



OUTCOME OF OPEN REDUCTION AND INTERNAL FIXATION BY PLATE OSTEOSYNTHESIS IN DISTAL HUMERUS FRACTURES: A PROSPECTIVE STUDY

Orthopaedics

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ABSTRACT

Introduction- Distal humerus fractures are infrequent (<2%) and considered some of the most difficult fractures to treat. They frequently arise in osteopenic bone, are multifragmented, have complex morphology and offer limited options for internal fixation. Main principle of surgical treatment is anatomic articular reduction, restoration of fracture anatomy of distal humerus and creating a rigid fixation construct to tolerate early range of motion. Open reduction and internal fixation by plate osteosynthesis via transolecranon approach is the most common approach used currently. **Materials And Methods-** A prospective study was conducted between June 2017 to November 2019 in the Orthopaedics Department at Agartala Government Medical College and G B Pant hospital where 30 patients with distal humerus were treated with open reduction and internal fixation with plate osteosynthesis via posterior trans-olecranon approach with use of cancellous cannulated screws and K-wire as and when needed. The functional assessment of the patient was done according to the Mayo Elbow Performance Index. **Results-** 30 patients with distal humerus fractures fulfilling the inclusion criteria were included in the study. One patient was lost to follow up so final result comprised of 29 patients. Mean age group of patients was 36.5 years with range of 18-67 years. Mean time for radiological union in our study was 13.6 weeks. Final functional outcome according to MEPI score was excellent in 12(41.4%) cases, good in 13(44.8%) cases, fair in 3(10.4%) cases and poor in 1 case(3.4%). Hardware prominence was the most common complication found in our study in 10.3% of cases followed by infection comprising 6.9% of total. **Conclusion -** We conclude that open reduction and internal fixation by plate osteosynthesis is the treatment of choice for distal humerus fractures especially AO type C fractures where anatomical reduction and rigid fixation is essential for early motion and good outcome.

KEYWORDS

Distal humerus fracture; Mayo elbow performance index; plate osteosynthesis;

INTRODUCTION

Distal humerus fractures are infrequent (<2%)¹ and considered some of the most difficult fractures to treat. They frequently arise in osteopenic bone, are multifragmented, have complex morphology and offer limited options for internal fixation². These fractures exhibit a bimodal age distribution, with the highest incidence occurring in males aged 12 to 19 years, and in females aged 80 years and older^{3,4}.

Management of distal fracture humerus has evolved from conservative treatment involving bag of bone technique and cast or splint immobilization to surgical management with open reduction and internal fixation, Ilizarov or JESS type external fixator and primary elbow arthroplasty^{5,6}. With the advancement in surgical techniques and implants surgical treatment is now the method of choice for management of the distal humerus fractures⁷.

Main principle of surgical treatment is anatomic articular reduction, restoration of fracture anatomy of distal humerus and creating a rigid fixation construct to tolerate early range of motion⁸. Open reduction and internal fixation by plate osteosynthesis via transolecranon approach is the most common approach used currently.

Different type of implants like K-wires, cancellous screws, reconstruction plates, one-third tubular plates and pre-contoured distal humeral locking plates are used in combination⁹. Pre-contoured distal humeral locking plate provide higher stability especially in osteopenic bone by permitting multiple screws in small distal fragment as compared to older conventional implants¹⁰⁻¹¹.

The aim of this study is to assess the functional outcome of surgical treatment for distal humerus fractures using plate osteosynthesis.

MATERIALS AND METHODS

This was a prospective study conducted between June 2017 to November 2019 in the Department of orthopaedics at Agartala Government Medical College and G B Pant hospital and included 30 patients. All patients presenting to Orthopedic OPD or admitted to ward with distal humerus fracture and fulfilling inclusion criteria were included in study. The study was conducted after obtaining permission from institutional ethics committee of Agartala Govt. Medical College.

