International Journal of Orthopaedics and Physiotherapy
Online ISSN: 2664-8997, Print ISSN: 2664-8989
Received: 15-03-2019; Accepted: 30-03-2019; Published: 16-04-2019
www.orthopedicsjournals.com
Volume 1; Issue 1; 2019; Page No. 27-30

Study of functional outcome of intercondylar fracture of distal humerus in adults treated with distal humerus locking plate

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Abstract
This study is done to evaluate the functional outcome of intercondylar fracture of distal humerus in adults treated with distal humerus locking plate.
Material and Methods: This study is prospective postoperative evaluation of 20 patients with distal humerus fracture (Close and Open grade 1 and Intra-articular distal humerus fracture type B and C) who were treated with Open reduction and internal fixation with plating.
Results: All patients treated with open reduction and internal fixation with plate using posterior approach to elbow with olecranon osteotomy, achieved union by end of 6 months. Mayo elbow performance score at final 9 months were noted as excellent (more than 90) in 12(60%) patients, good (75-89) in 4 (20%) patients, fair (60-74) in 3 (15%) patients, and poor(less than 60) in 1 (5%) patient. Few complications like elbow stiffness in 2 patients, superficial infections in 3 patients, 1 case of ulnar nerve neurapraxia were noted which were treated conservatively. There were no major complications.
Conclusion: The distal humerus intraarticular fracture of humerus can be managed effectively by operative management. The surgical method requires anatomic reduction and stable and rigid fixation with reconstruction of articular congruity and also requires post-operative early mobilisation, which is a must for good outcome.

Keywords: intercondylar fracture of humerus, mayo elbow performance score

Introduction
Distal humerus fracture is one of the most complicated and challenging fracture of upper extremity and it accounts for approximately 2% of all fractures [1]. It has bimodal age distribution with peak incidence between 12 to 19 years usually in males, and 80 years and older in females [2].
The most common mechanism of injury occurs in one of two ways, low energy trauma like simple fall from standing height or high energy trauma like road traffic accidents especially in young patients. The most common fracture pattern is extra articular fracture accounting for 40% of all fractures. Bi-column or intra-articular fractures were second most common accounting for 37% [3]. In general, 70% of patients sustain an elbow fracture fall directly on to the elbow because they are unable to break their fall with an outstretched hand [4]. The unique orientation of distal humerus with its complex structural anatomy poses a constant challenge in its management.
World literature has discussed various modalities of management of injuries around elbow joints. Recommendation for treatment has ranged from conservative treatment to operative reduction and extensive internal fixation. The goals of the surgical treatment are to restore articular congruity of the distal humerus with rigid and stable internal fixation that will enable early range of motion and full rehabilitation [5, 6].
This study is an attempt to understand the management of these difficult and challenging distal humerus fractures in adults.

Material and methods
This study is prospective evaluation of 20 patients with distal humerus fracture who were treated with Open reduction and internal fixation with plating from July 2017 to July 2019 at Mata Gujri Memorial medical college & LSK hospital, Kishanganj, Bihar in the group ranging from 18 to 70 years of age. A written consent was taken from the patients and their attendants.

Inclusion criteria
- Patient > 18 years
- Close and Open grade 1 (Gustillo - Anderson classification) fractures of distal humerus
- Intraarticular distal humerus fracture type B and C (AO classification system)
- Patients consent to participate in the study
- Patients who were fit for surgery

Exclusion criteria
- Age < 18 years
- Open fracture grade 2 and 3 (Gustillo- Anderson classification)
- Intraarticular distal humerus fracture type A (AO classification system)
- Pathological fracture
- Fractures associated with neurovascular deficit
- Patients not giving consent for study
- Patients not fit for surgery

All patients were evaluated, history and clinical examination with special focus on vascular and neurological deficit after giving primary treatment. Preoperative Radiological examination of the elbow in both AP (Anterior- Posterior) view and lateral view along with CT scan were taken of all the patients (case illustrations 1 and 2). The average of the patient was 40.35 years (range 20-70 years). AO classification showed 16 C-type fractures (8*13C 1, 6*13C 2, 2*13C 3) and 4 B-type fracture (1*13 B1, 1*13 B2, 2* 13 B3). There were 17 closed and 3 was open grade 1 fracture of distal humerus.

Preoperatively, all the patients were immobilised in above elbow POP slab and elevation of limb. Special attention was given to open grade 1 fracture in which primary debridement and closure was done and surgery was delayed for healing.

All the patients were put in lateral decubitus position and arm was supported in holder with forearm hanging. The patients underwent Open reduction and internal fixation with bi-column plating for the sustained fracture using posterior approach to the elbow with Chevron olecranon osteotomy [7, 10]. This approach provides maximum visualisation of articular surface [11, 12]. All patients were given general anaesthesia or brachial block. The implants used were distal humerus locking plate and cancellous screws as lag screws and K-wires for primary fixation. The olecranon osteotomy was reduced under direct vision and fixed by tension band wiring. Patients were kept in postoperative ward under observation for 24 hours and then shifted to their respective wards. On post-op day 2, the drain was removed and x-rays were taken in both AP and Lateral views. The patients were instructed to keep their limb elevated and active movement of fingers and elbow was encouraged. Early controlled mobilization was started after 24 hours depending upon the rigidity and stability of the fracture fixation in the form of flexion-extension and pronation-supination. The wound was inspected on POD 2 and every alternate day, and then sutures were removed on POD11. The patients were discharged with advice of active and passive exercise of the elbow. Patients were followed up 3 weeklies in first 3 months, then 6 weeklies in next 6 months and then at every 3 months interval after the surgery. At the time of follow-up, the cases were evaluated for any residual pain, tenderness, mobility of fragments, union, neurovascular complications, range of motion of elbow and proximal and distal joints. Any residual ankyloses, deformities, complications were noted down and when necessary appropriate physiotherapy and treatment were given and radiological evidence of union, deformity etc were taken. The final result was evaluated at 6 months using Mayo elbow performance score which includes a 100 points system with presence or absence of pain given most important consideration along with assessment of the arc of joint motion, stability and functionality of elbow [13].

