

## Original Research Article

# A study of functional outcome after osteosynthesis of intercondylar fracture of distal humerus in adults with pre-contoured locking compression plate system

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### ABSTRACT

**Background:** Intra-articular fracture of distal humerus is considerable cause of morbidity in adults. The new pre-contoured LCP system provides better angular stability in fixation of inter-condylar distal humerus fracture.

**Methods:** A prospective study of 25 patients with distal humerus fracture treated with pre-contoured double plate system is conducted in Department of Orthopaedics, RIMS, Ranchi between April 2017 to March 2018. These patients were followed up 3 weekly in first 3 months, then 6 weekly in next 6 months, then at every 3 month interval. Clinical and functional outcome was evaluated on the basis of Mayo elbow performance score (MEPS).

**Results:** 24 fixed elbows were reviewed at a follow-up period of 1 year. Results obtained were graded on the basis of MEPS, 21 patients (87.5%) were graded excellent to good, fair in 2 patients (8.3%) and poor in 1 case (4.1%). Average time interval between surgery and admission was 9 days (average 4-14 days). All the fractures as well as the olecranon osteotomies united by 10-16 weeks (12.56 weeks). Superficial wound infection and transient ulnar nerve palsy was reported in 3 (12.5%) and 1 (4.16%) respectively and was managed conservatively. 1 patients did not reported in follow up.

**Conclusions:** We conclude that osteosynthesis with pre contoured dual plating of closed intracondylar distal humerus fractures provide good fixation and early rehabilitation, leading to high rate of bone union and minimal soft tissue damage.

**Keywords:** Intercondylar distal humerus fractures, Pre-contoured LCP system, Perpendicular plating

### INTRODUCTION

Intra-articular fractures of the distal humerus constitute 0.5-7% of all fractures and 30% of elbow fractures.<sup>1</sup> The chances of functional impairment and deformity are very high following conservative treatment of such distal intra-articular fractures of the humerus, and stable internal fixation may be difficult to achieve due to the complexity of the fracture and associated osteoporosis.<sup>2</sup> Good anatomical alignment, stabilization, and early mobilization can provide satisfactory results. The

complex anatomy of the elbow joint, the adjacent neurovascular architecture and the sparse soft tissue envelop combine to make these fractures difficult to treat.<sup>1,2</sup> Prior to the 1970's great emphasis was laid on conservative treatment of these fractures either by the use of plaster or by traction on the olecranon, which led to considerable stiffness and poor functional results.<sup>3,4</sup> Restoration of painless and satisfactory elbow function after a fracture of the distal humerus requires anatomic reconstruction of the articular surfaces, restitution of the overall geometry of the distal humerus and stable internal

fixation of the fractured fragments to allow early and full rehabilitation.<sup>5,6</sup> Acceptable results have been reported in a majority of patients treated by open reduction and internal fixation.<sup>7,8</sup> The lack of stability and the complex anatomy of the distal humerus led to the development of anatomically pre-shaped implants that provide good clinical results, although complication rates remained considerably high.<sup>9,10</sup> Recently, anatomically pre-contoured and angular-stable implants with extensive distal screw options for double plate osteosynthesis such as the locking compression plate (LCP) distal humerus plate system were introduced, promising an enhanced stability in complex fractures and an ease in application. Biomechanical studies have proven the advantages of these implants, particularly in reduced bone quality.<sup>11,12</sup> Recent studies have shown that open reduction and internal fixation with a pre-contoured plating system is an effective treatment method for distal humerus fractures.<sup>9</sup> The aim of this study was to evaluate the functional outcome and complications of AO type C fractures of distal humerus treated with anatomically pre-contoured locking plate.

**METHODS**

A prospective observational study of 25 patients with distal humerus fracture treated with pre-contoured double plate system is conducted in Department of Orthopaedics, RIMS, Ranchi between April 2017 to March 2018 (1 year) in the age group ranging from 18 to 70 years with mean age 50.2 years.

**Inclusion criteria**

- Skeletally matured; male and female patients.
- AO/OTA type C distal humerus fractures.
- Patients who are willing to participate in the study.
- Patients who are fit for surgery.

