

A Prospective Study on Functional Outcome of Adult Type C Distal Humeral Fractures with Bicolumnar Fixation

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Abstract: *In young adults, most distal humerus fractures occur from high- energy trauma, sideswipe injuries, motor vehicle accidents, fall from height and gunshot wounds. In elderly persons with more osteoporotic bone most of these injuries occur from trivial falls. Surgeons who treat fracture of the distal humerus frequently have realized the challenges that arise related to poor bony quality, distal separation of the articular fragment from the columns of the distal humerus and fragmentation of the articular surface in one or more. Even minor irregularities of the joint surface of the elbow usually cause some loss of function. Surgical treatment for these fractures has evolved significantly in the last 30 years. In the 1960's and 1970s, most surgeons condemned surgical treatment due to high failure rates with loss of fixation, non union and elbow stiffness. In the 1970s, treatment began to shift from casting and the "bag of bones" technique to surgical intervention with limited internal fixation. Again, results generally were poor due to lack of adequate stabilization for early motion. In the early 1980s, the AO-ASIF group reported good and excellent results in 27 of 39 patients with comminuted fractures of the distal humerus. These by far were the best results reported in the treatment of these difficult fractures at that time. This led to an increased enthusiasm for surgical reduction and fixation.*

Keywords: distal humerus fracture, bicolumn fixation, intercondylar screw, functional outcome

1. Introduction

In young adults, most distal humerus fractures occur from high- energy trauma, sideswipe injuries, motor vehicle accidents, fall from height and gunshot wounds. In elderly persons with more osteoporotic bone most of these injuries occur from trivial falls.

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Surgical treatment for these fractures has evolved significantly in the last 30 years. In the 1960's and 1970s, most surgeons condemned surgical treatment due to high failure rates with loss of fixation, non union and elbow stiffness.¹ In the 1970s, treatment began to shift from casting and the "bag of bones" technique to surgical intervention with limited internal fixation. Again, results generally were poor due to lack of adequate stabilization for early motion. In the early 1980s, the AO-ASIF group reported good and excellent results in 27 of 39 patients with comminuted fractures of the distal humerus. These by far were the best results reported in the treatment of these difficult fractures at that time. This led to an increased enthusiasm for surgical reduction and fixation.

2. Aim of Study

The purpose of this prospective study is to assess the

functional outcome of adult comminuted supracondylar fracture with intercondylar extension by open reduction and bicolumnar fixation.

3. Materials and Methods

This study is a prospective study conducted in sree balaji medical college and hospital ,chromepet ,Chennai from January 2015 to December 2018. Adult with distal humerus fracture type C were recruited from January 2015 to December 2018. The maximum follow up was a period of 36 months and minimum followup was a period of 12 months.

3.1 Materials

During the above period 35 patients with acute displaced type C fractures were treated with open reduction and internal fixation with bicolumnar plating and all the patients were followed up.

Inclusion criteria

- 1) Age between 26 to 60
- 2) Displaced adult distal humerus fracture
- 3) Multiple trauma patients
- 4) Upto Grade I Open fractures

Exclusion criteria

- 1) Age less than 26 years
- 2) Malunion & nonunion with preoperative stiffness
- 3) Grade II and III open fractures