Inclusion Criteria

1. Closed distal humerus fractures in patients aged > 18 years both

male and female.

2. Willing to give consent.
3. Medically fit for surgery.

Exclusion Criteria

1. Compound fractures.
2. Pathological fractures.
3. Patients on long term corticosteroid treatment.
4. Associated forearm fractures of ipsilateral limb.

After admission a careful history and thorough clinical examination of the injury site was done and recorded in the proforma. Any neurovascular deficit found was recorded and addressed. Methodical examination was done to rule out other associated injuries. X-ray of involved elbow was done taking anteroposterior and lateral views. CT scan of involved elbow was done as needed. The limb was immobilized in above elbow slab with arm pouch sling. All routine investigations were done pre-operatively. All patients were operated upon following a thorough explanation of the surgery, surgical strategy, and prognosis to the patient and attendant, and after receiving appropriate written consent. All patients were treated with open reduction and internal fixation with plate osteosynthesis via posterior trans-olecranon approach with use of cancellous cannulated screws and K-wire as and when needed.

Operative Technique

General anesthesia was used in all cases. Patient was placed in lateral decubitus and tourniquet was applied and time noted. Exposure was done through posterior midline incision. Olecranon V or chevron osteotomy was done after isolating the ulnar nerve. Fracture was exposed after elevating osteotomized olecranon fragment along with triceps tendon proximally. After freshening of margins condyles were reduced first and provisionally fixed with K-wires. 4 mm cancellous screws were then placed across the reduced condyles. After reduction of condyles medial and lateral column were reduced and stabilized by k-wires following which reconstruction of medial and lateral pillars were done with the help of pre-contoured distal humeral locking plates or reconstruction plates depending upon the fracture morphology. Olecranon osteotomy was fixed with K-wires and tension band wiring in figure of 8 loop. Surgical wound was closed under suction drain and above elbow backslab was applied.

Post-Operative Care And Follow Up

Post operatively dressing was done at 2nd and 5th post-operative day and

sutures were removed at 13th post-operative day. Arm pouch sling was given post-operatively and patient were advised to do an active range of elbow movements as the pain permits. Follow up was done at 6 weeks, 12 weeks and thereafter every 6 months. The clinical outcome and functional scoring were assessed at 3 months, 6 months and 1 year according to the Mayo Elbow Performance Index.

MAYO ELBOW PERFORMANCE INDEX		
FUNCTION	DEFINITION	POINTS
PAIN (Max. 45 points)	None	45
	Mild	30
	Moderate	15
	Severe	0
MOTION ARC (DEGREES) (Max. 20 points)	>100	20
	50-100	15
	<50	5
STABILITY (Max. 10 points)	Stable	10
	Moderate Instability	5
	Gross Instability	0
FUNCTION (Max. 25 points)	Able to Comb Hair	5
	Able to Feed oneself	5
	Able to perform personal Hygiene tasks	5
	Able to put on Shirt	5
	Able to put on Shoe	5
TOTAL		100

Evaluation Of Results

Excellent	90 or more
Good	75-89
Fair	60-74
Poor	<60

RESULTS

30 patients with distal humerus fractures fulfilling the inclusion criteria were included in the study. One patient was lost to follow up so final result comprised of 29 patients.

Table I: Age And Sex Distribution Of The Patients

Characteristics	Number of patients (n)	Percentage (%)
Sex		
Male	22	76
Female	7	24
Age Groups		
18-30 years	12	41.4
31-45 years	9	31.0
46-60 years	6	20.7
>60 years	2	6.9

Mean age group of patients was 36.5 years with range of 18-67 years.

Table II: Side Involved

Side	Number of patients (n)	Percentage (%)
Right	18	62
Left	11	38

Fracture on the right side dominated with 62% of total cases while remaining 38% were on left side.

