



## A PROSPECTIVE FOLLOW UP STUDY OF FUNCTIONAL OUTCOME OF SUPRACONDYLAR HUMERUS FRACTURE WITH INTERCONDYLAR EXTENSION TREATED WITH OLECRANON OSTEOTOMY APPROACH

<b>Dr. Pradeep Choudhary*</b>	Junior resident, Department of Orthopaedics, Dr. S.N. Medical college, Jodhpur, Rajasthan, India. *Corresponding Author
<b>Dr. Mahesh Bhati</b>	Senior Professor, Department of Orthopaedics, Dr. S.N. Medical college, Jodhpur.
<b>Dr. Ramniwas Bishnoi</b>	Associate Professor, Department of Orthopaedics, Dr. S.N. Medical college, Jodhpur.
<b>Dr. Aditya Srimal</b>	Junior Resident, Department of Orthopaedics, Dr. S.N. Medical college, Jodhpur, Rajasthan, India.
<b>Dr. Jayesh Chouhan</b>	Junior resident, Department of Orthopaedics, Dr. S.N. Medical college, Jodhpur, Rajasthan, India.

### ABSTRACT

**Introduction-** Olecranon osteotomy is standard approach for low transcondylar and intercondylar distal humerus fractures. Distal humerus fractures are difficult to manage successfully because of the local anatomic constraints, the frequent presence of comminution, displacement and osteopenia. We studied the functional outcome and complications following surgical fixation using this approach.

**Material And Methods-** A total 20 consecutive patients (male:15, female:5), having mean age 42.1 yrs, of Distal Humerus fractures who will attend the casualty or O.P.D during the thesis period (June 2018 to October 2020) at Mahatma Gandhi Hospital & Mathuradas Mathur Hospital Jodhpur (Rajasthan) will be included in study group and managed surgically using olecranon osteotomy approach. Functional outcome was evaluated using the Mayo Elbow Performance Score (MEPS) and complications were observed.

**Results-** Mean loss of extension was 10°. Mean flexion achieved was 122.75°. Mean range of movement at treated elbow was 113°. All fractures united by the end of 3 months. Final results were excellent in 8 cases; good in 7 cases; fair in 4 and poor in one case. Most common complication in our study was discomfort due to hardware (6 cases). Superficial infection occurred in 2 cases. Screw/wire backout occurred in 2 cases. Elbow stiffness and malunion happened in one case. Functional outcome was also dependant on fracture subtype.

**Conclusion-** Intraarticular distal humerus fracture treated with olecranon osteotomy approach had good articular exposure and surgical fixation. This approach had good functional outcome and fewer complications.

**KEYWORDS :** intra-articular, MEPS (mayo elbow performance score), trans-olecranon approach

### INTRODUCTION-

Fractures of the distal humerus accounts for 2-6% of all fractures and 1/3 of all humeral fractures. Intraarticular distal humerus fractures are very rare accounting for 0.5% of all fractures<sup>1</sup>. In elderly persons with more osteoporotic bone, these injuries occur from simple falls<sup>2</sup>. Distal humerus fractures are difficult to manage successfully because of the local anatomic constraints, the frequent presence of comminution, displacement and osteopenia<sup>3-8</sup>. Although reasonable results were reported after conservative treatment in the past, it usually results in loss of elbow movement and permanent disability<sup>3,9,10</sup>. In the elbow, the principles of good anatomical alignment, absolute stabilization and early mobilization is of prime importance than in any other joint. Moreover, accurate reconstruction of the articular surface is not always possible by closed manipulation<sup>3</sup>. The recent trend for displaced, intra-articular fractures of distal humerus is open reduction and stable osteosynthesis with early rehabilitation<sup>5,7,11,12,13,14,15</sup>.

Intercondylar and low transcondylar distal humeral fractures frequently require operative exposure and stabilization of the medial and lateral columns as well as the articular surface<sup>16</sup>. Olecranon osteotomy is a well-established technique, providing access to the distal humerus for reduction and fixation of intra-articular fractures. There is controversy because of the considerable complications inherent in this technique. The aim of my study is to examine the anatomical and functional consequences of this technique of exposure on elbow. Here we have used chevron osteotomy for treatment of distal humerus fracture.

### MATERIAL AND METHODS-

A total 20 consecutive patients of Distal Humerus fractures who will attend the casualty or O.P.D during the thesis period (June 2018 to October 2020) at Mahatma Gandhi Hospital & Mathuradas Mathur Hospital Jodhpur (Rajasthan) will be included in study group.

