

# A Study on Precontoured Locking Compression Plate Through Trans-olecranon Approach Management of Inter Condylar Fractures of Distal Humerus in Adults

Shivashankarappa A<sup>1</sup>, Prasad NC<sup>2</sup>, ShaikHussain Saheb<sup>3</sup>

**Author Affiliation:** <sup>1,2</sup>Associate Professor, Department of Orthopedics, JJM Medical College, Davanagere 577004, Karnataka, India.

**Corresponding Author:** Prasad NC, Associate Professor, Department of Orthopedics, JJM Medical College, Davanagere 577004, Karnataka, India.

**E-mail:** [anatomyshs@gmail.com](mailto:anatomyshs@gmail.com)

## How to cite this article:

Shivashankarappa A, Prasad NC, Shaik Hussain Saheb/A Study on Precontoured Locking Compression Plate Through Trans-olecranon Approach Management of inter Condylar Fractures of Distal Humerus in Adults. J orth. Edu. 2020;6(3):73–79.

## Abstract

**Background:** Intercondylar fractures of distal humerus are uncommon injuries and present the most difficult challenge among fractures of lower end of humerus. Distal humerus fractures with intra-articular extension are complex injuries that require meticulous approach for fixation. The principle involves anatomical reduction and absolute fixation with perfect stabilization of extraosseous implants. The functional outcome has been greatly influenced by the early graduated rehabilitative exercise.

**Aim and Objectives:** The Aim of the present study is to evaluate the Functional Outcome of Surgical Management of Intercondylar Fractures of distal humerus in Adults by Open Reduction and Internal Fixation using pre-contoured locking compression plates through trans-olecranon approach.

**Materials and Methods:** Prospective study includes 20 Adult patients with intercondylar fracture of distal humerus admitted to Chigateri General Hospital and Bapuji Hospital attached to J.J.M Medical College, Davanagere between the periods September 2016 to September 2018 satisfying inclusion criteria.

**Results:** In this study of 20 cases, there were 10 males and 10 females with average of 50.8 years. 12 cases were due to RTA and 8 due to direct fall. There was a predominance of left side (13). Out of 20 Cases, 3 (15%) were of B1 type, 1 (5%) were of type B2, 6 (30%) were of CI, 5 (25%) of C2 and 5 (25%) were of type of C3. Excellent results in 12 (60%), good in 4 (20%), fair in 3 (15%). and poor results in 1 (5%) case, according to MEPS.

**Conclusion:** Anatomically pre-shaped distal humerus locking plate system is useful in providing stable fixation for complex distal articular fracture and facilitating early postoperative rehabilitation. Clinical and radiological results show good healing rate with good range of motion.

**Keywords:** Intercondylar; Pre-contoured LCP; Trans-olecranon; Distal humerus.

## Introduction

Approximately 7% of all adult fractures involve the elbow; of these, approximately one-third involve the distal humerus. Distal humerus fractures, therefore comprise approximately 2% of all fractures. Distal humerus fractures remain as one of the most challenging injuries to manage. They are commonly multifragmented, occur in osteopenia bone and have complex anatomy with limited options for

internal fixation. Treatment outcomes are often associated with elbow stiffness, weakness and pain. A painless, stable and mobile elbow joint is desired as it allows the hand to conduct the activities of daily living, most notably personal hygiene and feeding. Therefore, starting with a highly traumatized distal humerus and finishing with a stable, mobile and pain free joint requires a systematic approach. Thought is required in determining the operative indications, managing the soft tissues, selecting a

surgical approach, obtaining an anatomic articular reduction and creating a fixation construct that is rigid enough to tolerate early range of motion<sup>1</sup>.

In the early and middle parts of twentieth century, operative treatment was combined with devascularizing exposure, inadequate fixation, and cast immobilization. The result was often elbow stiffness and delayed healing. In this context, non-operative treatments, such as the so-called bag-of-bones technique (a short duration of immobilization in either a cast or a collar and cuff followed by mobilization as tolerated) were established as treatment alternatives. Depending upon the frequency of comminution and displacement, open reduction and internal fixation with 1/3 tubular plate, pre-contoured LCP, reconstruction plate, Kirschner wire and double tension band wiring can be done individually or in combination<sup>2</sup>.

