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A prospective study of functional outcome in intra articular distal humerus fracture treated with dual plating

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Abstract
Background: In adults, distal humerus fractures are uncommon and intra-articular, oftenly involve both the medial and lateral columns. Open reduction and surgical fixation with plating gives good results. The aim of this study is to evaluate clinical outcome in intra articular distal humerus fractures treated with dual plating and evaluate the intermediate term results (minimum follow up of two years) of communited intra-articular distal humerus fractures treated with bicolumnar plating with or without olecranon osteotomy in elderly Indian population.
Methods: This is a prospective type of study of 20 cases of supracondylar fracture humerus with inter condylar extension treated surgically with dual plating which were admitted to Jaya Aarogya Hospital & Trauma Center, Gwalior, Madhya Pradesh, between 2015 to 2016. All the patients of supra condylar fracture distal humerus with age between 18 to 60 years with medical fitness for surgery were included in the study.
Results: The mean age of the patient was 40±2 years, 12(60%) cases were males, and 8(40%) cases were females. Right sided involvement was more frequent in the present study 13(65%) cases. 14(70%) cases sustained fracture due to road traffic accident, 06(30%) cases had a domestic fall. The average duration of surgery was 94±10 mins. The average duration of the radiological union was 14±06 weeks in 12(60%) cases, 15±04 weeks in 5 (25%) cases, 19±05 weeks in 3 (15%) cases. The outcome was calculated using the ASES and DASH scores. The American shoulder and elbow surgeons score showed excellent in 5 (25%) good in 11 (55%) fair in 4(20%) and no poor outcome.
Conclusions: For good functional results, precise preoperative planning, adequate surgical approach, anatomical inter fragmentary stabilization, medial-post erolateral plating, and early post-operative physiotherapy help in restoring painless and functional elbow for distal humeral intra-articular fractures. This step-by-step approach results in satisfactory functional results.

Keywords: Distal humerus, double plating, Intercondylar fracture, internal fixation, olecranon osteotomy

Introduction
Distal humerus fractures make up 0.5 to 2% of all fractures, but up to 30% of fractures involving the elbow [1]. In adults, most distal humerus fractures are intra-articular and involve both the medial and lateral columns [1]. There have been variable reports as regards to functional outcome of open reduction and internal fixation of these fractures. Also, newer literature suggests, total elbow arthroplasty as a reasonable option in these patients barring the cost [2]. Achieving a good functional range of motion at the elbow with stability are the primary objectives in managing a communited distal humerus fracture. Hence, it is very necessary to determine if fracture fixation is successful in achieving a stable mobile joint [2].
Several classification systems for intra-articular both column fractures of the distal humerus have been pro-posed. The Orthopaedic Trauma Association's alpha-numeric system 3, assigned three main types: Type A (extra-articular), Type B (partial articular), and Type C (complete articular). The OTA system's clinical application is limited and is hindered by poor inter-observer reliability beyond identification of the basic three types [1].
Different types of implants like K wires, 4mm cancellous screws, 3.5mm recon plates and one third tubular plates are used during operative procedure.

Pre-contoured column specific locking plates useful in osteoporotic bone fixation [3]. Several variables are important in successful management of these fractures: restoration of articular congruity, secure bony fixation, achievement of bony healing, maintenance of a functional range of motion, and avoidance of complications such as hypertrophic ossification and ulnar neuropathy [3].

The aim of the study was to evaluate the intermediate term results (minimum follow up of two years) of communited intra-articular distal humerus fractures treated with bicolumnar plating with or without olecranon osteotomy in elderly Indian population.

Materials and Methods

This is a prospective type of study of 20 cases of supracondylar fracture humerus with inter condylar extension treated surgically with dual plating which were admitted to Jaya Aarogya Hospital & Trauma Center, Gwalior, Madhya Pradesh, between 2015 to 2016. All the patients of supra condylar fracture distal humerus with age between 18 to 60 years with medical fitness for surgery were included in the study. Patients medically unfit for surgery and those not willing for surgery is not included in this study.

The Inclusion criteria were skeletally matured patients with closed distal third extra-articular humerus fractures. Patients with polytrauma, intraarticular fractures, open fractures and patients with prior radial nerve involvement were excluded from the study. All the necessary pre-operative work-up was done in the form of Radiological and hematological investigations. Well written informed consent was taken from all the patients enrolled in the study. Prior ethical committee approval was obtained. The Disabilities of Arm and Shoulder and Hand (DASH) 4-6 score and the Mayo Elbow Performance (MEP) score 4-6 were calculated. DASH score is thirty point exhaustive questionnaire that accurately analyses the function of the arm, elbow and hand scoring the difficulty with which the patient performs a given activity from 1 to 5. The MEP score is an elbow centric score that assesses the pain, mobility, stability and function of the elbow.