#### a. Inclusion Criteria:

1. Intra articular fractures of distal humerus
2. Age > 18 years of either gender.
3. AO Types B1, B2, B3 and C1, C2, C3
4. Closed, Grade I and grade II open injuries
5. Consenting to study

#### B. Exclusion Criteria:

1. With vascular injuries
2. Grade III compound Open fractures
3. Severe unreconstructable intra-articular comminuted fractures in elderly
4. Uncooperative patients for the rehabilitation and follow up
5. Patients who were not medically fit for surgery
6. not willing to participate

Primary & pre-operative management: Upon arrival in the department of casualty/OPD, thorough clinical examination of patients was done including neurovascular examination. Radiography in form of x-rays and CT scans with 3D reconstruction were done to know the exact geometry of fracture. Written informed consent was obtained from every patient regarding the surgery and inclusion in the study. The patients were evaluated using a standardized pre-

anaesthetic work-up and other associated injuries were treated using the appropriate treatment for that particular disease.

**Operative Procedure:-**

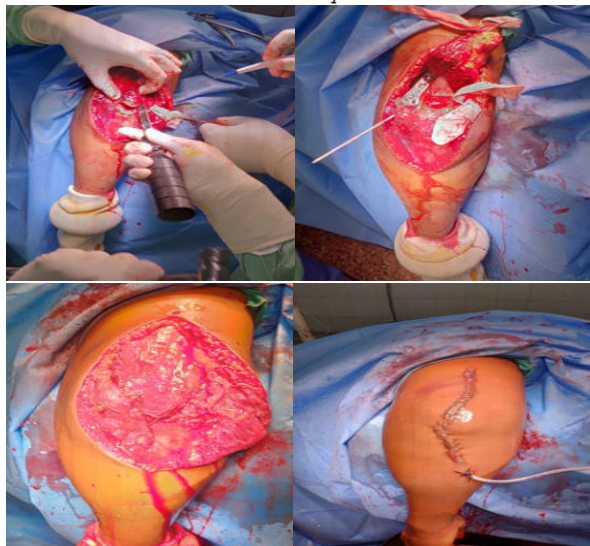
All patients will be administered a dose of intravenous antibiotic (Inj. Ceftriaxone ) at least 30 minutes before the inflation of tourniquet. Tourniquet will be applied on the involved limb at the high above elbow level. Entire limb below the level of tourniquet will be prepared with 10% Povidone Iodine and Sterillium solution. Intra operative image intensifier will be used in all patients to assess the articular reduction and the alignment of the limb.

**Surgical Technique:**

Under all aseptic conditions painting and draping was done. Elbow was exposed through an incision beginning just medial to midline of arm 10-12 cm proximal to the olecranon tip to point 5cm distal to olecranon tip along the posterior border of shaft of ulna. Skin and subcutaneous tissue reflected to either side carefully to expose olecranon and triceps aponeurosis. Ulnar nerve identified, isolated and retracted carefully out of surgical field with the help of rubber glove sling.

v- shaped Olecranon osteotomy was done incompletely with saw and completed with an osteotome ,2cm distal to the tip after predrilling and tapping the olecranon along longitudinal axis of ulna upto medullary canal for easy and accurate reduction and fixation of olecranon after completion of reduction and fixation of intercondylar fracture humerus. Osteotomised olecranon and attached triceps tendon was reflected proximally which gave excellent exposure of posterior aspect of lower end of humerus.

Fracture fragments were exposed completely, small pieces were fitted with each other and temporarily held with K-wires. Headless screws were often used whenever necessary. The definitive fixation of articular surface was done using 4.5mm cannulated screw inserted from lateral to medial direction. Two cannulated screws were preferred to attain rotational stability. This articular fragment was then attached to the condyle and temporarily fixed with K-wires. Fractures sites were stabilised with orthogonal plating: one plate on the medial side and the other on the posterolateral side, roughly perpendicular to each other as per AO principle. First, a plate was applied posterolaterally followed by medial plating or 4mm cc screw, roughly perpendicular to each other as per AO principle . Fracture fragments were fixed with anatomically contoured locking plates. Thorough saline irrigation was done at this step. Tourniquet was released and complete haemostasis was achieved in every case.



The olecranon osteotomy was fixed with two 1.8mm /2mm smooth K-wires perforating the anterior cortex distal to the coronoid process and stabilised with 18-gauge wire in accordance with tension banding principles. The tips of the K-wires were bent at triceps insertion and impacted to bone. After reduction and fixation, direct visualisation of joint congruity was confirmed, with fluoroscopy to observe joint motion. Passive movements of elbow were checked. The wound was closed in layers with suction drain. Sterile dressing was put and the elbow was immobilised in 70 degree flexion.

