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Original Research Article

Intra Articular Type C Distal Humeral Fractures Fixed with Orthogonal (90-90) Plating.

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Abstract:

Background: Distal humeral fractures account for 2% of all fractures and 30% of fractures around elbow joint. They occur in bimodal distribution, with one peak in young patients following high energy trauma and another in elderly due to low energy trauma. The current standard of care like any other intra articular fracture is stable anatomical reduction and early mobilization of elbow joint. We studied functional results of forty-seven patients fixed with orthogonal dual plating using Mayo's Elbow Performance Index.

Materials and Methods: Distal humerus intra articular fractures (AO TYPE C) were treated with open reduction and internal fixation with orthogonal plating in forty-seven patients. Functional outcome was evaluated using Mayo Elbow Performance Index along with radiological outcome.

Results: The mean duration of follow up was 27.2 months. Forty-four fractures united primarily. One patient with compound grade 2 injury had deep infection treated in two stages, first debridement and implant removal and re-fixation after six weeks, had poor outcome. Two patients were lost to follow up, forty-five patients were available for final follow up. Another patient had skin impingement due to back out of K wires used for olecranon osteotomy fixation, K wires removal was done. Two had elbow stiffness, treated with arthrofibrolysis. The mean arc of elbow was 108 degrees. The mean MEPI was 84.55. The mean elbow flexion contracture was 11.6 degrees.

Discussion: The management of intra articular distal humeral fractures has many variables with respect to the approach to reduce the fractures and use of implants which can hold the fragments in reduction. In due course of time, these factors play an important role in the functional outcomes of the patients. Faster rehabilitation, good elbow range of motion and satisfactory bony union all contribute to the final outcomes in these complicated fractures.

Conclusion: Distal humerus fractures are challenging to manage. Good prognosis depends on many factors like fracture communition, need for olecranon osteotomy and good post-operative rehabilitation. In our study we have observed better outcome scores in C1 and C2 type of fracture as compared to C3 type.

Keywords: Distal Humeral Fractures, Locking Plates, Open Reduction, Intra Articular, Olecranon Osteotomy.

Introduction

Distal humeral fractures are uncommon injuries around elbow joint, accounting for 2% of all fracture [1, 2]. The current standard treatment in young patients is stable anatomical fixation, to facilitate early elbow mobilization. [3-6] The last decade has seen advances in the understanding of elbow anatomy, improvements in surgical approaches, new innovative fixation devices, and an evolution of postoperative rehabilitation protocols (Singh and Waikhom 2004) [7-9]. Despite the advances in the management of distal humeral fractures, the optimal treatment still remains controversial. There are no clinical or bio-mechanical studies which conclude regarding the placement of plates, whether parallel plating or 90-90 orthogonal plating is better. Restoration of a functional elbow joint and the avoidance of joint stiffness following a distal humerus fracture require early range of motion (ROM) of the elbow, which depends on anatomic reduction of the intra-articular fragments of the fracture and their stable

fixation [10,11]. Primary total elbow arthroplasty (TEA) has evolved to become a viable treatment option for elderly patients with articular fragmentation comminution and osteopenia [11, 12, 13].

However, in the management of intra-articular distal humerus fractures in adult's controversy still exists regarding the surgical approach, type of olecranon osteotomy, method of stabilization of osteotomy, type of fracture stabilization, use of orthogonal or parallel plate fixation, need for anterior transposition of ulnar nerve, place for primary TEA and type of rehabilitation schedule after surgical fracture treatment. [8] In 2003, Schildhauer et al described an extensor mechanism-sparing, paratricipital, anconeus-preserving approach with bicolumnar visualization through medial and lateral windows with the triceps insertion on the olecranon kept intact. [31] We routinely use this approach when olecranon osteotomy is not done.

The limiting factor with the AO/ASIF (Orthogonal fixation) technique is inadequate fixation of the distal fragments and, therefore, insufficient stability between the distal fragments and the shaft. If early motion is attempted in the face of tenuous fixation, nonunion at the supracondylar level may occur. [10] Alternatively, prolonged immobilization used to prevent failure of insufficient fixation may result in elbow stiffness. [9] We studied forty-five patients with type C distal humeral fractures fixed with orthogonal plating. The results were analyzed with MEPI and serial radiographs.

