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A Prospective Study of Surgical Management of Intercondylar Fractures of Distal End of Humerus Treated with Locking Compression Plate

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Abstract

Background: Restoration of painless and satisfactory elbow function after a fracture of the distal humerus requires anatomic reconstruction of the articular surface, restitution of the overall geometry of the distal humerus, and stable fixation of the fractured fragments to allow early and full rehabilitation. *Methods:* We studied 25 consecutive patients with distal humerusintercondylar (AO Type C) fracture, included in study as per inclusion criteria. The following methods of statistical analysis have been used in this study. The data collected was entered in Microsoft Excel and Statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) 20.0 software. *Results:* A prospective study was conducted in sapthagiri hospital between September 2015 to May 2016. We studied 25 consecutive patients with distal humerusintercondylar (AO Type C) fracture, included in study as per inclusion criteria. *Conclusion:* Operative treatment with rigid anatomical internal fixation should be the line of treatment for all AO type C fractures, more so in young adults as it gives best chance to achieve good elbow function. Stable fixation allows early, active and aggressive postoperative mobilization.

Keywords: Distal HumerusIntercondylar; Locking Compression Plate; Mayo.

Introduction

Distal humeral fractures account for approximately 2%–6% of all fractures and for approximately 30% of all elbow fractures [1]. The complex anatomy of the distal end of the humerus, with its unique orientation of articular surfaces supported by a meager amount of cancellous bone, makes its fracture a constant challenge to orthopaedic surgeons [2].

The complex shape of the elbow joint, the adjacent neurovascular architecture, and the sparse soft tissue envelope combine to make these fractures difficult to treat. Acceptable results have been reported in a majority of patients treated by open reduction and internal fixation [3]. There is a bimodal distribution with respect to the patients age and gender. Peaks of incidence were described in males age 12 to 19 years and in females age 80 and older [4].

The most common causes of these fractures are falls in the elderly population and sports injuries or road traffic accidents in the younger patients [5]. Up to now, the rareness of distal humerus fractures has prevented any single surgeon from gaining sufficient experience in managing the different fracture patterns, resulting in differing recommendations for treatment [6]. Majority of the distal humerus fractures (96%) have a complex pattern involving both the columns and the articular surface (AO type C injuries) [7].

The only reliable method for restoring the normal alignment and contour of the distal humerus is

operative exposure and direct manipulation of fracture fragments. However, fixation of fracture fragments must be stable enough to allow motion while ensuring union. 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 [8].

By the 1970s, the advent of the AO group and the introduction of new instrumentation and techniques helped the surgeons to achieve accurate anatomical reduction and stable internal fixation. This allowed early mobilization of the joint and gave satisfactory results [9].

Bicondylarintraarticular fractures of the distal humerus, because of their rarity and often associated significant displacement, comminution, and osteopenia, present the orthopedician with a difficult injury to reliably treat successfully. As with any displaced intraarticular fracture, the principles of anatomic restoration of the articular surface, stable fixation, and early motion are the optimal treatment goals [10].

Restoration of painless and satisfactory elbow function after a fracture of the distal humerus requires anatomic reconstruction of the articular surface, restitution of the overall geometry of the distal humerus, and stable fixation of the fractured fragments to allow early and full rehabilitation [11].

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 [12].

Methodology

We studied 25 consecutive patients with distal humerusintercondylar (AO Type C) fracture, included in study as per inclusion criteria. On admission of the patient, a careful history was elicited from the patient and/or attendants to reveal the mechanism of injury and the severity of trauma. The patients were then assessed clinically to evaluate their general condition and the local injury. Methodical examination was done to rule out fractures at other sites. Local examination of injured elbow revealed swelling, deformity and loss of function. Any nerve injury was looked for and noted. Distal vascularity was assessed by radial artery pulsations. Radiographic study was done taking AP and lateral X-ray of the involved elbow. CT scan was done in communited fractures especially to rule out capitellum fracture. All patients were informed before they were included in study and written consent for willful participation was taken. Fractures were classified as per AO classification and only AO type C were included in the study. All patients were treated surgically using posterior trans-olecranon approach with ulnar nerve exploration and fixation using dual plating and tension band wiring for olecranon osteotomy.