**Post-operative Protocol:**

post-operatively, patients were instructed to move their fingers actively and limb elevation was maintained. Clean dressing was done on third day post-operatively and elbow was put to full range of motion once as per tolerability of the patients. Intravenous antibiotics were given for 5-6 days, later converted to oral until suture removal. Sutures were removed on the 12-15<sup>th</sup> postoperative day. Patients were later discharged with above elbow posterior POP slab and advised to perform active shoulder and finger movements. After 4 weeks postoperatively, POP slab was removed ,an arm pouch sling was given and patient were advised to do active range of movements as the pain permits. Patients were asked to come at 2months,3months ,6 months and thereafter every 6 months. At each follow up, patients were evaluated clinically and radiologically for union, and the outcomes were measured in terms of Mayo elbow performance score (MEPS).

**RESULTS-**

Maximum number of patients were in the age group 21-50yrs, with age ranging from 18-75 yrs. Mean age was 42.1years. Male/female ratio was 3:1. Mean age of males(38.6 years) was significantly less than that of females(52.6 years). Left side was involved 1.85 times more than right side. Fall on ground was the most common mode of injury accounting for 55% of the cases, road traffic accident was second most common mode (30%). Average duration between injury and surgery was about 4days. In our study most common type of fracture was A.O. type C2, accounting for 50% of the cases. In our study all of the patients were having loss of extension 30 degree or less. 90% of patients were having flexion of > 120 degree. Only in 1 case flexion was <90 degree. In our study none of the patients was having full range of movements, yet 13 patients were having > 100 degree range of movement at elbow joint. Most common associated injury in our study was fracture distal end of radius followed by clavicle. Most common complication in our study was discomfort due to hardware(6 cases). Superficial infection occurred in 2 cases. Screw/wire backout occurred in 2 cases. Elbow stiffness and malunion happened in one case. There were none complications like ulnar nerve injury, heterotopic ossification and non-union at osteotomy site. Mean loss of extension was 10°. Mean flexion achieved was 122.75°. Mean range of movement at treated elbow was 113°. In our study A.O. type B, C1, C2 had excellent to good results, C3 was associated with fair and poor results. Union was achieved in all cases and mean time of union was 12.1 weeks. Final results were excellent in 40%; good in 35%; fair in 20% and poor in 5% of cases.

**Table : Correlation Between Fracture Type And Results**

S.N.	Results	A.O. type of fracture					
		B1	B2	B3	C1	C2	C3
1	Excellent	1	0	0	2	6	0
2	Good	0	0	0	4	2	0
3	Fair	0	0	0	1	2	1
4	Poor	0	0	0	0	0	1

**Table : Final Results (As Per Mayo's Criteria)**

S.N.	Results	No. of patients	Percentage
1	Excellent	8	40
2	Good	7	35
3	Fair	4	20
4	Poor	1	5



**DISCUSSION-**

Intraarticular fracture of distal humerus which was once considered to be rare fracture is a fairly common entity being faced by present day trauma surgeons. The anatomical complexity of the distal humerus combined with the frequency of comminution and displacement, have made the surgical reconstruction difficult. The fabrication of newer implants and improved surgical techniques have increased the reliability of operative stabilization and maintenance of intraarticular congruency of distal humerus thereby allowing early mobilization of the elbow, which is the key to success of any intraarticular fracture.

The present study was undertaken to evaluate the functional outcome of intercondylar fracture of distal humerus through transolecranon approach. This approach provides excellent visualization of joint surface. An anatomic comparison in cadavers demonstrated only 35% of articular surface is adequately exposed with a standard triceps splitting approach whereas in triceps reflecting approach 46% of joint surface is exposed and the most extensive exposure, 57% of articular surface is exposed through olecranon osteotomy.

In our study the maximum number of patients were in the age group of 21-50 years with the mean age of 42.1 years. In the study reported by E. Yilmaz and M. Bulut 2009, the average age of the patients was 41.6 years; which is quite comparable with our study. The younger age group had more successful outcomes than the elderly group. This may be attributed to the poor bone quality and non-compliance of patients leading to poor functional outcome like stiffness. The incidence of intraarticular fracture of distal humerus in males was about three times as compared to females. Male/female ratio in our study is similar to that reported in studies of E. Yilmaz & M. Bulut 2009 and R. Singh et al 2019. The reason behind high male/female ratio is that males have more responsibility for outdoor activities; thus, they are more prone to be injured. Most common mode of injury in our study was fall on ground (55%) followed by road traffic accident. This observation is not comparable with previous studies because many RTA cases were excluded due to grade 3 open injuries. The victims of road traffic accident were of comparatively younger age group.

