

Distal Humerus Fracture Management in Adults, in a Tertiary care Rural Hospital of Central India

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Abstract

Introduction: We planned this study to evaluate the functional outcome of the management of distal humerus fracture by open reduction and internal fixation, in a tertiary care rural hospital of central India.

Materials and Methods: Patients attending orthopaedics OPD and the Accident and Emergency centre of Kasturba Hospital, MGIMS Sevagram, having distal humerus fracture between the period from May 2015 to October 2017. 37 participants with distal humerus fractures, fulfilling inclusion and exclusion criteria and after getting their written informed consent in English and in regional language were included in the study. All the cases were operated with open reduction and internal fixation with suitable implant.

Results: 37 adult patients were operated for distal humerus fracture. 21 were males and 16 were females. Mean age was 43.8 years. Mean Range of Motion for flexion – extension movements in our study was 1020 (Range of 500-1400) with mean flexion of 1140. According to Mayo Elbow Performance Score (MEPS), functional outcome was Excellent in 12 (32.4%) patients, Good in 18 (48.7%) patients, Fair in 7 (18.9%) patients and Poor in one (2.7%) patient. Average MEPS was 83.8(sd±12.2). Overall Excellent to Good outcome was observed in 30 (81.1%) patients.

Discussion - Many techniques have been described in the fixation of distal humerus fractures. Anatomical restoration of the articular surface with stable fixation of the fragments that allows for early motion is the goal of surgical treatment. Standard surgical techniques should be used for fixation of both columns, using combination of implants.

Conclusion: The management of distal humerus fracture needs systematic and meticulous approach, understanding the fracture type, necessary radiological investigations, its natural history, using the principles of fracture treatment, selection of implant. In surgical management with open reduction and internal fixation of fractures of distal humerus, anatomical reduction of the articular surface, stable internal fixation of the distal humerus, medial and lateral columns are of prime importance in achieving an excellent outcome.

Keywords: Distal humerus fracture, Elbow, Functional outcome, Mayo Elbow Performance Score (MEPS), open reduction and internal fixation.

Introduction

A distal humerus fracture is defined as a fracture with an epicentre that is located within a square whose base is the distance between the epicondyles on anteroposterior radiograph (1).

Distal humerus fractures are relatively uncommon orthopaedic injuries, which constitutes less than 7% of adult fractures and approximately 30% of fractures about the elbow (2,3). Fracture patterns being mainly distributed bimodally (4), differentiating between young male (high energy trauma) and elderly female patients (osteoporotic fractures) (5). Lateral column injuries are more common than medial column injuries and multiple types have been described. Incidence of distal humeral fractures seems to be increasing among the

elderly. Fractures of the distal humerus are challenging to treat and carry relatively high complication rate (6). Pain, deformity, instability, stiffness, non-union, malunion and ulnar neuropathy are commonly reported complications. A painless, stable, and mobile elbow joint is desired as it allows conducting the activities of daily living, most notably personal hygiene and feeding. Anatomical restoration of the articular surface with stable fixation of the fragments that allows for early motion is the goal of surgical treatment. Systematic approach is required for a highly traumatized distal humerus to be finished as a stable, mobile and pain-free joint. The management of distal humeral fractures has evolved over the last few years. Usually, fractures managed by closed reduction and cast application give poor results. Standard surgical techniques are used for fixation of both columns, using combination of reconstruction plates, dynamic compression plates, locking compression plates, one third tubular plates and screws and K-wires. Severe comminution, bone loss, and osteopenia predispose to unsatisfactory results because of inadequate fixation of the fracture (7,8). 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

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Table 1: Mayo Elbow Performance Score

Function	Points	Definition	Points
Pain	45	None	45
		Mild	30
		Moderate	15
		Severe	0
Motion	20	Arc >1000	20
		Arc 50-1000	15
		Arc <500	5
Stability	10	Stable	10
		Moderate instability	5
		Gross instability	0
Function	25	Comb hair	5
		Feed	5
		Hygiene	5
		Wear shirt	5
		Wear shoes	5

Table 2: 2 Age Wise Distribution

Age	Number of Patients	Percentage
18-44 Years	19	51.30%
45-60 Years	10	27.10%
>60 Years	8	21.60%
Total	37	100.00%

Table 3: Mode of Trauma

Mode Of trauma	Number of Patients	Percentage
Assault	1	2.70%
Fall	17	45.90%
RTA	19	51.40%
Total	37	100.00%

protocols. Till date as new techniques are being designed, a clear cut protocol is yet to be established. Many controversies exist and many questions remain unanswered. Being relatively a rare fracture, problem is accentuated as individual surgeons do not come across sufficient number of cases to accumulate sufficient experience to critically evaluate the results. Hence we planned this study to evaluate the functional outcome of the management of distal humerus fracture by open reduction and internal fixation.