Inclusion Criteria

- Patients over 18 yrs of age.
- Patients with Intercondylar fractures of distal end of Humerus (AO Type C).

Ecclusion Criteria

- Open fractures.
- Skeletally immature patients.
- Fractures with neurovascular deficits.
- Ipsilateral fractures of the same limb.
- AO type A and B distal humerus fractures.

Method of Statistical Analysis

The following methods of statistical analysis have been used in this study. The data collected was entered in Microsoft Excel and Statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) 20.0 software. The methods used were

- Student Paired t test.
- Student Unpaired t test.

Pre-Operative Preparation

All the patients were admitted and underwent pre-operative workup as per the following protocol:

- Complete blood picture with ESR
- Blood Group and Rh typing

- Renal Function Tests.
- HIV and HBsAg status.
- Random blood sugar.
- Chest X-ray and ECG.
- Bleeding and Clotting time.
- Medical and Surgical Reference where indicated for operative fitness.

After anaesthetic fitness the patients were posted for surgery as early as possible.

Informed, valid and written consent for surgery from the patient and first order relative.

Results

In our study, distribution of age was between 21-67 years. The youngest patient was 21 years & oldest was 67 years. The average age was 41.24 years with peak incidence of between 21-30 years.

In our study 12 (48%) patients sustained fractures following Road Traffic Accidents, 12(48%) sustained fracture due to self fall and 1(4%) had fall from height.

We had 4 patients (16%) of AO C1 type, 9 patients (36%) of AO C 2 type and 12 patients (48%) of AO C 3 type.

We had 6 patients (24%) operated within 20 hours of trauma, 12 patients (48%) operated between 21-30 hours of trauma and 7 patients (28%) operated after 31 hours of trauma.

There was statistical significant difference in flexion range of movement arc at 2 and 6 months in our study. Flexion ROM arc was better at 6 months than at 2 months in our study.

There was statistical significant difference in MESS score at 2 and 6 months in our study. MESS score also was better at 6 months than at 2 months in patients in our study.

Table 1: Distribution of samples by age groups

Age Groups	**No of** Samples	% **of** Samples
21-30yrs	9	36.00
31-40yrs	5	20.00
41-50yrs	3	12.00
51+yrs	8	32.00
Total	**25**	**100.00**
Mean age	41.24	
SD age	15.42	

Table 2: Distribution of samples by mode of injury

Mode of injury	**No of** Samples	% **of** Samples
RTA	12	48.00
Self fall	12	48.00
Others	1	4.00
Total	**25**	**100.00**

Table 3: Distribution of samples by status of AO type

AO type	**No of samples**	**% of samples**
C1	2	8.00
C2	9	36.00
C3	14	56.00
Total	**25**	**100.00**

Table 4: Distribution of samples by Time duration for surgery

Time duration	**No of samples**	**% of samples**
<=20hours	6	24.00
21-30hours	12	48.00
>=31hours	7	28.00
Total	25	100.00
Mean duration	33.16	
SD duration	23.68	

Table 5: Comparison of 2 months and 6 months Rom Arc scores by paired t test

Time	**Mean**	**Std.** DV.	**Mean Diff.**	**SD Diff.**	**% of change**	**Paired t**	**P-value**
2 months	66.60	14.77					
6 months	96.60	17.72	-30.00	14.14	-45.05	-10.6066	0.0001*

*p<0.05

Table 6: Comparison of 2 months and 6 months MESS scores by paired t test

Time	Mean	Std. DV.	Mean Diff.	SD Diff.	% of change	Paired t	P-value
2 months	69.80	11.13					
6 months	85.60	15.02	-15.80	9.86	-22.64	-8.0109	0.0001*

*p<0.05

Table 7: Comparison of AO types (C2 and C3) with respect to ROM Arc scores at 2 months and 6 months by t test