**Exclusion criteria**

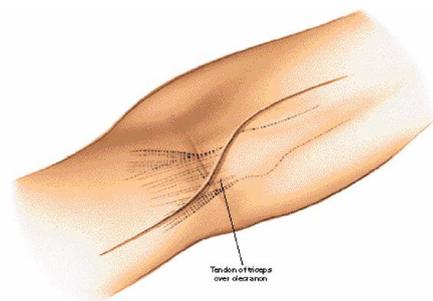
- Skeletally immature patients.
- Open fractures.
- Undisplaced fractures.
- Grossly comminuted fractures (bag of bones).
- Fractures associated with neurovascular deficits.
- Patients not willing for surgery.
- Pathological fractures.

On admission of the patient a careful history of injury and the severity of trauma elicited from the patients and/or attendants. The patients were then assessed clinically to evaluate their general condition and the local injury. Radiograph of elbow i.e., anteroposterior view and lateral view were taken and fractures were classified according to the AO classification. Next the limb was immobilized in an above elbow slab and an arm-pouch. The patient was taken for surgery after routine investigations and after obtaining fitness for the surgery by physician or

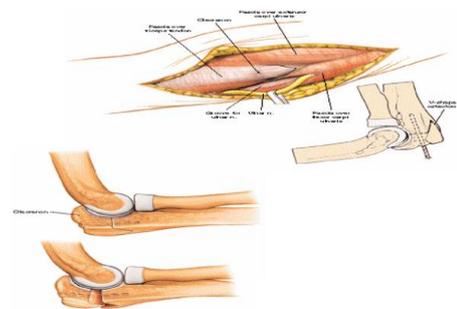
anaesthesiologist and any other related specialty. The consent for surgery was taken from the patients and their attendants after explaining the procedure and the possible complications. Patients underwent open reduction and internal fixation with bicolumnar precontoured anatomical locking plate for the sustained fractures under general anaesthesia. Post-operative physiotherapy was followed according to the protocol to evaluate the functional outcome. Patients were followed up at 1<sup>st</sup> post-operative day, 3 weekly in first 3 months, then 6 weekly in next 6 months, then at every 3 months interval after the surgery.

**Operative technique**

Brachial block was used in all of the patients. All the patients were put in lateral decubitus position with arm supported and forearm hanging. A transolecranon approach was used.



**Figure 1: Incision for posterior approach to elbow.<sup>13</sup>**



**Figure 2: Dissect the ulnar nerve from its bed and hold it free with tape. Predrill the olecranon before performing an osteotomy for easy reattachment. A V-shaped osteotomy is inherently more stable than a transverse osteotomy.<sup>14</sup>**

The distal end of the humerus was approached using trans-olecranon approach. The ulnar nerve is isolated and fascia over the flexor carpi ulnaris is longitudinally split over 5 cm to enhance the nerve mobility. Then gently retract from its bed with a moist tape. Prior to performing the olecranon osteotomy, the proximal ulna was predrilled with 3.2 mm drill bit. The osteotomized olecranon fragment was elevated proximally leaving a margin of the triceps tendon on either side to suture upon completion of the surgery. Reduction and fixation of the

condyles was done, AO cannulated cancellous screw of 4 mm was inserted across the reduced condyles. Medial and lateral pillars were reconstructed using anatomically Precontoured 3.5 mm distal humerus locking plates and screws. 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 fixed with tension band wiring with obliquely placed Kirschner wire through tip of olecranon. After discharge, patients were advised to report for follow up at 13<sup>th</sup> postoperative day for suture removal and then at 3 weekly in first 3 months, then 6 weekly in next 6 months, then at every 3 months interval. The final results were assessed 1 year after the procedure.

The final results were evaluated using the Mayo elbow performance score.<sup>9,15,16</sup> This system is based on 100 units. Pain is the most important consideration to the patient and is assigned 45 units.

**Table 1: Mayo elbow performance score.**<sup>9,15,16</sup>

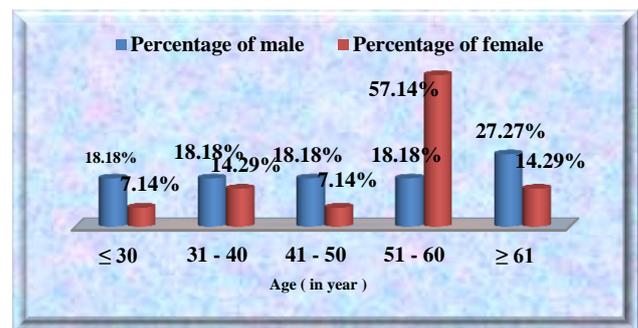
Function	Definition	Points	Score classification
<b>Pain</b>	None	45	Excellent >90
	Mild	30	
	Moderate	15	
	Severe	0	
<b>Motion</b>	Arc >100	20	Good 75-89
	Arc 50-100	15	
	Arc <50	5	
<b>Stability</b>	Stable	10	Fair 60-74
	Moderate instability	5	
	Gross instability	0	
<b>Function</b>	Comb hair	5	Poor <60
	Feed	5	
	Hygiene	5	
	Shirt	5	
	Shoe	5	
<b>Total</b>		100	