3.2 Methods

Preoperative Evaluation

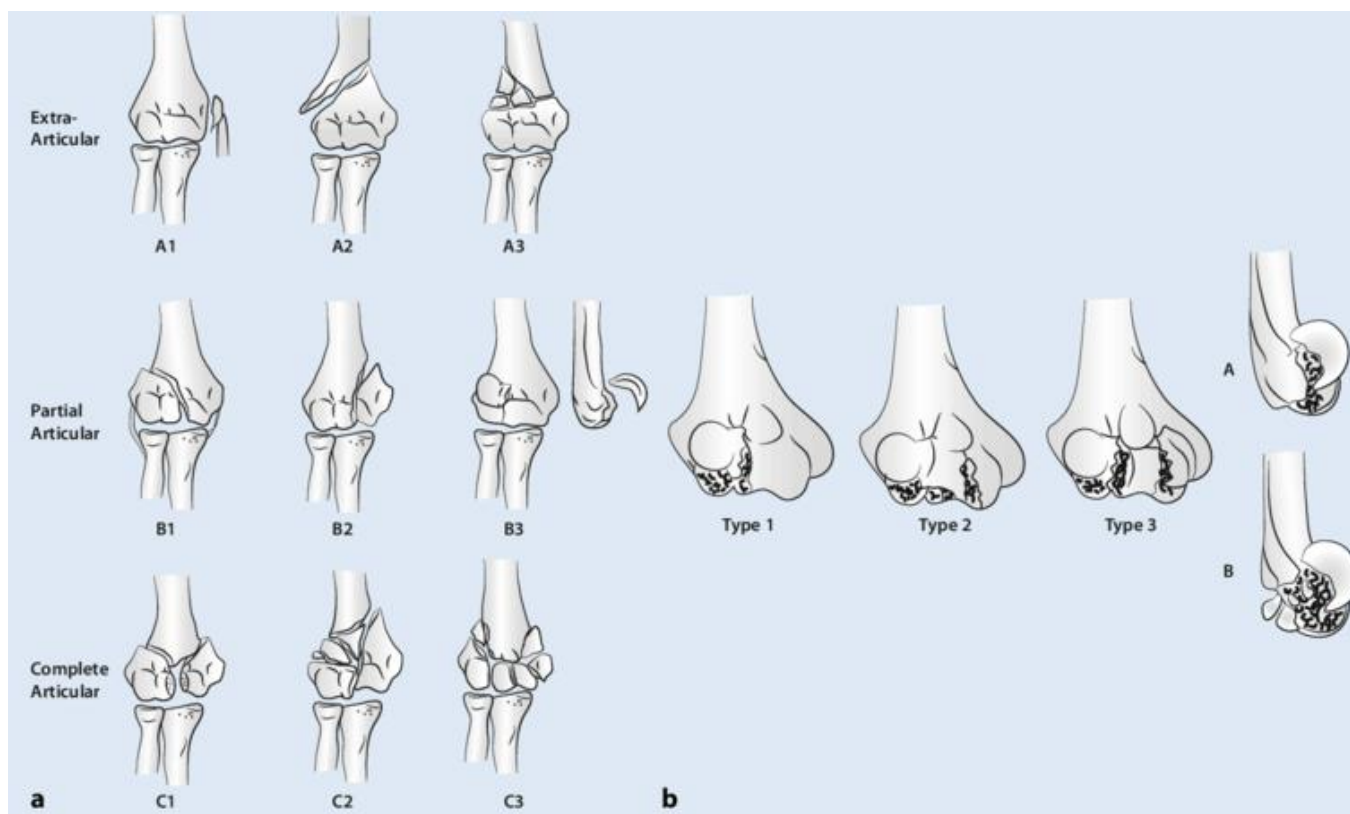
On admission, careful history was elicited from the patient or attendants to reveal the mechanism of injury. The patients were examined clinically for vitals signs, associated surgical and medical comorbidities and local examination for skin and soft tissue injuries, evidence of fracture displacements, deformity and neurovascular status. Fracture configuration was assessed by taking x-ray and CT scans and pre operative planning was done.

Treatment Protocol

25 out of 35 were operated under regional block and rest were operated under general anaesthesia. All cases were operated under tourniquet Control. The patients were placed in prone position with the involved extremity hanging off the operating table in flexed position or alternatively patients were placed in the lateral position with the involved extremity hanging over a bolster.

Surgical Technique

With the patient in prone or lateral position, patients under tourniquet control with the tourniquet applied as proximally as possible in the arm after exsanguination the tourniquet was inflated to approximately 220 mmHg.