The result of operative fixation of fractures of the distal humerus remained unpredictable until improved techniques for the fixation of small, articular fractures as developed by the Arbeitsgemeinschaft für Osteosynthesefragen/association for the study of internal fixation (AO/ASIF) and others were applied. On the basis of the results reported in the more recent series, fixation with two plates at 90 degrees angle with one another has become the standard against which all other treatments are measured. Despite the confidence in operative fixation that believes this shift in treatment preference, these remain challenging fractures to treat effectively and best managed by surgeons with interest and experience in skeletal trauma involving upper extremity. Even the most experienced surgeons, however may be intimidated with certain fracture characteristics, including poor bone quality, fractures involving the distal most aspects of the bone columns and fragmentation of articular surface in sagittal and coronal planes. Some have even suggested total elbow arthroplasty as an alternative to operative fixation.

Although it is wise to be prepared to perform a total elbow arthroplasty in the event that a complex fracture is not amenable to internal fixation, one must keep in mind the functional limitations and eventual failure associated with total elbow arthroplasty. A surgeon treating a healthy active patient with a fracture of distal humerus should make every attempt to reconstruct and preserve the distal humerus<sup>3</sup>.

The quality of elbow function following intercondylar fractures is related to the degree to which normal anatomic relationships are restored. Residual elbow stiffness still remains the worst

complication of intercondylar fractures as it is poorly tolerated because of lack of compensatory motions in adjacent joints. The aim of the present study is to evaluate the functional outcome of surgical management of intercondylar fracture of distal humerus in adults. The present study is conducted to evaluate the functional outcome of surgical management of intercondylar fractures of distal humerus by open reduction and internal fixation with pre-contoured locking compression plate through trans-olecranon approach.

## Materials and Methods

### Source of Study

This study includes 20 cases of intercondylar fracture of distal humerus admitted in Bapuji Hospital and Chigateri General Hospital, attached to J.J.M. Medical College, Davangere. Patients with intercondylar fracture of the distal end of the humerus included for study.

Patients were admitted in the wards. A thorough clinical examination was performed, a careful history was elicited from the patient and/or attendants to reveal the mechanism of injury and the severity of trauma, including age, sex, occupation, complaints and any other medical illnesses & clinically to evaluate their general condition and the local injury or rule out fractures at other sites. Local examination of injured elbow revealed swelling, deformity and loss of function. Any nerve injury was ruled out. Palpation revealed abnormal mobility and crepitus. Distal vascularity was assessed by radial artery pulsations, capillary filling, pallor and paraesthesia at finger. Radiographic study was done taking anteroposterior and lateral x-ray of the involved elbow. The limb was then immobilized in above elbow plaster of paris slab with sling. The patient was taken for surgery after routine investigations and after obtaining fitness towards surgery from Physician. In all patients a posterior trans-olecranon approach was used to give better exposure of the articular surface.

### Preoperative Planning

- Consent of the patient or relative was taken prior to the surgery.
- A dose of tetanus toxoid and antibiotic were given preoperatively.
- Preparation of the part was done a day before the surgery.
- The injured elbow was immobilised in an above elbow slab with sling during

preoperative period.

- Instruments to be used were checked before sterilised.

#### **Position**

- All the patients were put in lateral position with arm supported and forearm hanging.
- Pneumatic tourniquet/ Esmarch tourniquet is recommended.