Aim and Objectives:

To assess the functional outcome of distal humerus fractures after surgical management i.e. open reduction and internal fixation in a tertiary care rural hospital of central India.

Materials And Methods

This was a follow up study and was conducted in tertiary care centre at a rural setup with study participants as the patients attending orthopaedics OPD and the Accident and Emergency centre of Kasturba Hospital, MGIMS Sevagram, having distal humerus fracture between the period from May 2015 to October 2017. 37 participants with distal humerus fractures, fulfilling inclusion and exclusion criteria and after getting their written informed consent in English and in regional language were included in the study. All the cases were operated with open reduction and internal fixation with suitable implant.

Inclusion criteria:

- All closed fractures of distal humerus.

- Open Gustilo and Anderson type I fracture of distal humerus.
- Mature skeleton (Age above 18 years).

Exclusion criteria:

- Patients with pathological fractures.
- Associated ipsilateral fracture in same upper limb.
- Fractures with neurological involvement.
- Infection or Poor skin conditions at operative site.
- Open fractures Gustilo and Anderson type II or type III.

Preoperative Protocol:

Patients were given analgesics and elbow was immobilised with Above Elbow slab and evaluated using radiographs in anteroposterior and in lateral views and complex fractures were evaluated using Computed Tomography scan.

Operative Procedure

The patient positioned lateral under suitable anaesthesia. We used posterior midline approach most commonly with variations in deep approaches. Different Implants were used according to different fracture as per classification and the need of the case (Figure 1). Locking plates, Medial or lateral column plate, dynamic compression plate, reconstruction plate, TENs, K wires, stainless steel wire, cannulated cancellous screw with washer, Herbert screw, Titanium Elastic Nails, Limited contact dynamic compression plate are the implants used according to the need for fixation of distal humerus fractures.

Table 4: Complications and its management done

Complications observed and its management done	Frequency
Joint stiffness (Arthrolysis And Implant Removal)	1
K wire Migration (K wire removal)	1
Superficial infection, one converted to deep infection other associated with skin penetration by implant (Debridement)	2
Olecranon osteotomy TBW K Wire Loosening	1
(Removal of k wire)	
Skin Penetration By Implant (Implant Removal)	1
Implant prominence (Implant removal)	1
Total No. complications in 4 (10.8%) cases	7

The principles of internal fixation followed were (9) -

- Temporary fixation of bone fragments with K-wires;
- Restoring the normal width along with aligning the trochlear groove with the anterior humeral cortex;
- Fixation of articular fragments to the medial and lateral bone columns using shaped plates;
- Intra-operative verification that the hardware does not penetrate articular surfaces and fossa, and allows for full range of motion;

Drain was then placed and the wound closed. The arm was then placed in a bulky non compressive dressing with plaster splint. Figure 2 shows the steps of surgery.

Post-operative protocol: Immediate postoperative radiograph in antero-posterior and lateral plane were done. Gentle ROM exercises with active and assisted mobilisation of elbow were begun as soon as pain and swelling had subsided and the wound had dried. Progressive advancement of motion exercises was advised and motivated them for the same. Follow up was done at interval of 2 weeks, 1 month, 2 months, 3 months, 6 months and 6 months thereafter. During follow up visit a plain radiograph of anteroposterior and lateral views were taken to assess the radiological union and functional outcome was assessed according to Mayo Elbow Performance Score.

• Mayo Elbow Performance Score (10): (Table no.1)

Statistical Analysis:

The collected data was entered and analysed using Epi Info 2000 (Centre for Disease Control and Prevention, Atlanta, Georgia, USA) SPSS version 16 (SPSS 16.0 for Windows, release 16.0.0. Chicago: SPSS Inc).