Surgical technique

Brachial block was used in 17 cases and general anesthesia in 3 cases. Pneumatic tourniquet was used in all cases. Scrubbing and draping of injured upper limb done. Tourniquet was inflated and time noted. The standard surgical steps were followed. All the patients were administered three doses of second generation cephalosporin (one at the time just before the procedure and two doses at 12 hourly interval postoperatively). Elbow was exposed posteriorly through midline incision beginning 8cm proximal to the tip of the olecranon and with slight radial deviation at the olecranon tip and extending distally 6 cm towards forearm. Skin and subcutaneous tissue dissected to expose the olecranon and triceps tendon. The ulnar nerve is isolated and fascia over the flexor carpi ulnaris is longitudinally split to enhance the nerve mobility, and then gently retracted from its bed with a moist tape. Distal end of the humerus is exposed through transolecranon approach. An intra-articular olecranon osteotomy was made in a shallow 'V' or Chevron fashion in the center of the olecranon sulcus that is approximately 2cm from the tip of the olecranon using thin bladed oscillating saw and completed with a thin osteotome. The osteotomized olecranon fragment was elevated proximally along with the triceps tendon. The fracture was exposed fracture fragments were assembled. Reduced condyles were provisionally fixed with K (Kirschner) wire 4mm cancellous screw was inserted across the reduced condyles. Reduction and temporary stabilization of the medial and lateral columns was done by using crossed K wire. Medial and lateral pillars were reconstructed using pre-contoured 3.5 mm reconstruction plate and screws or one third tubular plate along with 3.5 mm screws.

Adequacy and anatomical reduction was checked in both the orthogonal views at every important step. Meticulous wound closure was done and arm pouch was given post-operatively Patients were instructed to keep the limb elevated and move their fingers. Intravenous antibiotics given up to 5th post-operative day. Oral antibiotics and analgesics were given to the patient till the time of suture removal. Sutures were removed after the 10th postoperative day depending on wound condition. No suction drains were used in any of the case. Similar pain control protocols were followed for all the cases. An arm pouch was given to all the patients post-operatively for 2 weeks. Mobility in the form of elbow and shoulder exercises was started from post-operative day 1.

Results

The mean age of the patient was 40±2 years, 12(60%) cases were males, and 8(40%) cases were females. Right sided involvement was more frequent in the present study 13(65%) cases. 14(70%) cases sustained fracture due to road traffic accident, 06(30%) cases had a domestic fall. All the fractures were classified using the AO Classification system. 14(70%) cases were the 12-A1 and 12-A2 type, thus making type 12-A as the commonest fracture pattern 4(20%) cases were 12-B1 and 12-B2 type whereas 2(10%) cases were 12-C1 type comminuted fracture respectively.

The average duration of surgery was 94±10 mins. There were no cases of neurovascular injury encountered in the present study. The average duration of the radiological union was 14±06 weeks in 12(60%) cases, 15±04 weeks in 5 (25%) cases, 19±05 weeks in 3 (15%) cases. There was hard ware prominence in 3(15%), Heterortropic ossification with stiffness in 1(15%), Delayed wound healing 1(15%), There were no cases of superficial or deep infection encountered in the present study. No cases of nonunion or malunion were observed. All the patients were followed-up at 3, 6 and 12 months respectively. The outcome was calculated using the ASES and DASH scores. The American shoulder and elbow surgeons score showed excellent in 5 (25%) good in 11 (55%) fair in 4(20%) and no poor outcome. ASES scoring system consists of patient related and patient reports component. It consists of 13 questions. An excellent score is between >34 points, Good is 28-33, Fair is 21-27, and the poor score is <21.

Results

The present study consists of 20 cases of supracondylar fracture humerus with inter condylar extension treated by open reduction and internal fixation with Dual plating (3.5mm reconstruction plate and 1/3rd tubular plate).

Fig 1: pre-operative radiograph

Fig 2: Immediate post-operative radiograph

Table 1: Age incidence

Age (year)	No. of patients	Percentage
18-30	8	40%
31-40	8	40%
40-52	4	20%

In age distribution, 08 (40%) patients were between 18-30 years, 08 (40%) patients were between 31-40 years, 4(20%) patients were between 41-52 years. The range of age was between 18-52 years, with mean age of 34.50 years. The maximum incidence was between 18 to 40 years i.e. 16 cases (80%).

Fig 3: 3 months old post-operative radiograph Patients were followed post operatively at 6, 10 and 14 weeks thereafter every 3 months up to 1 years

Fig 3: Post-operative elbow range of movements

At follow up detailed clinical examination was done and patients were assessed subjectively for the symptoms like pain, swelling and restriction of joint motion. The functional assessment of the patient was done according to Mayo Elbow Performance (MEP). The MEP score is an elbow centric score that asses the pain, mobility, stability and function of the elbow.

Table 2: Sex incidence

Sex	No. of patients	Percentage
Male	12	60%
Female	08	40%

In sex distribution, there were 12 (60%) males and 8 (40%) females.