#### **Operative Procedure**

- Type of anaesthesia:
- General anaesthesia (GA) was used in 12 cases and brachial block in 8 cases.
- Pneumatic tourniquet/ Esmarch tourniquet was used in all cases and time noted.
- Painting and draping of the part was done.
- The distal end of the humerus was approached using trans-olecranon approach.
- Elbow was exposed posteriorly through an incision beginning approximately 5cm distal to the tip of the olecranon and extending proximally midline of the arm approximately 8cm above the tip of the olecranon.
- The skin and subcutaneous tissue were reflected to either side carefully to expose the olecranon and triceps tendon.
- The ulnar nerve is isolated and fascia over the flexor carpi ulnaris is longitudinally split over 5cm to enhance the nerve mobility. Then gently retracted from its bed with a moist tape.
- Prior to performing the olecranon osteotomy, the proximal ulna was predrilled with 3.2mm drill bit and then partially tapped for a 6.5mm AO cancellous bone screw.
- 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.
- The location was best identified by elevation of the anconeus muscle on the olecranon to directly visualize the articular surface. A sponge was placed from lateral to medial and used as a counter traction of the osteotomy created with thin bladed oscillating saw and completed with a thin bladed osteotome.
- The osteotomized olecranon fragment was elevated proximally leaving a margin of the triceps tendon on either side to suture upon completion of the surgery.
- The fracture hematoma was cautiously removed.

- Fragments of the humerus were assembled in the following ways -
  - » Reduction and fixation of condyle together.
  - » Fix the medial or lateral epicondylar ridge to the humeral metaphysis, if it is fractured.
  - » Reassembled condyles are fixed to the humeral metaphysis.
- Reduction and fixation of the condyles was done in the following ways -
  - » Condyles were reduced and held with a bone holding clamp
  - » Reduced condyle was provisionally fixed with Kirschner wire.
  - » AO cannulated cancellous screw of 4mm was inserted across the reduced condyles.
- Reduction and fixation of the condyles to metaphysis was done in the following ways-
  - » Reduction and temporary stabilization of the medial and lateral columns was done by using crossed Kirschner wire.
  - » Medial and lateral pillars were reconstructed using pre-contoured bicolunar LCP applied at posterolateral and medial aspect of distal humerus.
- The stability of the internal fixation was tested by putting the elbow through a range of motion.
- The olecranon osteotomy was reduced under direct vision and held with/ reduction clamp. 6.5mm AO cancellous screw was introduced from the tip of the olecranon. Periosteum was stripped from the shaft of the ulna distal to the osteotomy site and transverse hole was drilled approximately 3-5cm distal to osteotomy site. A No. 16 stainless steel malleable wire passed through the thin transverse hole and crossed over the posterior surface of the olecranon in a figure of eight manner and then passed behind the triceps tendon and around the neck of the screw and tightened.
- Instead of 6.5mm AO cancellous screw with tension band wiring, osteotomy can also be fixed with tension band wiring with obliquely placed Kirschner wire.
- At the completion of the fixation the elbow was again put through a range of motion to test the security of the internal fixation.
- The tourniquet was let down and haemostasis carefully secured and over a large suction drain the wound was closed in layers. Pressure bandage was applied and limb immobilized with above elbow plaster of paris slab.

*After Treatment:* Patients were instructed to keep the limb elevated and move their fingers and shoulder joint. Suction drain was removed after 24-48 hours. Wound was inspected after 3-4 days postoperatively. Antibiotics and analgesics were given to the patient till the time of suture removal. Suture/staples were removed on the 10th postoperative day and check X-ray in anteroposterior and lateral views were obtained. Later patients were discharged with the forearm in an arm pouch and advised to perform shoulder, elbow, wrist and finger movements. Patients were advised not to lift heavy weight or exert the affected upper limb.

*Follow-up:* After discharge, patients were advised to report for follow up after 4 weeks, 3 months, 6 months and 1 year. Patients were instructed to carry out physiotherapy in the form of active flexion-extension and pronation-supination without loading. At follow up a detailed clinical examination was done and patients were assessed subjectively for the symptoms like pain, swelling and restriction of joint motion and outcome evaluation done by Mayo Elbow Performance Score (MEPS). The results are expressed as Mean and range values for continuous data, number and percentages for categorical data was analysed by chi-square test. A P-value of 0.05 or less was considered for statistical significance.