Results

Present study comprised of 37 patients with distal humerus fracture. Mean age of the patients was 43.8 (sd±17.3). There were 21(56.7%) males and 16 (43.3%) females. Majority of the patients were in the age group of 18-44 years i.e. 19 patients (51.3%). (Table 2).

Road traffic accidents was cause of 19 cases (51.4%), fall in 17 cases (45.9%) and assault in 1 case (2.7%) (Table 3). 33 (89.2%) patients were having closed fractures and 4 (10.8%) were having Open Grade I fracture. The involvement of right side is more than left side.

In this study distal humerus fractures were classified according to Arbeitsgemeinschaft fur Osteosynthesefragen (AO) Classification. Figure 3, shows 18 (48.6%) patients were having extra articular, 3 (8.1%) patients were having partial articular and 16 (43.3%) patients were having intra-articular distal humerus fracture.

In this study different implants were used for fixation of fracture. Only plate fixation were used in 17(45.9%) cases, Plates with lag screws used for fixation in 10 (27.1%) cases, Only screws used for fixation in 5(13.5%) cases, K wires used for fixation in 2(5.4%) cases, K wires with screws used for fixation in 2(5.4%) cases and Titanium Elastic nails (TENs) used for fixation in 1(2.7%) cases. In most of the Patients Range of Motion (ROM) exercises started at around 12th day for 36(97.3%) patients.

Mean Range of Motion for flexion – extension movements in our study was 1020 (Range of 500-1400) with mean flexion of 1140. The functional assessment of the patient was done according to Mayo Elbow Performance Score (MEPS) at the end of clinico-radiological union. According to MEPS, functional outcome was Excellent in 12 (32.4%) patients, Good in 18 (48.7%) patients, Fair in 7(18.9%) patients and Poor in one (2.7%) patient. Average MEPS was 83.8(sd±12.2). Overall Excellent to Good outcome was observed in 30(81.1%) patients. The same is shown in following figure no. 4.

Complications

Following table no.4 shows the complications occurred and its treatment done. There were overall total 7 complications in 4(10.8%) cases

Discussion

Distal humerus fractures are relatively uncommon orthopaedic injuries, which constitutes less than 7% of adult fractures and approximately 30% of fractures about the elbow (2,3). In our study Mean age of the patients with distal humerus fracture was 43.8 (sd±17.3). Adequate exposure is critical for good reduction and fixation and it is agreed that the best exposure of both columns of the distal part of the humerus and the articular surface is achieved through a posterior approach (11).

Table 5: Different studies with its Mayo Elbow Performance scores.

Study	Total patients studied(n= No. of patients available for final followup)	Mayo Elbow Performance Score(MEPS), n= number of patients				Mean MEPS
		Excellent	Good	Fair	Poor	
Sanchez-Sotelo J (7)	32	11	16	2	3	85
Athwal GS et al. (22)	37	14	8	7	3	82
Liu D et al. (23)	21	17	2	2	0	--
Huang JI et al (24)	23	6	3	3	2	83
Erpelding JM (25)	24	15	7	2	0	91.5
Gupta RK et al.(26)	40	33		5	2	85
Fernández-Valencia JA (27)	12	9	3	0	0	93.3
Govindasamy R (28)	38					
	Gr. A (20 pt.)	15	5		0	88.25
	Gr. B (18 pt.)	13	5		0	93.61
Jain D (29)	26	21	5	0	0	96.1
Kamrani RS et al (30)	17	9	6	2	0	88
Mahaptra S. (31)	60	8	40	8	4	80.08
Schmidt-Horlohe, KH et. al (32)	39	36		3		85
Bhatia C (33)	28	9	13	4	2	89
Present Study	37	12	18	6	1	83.8