AO types	2 months		6 months		Difference	
	Mean	SD	Mean	SD	Mean	SD
C2	72.22	12.02	104.44	11.30	32.22	13.94
C3	67.92	14.99	97.08	17.12	29.17	14.43
Total	66.60	14.77	96.60	17.72	30.00	14.14
t-value	0.7066		1.1168		0.4870	
P-value	0.4884		0.2780		0.6319	

Table 8: Comparison of AO types (C2 and C3) with respect to MESS scores at 2 months and 6 months by t test

AO types	2 months		6 months		Difference	
	Mean	SD	Mean	SD	Mean	SD
C2	73.89	6.01	93.33	10.90	19.44	7.68
C3	72.08	8.91	83.75	15.97	11.67	9.13
Total	69.80	11.13	85.60	15.02	15.80	9.86
t-value	0.5236		1.5457		2.0630	
P-value	0.6066		0.1387		0.0530	

Table 9: Distribution of samples by final results

Final results	No of samples	% of samples
Excellent	11	44.00
Good	10	40.00
Fair	2	8.00
Poor	2	8.00
Total	**25**	**100.00**

There was no statistically significant difference between AO type C2 and C3 fractures at 2 months and 6 months with respect to flexion ROM arc.

There was no statistically significant difference between AO type C2 and C3 fractures at 2 months and 6 months with respect to MESS scoring.

In our study we had 84% of patients with good to excellent results.

The average time taken for union was 10.4 weeks. Type C1 fractures took an average time of 11.5 weeks, Type C2 fractures took 9.7 weeks, Type C3 fractures took 11 weeks for union.

All the fractures showed complete union in our study and there were no patients of non union.

Discussion

In our study, fractures were commoner in the 21-30 years age group, with average age being 40.24 yrs. In our study there was a bimodal distribution of patients with 9 patients between 21-30 years and the most common mode of injury in these was road traffic accident. This could be attributed to increased mobility in urban youth. 2nd peak was >51 years old patients (8 patients) in whom the most common mode of injury was self fall.

Our findings are comparable to the study made by Tyllianakis et al (2004) and G Chen et al (2011).

In our present series we included only AO type C fractures. Among them there were 2 (8%) cases of type C1 fracture, 9 (36%) cases of type C2 fracture, 14 (56%) cases of type C3 fracture.

We had 14 patients of AO type C3 fracture. Out of these the mode of injury was Road traffic accident in 6 patients (42.8%) and self fall in 8 patients (57.2%). Our findings were comparable with JA Fernandez-Valencia et al [13] (2013) in which out of total 6 patients with AO type C3 fractures the mode of injury was Road traffic accident in 2 patients (33.3%) and self fall in 4 patients (66.6%).

- 80% of patients in our study had 10-15 degrees of fixed flexion deformity of elbow probably due to the irritation by tension band wiring and olecranon bursitis.
- We had better results in patients aged less than 39 years compared to patients more than 40 years age. The could be due to the good physiotherapy

protocol followed correctly by young patients.

- We had better results in male patients as compared to female patients which could be because of poor pain tolerance in females.
- We had only 2 patients treated with parallel dual plating and 23 patients treated with orthogonal dual plating. Since the first group had only 2 patients it was not possible to statistically compare between them.
- The type of implant used for fixation was less significant if the surgery was done correctly with proper intercondylar reduction and pillar reconstruction.
- There were differences in functional outcome between AO type C1, C2 and C3 fractures with respect to flexion ROM arc and MESS score at 6 months but these differences were not statistically significant.

Tian D et al (2013) compared two groups in his study. One group treated with parallel plating and other with perpendicular plating. There was no significant difference between two groups with respect to ROM arc and MESS score.

Conclusion

- Operative treatment with rigid anatomical internal fixation should be the line of treatment for all AO type C 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.
- We used transolecranon approach in all patients as it provides best visualization of articular surface.
- Use of LC plates will suffice and more importance should be given to achieve goodintercondylar reduction and pillar reconstruction.

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