For statistical analysis “test of significance for difference of two means”, “Chi-square proportion test { $\chi^2$ -Test}” and “Chi-square distribution { $\chi^2$ -Test}” were used.

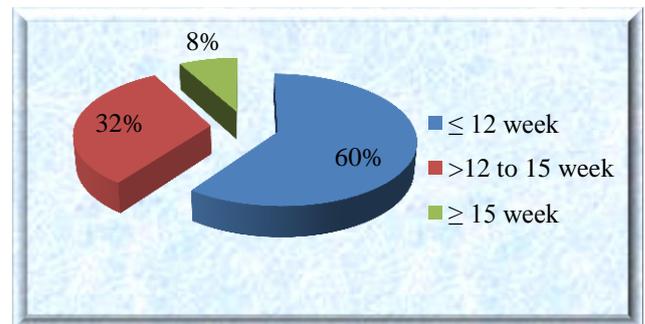
**RESULTS**

Present study was a two year prospective observational study conducted at Tata main hospital, Jamshedpur to evaluate the functional outcome of intercondylar fractures of humerus managed with precontoured locking plates. This study consisted of total 25 patients. In the present study maximum numbers of patients were found to be in sixth decade with average age 50.20 years. There were 11 male and 14 female patients.

Left side 14 (56%) distal humeral fractures were more common than right side 11 (44%) in the present study. 14 out of these were non-dominant extremities. In the present study mode of injury was direct fall in 13(52%) and RTA in 12 (48%). In the present study 8 cases of AO type C1, 12 cases of AO type C2 and 5 cases of AO type C3 fractures were included. 4 out of the total patients also had associated injuries like, head injury, chest injury and ipsilateral distal end radius fracture. All the patients were operated via transolecranon approach and fracture was fixed with bicolumnar precontoured distal humerus locking plates. Fracture union was achieved in all the patients with a mean duration of 12.56 weeks.

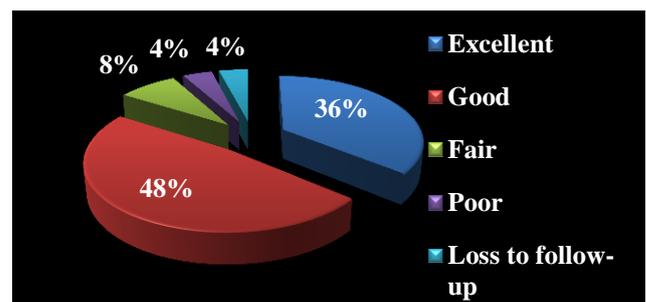


**Figure 3: Age and sex distribution.**



**Figure 4: Radiological union among patients.**

24 fixed elbows were reviewed at a follow-up period of 1 year. Results obtained were graded on the basis of MEPS. Excellent results were achieved in 9 (36%), good results in 12 (48%), fair in 2 patients (8%) and poor in 1 case (4%). 1 patients did not reported in follow up.



**Figure 5: Results among the patients.**

A mean arc of motion of  $108^{\circ} \pm 12.54^{\circ}$ , mean supination of  $80.4^{\circ} \pm 5.39^{\circ}$  and mean pronation of  $77.6^{\circ} \pm 8.05^{\circ}$  were reported at final follow up. Mean final MEPS of  $82.2 \pm 11.99$  was recorded among the study group.

**Table 2: Comparison of range of motion with results.**

Results	Range of motion ( $\mu \pm \delta$ )
Excellent (n=9)	118.13 $\pm$ 10.67
Good (n=12)	108.33 $\pm$ 4.92
Fair (n=2)	100 $\pm$ 8.16
Poor (n=1)	70 $\pm$ 0

Few complications like elbow stiffness, ulnar nerve neuropathy 1 (4%), superficial infection 3 (12%) and screws back out were reported among the patients. Despite these complications the overall functional result was good; suggesting that open reduction and internal fixation with precontoured distal humerus locking plate is an effective treatment modality in these fractures.