Multiple constructs have been recommended for fixation of articular surface to the diaphysis of the humerus. In our study only plates were used in 17(45.9%) cases, Plates with lag screws used for fixation in 10 (27.1%) cases, Only screws used for fixation in 5(13.5%) cases, K wires used for fixation in 2(5.4%) cases, K wires with screws used for fixation in 2(5.4%) cases and TENs used for fixation in 1(2.7%) cases for fixation of fractures of the distal humerus. The goal of operative treatment was to restore elbow function by obtaining anatomic and stable reduction of the articular surface. Central to this goal is rigid fixation of the anatomic surface so that early motion may be instituted. Intraarticular fractures are managed by converting them to a partial articular by quickly restoring one column. Thereafter, remaining fragments are fixed to the stabilized column. Helfet D. (12) compared quantitatively three common configurations of various implants used for fixation of distal humeral fractures. The double plate construct, irrespective of plate type, was significantly stronger, both in rigidity and fatigue testing, than cross screws or the single "Y" plate. If rigid stabilization of supracondylar or bicondylar distal humeral fractures is desired, then two plate constructs, at right angles (the ulnar plate medially, the lateral plate posteriorly), are biomechanically optimal. There is no general agreement over the ideal surface for plate fixation in distal humerus fractures and significant controversy exists about whether orthogonal or parallel plating is superior for

fixation of distal humeral fractures (13).

Of five biomechanical studies of distal humeral fracture fixation in the literature, only three have compared the 90-90 plate fixation (medial and posterolateral plates perpendicular to each other) to parallel plate fixation (medial and lateral plates in the sagittal plane) (12)(14)(15)(16). Of these three studies, two showed parallel plate fixation to be substantially more stable than orthogonal plate fixation (14,16), while one demonstrated no difference (15). Schemitsch et al. (16), Arnander et al. (17), demonstrated significantly higher strength and stiffness in the parallel group versus the orthogonal group. In a study done in 1994 Schemitsch et al. (16) conducted biomechanical evaluation of different methods of internal fixation of the distal humerus.

Five different constructs were studied:

1. Two columns posteriorly fixed by plates
2. Single posterior 'Y' plate
3. Two plates applied: one posteriorly on the lateral column and the other medially on the medial column orthogonal (90-90)
4. Two plates applied at right angles: posteromedially on the medial column and laterally on the lateral column
5. Two plates applied opposite to each other (parallel-180°), laterally over the lateral column and medially over the medial column

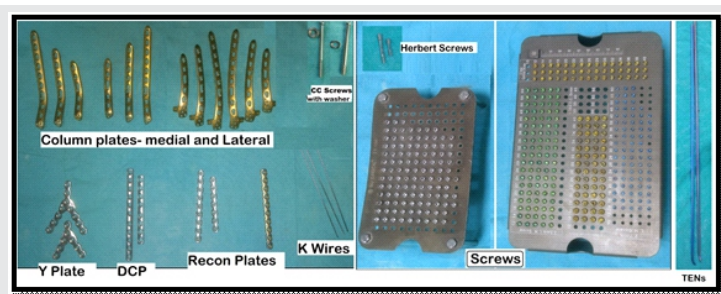


Figure 1: Different Implants Used for Fixation of Distal Humerus Fracture

• The plates must be strong enough and stiff enough to resist breaking or bending before union occurs at the supracondylar level.

In present study, open reduction and internal fixation surgery performed in every case. The average follow up period in our study is 12.4 months. Range of motion was more than 1000 in 23 (62.16%) patients and was between 500-1000 in 13 (35.13%) patients and less than 500 in 1 (2.71%) case. Average pronation was 630 and average

