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Evaluation of extra-articular distal humerus diaphyseal fractures treated with single pre-contoured locking lateral column plating

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Abstract
Background: A prospective study was done in the Department of Orthopedics in D.Y HOSPITAL, Navi Mumbai from January 2015 to May 2017 to evaluate outcomes of single column plating in extra articular distal comminuted as well as non-comminuted humerus diaphyseal fractures.
Methods: All the patients attending OPD and emergency with extra articular distal humeral diaphyseal fracture with or without neurological deficit were admitted and operated in our hospital over a period of 2 year and 3 months.AO classifications was used to classify fractures. All the 20 subjects (n=20) of fracture humerus were operated using postero-lateral approach and Extra Articular Distal Humerus Locking compression plate 3.5 mm was used (EADHP). Clinical and Radiological evaluation was done at each follow up and functional outcomes were evaluated using Mayo Elbow Performance score (MEPS) which includes Pain intensity, Motion, stability and function.
Results: The mean age was between 19-60 years, with mean age of 37.3 years. The maximum incidence was between 19 to 35 years i.e. 11 cases (55%). Road traffic accident (RTA) was major cause of trauma-11 cases (55%), fall while working at house at work place was seen in 45% cases. Average radiological union was seen at 23.5 weeks. 3 of 20 patients had radial nerve palsy at presentation, of which 2 recovered completely and one recovered partially after exploration and plating. One suffered iatrogenic neuropraxia which recovered with 6 weeks. Average post-operative ROM at 6 months was flexion- 128°, full extension in 17 cases and + 10º in 3 cases, pronation 85° and supination 82°. Average MEPS score was 95.5.
Conclusion: EADHP offers us advantage over conventional dual plating or single posterior plating in terms of less soft tissue exploration, rigid construct, anatomically contoured plating and can be considered as many options for fixation of extra articular distal humeral fractures with excellent radiological and functional outcomes.

Keywords: Humerus Diaphyseal fracture, extra-Articular fracture, single column plating, EADHP, MEPS

Introduction
Fractures of the humeral shaft account for roughly 3% of all fractures. Extra articular diaphyseal fractures of distal humerus occur at an anatomical watershed between the humerus shaft and the intercondylar region and most of them are either spiral fractures or with butterfly fragment due to shear deforming forces. The fracture is often difficult to operate due if articular extension or severe communition is present. Initially popularized by Sarmiento in 1977 Functional bracing was the “gold standard” for conservative treatment because of its ease of application, adjustability, allowance of shoulder and elbow motion, relatively low cost, and reproducible results. Our most common indication for operative treatment is early mobilization of patients. The goal of operative treatment of humeral shaft fractures is to reestablish length, alignment, and rotation with stable fixation that allows early motion and ideally early weight bearing on the fractured extremity[1]. Options for fixation include plate osteosynthesis, intramedullary nailing, and external fixation. Plate osteosynthesis remains the “gold standard” of fixation for humeral shaft fractures. Plating can be used for fractures with proximal and distal extension and for open fractures.

Double columnar plating using two 3.5-mm plates in orthogonal (90^0–90^0) or parallel (180°) patterns are generally recommended. Standard single-plating techniques typically fail to achieve adequate stabilization [3, 4, 5]. However despite good functional results, non-unions and infections is seen with double-plating techniques [5, 6]. To curtail extensive soft tissue and periosteal stripping and to decrease surgical time, authors have used a single posterolateral compression plate for fixation of non-comminuted extra-articular distal humerus fractures [2, 5, 7]. The advantages of a single plate would include decreased surgical exposure, decreased surgical time and potentially faster rehabilitation due to minimal iatrogenic soft tissue injury.

Laboratory studies of locking plate constructs have shown superior fixation compared to standard compression plates for tibial and femoral metaphyseal and diaphyseal fractures [8, 9]. Post operatively anatomical restoration with rigid and resolute fixation is the keystone to minimize the risk displacement and residual deformity and ultimately post traumatic arthritis. The locking compression lateral column extra-articular distal humerus plate (EADHP, Synthes) also known as the "J-plate", is an anatomically pre contoured, angular stable fixation system designed for extra-articular fractures of the distal humerus. The plate comes with many advantages like less tissue dissection, earlier mobilization, rigid construct and relatively less instrumentation as compared to other plating techniques.

To achieve better anatomical and functional and radiological outcome, and achieve satisfactory elbow function role of EADHP have been studied.