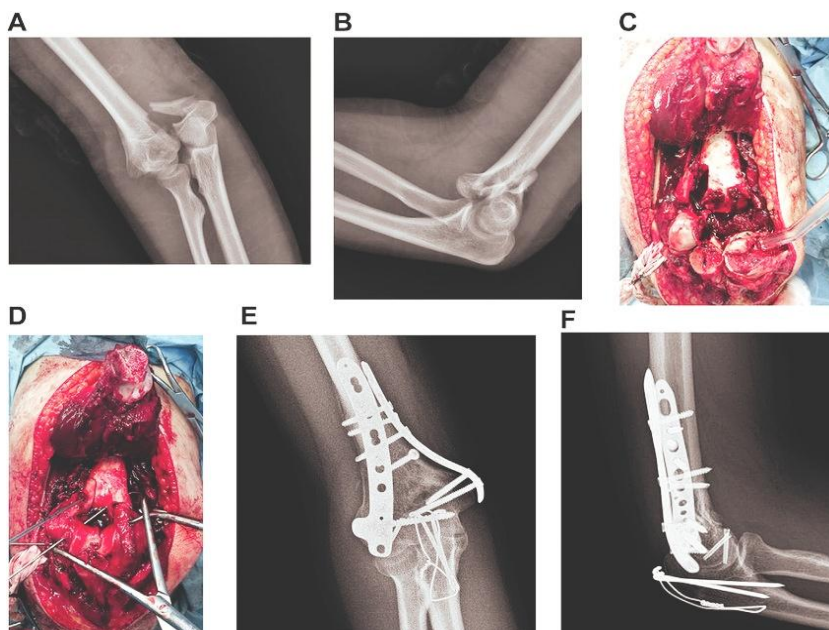


Through posterior approach elbow was approached. Olecranon osteotomy was done and fracture site was exposed. Primarily the intercondylar fracture reduced and fixed with k-wires. Then the condyles were fixed with 4mm cannulated cancellous screws. The columns were fixed with anatomical locking plates on the medial and lateral side.

It was important to ensure that none of the implants encroach upon the olecranon fossa which will result in impairment of extension. Following olecranon osteotomy

was fixed using tension band wiring technique with cancellous screws or tension band wiring with k-wire.

Tourniquet removed and haemostasis achieved and wound wash given and wound closed in layers with suction drain without tension at the suture site. The time of surgery was 62 minutes to 88 minutes in all the cases with a mean time period of 71 minutes.



A-type c fracture AP view
 B-type c fracture lateral view
 C and D- intra op picture
 E and F – post op xray AP and Lateral view

Post-Operative Care

- The patient was placed in a posterior splint (i.e. above elbow slab) with a bulky dressing and neurological status checked every 4th hourly.
- After 48 hours, the first post-operative dressing was done, drains were removed.
- The subsequent dressing was kept light and firm.
- Patients were discharged by 6th day and advised to come for review on 12th day for suture removal and POP removed.
- The patient was given injection cefaperazone and sulbactam 1.5gm iv for 48hrs and converted to oral antibiotics which are continued for 5 days.
- All patients were put on capsule indomethacin 25mg tds for 6 weeks.

All patients were subjected for passive physiotherapy after one month and full activity after 3 months. Full activity was allowed at three to four months as fracture consolidation occurred.



A-fracture type c distal humerus, B and C –post op xray AP and Lateral

Follow up

Patients were kept under regular followup. In patients with rigid fixation, active gentle motion of involved limb several times a day within the limits of pain was advised within 1st week postoperative period. All patients were encouraged to achieve greater than 60° of range of motion within a month.



Post op functional outcome

4. Results and Analysis

Post operatively patients were reviewed every two weeks for the first two months and monthly for the next two months, then every two months until fracture healing or full range of motion was regained.

Sex distribution

27(77.14%) patients were male and 8(22.85%) were female.

Mode of injury

The mechanism of injury was RTA in 25(71.42%), Direct trauma in 7(20%) , Fall from height in 3(8.57%) ,10(28.57%) fractures involved the left elbow of which one was dominant and 25(71.42%) were right elbow all of which were dominant. Two among 35 cases were open fractures. Nine patients had associated injuries of which 6 had head injury, two with multiple rib fracture on ICD, four with fracture of clavicle and two had ulnar nerve neurapraxia which recovered later in two months. Twelve patients had associated diabetes mellitus, six had systemic hypertension. According to **AO/ASIF fracture classification** 5 were C1(14.28%), 25 were C2(71.42), 5 were C3(14.28%).

Functional task	Toileting	5 points
	Dressing	5 points
	Eating	5 points
	Writing	5 points
	Driving	5 points
Rating Of Mayo Elbow Performance Score		
Excellent : 90-100 points		
Good : 75-89 points		
Fair : 60-74 points		
Poor : Less than 60 Points		

Table 1: Descriptive Statistics based on Age Group

Age Group	Male	Female
26-30 years	12	1
31-35 years	5	2
35-40 years	7	4
41-45 years	2	1
46-50 years	1	0
51-55 years	0	0
56-60 years	0	0