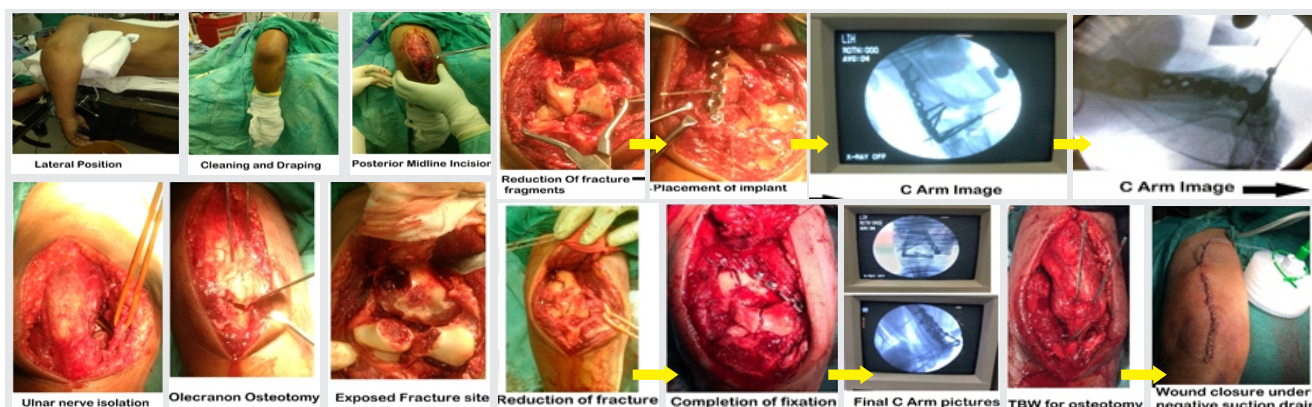


Figure 2: Steps of Surgery

The study concluded that two plates applied opposite to each other – a lateral buttress plate and a medial reconstruction plate (parallel) – achieved maximum rigidity in the absence of cortical contact. O'Driscoll (18) summarized some technical pearls for surgical fixation of distal humerus fractures:

- Every screw in the distal fragments should pass through a plate.
- Engage a fragment on the opposite side that is also fixed to a plate.
- As many screws as possible should be placed in the distal fragments.
- Each screw should be as long as possible. Each screw should engage as many articular fragments as possible.
- The screws in the distal fragments should lock together by interdigitation, creating a fixed-angle structure.
- Plates should be applied such that compression is achieved at the supracondylar level for both columns.

supination was 690. Morrey et al. showed that most activities of daily living can be performed in the 30° to 130° range (19).

In present study, all fractures were united. Union was defined as the presence of bridging callus or disappearance of the fracture line on three of four cortices seen on anteroposterior and lateral radiographs (20). A delayed union was diagnosed if the fracture healed between 12 and 24 weeks, nonunion was considered to be present if the fracture was not clinically or radiologically united after 24 weeks (5). Average time of union in present study was 9.35 ± 1.97 weeks. Average time of union in Mardanpour K (21) and Robinson CM (5) was 9-10 weeks and less than 12 weeks respectively.

The Mayo Elbow Performance Score (MEPS) is an elbow centric scores those asses the Pain, Stability, Range of Motion and Functions of the elbow. In this study, overall Excellent to Good outcome was observed in 30 (81.1%)