Materials and Methods

This prospective study was done in Dept. of Orthopedics, D.Y hospital; Navi Mumbai and a total of 20 patients presenting with extra articular communited /non communited diaphyseal humerus fracture in OPD and emergency with or without neurological deficit were included. The inclusion criteria were

1) Patients willing to undergo procedure with explained consent.
2) Communited and non-communited fractures diaphyseal fractures.
3) Any neurological deficit –wrist drop or sensory alteration due radial nerve involvement.
4) Patients above 18 and below 55 years of age.
5) Patients without other associated fractures in the ipsilateral upper limb.

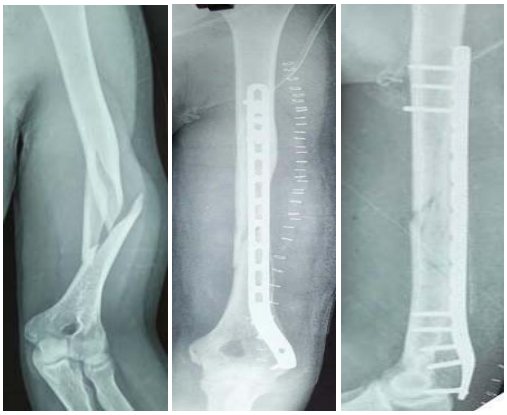
Patients were excluded if

1) Intra articular, complex and Compound fractures.
2) Pathological fractures and Poly trauma patients with expected delay in primary and immediate fixation were also excluded.
3) Immune-compromised patients, uncontrolled Diabetes, chronic steroid therapy and severely debilitated

All the patients were evaluated radiographic and clinically. Antero-posterior (AP) and lateral views of the whole shaft humerus were taken. Clinically wrist drop or sensory loss was evaluated. AO classification was used to classify fractures. All the patients were operated on elective basis after proper pre- anesthetic Checkup. All the 20 subjects (n=20) of were operated using postero-lateral approach by same surgeon and Extra Articular Distal Humerus Locking compression plate 3.5 mm was used (EADHP). 3.5 mm LCP extra articular distal humerus plate (EADHP) system is a "J" shaped titanium plate which is anatomically precontoured for application on the posterolateral surface of the distal humerus. Proximally, the plate uses elongated 3.5 mm combo hole system with locking and non locking screw options in the humeral shaft and distally it is curved along the lateral condylar ridge which prevents impingement over the olecranon fossa and triceps irritation. Five screws holes distally are angled medially for achieving a strong purchase in the trochlea and capitellum. The plate head is tapered in both planes to minimize soft tissue irritation. This provides excellent purchase in distal fragment.

Operative procedure

We used posterolateral approach as described by Moran[7]. After GA patients were placed in the lateral decubitus position. Longitudinal skin incision of 15 to 18 cm in length over the posterolateral aspect of the arm was given and extended distally midway between the lateral epicondyle of the humerus and the tip of the olecranon approximately 4 cm distal to the elbow joint. The proximal portion of the incision was located 4 cm posterior to the lateral intermuscular septum. From the midpoint of the incision, tissue was dissected laterally until the lateral intermuscular septum was reached. The triceps fascia was incised longitudinally a few millimeters posterior to the intermuscular septum, and triceps was separated from the intermuscular septum distally to proximally. Distally fascia was incised at the lateral edge of the anconeus and carried up to 4 cm distal to the lateral epicondyle. Anconeus muscle was retracted with fascia in continuity with the triceps. Posterior antebrachial cutaneous nerve was identified as it leaves the posterior compartment at the lateral intermuscular septum. Radial nerve identified and held laterally with feeding tube. The triceps muscle was retracted medially to expose the posterior humeral shaft. Fracture site was identified and end were curetted and entrapped periosteum if any was removed. A Pre-contoured LCP 3.5mm lateral column plate was placed and held in position with bone holding clamps. In Comminuted fractures SS wiring can be done or Lag screw can be used to first fix the butterfly fragment prior to plate fixation.3 locking screws proximally and 4-5 locking screws distally were fixed. Screw sizes were checked using depth gauge and checked under C-arm. The fascia was sutured with interrupted sutures loosely and drain was placed, (removed after 48 hours) dressing was done and U-Slab was given post operatively which was removed after 14 days and mobilization was started. This temporary immobilization allows soft tissue healing. The patients were followed up for maximum up to 12 months and clinical, radiological and functional outcomes were assessed at 2nd week (when U slab was removed), 6th week, 12th week and 6th month. Exercises were initiated after 2 weeks as per physiotherapy protocols. Functional outcomes were evaluated using Mayo Elbow Performance score (MEPS) which includes Pain intensity, Motion, stability and function. Fracture humerus fixed with single Lateral column plate via posterolateral approach in 35yr/m



Observations

Total 20 patients were included in this study. The youngest patient in this series was 22 years and oldest was 58. Fractures were classified as per AO type. Most common type was A2.