Table 3: Side incidence

Side	No. of patients	Percentage
Right	13	65%
Left	07	35%

Right upper limb was involved in 13(65%) cases and left upper limb in 7 (35%) cases.

Table 4: Mode of injury

Mode of injury	No. of patients	Percentage
RTA	14	70%
Slip and Fall	06	30%

In mode of injury, 14 cases (70%) were due to road traffic accident (RTA) and 6 cases (30%) were due to direct fall injury. All the cases were operated electively on regular operation theatre days. In the post-operative period one patient developed superficial wound infection in which suture removal was delayed. Hard ware protrusion at tension band wiring site in three patients. Heterotropic ossification with elbow stiffness occurred in one patient. Radiological union was seen at 4 months to 7 months. The average duration of the radiological union was 14±06 weeks in 12 (60%) cases, 15±04 weeks in 5 (25%) cases, 19±05 weeks in 3 (15%) cases.

Table 5: Complications

Complications	No. of patients	Percentage
Hard ware protrusion	3	15%
Heterortropic ossification with stiffness	1	5%
Delayed wound healing	1	5%

Table 6: MEP Score

Group	MEP Score	No. of cases
Excellent	91-100	5
Good	75-90	11
Fair	60-74	4
Poor	<60	0

According to MEP score clinical outcome was excellent in 5(25%) good in 11(55%) fair in 4(20%) and no poor outcome.

Discussion

Treatment of distal humerus fractures mainly the intra articular types is a challenging task. These fractures may be compounded by many problems such as significant communition and multiple intra-articular fracture lines [4].

A study by Meloy GM *at al*. [5], show that Patients treated with single-column plating had similar union rates and alignment. However, single-column plating resulted in a significantly better range of motion with less complications. This problem is further compounded by increased incidence of osteoporosis in the older population. Several studies have demonstrated a good outcome of fixation in these fractures. However, many studies have quoted a significant failure rate of upto 25% especially in elderly patients. In adults, most of distal humerus fractures are intra-articular and involve both the medial and lateral columns [2]. Due to the characteristic intra articular involvement, displacement, and poor control of fracture fragments with closed treatment, we typically treat these fractures operatively. The goal of treatment is restoring painless and functional elbow in a fractured distal humerus which requires anatomical reconstruction and stable fixation [3].

In our study most of distal humerus fractures are intra articular and involve both the medial and lateral columns.

The decision to offer operative intervention for distal humerus fractures is based on many factors, including fracture type, intra articular involvement, fragment displacement, bone quality, joint stability, and soft-tissue quality and coverage [6]. In addition, individual factors, such as patient age, overall health condition, functional extremity demands, and patient compliance, are all considered. Preoperatively, patients must understand outcome expectations and the importance of rehabilitation [6]. Primary goals for operative intervention are to restore articular congruity and elbow stability [7]. Another goal is to decrease the possibility of posttraumatic arthritis and elbow stiffness [6]. Studies have supported the notion that distal humerus fractures in adults are optimally treated with open anatomic reduction and stable fixation to allow early anatomic restoration and upper-extremity ROM. Although operative intervention is not without complications, the risk can be reduced by paying detailed attention to anatomic reduction, soft-tissue handling and preservation, stable fixation, and early mobilization. For articular fractures and unstable nonarticular fractures, operative treatment with direct visualization of the joint surface and anatomic reduction and stabilization can prevent accelerated arthritis associated with articular incongruity [8].

Newer, minimally invasive, percutaneously inserted bridge plates also have been described and have been used to avoid extensive dissection and potential nerve injury [9, 10].

In our study, we treated all 20 cases with open reduction and internal fixation with dual plating in 90-90 configuration i. e. one plate on medial boarder and another on posterior surface of lateral column, were 12(60%) males and 8(40%) females comparable to study by Shaik RB *et al*. [1] and in Wang *et al*. [11] studies showed 60% males and 40% females. In which 14 cases (70%) were due to road traffic accident (RTA) and 6 cases (30%) were due to direct fall injury comparable to Henley *et al*. [11] study showed 61% cases due to RTA and 39% cases due to direct injury. Gabel *et al*. reported 100% cases due to direct injury and incidence Right upper limb was involved in 13(65%) cases and left upper limb in 7(35%) cases comparable to other studies by Jupiter *et al*. [12]

All patients achieved fracture union with mean MEP scores excellent in 5(25%) good in 11(55%) fair in 4(20%) and no poor outcome. All patients had radiologic evidence of fracture union and only one patients underwent a secondary procedure for removal of a heterotropic ossification mass.

In conclusion, for good functional results, precise preoperative planning, adequate surgical approach, anatomical interfragmentary stabilization, medial-posterolateral plating, and early post-operative physiotherapy help in restoring painless and functional elbow for distal humeral intra-articular fractures. This step-by-step approach results in satisfactory functional results.

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