Majority of patients fall in the 3rd and 4th decade of age

Descriptive Statistics based on Side Affected

Side Affected	No. of Patients
Right Side	25
Left Side	10

Descriptive Statistics based on Type of Fracture

AO TYPE	No. of patients
C1	5
C2	25
C3	5

Majority of patients had type C2 fracture pattern

All the fractures united radiologically with the average union time being 12 weeks (9 – 16wks) which is comparable with other studies. The average blood loss was 200ml(range 100-500ml). Ulnar nerve transposition was done in all the cases. Orthogonal plating done in 27(77.14%), parallel plating in 8(22.85%). Olecranon osteotomy fixed with K wire and TBW in 25(71.44%) cases, 5(14.28%) cases with cancellous screw and TBW and 5(14.28%) with cancellous screw alone. Post operatively elbow function was evaluated using physician based elbow scoring system using Mayo Elbow Performance Index (MEPI).²⁷ This index divides 100 points among a physician assessment of 4 criteria.

Table 4: Mayo elbow performance index

Criteria	Pain	45 points
		Ulna Humeral
	Motion Stability	10 points
	Functional tasks (5 nos.)	25 points
Pain	No pain	45 points
	Mild	30 points
	Moderate	15 points
	Severe	0 points
Ulna humeral motion	Flexion-extension arc <100°	10 points
	Flexion-extension arc >100°	20 points
Stability	Stable	10 points
	Unstable	0 points

According to Mayo Elbow Performance Index 28(80%) patients had complete pain free movements at the end of three months, 3(8.57%) had mild pain, 3(8.57%) moderate and 1 (2.85%) had severe pain. Among 35 patients 34(97.14%) patients had stable fixation and that 1(2.85%) patient having instability is mainly due to implant failure and nonunion. Regarding flexion extension arc 28(80%) patients had more than 100 degrees of FE arc 7(20%) patients had less than 100 degrees of FE arc. According to Mayo Elbow Performance Index 24(68.57%) patients had excellent outcome, 5(14.28%) had good 5(14.28%) had fair and 1(2.85%) had poor outcomes. 2(5.71%) patients had postoperative ulnar nerve injury in the form of paraesthesia which later recovered in six weeks. 2 (5.71%) patient had associated non-union which required resurgery with bone graft. One (2.85%) patient had skin breakdown at cancellous screw head used to fix the osteotomy with superficial infection which healed later on with antibiotics and other 1 (2.85%) patient had skin breakdown at K wire region used to fix the osteotomy which healed later on with secondary intention. One case (2.85%) of olecranon osteotomy fixed with cancellous screw alone went to nonunion which later required TBW and bone grafting.

Descriptive Statistics based on Type of Fixation of Fracture

Type of Fracture Fixation	No. of Patients
Orthogonal	27
Parallel	8

Descriptive Statistics based on Postoperative complications

Postoperative Complications	No. of Patients
Neuropraxia	1
Nonunion at Fracture site	1
Nonunion at Osteotomy site	0
Infection	1
Implant failure	0
Skin Breakdown at Cancellous Screw head region	0

5. Discussion

Fractures involving the distal humerus present a difficult problem in management. Intercondylar fractures of the distal humerus in adults are still more difficult to treat because of the nature of injury and the nonoperative approach to these fractures can neither ensure good restoration of the articular surface nor permit early mobilization of the elbow, key factors in achieving good function. Consensus is gradually building for surgical stabilisation of these fractures, largely as a consequence of significant advances in surgical technique and implants during the last decade ensuring a

stable osteosynthesis of small articular fragments.

In our study most of our patients were males and most of them fall within in the age group of 40 years. Road traffic accident and fall from height were the most common mode of injury which were in accordance with literature except for a little younger age group in our study, which probably is because of increased incidence of road traffic accidents in third & fourth decades of life.

The complex geometry of the distal humerus requires the normal condyle–shaft angle restored in the axial, coronal and sagittal planes. Intercondylar distance must be maintained in case of intercondylar comminution, to achieve an anatomic reduction with restoration of satisfactory function³⁶. Several methods of fixation have been described and numerous investigators have made biomechanical comparison of those methods and implants used^{34,28,42}. Although the rigidity of the reconstruction plate and 1/3rd tubular plate is questioned^{33,41} it is recommended for fixation of fractures over complex but nonweight bearing areas in most studies^{10,26,28,30,33-40}. In this series we used 3.5mm reconstruction plate to fix displaced fractures of the adult distal humerus, and the results were encouraging and the number of implant failure was very minimal as it was evident by one case of implant breakage placed for the medial column.