Materials and Methods

This is a retrospective study. Data of all patients presenting with distal humeral fractures (Type-C) operated by the authors at a single institute between 2012-2018. Forty seven consecutive patients (males: females, 32:15) presenting with pain and swelling of the elbow diagnosed to have fracture of distal humerus with radiographs and CT scan were included in the study. Mean age of patients was 44.15 years, with youngest patient was 21 years and oldest patient was 78 years. Two patients had an open injury (Gustilo Anderson type 2). Patients with previous injury to the elbow, pathological fractures, chronic drug usage which can interfere in bone healing were excluded from the study. Two patients lost to follow;f orty-five patients were available for final follow up. Average follow up period was 27.2 months, with follow up period from 6 months to 48 months. The preoperative radiographs were assessed to classify according to AO/Association of surgeons for internal fixation (Table 2). Postoperative radiographs were evaluated for fracture union, hardware position and heterotrophic ossification. [16]

Operative Procedure

Patients were placed in lateral decubitus with arm resting on arm rest without tourniquet. Standard posterior approach was used, with careful dissection of ulnar nerve. The paratricipital anconeus sparing approach was used in nineteen patients and Chevron olecranon osteotomy was done in nine patients where intra articular comminution was severe and intra articular reduction was difficult (C3). Intra articular fractures were reduced and fixed temporarily with 1.5mm k wires. No fragment was discarded except for very small ones. Intra articular reduction was held with pointed clamp, at most care was taken to reconstruct trochlea anatomically and recreate olecranon fossa. Intra articular reduction was fixed with 4mm cannulated cancellous screw. Both columns were later reduced to shaft and fixed temporarily with k wires. The condyle shaft orientation was restored using pre contoured postero lateral locking plates. The advantages of postero lateral plating are preservation of attachment of lateral collateral ligament and plate contouring is better. The distal end of the plate is placed such that it does not hinder radial head in full extension. The plates used were low cost to suit our population. Medial side plate applied along the medial ridge with sharp bend over medial epicondyle. Medially either locking plate or reconstruction plate was used where it was difficult to contour locking plates.

Columns were fixed with medial and lateral locking plates in eighteen cases. In remaining ten patients medial reconstruction and lateral locking plates were used. Olecranon osteotomy was fixed with tension band wiring using 1.5 k wires or 7mm cannulated cancellous screw. No ulnar nerve transposition was done.

Post operatively posterior slab was applied with elbow 70 degrees to 90 degrees for three weeks. The patients were followed up at 3 weeks, 6weeks, 3,6,12 months and yearly. Active range of motion was started at three weeks. Muscle strengthening exercise was stared at three months once radiological union was seen. Results were assessed using MEPI. [15]

Results

A total of 47 patients were included in the study. Two patients were lost to follow. The Mean age was 44.15 years (21-78 years). The Dominant side was involved in fifteen patients. Patients were followed up for mean period of 27.2 months (06 to 48 months). Mean period for radiological fracture union was 13 weeks (9 to 20 weeks). Mean fixed flexion deformity of elbow was 11.6 degrees. Mean elbow range arc was 108 degrees (80 to 135 degrees). Functional assessment was done with MEPI. Mean MEPI was 84.55. One patient had back out of k wire used for olecranon fixation, implant removal was done. We had two patients with infection which required debridement. Two patients had post-operative elbow stiffness, managed with arthrofibrolysis. None of the patients had ulnar

nerve related complications, olecranon osteotomy nonunion or myositis ossificans. (Table 5) It was difficult to assess valgus or varus deformity due to fixed flexion deformity of elbow. ANOVA Single factor analysis was used to know the difference between C1, C2 and C3 onMayo Elbow performance Index, Flexion degree and Loss of extension degree. (Table 6) There was no statistical significance between the three groups. T-test assuming unequal variance was used to know the difference between patients with and without osteotomy with respect to Mayo Elbow performance Index, Flexion degree and Loss of extension degree. There was no statistical significant difference between the two groups. This may be attributed to low sample size in two groups. (Table 7)

Table 1: Demographic Details

Characteristics	Patients
Age in years, Mean	21-78, 44.15
Gender n (%) Male Female	 32 (68.08) 15 (31.92)
Duration of Follow up in months Average in months	6- 48 27.2
Mechanism of injury n (%) MVA Fall from height Slip/trip and fall	 38(80.85) 04(8.51) 05(10.63)
Type of fracture according to AO n (%) C1 C2 C3	 21(44.68) 15(31.91) 11(23.40)

Table 2: Results according to AO fracture type

Ao Classification	Numbers	Mean MEPS	Mean Rom	Mean FFD
C1	20	86.25	115.25	9.75
C2	15	84.66	104.0	12.0
C3	10	81.0	111.0	14.5
Total	45	84.55	108.08	11.6

Table 3: Results based on surgical technique

Olecranon Osteotomy	Numbers	Mean MEPS	Mean Rom	Mean FFD
Yes	15	80.66	107.0	14.0
No	30	86.50	115.5	10.33