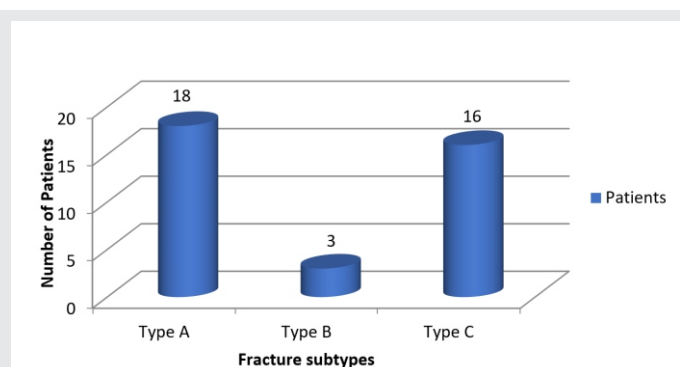


Figure 3: AO Classification of Distal Humerus Fracture

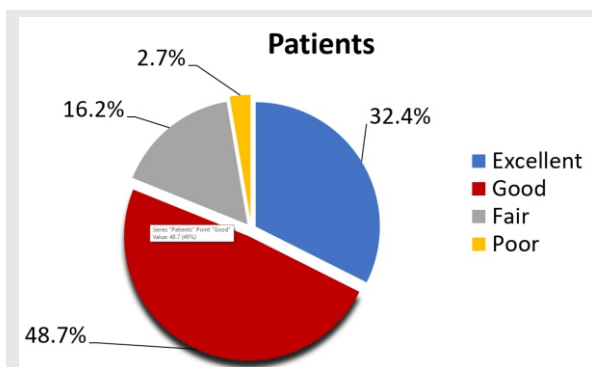


Figure 4: Final Outcome according to MEPS

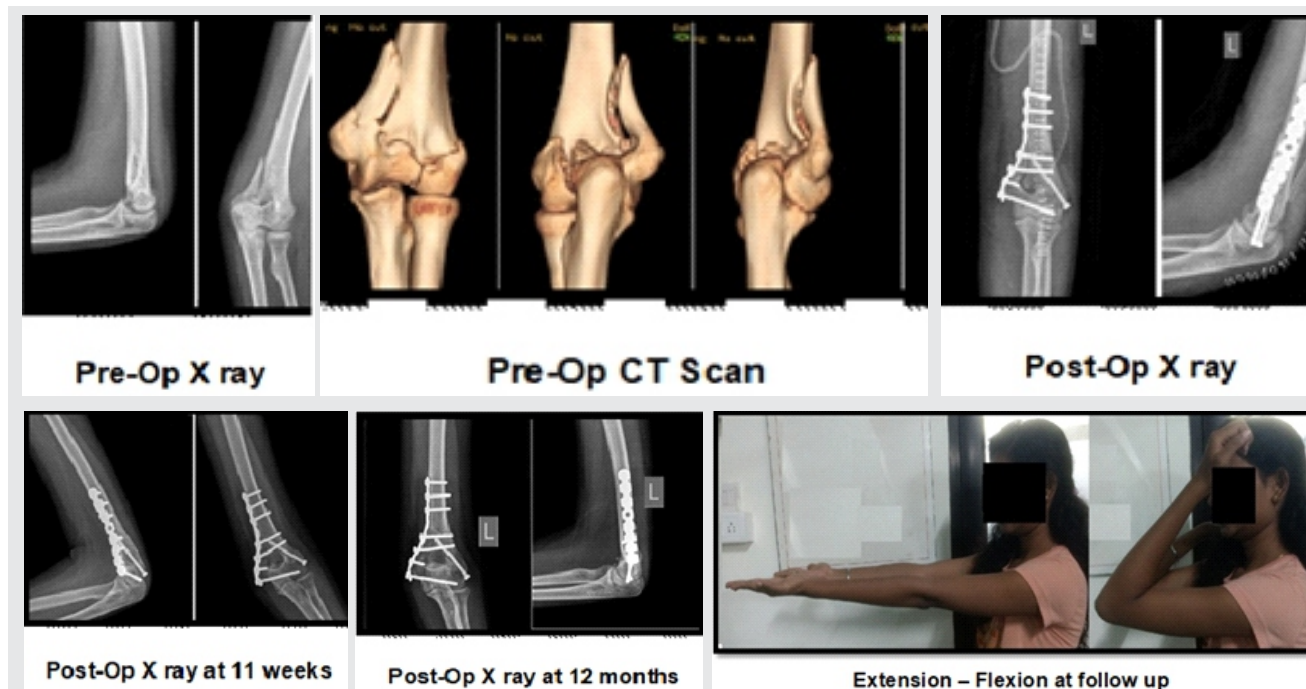


Figure 5: Case 1

patients. This could be because of proper selection of patients as per inclusion and exclusion criteria, proper preoperative care, decision about the timing of operation and stable fixation, early mobilization. Table no. 5 shows MEPS of different studies.

In distal humerus fractures, when osteosynthesis is stable and allows early postoperative mobilization, functional results are satisfactory in 75% to 85% of cases (5,34). Single method of fixation could not be applied to every case. The general principles of elbow surgery, including meticulous joint restoration and stable primary fracture fixation are of decisive importance for good functional results. In present study, Type A fractures had 50% excellent, 37.5% good, 12.5% fair outcome whereas for Type C fractures 17.5% had excellent, 52.9% good, 23.5% fair and 5.8 % poor Outcome. For Extra-articular fracture mean mayo score was 87.4 (sd±10.6) whereas for intra-articular fracture mean mayo score was 78.2(sd±11.5). The difference in mean was found to be significant ($p < 0.05$).

Complications observed in this study were includes stiffness of joint , Superficial and Deep infection, K wire loosening of an osteotomy closure, K wire migration, penetration of skin by K wire and implant prominence. We didn't encounter any ulnar nerve injury in this study. This may be attributed to our earliest step of isolation of ulnar nerve with a red rubber catheter and not to mobilise it or transpose to anterior aspect of elbow. Normally nerve injury occurs in 25% of cases and affects either the median or ulnar nerves (40,41). It is

important to determine if the ulnar nerve is injured, as it will need to be transposed during the fixation process. Ruan(40) and Chen(41) believed that transposition is only necessary if the patient displays clinical signs before the surgery. They concluded that, patients who underwent ulnar nerve transposition at the time of ORIF of distal humerus fractures had almost four times the incidence of ulnar neuritis than those without transposition and hence they do not recommend routine transposition of the ulnar nerve at the time of ORIF of distal humerus fracture.