Table III: Mode Of Injury

Mode of injury	Number of patients (n)	Percentage (%)
RTA	20	69
Fall	9	31

Table IV: Type of Fracture as per AO classification

AO Classification Type	Number of patients (n)	Percentage (%)
A3	4	13.8
B1	3	10.3
C1	11	38
C2	6	20.7
C3	5	17.2

Most common fracture type as per AO classification was C1 type comprising 38% of cases followed by C2 comprising 20% of cases.

Table V: Treatment Profile Of The Participants

Characteristics	Number of patients(n)	Percentage (%)
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Injury to surgery interval		
<1 week	22	75.9
1-2 week	5	17.2
>2 weeks	2	6.9

Type of plate used		
Bi-pillar plating	24	82.8
Single pillar plating with cc screws and k-wiring	5	17.2
Fracture time to union		
10-12	7	24.1
13-15	19	65.6
>15	3	10.3
Type of post-operative complication		
Hardware protrusion	3	10.3
Infection	2	6.9
Heterotopic ossification	1	3.4
Ulnar nerve neuropraxia	1	3.4

The average duration between injury and surgery was 5.8 days with a range of 3-21 days. Majority (83%) of patients fracture were internally fixed with plating on both medial and lateral column whereas single pillar plating with reinforcement from K-wires and CC screws were done in 17% of cases. Majority (66%) of the patients fracture united within 13-15 weeks with average time of 13.6 weeks. Hardware protrusion was the most common complication found in our study comprising 10% of cases with infection the of the surgical wound the close next constituting 7% of total.

Table VI: Functional Outcome Of Fracture

Functional outcome	Number of patients (n)	Percentage (%)
Excellent	12	41.4
Good	13	44.8
Fair	3	10.4
Poor	1	3.4

Final functional outcome evaluated as per MEPI scores was found to be excellent in 12 cases (41.4%) and good in 13 cases (44.8%) with combined excellent to good outcome in 85% of total cases. 3 cases (10.4%) had fair outcome while poor outcome was observed in 1 case (3.4%).

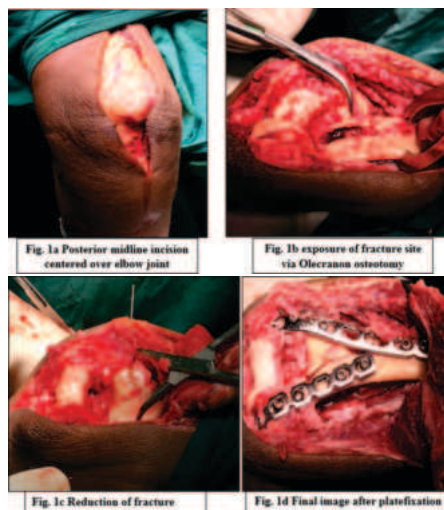


Fig. 1 Intra-operative Fractures



Fig. 2 Pre-operative X-ray showing AO Type C1 distal humerus fracture



Fig. 3 Immediate Post-operative X-ray showing fixation of fracture by dual plating with TBW for olecranon osteotomy



Fig. 4 X-ray after fracture union

Fig. 5a clinical image showing elbow flexion at final follow-up



Fig. 5b clinical image showing elbow extension at final follow-up



Fig. 5c clinical image showing supination at final follow-up

Fig. 5d clinical image showing pronation at final follow-up



Fig. 6 Pre-operative X-ray showing AO Type C1 distal humerus fracture

Fig. 7 Immediate Post-operative X-ray showing fixation of fracture by dual plating with TBW for olecranon osteotomy



Fig. 8a clinical image showing elbow extension



Fig. 8b clinical image showing elbow extension



Fig. 8c clinical image showing pronation



Fig. 8d clinical image showing supination



Fig. 9 Post-operative image showing wound infection

DISCUSSION

Distal humerus fractures are one of the most difficult fractures to treat as they are mainly intra-articular, comminuted and require a good surgical exposure as well as surgeon's expertise for good functional outcome. As elbow joint is not a very forgiving joint in terms of stiffness, prolonged immobilization invariably leads to poor functional outcome. So, the goal of treatment in distal humerus fractures is to provide anatomical reconstruction with rigid internal fixation to provide early elbow motion^{12,13}. Out of various surgical approaches for distal humerus fractures (Olecranon osteotomy, the triceps-splitting, triceps-sparing, and triceps-lifting^{14,15}) currently used, olecranon osteotomy is most commonly preferred as it provides best exposure for anatomical reduction of articular fragments and plate fixation^{15,16}.