Table 4: Results based on type of implant used

Implants Used	Numbers	Mean MEPS	Mean ROM	Mean FFD
Dual LCP	35	81.42	111.7	12.28
Medial Recon Plate and Lateral LCP	10	86.50	117.0	9.0

Table 5: Findings at post-operative follow up

Characteristics	Patients(n=45)
Post-operative complications Deep wound infection Hard ware back out(TBW) Elbow stiffness	 2 (4.4%) 1(2.2) 2(4.4%)
According to MEPI score Excellent Good Fair Poor	 15 25 04 01
Function at the end of final follow up	
Mean ROM Mean FFD	108.08 11.6

Table 6: Functional results based on fracture type

	Type C1 n=20	Type C2 n=15	Type C3 n=10	P VALUE
Mayo Elbow performance Index, Mean	86.25±8.56	84.66±8.33	81.00±13.70	0.39
Flexion degree, Mean	115.25±18.67	104.00±20.28	111.00±23.66	0.78
Loss of extension, degree	9.75±7.34	12.0±7.74	14.5±8.31	0.28

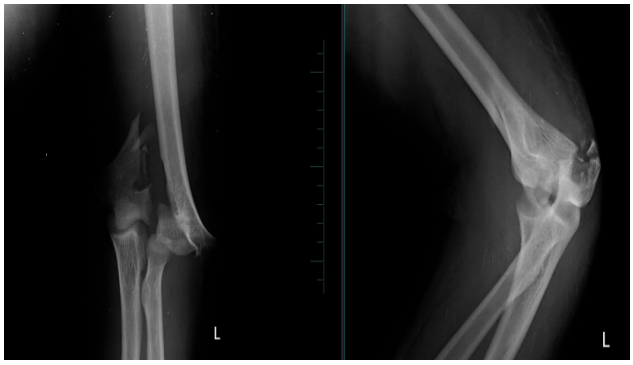
Presence of complications (%)	1 (5.00)	1 (6.66)	2 (20.00)	-
Surgical technique (%) Osteotomy Without osteotomy	 03 (15.00) 17 (85.00)	 03 (20.00) 12 (80.00)	 09 (90.00) 01 (10.00)	-

ANOVA Single factor to know the difference between C1, C2 and C3 onMayo Elbow performance Index, Flexion degree and Loss of extensiondegree.

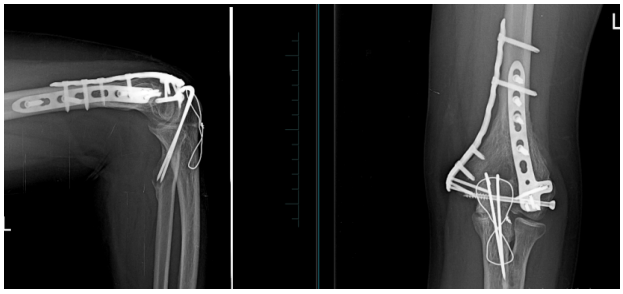
Table 7: Comparison between scores of patients with and without osteotomy

	With Osteotomy n=15	**No osteotomy n=30**	**P Value**
Mayo Elbow performance Index, Mean	80.66±12.93	86.50±7.32	0.12
Flexion degree, Mean	107.66±25.27	115.50±16.67	0.28
Loss of extension, degree	14.00±8.49	10.33±7.18	0.16

