



ROLE OF POSTEROLATERAL LOCKING COMPRESSION PLATE IN DISTAL THIRD EXTRA-ARTICULAR FRACTURES OF HUMERUS – AN OBSERVATIONAL STUDY

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ABSTRACT

Background: Extra-articular fractures of the distal third shaft are the most common fractures seen in the distal humerus. These are one of the most difficult injuries to treat due to the complex anatomy of the distal humerus. EADHP's have brought in significant changes in the management of these fractures. **Materials and Methods:** A total of 25 patients with extraarticular fractures of the distal humerus were enrolled in the study who underwent surgical fixation of the fracture with single column posterolateral EADHP through a posterior triceps-splitting approach. Patients were followed up at regular intervals of 6 weeks, 3 months and 6 months for assessing fracture healing and the functional recovery at each follow-up. **Results:** There were 18 men and 7 women with a mean age of 36.92 ± 8.28 years. Most common fracture pattern was AO 12B1, which was observed in 36% of cases. Mean duration of injury at presentation was 4.72 ± 9.10 days. The mean duration of fracture healing was 15.64 ± 6.70 weeks. Mean range of flexion arc was 131.28 ± 3.92 degrees. There were 23 patients with excellent MEPS outcomes and 2 patients had reported good outcomes. There was one case of non-union requiring revision plating with bone grafting. **Conclusion:** The findings of the present study show that EADHP was associated with excellent fracture healing. It can be safely applied on the posterolateral aspect of humerus with a triceps splitting or sparing approaches while preserving the soft tissue over the medial column resulting in excellent recovery of functions. Hardware complications are minimal with no loss of fixation. EADHP can be considered a stable and safe implant for the management of extra-articular fractures of the distal third of the humerus.

KEYWORDS : Extraarticular Distal Humerus Plate, Posterolateral, Single Column, Anatomical plate, Triceps splitting, MEPS

Introduction:

The extra-articular fractures of the distal humerus involve the watershed area between the proximal two-third of the shaft of the humerus and the intercondylar region[1]. These account for approximately 2% of all orthopaedic injuries. Extra-articular injuries constitute about 40% of all the distal humerus injuries and are the most common fractures seen in the distal humerus[2]. They are one of the most difficult injuries to treat due to the complex anatomy of the distal humerus where the cylindrical shaft flattens antero-posteriorly into triangular metaphyseal flare with the olecranon fossa distally which is difficult to obtain adequate fixation in the region[3].

The goal of treatment is to achieve good alignment with uneventful fracture healing and early return to pre-injury level of functions. A variety of implant designs, surgical approaches and techniques have been tried in the past. However, the consensus around the ideal method of fixation continues to evolve with introduction of better implants. Recently, the introduction of anatomical precontoured locking plates has brought in significant changes in the management of these fracture. However, the outcomes of surgery still need to be established. The present study evaluates the early clinical outcomes and radiographic results after an open reduction and single-column posterolateral fixation of the fractures of the distal third shaft of the humerus with Extra-articular Distal Humerus Locking Plate (EADHP).

Materials and Methods:

The study was conducted in Department of Orthopedics, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana-Ambala, where a total of 25 patients presenting with extra-articular fractures of the distal third of the humerus in the period from 16th November 2018 to 31st August 2020 were included in the study.

The inclusion criteria were:

1. Patients aged between 18 years to 50 years with radiographically

1. proven extra-articular fractures of distal humerus
2. No other associated fractures in the limb under study.
3. Patient giving written informed consent for enrolment into the study

Patients were excluded from the study in case of:

1. Age less than 18 years and more than 50 years
2. Compound fractures
3. Intra-articular extension of the fracture.
4. Other associated fractures in the affected limb.
5. Patients with polytrauma.
6. Comorbid conditions like uncontrolled diabetes, hypertension, deranged hepatic or renal functions
7. Patients not giving consent for the study.