## Results

The present study consists of 20 cases of intercondylar fractures of distal humerus treated by open reduction and internal fixation with pre-

contoured bicolumnar locking compression plate through trans-olecranon approach. In present study, 2 patients (10%) were between 21- 30 years, 3 patients (15%) were between 31-40 years, 4 patients (20%) were between 41-50 years, 7 patients (35%) between 51-60 years and 4 patients (20%) between the age of 61- 70 years. The range of age was between 22- 70 years, with mean age of 50.8 years. The maximum incidence was in the fourth and fifth decade. In the present series, there were 10 (50%) females and 10 (50%) males with a Male : Female ratio of 1:1. In the present study there were no cases of type A1, A2, A3 & B3 fractures. There were 3 (15%) cases of type B1 fractures, 1 (5%) cases of type B2 fractures, 6 (30%) cases of type C1 fractures, 5 (25%) cases of C2 fractures and 5 (25%) cases of type C3 fractures.

**Table 1:** Grading of Results

Results	No. of cases	Percentage(%)
Excellent	12	60.0
Good	4	20.0
Fair	3	15.0
Poor	1	5.0
Total	20	100

In the present study there were 12 cases (60%) had excellent result, 4 (20%) had a good result, 3 (15%) had fair and 1(5%) had a poor result as per Mayo Elbow Performance scoring system(Table 1). In the present study there were no type A fractures, 4 cases were of type B out of which 3 had excellent and 1 had a good result. There were 16 cases of type C fractures, out of which 9 had excellent, 3 had good and 3 had fair results and 1 had a poor result.

**Table 2:** Outcome in relation to Type of fracture.

Results	TOF					Total
	B1 No. (%)	B2 No. (%)	C1 No. (%)	C2 No. (%)	C3 No. (%)	
Excellent	2(66.7)	1(100.0)	5(83.3)	3(60.0)	1(20.0)	12(60.0)
Good	1(33.3)	-	-	1(20.0)	2(40.0)	4(20.0)
Fair	-	-	-	1(20.0)	2(40.0)	3(15.0)
Poor	-	-	1(16.7)	-	-	1(5.0)
Total	3(100)	1(100)	6(100)	5(100)	5(100)	20(100)

## Discussion

Intercondylar fractures of the distal humerus are difficult to treat because of the nature of injury and the fact that most surgeons do not have a great deal of experience with them.<sup>1</sup> Most intra-articular

fractures of the distal humerus are often displaced and therefore the successful treatment demands an anatomic reduction, stable fixation and the ability to allow early elbow motion. As the elbow joint tolerates immobilization poorly, the functional outcome after surgical treatment is unavoidably worsened by prolonged immobilization. Despite

being uncommon, distal humerus fractures pose the greatest challenge in terms of surgical fixation and absolute anatomical reduction. Surgical expertise is of paramount importance. Good functional outcomes are expected with intelligent surgical approach and early rehabilitation. Articular surface restoration and reconstruction of elbow joint is mandatory to restore maximum joint function. This can be safely achieved by stabilization of fracture fragments with plate osteosynthesis based on restoration of joint congruity.<sup>4,5</sup>

Previous treatment methods of closed reduction with immobilization, traction and limited internal fixation have caused significant functional impairment with loss of range of movement. Hence, it is now generally accepted that the most favourable outcome of displaced intraarticular fractures is provided by surgical reconstruction. Different approaches have been described for type C distal humerus fracture repair. The posterior approach has been used by many surgeons because it exposes the articular surface of the distal humerus sufficiently.<sup>6,7</sup>

Although various approaches have been used for reduction and fixation of distal humeral fractures, the posterior approach through an olecranon osteotomy is the most widely used. This approach provides excellent visualisation, particularly of the distal articular fragments and the plate fixation<sup>8</sup>. In this study, a posterior approach with chevron-V shaped olecranon osteotomy was done most of cases. In our study, we did not report any cases of non-union of olecranon osteotomy. The use of chevron-V osteotomy has decreased the incidence of non-union.

All fractures as well as the chevron-V osteotomy united by 10-16 weeks. In this study, we used Locking Compression Plates to reconstruct both the medial and lateral columns as the locking plates provide a fixed plate screw construct with multiple screw options for easy application in distal complex fractures thereby providing angular stability. There is no consensus that whether the orthogonal or parallel plating is superior for fixation.