Conclusion and Clinical Relevance

Fractures in the distal humerus in adults will be continually challenge to the orthopaedic surgeon and operative



Figure 6: Case 2

treatment of these fractures is a major procedure and preliminary planning is necessary for success. The management requires systematic and meticulous approach, understanding the fracture type, necessary radiological investigations, its natural history, using the principles of fracture treatment, selection of implant and incorporating patient-related factors. In surgical management with open reduction and internal fixation of fractures of distal humerus, anatomical reduction of the articular surface, stable internal fixation of medial and lateral columns are of prime importance in achieving an excellent outcome.

Fractures of the distal humerus should be managed by open reduction and internal fixation so as to achieve good functional outcomes.

References

1. Court-Brown CM, Heckman J, McQueen MM, Ricci WM, Tornetta P. Rockwood And Green's Fractures In Adults, 7th Edition, section 2;33:948.
2. Babhulkar S, Babhulkar S. Controversies in the management of intra-articular fractures of distal humerus in adults. *Indian J Orthop.* 2011;45(3):216–225.
3. Nauth A, Mckee MD, Ristevski B, Hall J, Schemitsch EH. Distal Humeral Fractures in Adults. *J Bone Jt Surg.* 2011;93:686–700.
4. Watts AC, Morris A, Robinson CM. Fractures of the distal humeral articular surface. *J Bone Joint Surg Br.* 2007;89(4):510–515.
5. Robinson CM, Hill RMF, Jacobs N, Dall G, Court-Brown CM. Adult distal humeral metaphyseal fractures: epidemiology and results of treatment. *J Orthop Trauma.* 2003;17(1):38–47.
6. Ring D, Jupiter J. Fractures of the distal humerus. *Orthop Clin North Am.* 2000;31(1):103–113.
7. Sanchez-sotelo J, Torchia ME, Driscoll SWO. Complex Distal Humeral Fractures : 2007;961–970.
8. Gambirasio R, Riand N, Stern R, Hoffmeyer P. Total elbow replacement for complex fractures of the distal humerus. An option for the elderly patient. *J Bone Joint Surg Br.* 2001;83:974–978.
9. Begue T. Articular fractures of the distal humerus. *Orthop Traumatol Surg Res.* 2014;100(1):55–63.
10. Morrey BF, Adams RA. Semiconstrained elbow replacement for distal humeral nonunion. *J Bone Jt Surg Br.* 1995;77(1):67–72.
11. Wilkinson JM, Stanley D. Posterior surgical approaches to the elbow: A comparative anatomic study. *J Shoulder Elb Surg.* 2001;10(4):380–382.
12. Helfet DL, Hotchkiss RN. Internal fixation of the distal humerus: a biomechanical comparison of methods. *J Orthop Trauma.* 1990;4(3):260–4.
13. Gupta RK, Gupta V, Marak DR. Locking plates in distal humerus fractures: study of 43 patients. *Chin J Traumatol.* 2013;16(4):207–211.
14. Self J, Viegas SF, Buford WL, Patterson RM. A comparison of double-plate fixation methods for complex distal humerus fractures. *J shoulder Elb Surg.* 1995;4:10–16.
15. Jacobson SR, Glisson RR, Urbaniak JR. Comparison of distal humerus fracture fixation: a biomechanical study. *J South Orthop Assoc.* 1997;6(4):241–249.
16. Schemitsch EH, Tencer AF, Henley MB. Biomechanical evaluation of methods of internal fixation of the distal humerus. *J Orthop Trauma.* 1994 ;8(6):468–75.
17. Arnander MWT, Reeves A, MacLeod IAR, Pinto TM, Khaleel A. A Biomechanical Comparison of Plate Configuration in Distal Humerus Fractures. *J Orthop Trauma.* 2008;22(5):332–336.
18. O'Driscoll SW. Optimizing stability in distal humeral fracture fixation. *J Shoulder Elb Surg.* 2005;14(1):186–94.
19. Morrey BF, Askew LJ, Chao EY. A biomechanical study of normal functional elbow motion. *J Bone Joint Surg Am.* 1981;63(6):872–877.
20. Pankaj A, Mallinath G, Malhotra R, Bhan S. Surgical management of intercondylar fractures of the humerus using triceps reflecting anconeus pedicle (TRAP) approach. *Indian J Orthop.* 2007;41(3):219–223.
21. Mardanpour K, Rahbar M. Open reduction and internal fixation of intraarticular fractures of the humerus: Evaluation of 33 cases. *Trauma Mon.* 2013;17(4):396–400.
22. Athwal GS, Hoxie SC, Rispoli DM, Steinmann SP. Precontoured parallel plate fixation of AO/OTA type C distal humerus fractures. *J Orthop Trauma.* 2009;23(8):S75–S80.
23. Liu D, Li P. Treatment of distal humerus fracture with double-plating fixation. *Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi.* 2010;24(6):680–682.
24. Huang JI, Paczas M, Hoyer HA, Vallier HA. Functional outcome after open reduction internal fixation of intra-articular fractures of the distal humerus in the elderly. *J Orthop Trauma.* 2011;25(5):259–264.
25. Erpelding JM, Mailander A, High R, Mormino MA, Fehring E V. Outcomes Following Distal Humeral Fracture Fixation with an Extensor Mechanism-On Approach. *J Bone Jt Surgery-American* 2012;94(6):548–553.
26. Gupta RK, Gupta V, Marak DR. Locking plates in distal humerus fractures: study of 43 patients. *Chin J Traumatol.* 2013;16(4):207–211
27. Fernández-Valencia JA, Muñoz-Mahamud E, Ballesteros JR, Prat S. Treatment of AO Type C Fractures of the Distal Part of