Picture 1: Pre-operative radiographs



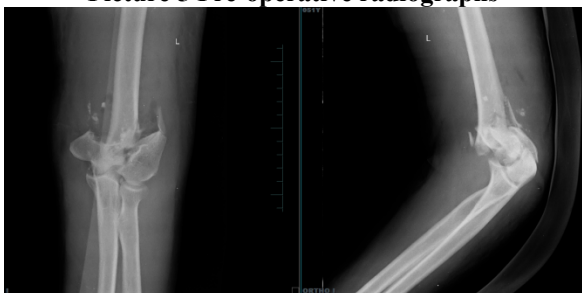
Picture 2: Post-operative Radiographs



Picture 3: Clinical Picture depicting ROM Flexion and extension

Picture 4 Clinical picture depicting pronation and supination

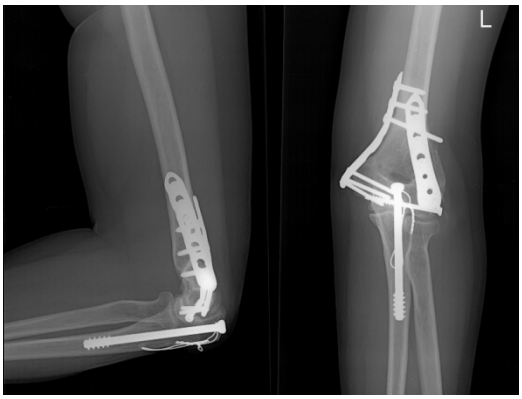
Picture 5 Pre-operative radiographs



Picture 6 Post-operative radiographs

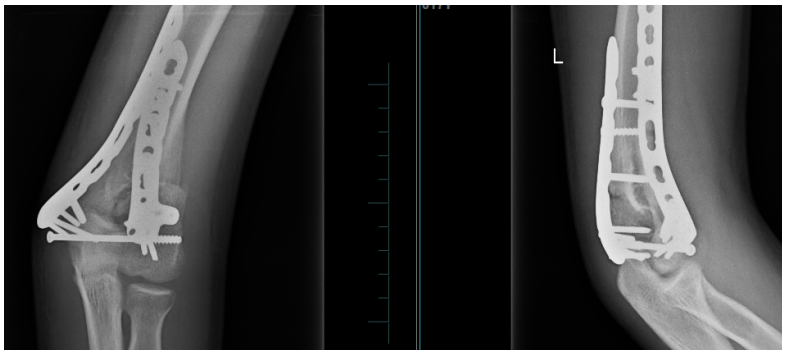
Picture 7 Clinical picture depicting supination and pronation

Picture 8 Clinical picture depicting flexion and extension



Case 4 Pre-operative radiographs

Post-operative radiographs



t-test assuming unequal variance to know the difference between patients with and without osteotomy with respect to Mayo Elbow performance Index, Flexion degree and Loss of extension degree.

Discussion

The management of intra articular distal humeral fractures has many variables with respect to the approach to reduce the fractures and use of implants which can hold the fragments in reduction. In due course of time, these factors play an important role in the functional outcomes of the patients. Faster rehabilitation, good elbow range of motion and satisfactory bony union all contribute to the final outcomes in these complicated fractures.

Intra articular distal humeral fracture fixation is a technically demanding surgery. The complexity of the anatomy of distal humerus and the comminution of articular fragments make fixation more difficult. [16] Stable anatomical fixation and early range of motion are the key for good results. Despite this we land up in elbow stiffness. Articular fibrosis, intra articular comminution and disruption of extensor mechanism are the causes for stiffness of elbow. In our study olecranon osteotomy was done in 15 patients and paratricipital anconeus sparing approach in 30 patients. Mean MEPI, ROM and FFD are shown in (Table 7). Since osteotomy was done for AO C3 fractures in our study. Extensive soft tissue dissection and comminution may be the reason for the less outcome score.

The fixation of comminuted intra articular fractures by dual plating is considered more stable than unicolumnar single plating.[17,18,19,24] Dual plating techniques consist of parallel or perpendicular configuration. There has been controversy regarding the orientation of plates, with literature suggesting varying results between the two groups. [20,22, 23,24] .Various bio-mechanical studies have been done to compare between two configurations of plating. But there is no conclusive clinical evidence that parallel plating is technically better to perpendicular plating. There are only few studies to compare parallel with perpendicular plating. [24, 25] In our study we have used bicolumnar fixation with dual LCP in 35 patients and medial recon plate and lateral side LCP in 10 patients. Mean MEPI, mean ROM and mean FFD are shown in (Table 4). Improved functional outcome seen in patients fixed with recon plate and lateral LCP correlates with AO type C1 and C2 fractures. Comminuted C3 fractures were fixed with dual LCP.

Rehabilitation places a major role in the achieving a better outcome in the management of distal humeralfracture [26]. In our study mean ROM was 108 degrees and mean FFD was 11.6 degrees. In Hakan Ozdemir et al the mean elbow flexion was 115.1 degrees and the mean extension loss was 26.3 degrees [28]. In ZeynelMert Asfuroglu et al study the mean degrees of flexion and extension loss were 102.2 degrees (range 60-120 degrees) and 11.4 degrees (range 0-25) respectively, at final follow up[26].

Complications were noted in our study include infection and hardware prominence. Infections are more common in open fractures with a reported incidence of 3 to 12%. We had two patients with infection which required debridement. Two (7%) patients had post-operative elbow stiffness, managed with arthrofibrolysis. One patient with posterior skin impingement from the K wires used for tension band wiring done for olecranon osteotomy, required implant removal. None of our patients had nonunion of the fracture or ulnar nerve complications. (Table 5)

Limitation in our study was lack of control group to compare with a different surgical procedure. Our study sample size is less to compare results between osteotomy and no osteotomy groups.

Conclusion

Distal humerus fractures are challenging to manage. Good prognosis depends on many factors like fracture communition, need for olecranon osteotomy and good post-operative rehabilitation. In our study we have observed better outcome scores in C1 and C2 type of fracture as compared to C3 type.

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