We used orthogonal plating because it provides better mechanical stability although it requires more extensive soft tissue dissection. In this study, 20 cases of intercondylar fractures of distal humerus were treated with pre-contoured LCP in orthogonal fashion. Our experience with these

methods of fixation has given favourable results. The findings, the end results and various other data have been analysed and compared in the following discussion. In this study, fractures were commoner in the fourth and fifth decade with average age being 50.8 years (22-70). These findings were compared with the previous studies (Table 3).

**Table 3:** Comparison of Age Incidences

Name of Study	Age Range	Average age in years
Muhammad Noman Iqbal et al (2014) <sup>9</sup>	18-50 years	37
Singh Vetal (2016) <sup>10</sup>	18 - 62 years	37.5
Abhilekh Mishra et al (2015) <sup>11</sup>	18 - 62 years	38
Nasir Muzaffar et al (2014) <sup>12</sup>	22 - 70 years	39.68
Imran Mangi et al (2016) <sup>13</sup>	22 - 75 years	35
Sukhendu Sarkhel et al (2016) <sup>14</sup>	16-80 years	41.5
Present Study	22 - 70 years	50.8

This study accounted about 35 % incidence of fractures on right side and 65 % of the fracture on left side. Left sided predominance is probably due to a reflex mechanism during direct fall injury or in RTA (Table 4).

**Table 4:** Comparison of side involvement

Name of Study	Right	Left
Muhammad Noman Iqbal et al (2014) <sup>9</sup>	17(68%)	8 (32%)
Singh Vetal (2016) <sup>10</sup>	11 (40.74%)	16(59.25%)
Abhilekh Mishra et al (2015) <sup>11</sup>	6 (40%)	9 (60%)
Nasir Muzaffar et al (2014) <sup>12</sup>	6 (24%)	14(76%)
Imran Mangi et al (2016) <sup>13</sup>	13 (52%)	12 (48%)
Sukhendu Sarkhel et al (2016) <sup>14</sup>	31 (43.66%)	40 (56.34%)
Present Study	7 (35%)	13 (65%)

In this study, 40% of the cases were due to direct fall and 60% of cases had road traffic accident. Direct fall was usually a cause of injury in elderly female patients with RTA being common in the younger male patients. In this study, no cases of fractures of AO type A, 20% fractures of AO type B and 80% of fractures of AO type C (Table 5).

**Table 5:** Comparison of Fracture types according to AO classification.

Name of Study	AO - ASIF Type					
	A3	B1	B2	C1	C2	C3
Muhammad Noman Iqbal et al (2014) <sup>9</sup>	0	0	0	5	15	5
AbhilekhMishera et al (2015) <sup>11</sup>	0	0	0		20	
Nasir Muzaffar et al (2014) <sup>12</sup>	4	0	0	4	9	8
SukhenduSarkhel et al (2016) <sup>14</sup>	0	0	0	4	24	43
Present Study	0	3	1	6	5	5

In this study, functional outcome was based upon Mayo Elbow Performance Score. It was excellent in 12 patients (60 %), good in 4 patients (20 %), fair in 3 patients (10 %), poor in 1 patient (5%) (Table 6).

**Table 6:** Comparison of Functional Outcome

Name of Study	MEPS System			
	Excellent	Good	Fair	Poor
Singh Vetal (2016)[10]	4	13	7	3
AbhilekhMishera et al (2015)[11]	15	3	1	1
Nasir Muzaffar et al (2014)[12]		22	2	1
Imran Mangi et al (2016)[13]	12	8	3	2
SukhenduSarkhel et al (2016)[14]	60	7	3	1
Present Study	12	4	3	1

The functional performance compared favourably with other studies. The results appears better with MEPS, as this score provides only 20 points to motion and 80 points to pain, instability and function. These patients rarely complained of pain and instability and have good functional outcome. In this study, there were no intra-operative complication. There was two case of superficial infection of surgical site, which resolved with appropriate antibiotics and did not require debridement, one cases of ulnar neuropathy were seen which resolved spontaneously in 8 weeks after conservative treatment. One patient had a non-union, in which bone grafting was done. One patient had Implant failure in which there was back-out of 6.5 mm AO cannulated screw in TBW of olecranon Osteotomy.