In our study we used posterior approach with olecranon osteotomy in all cases. Average age in our study was 36.5 years with a range of 18-67 years. It was comparable to other studies like Rao et al¹⁸ and Mani et al¹⁹ with average age of 35 and 36.72 years respectively.

AO type C fractures were the most common type of fracture found in our study comprising 75.9% of all cases. It was comparable to similar studies done for distal humerus fractures in adults, in terms of type of fracture as per AO classification. Increase in prevalence of type C fractures is because of advances in mechanization and acceleration of travel these days resulting in more number of high velocity injuries.

Average elbow flexion in our study was 115° with a range of 90°-140°. It was comparable to other studies like Doornberg et al²⁰, Shin et al²¹ and Huang et al²² with average elbow flexion of 106°, 110° and 128.4° respectively. Raiss et al²³ in their study found the daily ROM of elbow required in 10 activities measured with infra-red light reflecting marker to be 110°. ROM found in our study is thus sufficient to perform daily activities of living. Forearm rotation was near normal with mean ROM of 160° (100-180°). It was similar to other studies.

Mean time for radiological union in our study was 13.6 weeks with a range of 10-18 weeks. Final functional outcome according to MEPI score was excellent in 12(41.4%) cases, good in 13(44.8%) cases and fair in 4(13.8%) cases. 86.2% patients in our study showed excellent to good outcome. It was similar to other studies like Sanchez-Sotelo et

al²⁴, Greiner et al²⁵, K.H.Schmidt-Horlohé et al²⁶ with excellent to good outcome in 80%, 83% and 92% of cases respectively. Average MEPI score was 84 with higher score in males as compared to females which could be due to increased prevalence of osteoporosis in females and higher incidence of distal humerus fractures in young males.

Hardware prominence was the most common complication found in our study in 10.3% of cases. In one case early implant removal was done after fracture union. Two cases were complicated with infection comprising 6.9% of total. Deep infection was found in 1 case which was treated by serial debridement and removal of implant after fracture union whereas one case of superficial infection was found which resolved after change of antibiotics and regular dressing. Nouraei et al²⁷ and Krishnamurthy et al²⁸ reported superficial infection in 26% and 10.3% of their cases respectively. Heterotopic ossification and ulnar nerve neuropraxia were two minor complications reported in 1 case each which were treated conservatively. Non-union, either of fracture site or olecranon osteotomy site was not observed in our study.

We used bi-pillar plating in 83% of the patients while single pillar plating was done in 17 % of the patients. We did not find any significant difference in final functional outcome and time of union between the two group but because of early mobilization, better range of motion was observed in dual plating group. Patients satisfaction were evaluated at final follow up with most of the patients found satisfied with the functional outcome with ability to return to their level of daily activities before injury with painless range of motion of elbow joint while few patients complained about elbow stiffness and occasional pain unrelated to activity level. The limitation of the current study was small sample size, absence of a control group and short follow up.

CONCLUSION

We conclude that open reduction and internal fixation by plate osteosynthesis is the treatment of choice for distal humerus fractures especially AO type C fractures where anatomical reduction and rigid fixation is essential for early motion and good outcome. Posterior trans-olecranon approach provides much needed exposure of the articular fragments and helps in anatomical reduction of the fracture. Physiotherapy post-surgery is of paramount importance in getting the desired functional outcome.

Conflict Of Interest- Nil

Source Of Funding- Nil

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