In our study left elbow was involved more (65%) than the right

side. Incidence is supported by the study of Jupiter et al 1985 & R. Chandra et al 1999. All the 20 cases in our study were classified as per AO classification. We had 1 type B1 (5%), 7 Type C1 (35%), 10 Type C2 (50%) and 2 cases of Type C3 (10%). Similar observation with slight variation were observed by E. Yilmaz & M. Bulut 2009 and N. Moradiya et al 2018. R. Singh et al 2019 observed in their study that A.O. type C3 was the most common type of fracture, accounting 50% of the cases. In the present study 30% of all patients under study had associated injuries, most common being fracture of distal end of radius of same side. Almost same observation were there in the study of E. Yilmaz & M. Bulut 2009, N. Moradiya et al 2018 and R. Singh et al 2019.

Average duration between injury and surgery in our study was about 4 days. Almost 50% of cases were operated within 48 hours of injury. This duration is similar with slight variation observed in studies of N. Moradiya et al 2018, R. Singh et al 2019 and E. Yilmaz et al 2009. In our series all 20 patients were having loss of extension of upto 30°. There is no any patient was having loss of extension more than 30°. Average loss of extension in our study was about 10°, which was comparable to previous studies.

In the present series 19 (95%) patients achieved flexion of  $\geq 100^\circ$  at operated elbow. Average flexion achieved in our study was about 122.75°. It is quite comparable with studies of E. Yilmaz & M. Bulut 2009 (121°), N. Moradiya et al 2018 (118°) and R. Singh et al 2019 (123°). As far as the range of motion achieved around operated elbow is concerned we observed that 19 patients (95%) achieved  $\geq 100^\circ$  of movements and one patient had range of motion about 70-80°. Average range of movements was about 113°. Most of the activities can be accomplished with 100° range of motion at elbow. It is comparable with studies of N. Moradiya et al 2018 (avg ROM-117°), E. Yilmaz 2009 (avg ROM-111°) and R. Singh et al 2019 (avg ROM-114°).

The most complication in our study was discomfort due to hardware prominence. In spite of the discomfort, hardware protrusion was well tolerated and acceptable to the most of the patients. Superficial infection was observed in 2 cases, both of these were due to post operative swelling and gap at suture line. Both these cases healed uneventfully with dressing and antibiotics with in due course of time. But one patient (grade I injury) had deep infection and implant exposed then patient went through implant removal and split skin grafting. So all these events lead him to malunion of fracture. 2 of the patients had complication like backing out of screws which were removed on regular followup of patients and 1 of the patient had stiff elbow due to lack of proper physiotherapy.

V-shaped Olecranon osteotomy was done in all of our cases. All of them were fixed with TBW with K wires. This allowed us complete examination of the articular surfaces of trochlea, capitellum, olecranon and radial head. It also gives access to the medial and lateral supracondylar ridges. Full evaluation of the fragments of the fracture and reduction can then be performed. Complications like ulnar neuropathy, non-union at osteotomy site, heterotopic ossification, avascular necrosis of fracture fragments, instability were not observed in our study. Our follow up was not long enough to predict late narrowing of joint space and posttraumatic arthritis of elbow. We also analyzed our results according to fracture type. Majority of fracture type C1 and C2 came out with excellent and good results. In the type C3 fractures we could achieve only fair result in one case and poor result in another case. This is because of extensive intra articular comminution in both sagittal and coronal planes. Poor result is also due to deep soft tissue infection and lead to removal of implant. In this study we used Mayo elbow performance score to evaluate the

functional outcome so following the above criteria we observed excellent result in 8(40%);good results in 7(35%); fair results in 4 (20%) and poor results in one case(5%).

In view of the limitations of the study, as there was a small study group, having only 20 patients and there was no control group. Longer follow up is required to look for long term result of transolecranon approach. Lastly, though we did not find any subjective difference in elbow extension with respect to opposite elbow, we did not objectively investigate extension strength. There were many factors which were beyond the control of the operating surgeons. These included late reporting to hospital, not following up the physiotherapeutic regime strictly and not coming back for regular checkups. But for these factors we are sure we would have achieved for better results. Nevertheless, we were quite satisfied with the final results in majority of cases and advocate that all adult patients having comminuted displaced intercondylar fracture distal humerus should be managed by open reduction and internal fixation at the earliest, to achieve best results.

### CONCLUSION-

Primary open reduction and internal fixation through olecranon osteotomy is the treatment of choice for intercondylar fracture of distal humerus in adults. Absolute stability of the system allows early post-operative rehabilitation and hence a better functional outcome. The principle of congruous articulation combined with biologically stable reconstruction of medial and lateral pillar supports while respecting the soft tissue attachments and early post-operative mobilization should be followed to achieve best possible functional outcome.

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