- the Humerus through the Bryan-Morrey Triceps-Sparing Approach. *ISRN Orthop*. 2013;2013:1-6.
28. Govindasamy R. Clinico-radiological Outcome Analysis of Parallel Plating with Perpendicular Plating in Distal Humeral Intra-articular Fractures: Prospective Randomised Study. *J Clin Diagnostic Res*. 2017;11(2):13-16.
 29. Jain D, Goyal GS, Garg R, Mahindra P, Yamin M, Selhi HS. Outcome of anatomic locking plate in extraarticular distal humeral shaft fractures. *Indian J Orthop*. 2017;51(1):86-92.
 30. Kamrani RS, Mehrpour SR, Aghamirsalam MR, Sorbi R, Zargar Bashi R, Kaya A. Pin and plate fixation in complex distal humerus fractures: Surgical technique and results. *Int Orthop*. 2012;36(4):839-844
 31. Mahapatra S, Abraham VT. Functional Results of Intercondylar Fractures of the Humerus Fixed with Dual Y-Plate; A Technical Note. *Bull Emerg trauma*. 2017;5(1):36-41.
 32. Schmidt-Horlohe KH, Bonk A, Wilde P, Becker L, Hoffmann R. Promising results after the treatment of simple and complex distal humerus type C fractures by angular-stable double-plate osteosynthesis. *Orthop Traumatol Surg Res*. 2013;99(5):531-541
 33. Bhatia C, Tiwari A, Goel R. Surgical management of intra-articular fractures of distal humerus in adults using triceps reflecting anconeus pedicle approach (TRAP). *Orthopaedic Journal of M. P. Chapter*. 2015;21(2):21-28.
 34. Holdsworth BJ, Mossad MM. Fractures of the adult distal humerus. Elbow function after internal fixation. *J Bone Joint Surg Br*. 1990;72:362-365.
 35. Ruan HJ, Liu JJ, Fan CY, Jiang J, Zeng BF. Incidence, Management, and Prognosis of Early Ulnar Nerve Dysfunction in Type C Fractures of Distal Humerus. *J Trauma Inj Infect Crit Care*. 2009;67(6):1397-1401.
 36. Chen RC, Harris DJ, Leduc S, Borrelli JJ, Tornetta P, Ricci WM. Is Ulnar Nerve Transposition Beneficial During Open Reduction Internal Fixation of Distal Humerus Fractures? *J Orthop Trauma*. 2010;24(7):391-394.

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