Table 1: Patients as per AO classification

Type	Number of Cases
12-A1	4
12-B1	7
12-B2	5
12-B3	4

Table 2: Maximum patients were in age group of 19-35(55%) years

Age group (years)	Number of Cases
19-35	11
36-50	5
51-60	4

Table 3: There were 13 male (65%) and 7 females (35%)

Sex	Number of Cases
Male	13
Female	7

Table 4: Right being the dominant hand was affected in 12 cases (80%)

Side	Number of Cases
Right	12
Left	8

Table 5: The mode of injury was fall in 11 cases (55%) and road traffic accidents in 9 cases (45%)

Mode of injury	Number of Cases
RTA	11
Fall	9

Results: The mean age was between 19-60 years, with mean age of 37.3 years. Type B fractures were more common in our study i.e. 80%. The maximum incidence was between 19 to 35 years i.e. 11 cases (55%). Road traffic accident (RTA) was major cause of trauma-12 cases (55%), fall while working at house at work place was seen in 45% cases. Majority of subjects were males 13 (65%) with right side was involved in majority of cases ie.12 cases (60%). Average radiological union was seen at 23.5 weeks. Average post-operative ROM at 6 months was flexion- 128°, full extension in 17 cases and + 10^{o} in 3 cases, pronation 85° and supination 82°. Clinical and Radiological evaluation was done at each follow up and functional outcomes were evaluated using Mayo Elbow Performance score (MEPS) which includes Pain intensity, Motion, stability and function. Average MEPS score was 95.5.There were no patients with secondary loss of reduction at the fracture site, non-union, ulnar nerve problems, superficial or deep infection.

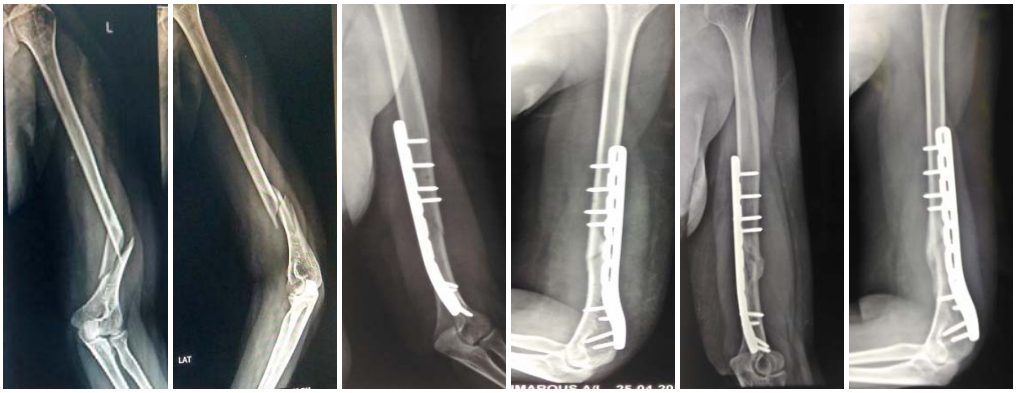
Complication: 3 of 20 patients had radial nerve palsy at presentation, clinically assessed by inability to dorsiflex wrist. After exploration and plating 2 patients recovered completely. One recovered partially wheras one suffered iatrogenic neuropraxia of radial nerve which recovered with 6 weeks.
Full extension was seen in majority of patients however 3 cases had $+10^{0}$ loss of extension