**Table 3: Post operation complications shown among the patients.**

Complications	No. of patients	%
Implant loosening	1	4
S/F infection	3	12
Stiffness	3	1
Ulnar neuropathy	1	4
No complications	16	64

## DISCUSSION

It is important to realize that final outcome of painless, functional range of motion at elbow causing no disability is more important than a sound radiographic and anatomic union. At the average follow up of 12 months, a mean arc of motion of  $108.6^{\circ}$  was achieved in our study which is comparable with other studies. The mean mayo elbow performance score was 82.2 comparable with other studies and signifies excellent results by maintaining functional arc of motion ( $30^{\circ}$  to  $110^{\circ}$ ).<sup>17-20</sup>

Within the last seven years, a two-column theory of the distal humerus anatomy has been advocated whereby the coronal plane of the distal humerus is in the shape of a triangle with the coronoid fossa and olecranon.

Fossa accounting for the majority of the central area, and the medial and lateral condyles forming two strong columns by proximal extension.<sup>21,22</sup> Fixation of the distal humerus must not only restore the capitellum-trochlea joint, but also the integrity of the medial and lateral columns. The articular segment functions architecturally as a tie arch.<sup>23</sup>

There are several options for fixation between the condyle and humeral metaphysis. These include the use of Y-shaped plates, single plates, double K-wire and K-

wire together with tension band wiring.<sup>5,24</sup> The aim is to facilitate biomechanical reconstruction of the before mentioned two column structure. We found that plates applied in orthogonal fashion gives the girder like effect by overcoming the bending forces and securing the two columns.<sup>20,27</sup>

Nowadays, the market offers anatomical plates designed especially for medial and lateral columns but these are expensive. We used re-constructive plates which are economical and give the stable and strong construct if applied in orthogonal fashion. Rigid fixation and early rehabilitation are the most important goals in treatment of type C elbow fracture. In our study, posterior approach with olecranon osteotomy was used in distal humerus fracture. This approach gives the better exposure of articular surface and both columns as well as it provides easy access to neural structures (ulnar nerve) and negates the risk of triceps injury without compromising extensor mechanism.<sup>20,25,26</sup>

Articular restoration is the most essential step followed by stabilization of the largest columnar fragment. Good exposure is mandatory for the fixation of Type C3 fractures and to provide good fixation. We found the operative field to be extensive, fracture reduction satisfactory and the implementation of early functional exercises easily possible. The most important step in these fractures is the early rehabilitation.<sup>27</sup> We started gentle active or active assisted exercises in the first week and active exercise around the third week. At the end of the sixth week we encouraged the patients to discontinue the cast. In each case, fracture reduction was satisfactory, fixation was strong and durable, fracture site stable and early post-surgical functional exercise was possible.

Post-operatively, 1 patient had transient ulnar nerve neuropraxia (which was completely recovered after 3 months), 3 patients had superficial infection which got better with antibiotics and dressings. Some degree of loss of extension is seen in most of the cases, more than 20 degree of stiffness is seen in 3 patients. Other complications encountered in our series were hardware failure and screws back out in 1, 15 patients had mild pain and 24 patients had no pain at all. There was no case of heterotopic ossification. This may relate to complete intraoperative hemostasis, unobstructed postoperative drainage, and early postoperative functional exercise.

Henley in their series of 33 patients observed fixation failure in 5 patients, infection in 2 patients, one superficial and one deep and heterotopic ossification in 2 patients.<sup>28</sup>

Sodegard et al in his series of 96 patients encountered 6 post-operative infections. 12 neural injuries and 16 fixation failures. Thus the complications in our study was comparable to other studies.<sup>29</sup>

## CONCLUSION

Open reduction and internal fixation with an anatomically precontoured locking plate is an effective method of treatment for AO type C distal humerus fractures. Stable fixation allows early, active and aggressive postoperative mobilization. This implant yields excellent or good results in majority of patients, even in C3 fractures because of improved biomechanics. Even in elderly patients it should be considered the treatment of choice. During open reduction internal fixation, articular reduction should be given primary importance. Vigorous, early, active rehabilitation is a must for good results. Residual pain is not uncommon and patients should be informed about this. Patient counselling is paramount.

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