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

Case 1: A 19-year-old female with fracture of distal end of humerus after road traffic accident.

Fig 1: Preoperative X-rays (lateral and AP views) and CT scan of distal end of humerus

Fig 2: Post op x ray (AP and lateral view)

Fig 3: Mayo elbow performance score of the same patient.

Case 2: A 64 yr old female with intraarticular fracture of distal end of humerus

Fig 4. Preoperative and Postoperative X ray (AP & Lateral) of fracture of distal end of humerus.

Fig 5: Mayo elbow performance scoring of same patient

Result

The present study was a 2 year prospective study conducted to evaluate the outcome of distal humerus intraarticular fractures managed with open reduction and internal fixation with plating at Mata Gujri Memorial medical college & LSK hospital, Kishanganj, Bihar. The study consisted of 20 patients; 14 male and 6 females. In our study, the most number of patients were in their 5th decade of life (table 1). Right side fractures (12,60 %) were more common compare to left side (8,40 %) and road traffic accidents were more common mode of injury (table 2).

Table 1: Age incidence

Age (years)	No of case	Percentage
11-20	2	10
21-30	5	25
31-40	4	20
41-50	6	30
51-60	1	5
61-70	2	10

Table 2: Mode of injury

Mode of injury	Cases (number)	%
RTA	15	75
Fall at home	5	25

In the present study, 8 cases of AO type C1, 6 cases of AO type C2, 2 cases of AO type C3, and 1 case of AO type B1, 1 case of AO type B2, 2 case of AO type B3 fractures were included. 6 out of all patients had other associated injury like head injury, chest injury and ipsilateral distal end of radius fracture. All of these were treated with open reduction and internal fixation with plate using posterior approach to elbow with olecranon osteotomy. All the fracture in our study achieved union by end of 6 months. Mayo elbow performance score at final 9 months were noted as excellent (more than 90) in 12(60%) patients, good (75-89) in 4 (20%) patients, fair (60-74) in 3 (15%) patients, and poor(less than 60) in 1 (5%) patient (table 3). Few complications like elbow stiffness in 2 patients, superficial infections in 3 patients, 1 case of ulnar nerve neurapraxia were noted which were treated conservatively. There were no major complications.

Table 3: Post-operative complications after 9 months

Complications	No of cases	Percentage
Stiffness	2	10
Superficial infection	3	15
Ulnar N neurapraxia	1	5
Heterotrophic ossification	None	0
Non union	None	0
No complications	14	70

The overall result of this present study suggests that open reduction and internal fixation with plate is an effective modality of treatment of intraarticular fractures of distal humerus.

Discussion

The distal humerus and its two-column anatomical concept, as per which the distal humerus is considered as a triangle where medial and lateral condyles forms column with proximal extension, and coronoid fossa and olecranon fossa occupying the central part [14, 15]. The articular segment functions as a "Tie- arch" architecturally [16]. These intraarticular fractures are in addition comparatively rare and the number of cases reported is hence relatively small so that comparisons between results are not entirely conclusive. The fracture being intraarticular, obviously an

exact alignment of articular congruity would be essential for a good result. Good knowledge and understanding of the relevant anatomical structures and peculiarities of the lower end of the humerus is very essential before embarking on this difficult surgery. Open reduction and internal fixation with stabilisation of both the columns and reconstruction of distal humerus articular congruity provides reliable and stable fixation which allows for early mobilisation even in complex fractures [17, 18].

In our study, we used posterior approach to distal humerus with olecranon osteotomy for fracture fixation. This approach is beneficial in providing a better exposure of the articular surface also gives better access to visualise ulnar nerve and also decreases the possibility of triceps injury and doesn't compromise the extensor mechanism [19].

Our study supports the evidence that sufficient stability to permit early mobilisation is very important, more than the construct of their fixation [20]. We had initiated gentle active exercise at the end of 1st week and active exercise at the end 2nd week. A poor fixation prolongs post-operative immobilization, which almost invariably produce poor functional results. Sodegard *et al*. study of 96 patients had encountered 6 post-operative infections, 12 neural injuries and 16 fixation failures, and our study has shown comparatively less incidence of complications [21]. Henley in study of 33 patients post-operative infection in 2 patients, heterotrophic ossification in 2 patients, and had observed 5 cases of fixation failures [22].

Conclusion

The distal humerus intraarticular fracture of humerus can be managed effectively by operative management. The surgical method requires anatomic reduction and stable and rigid fixation with reconstruction of articular congruity and also requires post-operative early mobilisation, which is a must for good outcome.

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