Table 6: Results of clinical and functional evaluation

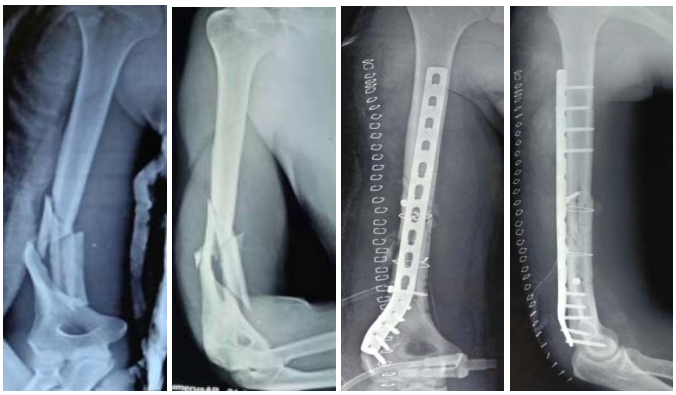
Sr.no	Age/sex	AO Type	Union period in weeks	MEPS	Other injuries
1	28/f	A1	22	100	None
2	33/m	B1	24	80	Radial nerve palsy
3	24/m	B3	21	100	None
4	56/m	A1	26	90	Distal radius #
5	31/f	B2	22	100	None
6	47/m	B1	24	100	None
7	25/f	A1	22	100	None
8	29/m	B2	21	100	Head injury
9	52/m	B3	24	90	None
10	34/m	A1	24	100	None
11	41/f	B2	23	90	None
12	29/m	B3	25	90	Radial nerve palsy
13	53/m	B1	22	100	None
14	43/f	B3	24	90	Distal radius #
15	27/m	B1	23	100	None
16	51/m	B2	26	100	None
17	48/f	B1	26	100	None
18	27/m	B1	22	100	Blunt trauma abdomen
19	36/m	B2	25	90	Radial nerve palsy
20	32/f	B1	24	90	Neuropraxia

Discussion

Distal humerus fractures remain one of the most challenging orthopaedic surgeries. They are commonly multi-fragmented, occur in osteopenic bone and have complex anatomy. Even after anatomical and stable reduction of fractures end results are often associated with elbow stiffness, weakness and pain. A painless, stable and mobile elbow joint is desirable as it allows the hand to conduct the activities of daily living. Functional bracing advocated by Sarmeinto is an effective modality for the management of these fractures; however, this method is technically demanding and there are various limitations such as skin problems, mal alignment, stiffness around shoulder joint, and lack of predictability of the final outcome. The incidence of nonunion with functional bracing has been reported to be from 5% to 24%. Pehlivan showed 100% union rates in treating isolated humeral shaft fractures with a custom-made functional brace. However, patients with poly trauma, open fractures, and fractures with neurovascular injury were excluded from their study. With increase in high energy motor vehicle trauma, the incidence of complex fractures, open fractures, and multiple injuries has risen leading to a shift toward operative management of humeral shaft fractures [11] historically, distal humeral fractures were treated conservatively due to poor results of surgery. Surgery was complicated by high infection rates and poor fixation due to rudimentary implants. Though non operative method may be appropriate in some cases, the modern literature strongly recommends open reduction and internal fixation. Extraarticular fractures of the distal humerus pose a special problem due to proximity to elbow joint which requires the fixation to be stable and less invasive to allow faster rehabilitation. A number of techniques have been proposed to overcome this problem. Moran proposed to use the conventional plate at 5° to 8° angle off center from the long axis of the humerus to enhance distal fixation, but the obliquity of the plate limited optimal proximal fixation [7]. Dual plating (both parallel and orthogonal) has also been used for these injuries. However, dual plating entails extensive soft tissue dissection, and there is a risk of infection and nonunion. Other plate designs, for example, metaphyseal locking plate, lambda plate, and lateral tibial head buttress plate have been used in isolated studies, but none of them offers a reliable alternative [2, 12-13]. Clinical studies using a single-column plate have demonstrated adequate fixation for extra-articular distal humerus fractures. It appears that some degree of cortical contact is necessary to provide adequate stability to achieve sufficient fixation with a single plate. A recent biomechanical study has shown that a locking plate placed on the lateral column with no medial buttress to prevent varus deformity provided less resistance to varus stresses compared to double-plating [10].



Case 1: 28yr/F fracture Humerus AP /Lateral pre-op & Post-op. After 6months



Case 2: 38yr/M fracture Humerus AP /Lateral pre-op & Post-op.

Conclusion: Single column anatomically contoured locking compression plate i.e. EADHP offers us advantage over conventional dual columnar plating or single posterior plating in terms of less soft tissue exploration, rigid construct, anatomically contoured plating and can be considered as many options for fixation of extra articular distal humeral fractures with excellent radiological and functional outcomes.

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