All patients were subjected to thorough clinical assessment and routine blood workup. Antero-posterior and lateral radiographs were done to assess the fracture type and rule out associated fractures. The limb was initially immobilized in a posterior arm splint. For the surgical fixation, the fracture was exposed through the triceps-splitting approach in lateral decubitus position and fixed with lag screws and a posterolateral anatomical precontoured EADHP (Figure 1). A negative suction drain was placed in the intermuscular plane and the wound was closed in layers after ensuring adequate hemostasis.



Figure 1 - Fixation of EADHP on the posterolateral column of the distal humerus

In the postoperative period, the limb was supported in arm sling. Passive ROM exercises of shoulder and elbow as well as active ROM exercises of the wrist and the hand were started in the immediate postoperative period after 24 hours as per pain tolerance of the patient. Active assisted ROM of shoulder and elbow was encouraged after 1 week. The patients were followed up in the Out-Patient Department to assess fracture healing and the functional status at postoperative 6 weeks, 3 months and the final follow-up at 6 months. 'Fracture union' was defined clinically as absence of pain and radiologically as the presence of bridging callus in at least two orthogonal views i.e anteroposterior and lateral views. If there were no signs of union after 4 months it was termed 'delayed union' and such patients were closely monitored with monthly follow-ups till union and if there was no progress even after 6 months, it was termed 'non-union'. The functional status of the involved limb was assessed using Mayo-Elbow Performance Score (MEPS) and Rodriguez-Merchan criteria[4] at each follow-up visit.

The data collected was compiled and analyzed with Statistical Package for Social Sciences (SPSS Inc., Chicago, IL). A p-value of less than 0.05 was considered significant. The study protocol was reviewed and cleared by the Institutional Ethics Committee before enrollment of patients for the study.

Results:

The demographic characteristics of the study population has been described in Table 1.

Table 1- Demographic and injury details of the study population

Parameter		Results
Gender Distribution		Male (18), Female (7)
Mean Age	Overall	36.92 ± 8.28 years
	Male	36.39 ± 7.99 years
	Female	38.29 ± 9.52 years
Side of Injury		Right (13), Left (12)
Dominant Limb Involvement		44%
Mode of Injury		MVA (16), FFH (4), Fall (3), Assault (2)
Fracture Characteristics		12A (10), 12B (12), 12C (3)

MVA - Motor Vehicle Accidents, FFH – Fall from height
 Mean duration of injury at the time presentation was 4.72 ± 9.10 days (range: 1 day - 40 days). The mean duration of surgery was 123 ± 20.25 minutes. The estimated mean blood loss was noted to be 227 ± 38.13ml. Bone grafting was done in 2 cases presenting late after failed conservative management. Pre-existing radial nerve injury was noted in 3 cases. Two patients had complete recovery by 4 months, whereas, one patient had only partial recovery at 6 months of follow-up. 16 patients had radiographic fracture healing by 12 weeks and by 24 weeks another 8 patients had achieved union. The mean duration of fracture healing was 15.64 ± 6.69 weeks ranging from 10 weeks to 36 weeks (Figure 2). A case with 12C1 fracture had poor healing response at 6 months requiring revision plating with bone grafting which went on to heal by 36 weeks.

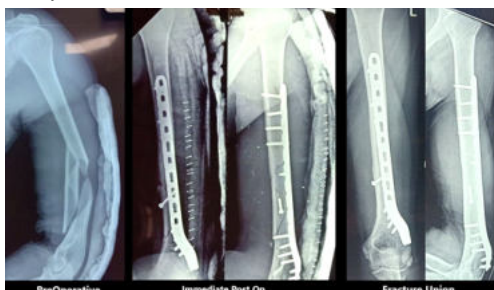


Figure 2 - Illustration of radiographic fracture union

At 6 weeks, the mean flexion was 111±10.10 degrees and the mean elbow extension lag was 24.84±6.80 degrees, which improved to a mean flexion of 133.8±3.82 degrees and a mean elbow extension lag of 2.52 ±2.4 degrees at 6 months. There was increase in the mean flexion

arc from 86.16±14.19 degrees at 6 weeks to 131.28 ±3.92 degrees at 6 months follow-up showing a significant improvement in the elbow range of motion (p<0.0001). (Figure 3)