According to **MEPI**, all type C1 fractures had excellent outcome, 9 out of 12 C2 fractures had excellent outcome, 2 had good outcome and one had poor outcome and among 5 C3 fractures 2 had poor outcome, 2 had fair outcome and one had excellent outcome comparable to other studies^{10,46,54,56,57,58} which concludes the influence of fracture geometry in functional outcome.

Most studies^{10,46,54-58} which analysed the outcomes of adult type C fractures with dual plating by their individual criterias concluded that a stable elbow, minimal or absent pain, no deformity, a ROM between 30- 120 degrees and return to near preoperative activity were all consistent with a satisfactory elbow.

6. Conclusion

From this study we arrive at the following conclusion:

- Open reduction and internal fixation must be considered as the treatment of choice in acute type C fractures of adult distal humerus unless contraindicated.
- Use of tourniquet is beneficial in distal humerus fracture fixation in reducing the operating time.
- Transolecranon approach is to be preferred in fixing type C3 fractures, as it provides better visualization to reconstruct the joint.
- The fracture pattern greatly influences the functional outcome as we had poor score on MEPI with type C3 fractures.
- Regarding functional outcome, majority of our patients with C1 and C2 fracture pattern had good score on MEPI.

References

- [1] Keon Cohen BT. Fracture of the elbow. *J Bone Joint Surgery* 1966; 48A: 1623.
- [2] Miller WE. Comminuted fracture of the distal end of the humerus in the adult. *AA OS Instructional Course Lectures. J Bone Joint Surgery* 1964; 46A: 644.
- [3] Miller DL. Blind nailing of the T-shaped fracture of lower end of humerus which involves joint. *JBJS* 1936; 21: 933-938.
- [4] Eastwood WJ. The T-shaped fracture of lower end of the humerus. *J Bone Joint Surgery* 1937; 19: 364.
- [5] Watson Jones P. *Fractures and joint injuries*. 4th ed. Living stone, Edinburgh, 1947.
- [6] Muller ME, Allgower M, Willenegger H. *Technique of internal fixation as fractures*. New York, Springer, 1958.
- [7] Desai PM, Divatia PA, Ravindra G. Intra-articular fractures of the lower end of humerus. *Clinical Ortho P India* 1989; 4.
- [8] Jupiter JB, Neff U, Holzach P, Allgower M. Intercondylar fractures of the humerus: an operative approach. *Am J Bone Joint Surgery* 1985; 67A: 226-31.
- [9] Gerard T, Gabel, Gregor Hanson. Intra-articular fractures of the distal humerus in adults - Post operative complications. *Clinic Orthop* 1987; 99-107.
- [10] Brain J, Holdsworth, Mossad MM. Fractures of the adult distal humerus - Elbow function after internal fixation. *Br J Bone Joint Surgery* 1990; 72B:362-5.
- [11] Job N, Doornberg, David Ring. Pain dominates measurements of elbow function and health status. *J Bone and Joint Surgery* 2005; 87- A: 1725-31.
- [12] Mickae Mikee et al. Re construction after malunion and non-union of intra-articular fractures of the distal humerus. *Methods and results in 13 adults. JBJS* 1994; 763: 614-21.
- [13] Snell RS. *Clinical anatomy*. 7th ed. Lippincott Williams and Wilkins, 2004.
- [14] Keith L, Moore, Arthus F. Dally. *Clinical Oriented anatomy*. 4th ed.
- [15] Lippincott Williams and Wilkins, 2004.
- [16] Muller M. *The comprehensive classification of fractures of long bones*. Berlin: Springer, Verlay, 1990.
- [17] Gabel GT, Hanson G, Bennett JB, et al. Intra-articular fracture of the distal humerus. *Clin Ortho P* 1987; 216: 99-108.
- [18] Meffer WE. Comminuted fractures of distal end of the humerus in the adult. *JBJS* 1964; 46-A: 644-657.
- [19] Reich RS, *Treatment of Intercondylar fractures of the elbow by means as traction. JB AM* 1936; 18: 997-1004.
- [20] Van Gorder G. Surgical approach in supracondylar T-Fractures of the humerus requiring reduction. *Am J Bone Joint Surgery* 1940; 22: 278-292.