assessed primarily by ATLS protocol and fractures were splinted after thorough clinical examination. Adequate radiological examination and other injuries have been ruled out. Patient had been taken for surgery as earliest as possible after anesthetic clearance. Preoperative plan for fractures decided after thorough assessment of orthogonal view of x rays including elbow joints. All patients were operated by a senior trauma surgeon.

**Surgical technique**
Patients were given a lateral decubitus position after anesthesia was given in from of general or regional anesthesia. All patients were operated by a posterior midline incision. Exposure had been taken either via splitting of triceps or retracting medially when needed. We usually did a triceps split where more exposure is needed while did a modified posterior approach where less exposure was required. Meticulous dissection and radial nerve handled with gentle care. We mobilized radial nerve in all cases. We addressed a fixation once adequate exposure was achieved. Fractures were fixed with pre-contoured 3.5mm anatomical locking plates in all cases. Primarily interfragmentary screws or lag screws, encircalge wires were applied whenever necessary prior to final plate construct where neutralization plate applied. We did not put any other additional plate fixation in our study. We did not use primary bone graft or bone graft substitute to any cases. Wound closure done in standard manner. We noted contusion of nerve with total integrity in 2 cases where patients were presented with preoperative radial nerve injuries.

**Postoperative Protocol**
All patients were given intravenous antibiotics for 48 hours followed by oral antibiotics for 10 days. Regular cleaning and dressing with sutures removal were done at two weeks. No external immobilization splints were used, instead we used arm pouch sling for 3 weeks. Patients were encouraged for range of motion at elbow from very next operative day along with fingers and wrist range of motion. Patients with radial nerve palsy were given static cock up splint for one month followed by dynamic splint thereafter with physiotherapy protocol.
We did not intervene surgically either case of radial nerve palsy. As both cases were classified as neuropraxic nerve injury.
All patients were regularly followed up at one month, 3 months and 6 months with clinical and radiological examination. At each follow up visit range of motion, clinical tenderness at fracture site with radiological signs of healing noted.

**Results**
We have evaluated 11 cases of closed distal third extraraticular humerus fractures. All patients had been treated with single precontoured 3.5 mm anatomical locking plates. We have included patients with mean age of 39 years in our study. minimum age of patient was 21 years where as maximum age of patient was 58 years. Higher patients were fallen in age group of 20-40years probably due to working age population exposed to road traffic accidents. There were 8 male patients (72.73%) and 3 feamale patients (27.27%). In our study maximum numbers of patients had injuries due to road traffic accidents 8 cases (72.7%) followed by domestic fall in 3 cases.
In our study 3(27.3%) patients had spiral fracture, 1(9.09%) patients had transverse fracture, 1(9.09%) patients had oblique fracture, 6(54.55%) patients had comminuted fracture. Higher chances of comminuted fractures in our study might be due to high velocity trauma injuries. Table 1 showing fracture classified according to its pattern and percentages.

**Table 1:** Classification of fractures.

| Fracture pattern | Cases | Percentage (%) |
|---|---|---|
| Spiral | 3 | 27.27 |
| Transverse | 1 | 9.09 |
| Oblique | 1 | 9.09 |
| Comminuted | 6 | 54.55 |
| Segmental | 0 | -- |

Mean Range of motion at elbow was 122.27. Minimum elbow range of motion was 0-110 degree and maximum elbow range was 0-135 degree was noted. None of the patient had an extensor lag at elbow joint. At final follow up we did not found any elbow stiffness among any patient. None of the patients had undergone any manipulation.
We noted mean radiological union time was 4 months. In our study 6 cases were shown radiological signs of union at 3 months, 3 cases united at 4 months and 2 cases united at 5 months. We did not found any nonunion in our study. No bone graft was used in our study while index surgery.
1 Patient had superficial infection which was resolved with cleaning and dressing and oral antibiotic course for 2 weeks. No patient had a post operative radial nerve palsy except those who had preoperative nerve palsies. We noted 2 preoperative radial nerve injuries with these fractures where primary osteosynthesis had been carried out and we found contusion of radial nerve intraoperatively. Both cases of radial nerve palsy had recovered in 5 months of duration and no other intervention had been carried out for it.
At final follow up patients had been evaluated with Mayo elbow performance score (MEPS). (Figure 1 and 2)
We found excellent score in 9 patients followed by 1 cases with good score and 1 cases with fair score. (Table 2)

**Table 2:** Mayo elbow performance score (MEPS) [5]

| Sr. | Score | Meps | Cases | Percentage |
|---|---|---|---|---|
| 1. | >90 | Excellent | 09 | 81.8% |
| 2. | 75-89 | Good | 01 | 9.09% |
| 3. | 60-74 | Fair | 01 | 9.09% |
| 4. | <60 | Poor | 0 | 0 |