Figure 3 - Functional status at the end of follow-up at 6 months

The mean MEPS at the end of follow-up at 6 months was 95.6±5.46 which was significantly higher compared to the previous follow-up with a mean value of 77 and 49.8 at 3 months and 6 weeks, respectively (p<0.0001). The mean MEPS among males and females was 96.66±3.83 and 92.85±8.09, respectively. The difference was statistically not significant(p=0.27). In Rodriguez-Merchan Scoring, there were 23 patients with excellent scores and 2 patients with good score at 6 months compared to only 2 patients reporting good-excellent grading at 6 weeks (p<0.001).

There was one non-union requiring revision plating with bone grafting. There was a case of post-operative transient radial nerve palsy which recovered completely by 4 months. There was one incidence of superficial wound infection, which healed with local wound care and antibiotics. There was no loss of fixation in any case, however three patients had reported hardware irritation but none requiring removal of the implant.

Discussion:

The extra-articular fractures of the distal humeral shaft have been one of the challenging injuries to treat in orthopaedic trauma clinics. The dilemma in the treatment arises due to the proximity of these fractures to anatomically more complex distal humerus where it is difficult to obtain adequate stability. The introduction of EADHP has eased the management of these injuries.

These injuries are known to have bimodal distribution with younger age being common in men due to high velocity injuries and osteoporotic fractures being common in elderly women [1,5]. In the study population in the present study was relatively young with a mean age of 36.92 ± 8.28 years. High-velocity trauma accounted for 64% of the injuries followed by fall from a height (16%). MVA has been noted as the most common cause of these fractures by various authors with some reports observing the proportion of MVA to as high as 92%[1].

Recently, studies have shown that splitting the triceps has an effect on the strength of the triceps muscle in the immediate post-operative period which might make the rehabilitation difficult[6]. In the present analysis, all cases were performed by triceps splitting approach and the mean MEPS was 95.6±5.46 and the mean loss in elbow extension was observed to be 2.52±2.4° indicating a minimal effect on the elbow extensor function.

An important goal in the surgeries of the distal humerus is the recovery of the elbow and shoulder functions. In a study by Ali N et al[7], the mean elbow flexion was noted to be 127°±12.07° and loss of extension up to 15 degrees; however, majority of the patients had achieved >100° of flexion arc. In the present study, the mean flexion at elbow was 133.8°±3.82° and six patients had loss of elbow extension by >5 degree. However, the mean flexion arc was >120 degrees in all patients. The shoulder ROM were comparable to the opposite side except for three cases with >5 degrees and one case with >10 degrees loss.

In the past, dual column plating and Y-plates have been tried to achieve stable fixation of these fractures. The advantages of anatomical precontoured EADHP are that the posterolateral curve enables more screws to be inserted into the distal fragment resulting in improved fixation and the tapered end of the plates reduces the soft-tissue

irritation as the plate lies underneath relatively thin soft-tissue layer. There are few reports of implant failures reported in the literature ranging from 0% to 5.3% by various authors[8]. In the present study, there were no incidences of hardware failure although three patients reported discomfort over the elbow due to the plate.

Ekholm et al reported the incidence of non-union with the non-operative treatment modalities to be up to 10%[9]. The rate of delayed union can range from 5% to 15.8% [7]. In our study, one patient had non-union and underwent a revision plating with bone-grafting and had successful union at 36 months.

Conclusion:

The findings of the present study show that the EADHP was associated with excellent fracture healing. The distal tapered curve enables the plate to be applied safely on the posterolateral aspect of humerus avoiding the olecranon fossa, which provides improved fixation due to the increased number of screws. It can be performed through a triceps splitting or sparing approaches while preserving the soft tissue over the medial column resulting in excellent recovery of functions. There were fewer cases of hardware irritation with no implant failures. EADHP can be considered a stable and safe implant for the management of extra-articular fractures of the distal third of the humerus

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