The present study was conducted to assess the functional outcome of surgical management of twenty cases of intercondylar fracture of distal humerus. Inter condylar fractures of the distal humerus are commoner in fourth and fifth decade of life with equal incidence of fracture in male and female. The common mode of injury was Road Traffic Accidents followed by a direct fall on elbow and also left side more involved than right side. Inter condylar fractures demands careful

evaluation, classification of fracture type and preoperative planning. Trans-olecranon approach provides best visualisation of articular surface. Open reduction internal fixation should be done as early as possible. Delay in open reduction internal fixation with extensive soft tissue dissection leads to increased chances of elbow stiffness due to periarticular fibrosis. Operative treatment with rigid anatomical internal fixation should be the line of treatment for all grades of AO-ASIF type fractures, more so in young adults as it gives best chance to achieve good elbow function. During open reduction internal fixation, anatomic nature of articular surface should be given prime importance. Anatomically pre-shaped distal humerus locking plate system is useful in providing stable fixation for complex distal articular fracture & facilitating early postoperative rehabilitation.

## References

- George S A. distal humerus fractures. In rockwood and green's fracture in adult. Philadelphia. Lippocott Williams & Wilkins. Vol 1, 8th ed. 2015:1229-1283.
- Jupiter JB, Neff U, Holzach P. Intercondylar fractures of the humerus: An operative approach. J bone joint SurgAmr. 1985;67:226-238.
- Brown RF, Morgan RG. Intercondylar T shaped fracturers of the humerus. Results in ten cases treated by early mobilisation. J Bone joint surg Br. 1971;53(3):425-428.
- Pollock JW, Faber KJ, Athwas GS. Distal humerus fractures. OrthopVlin North Amr. 2008;39:187-200.
- Anglen J. Distal humerus fractures. J AmrAcadorthop Surg. 2005;13:291-97.
- Wei W, Zhang T, Xin J. The treatment and its results of type C fractures of distal humerus. Chin J orthop. 2005;25(11):679.
- Athwal GS, Rispili DM, Steinmann SP. The anconeus flap transolecranon approach to the distal humerus. J Orthop Trauma Surg. 1999;119:467-69.
- Ring D, Gulotta L, Chin K, Jupiter JB. Olecranon osteotomy for exposure of fracture and nonunions of the distal humerus. J orthop trauma. 2004;18:446-49.

9. Muhammad NI, Intikhab T, Muhammad K, Imran M, Aamir AS. Rate of union in complex distal humerus fractures using anatomical contoured locking plates. *Jour Pak Ortho Asso.* 2014;26(2):10-14.
10. Singh V, Uiquey S, Ganvir A, Maravi DS, gaur S. Outcome analysis of intercondylar humerus fractures treated by locking compression plates. *Inter Jour Med Res Rev.* 2014;3:414-419.
11. Abhilekh Mishra, VidyaBhusan S, Amit Chaurasia, Lakhtakia P. operative management of intra-articular distal humeral fractures with locking plates. *Jour Evol Med and Dent scien.* 2015;94(4):15923-26.
12. Nasir M, Khurshid B, Rafiq A, Rayees W, Mansoor D. Functional results after osteosynthesis of distal humeral fractures with pre contoured results after osteosynthesis of distal humeral fractures with pre contoured LCP system. *OriopediaTraumatologiaRehabilitacj.* 2014;16(4):381-85.
13. Imran Mangi, IntikhabTaufiq, Muhammad KR, Muhammad NI. Functional outcome of elbow reconstruction after using precontoured locking compression plate. *JPOa.* 2014;26:1-5.
14. Sukhendu S, Sailendra B, Somnath M. Condylar orientation plating in comminutedintra-articularfractures of adult distal humerus. *Ind Jour Ortho.* 2015;49:523-26.