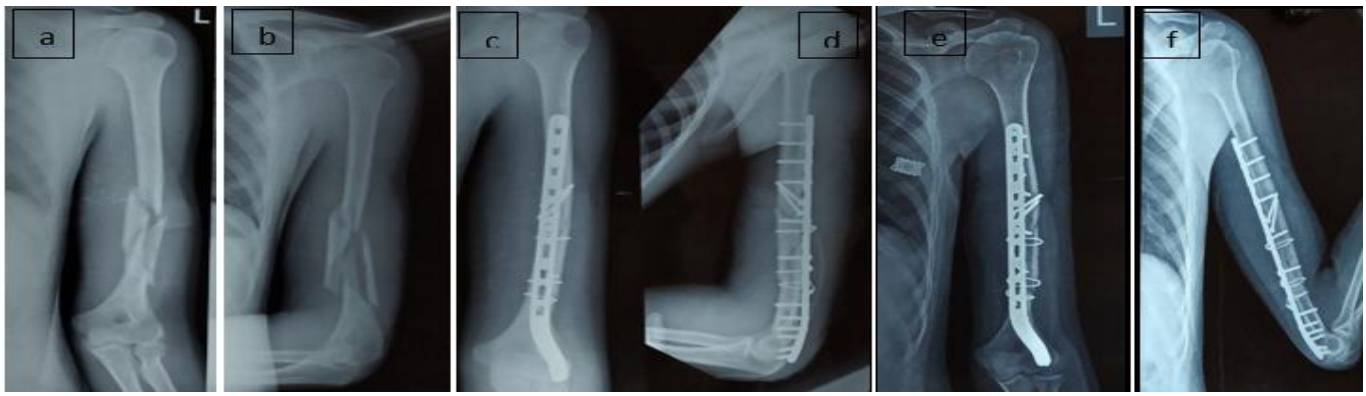


**Fig 1:** (a, b) preoperative radiograph anteroposterior (ap) and lateral view (c, d) immediate postoperative x ray ap and lateral view (e, f) postoperative radiographs at final follow up ap and lateral view


**Fig 2:** (a, b, c) clinical images at final follow up

## Discussion

Management of extra-articular distal one third humerus shaft fractures with plate osteosynthesis is often cumbersome, as traditional centrally placed posterior plates often encroach on the olecranon fossa, limiting distal osseous fixation [4].

About 23.6% of distal third humerus fractures were associated with radial nerve palsy [6] although these palsy recovered in most number of cases without any additional intervention. Surgical treatment of palsy adds an additional socioeconomic burdens to hospital as well as patients.

In the management part of these fractures implant choice should be done on basis of fracture personality, level of fractures, force acting at nearby elbow joints as well as at a fracture site and local soft tissue conditions.

Levy *et al*. [4] published good results using a posterior approach and a modified lateral tibial head buttress plate that allows added distal fixation over conventional straight plates. All of them healed without any complications.

Tejwani *et al*. [7] in their recent biomechanical study showed that 2 reconstruction plates construct is much stiffer than the single posterolateral locking plate in the treatment of an extraarticular distal humerus fracture. Prasarn *et al*. [8] showed the use of precontoured anatomical locking plates along with additional fixation with 2.7mm or 3.5 mm reconstruction plates in the treatment of extra articular distal humerus fracture in 14 patients.

Along with this study other biomechanical study also showed superiority of two plate construct over one plate construct. Double plate construct for these fractures should be advised by many literatures when comminution is extensive. Distal one third extra articular shaft fracture should be considered a different entity and treated accordingly because of their different anatomy than the middle third of diaphysis where purchase and screw positioning is relatively easier and adequate. Shorter distal fragment needs stable and adequate fixation to restore normal alignment and appropriate stability. Traditional use of 4.5 mm dynamic compression plates do not overcome to these problems where less number of cortex screws placed. For that precontoured 3.5 mm anatomical locking plate with flares provide much stable fixation with additional screw insertion at lateral column which provides much stable construct without impingement at olecranon fossa. Use of interfragmentary screw or lag screw wherever needed gives superiorty to construct. We did not face any non union in our study of 11 cases. We also doesn't do tendon transfer or nerve injury related procedure after final fixation as cases with radial nerve palsy recovered within maximum of 6 months period. This finding doesn't necessarily confirm the conservative approach to injury but probably suggesting that most of the injuries are neuropraxic insult and intervention is needed case by case basis, type and level of nerve injury. Optimal stabilization of distal humerus with locking precontoured plate helps early mobilization and prevent stiffness at elbow. We did not have any reoperation in our study. Though our sample size is lesser and relatively shorter outcome of clinical follow up, further studies with comparision with other methods and longer follow up may be needed.

## Conclusions

Management of Extraarticular distal third of humerus fractures are relatively difficult as compared to their midshaft counterparts. The basic problem faced by orthopaedic surgeons are short fractured fragment, difficulty in positioning of conventional implants, impingement at olecranon fossa and elbow stiffness. To overcome these difficulties precontoured anatomical 3.5 mm locking plates gives better purchase at distal fractured fragment with rigid fixation which allows early rehabilitation at elbow range of motion.

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