

Functional Outcome of Patients Treated with Bicolumn Fixation in Distal Humerus Fractures: A Prospective Study

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Abstract

Introduction: In young adults, most distal humerus fractures occur from high energy trauma, sideswipe injuries, motor vehicle accidents, falls from height, and gunshot wounds. In elderly persons with more osteoporotic bone; most of these injuries occur from simple falls. Even minor irregularities of the joint surface of the elbow usually cause some loss of function.

Aim: To analyze the functional outcome of patients treated with bicolumn fixation in distal humerus fractures.

Materials and Methods: A prospective study randomly selecting 21 patients of fractures of distal humerus in adults treated by open reduction and internal fixation with bicolumn fixation.

Results: All the fractures united within the study period. Elbow stiffness was encountered in four patients was due to infection, hardware prominence, and delayed union. There were no cases of nonunion.

Conclusion: Bicolumn fixation helps in achieving a good functional outcome anatomical reduction, rigid stabilization, and early mobilization that are essential features of these types of intra-articular fractures.

Key words: Bicolumn fixation, Distal humerus fracture, Dual plating, Intra-articular elbow fracture

INTRODUCTION

In young adults, most distal humerus fractures occur from high-energy trauma, sideswipe injuries, motor vehicle accidents, falls from height, and gunshot wounds. In elderly persons with more osteoporotic bone; most of these injuries occur from simple falls.¹ So improved understanding of the complex pathoanatomy of unstable distal humerus fractures in adults has prompted a global interest in more precise treatment for this diverse group of injuries. Surgeons who treat fracture of the distal humerus frequently have realized the challenges that arise relate 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 planes.² Even minor irregularities of the joint surface of the elbow usually cause some loss of function.

Aim

To analyze the functional outcome of patients treated with bicolumn fixation in distal radius fractures.

MATERIALS AND METHODS

This is a prospective study conducted in the Department of Orthopaedics, Tirunelveli Medical College Hospital. The Institutional Ethics Committee approval and informed consent from the patients were obtained. Inclusion criteria: Occupational Therapy Assistant (OTA) Class 13 A2, A3, C1, C2, and C3, intra-articular displacement >2 mm, marked supracondylar comminution and displacement, open fracture, floating elbow, and multiple injured patient. Exclusion criteria: The patients lost to follow-up, patients

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without skeletal maturity, OTA Class A1, B1, B2, and B3, the patients who were not medically fit for surgery, grossly contaminated open fractures, severe osteopenia, an insensate or avascular arm (occurs in severe side swipes, crush or avulsion – type injuries), mangled extremity severity score >7.

Pre-operative Planning for Open Reduction and Internal Fixation (ORIF)

These fractures were frequently comminuted and this is not clearly evident on the radiographs. The exact nature, geometry, and configuration of fracture fragments are assessed and understood before surgery is performed. This was accomplished by anteroposterior and lateral radiographs. After initial work up, the operative fixation of the fractures was performed on the next elective operation list, i.e., within the next 2-3 days. Computed tomography scanning with three-dimensional reconstruction was done whenever the fracture configuration was doubtful. Before surgery, detailed instructions were given to each patient that the result of the procedure considerably depended on the patients own motivation to regain full function subsequently and that active motion of the joint in spite of the post-operative pain is an essential part of the treatment. Radiographs were taken at regular intervals to assess that the movements did not affect rigidity of fixation.

Implant Selection

The 3.5 mm reconstruction plates, Asian DCP, 1/3 tubular plates of appropriate size was kept ready. Pre-operative templating was done. In addition cancellous screws and k-wires are made available at the time of surgery.

- A dose of tetanus toxoid and antibiotic were given preoperatively
- Preparation of the part was done a day before surgery and above elbow plaster of paris slab was reapplied
- Instrument to be used were checked before hand and sterilized
- Surgery was performed under general anesthesia in 12 cases. While rest were operated under brachial plexus block.

Principles of Internal Fixation (Intra-articular Fractures)

1. Reconstruction of the base of the triangle, i.e., reconstruction of the trochlea, and convert into supracondylar fracture
2. Alignment and fixation of shaft, reconstruction of medial and lateral pillars complete restoration.

Post-operative Protocol

- The patient is placed in a posterior splint (i.e., above elbow slab) with a bulky dressing and neurological status checked every 4th hourly
- Check X-ray taken on 1st post-operative day (POD)

- After 48 h, the first post-operative dressing is done and drains are removed. Mobilization of the elbow joint was started when fixation was found rigid. The subsequent dressing is light and firm.
- The patients were discharged by 6th day and advised to review on 10th day for suture removal
- The patient was given injection cefotaxime 1000 mg and injection Garamycin 80 mg for 5 days and converted to oral antibiotics which are continued for 10 days
- The patient was advised at the time of discharge to continue the slab, arm pouch, oral antibiotics, and shoulder mobilization.

Follow-up

The patient comes for follow-up on 12th POD. The sutures were removed. In patients with rigid fixation, active gentle motion of involved limb several times a day in concurrence with the pain was advised. Active mobilization was encouraged. Full activity was allowed at 3-4 months as fracture consolidation occurred. Postoperatively patients were reviewed every 2 weeks for the first 2 months and monthly for the next 2 months, then every 2 months until fracture healing or full range of motion was regained.

Elbow Function

Postoperatively elbow function was evaluated using physician based elbow scoring system the Mayo Elbow Performance Index.³

RESULTS

About 19 cases in our study were operated with orthogonal plating which provided absolute stability for early mobilization. The posterolateral plate used commonly was the Asian DCP which requires little contouring whereas the medial plate required heavy contouring and the more malleable 1/3 tubular plate was used for the purpose. Several authors have documented a 20-25% rate of unsatisfactory result following orthogonal plating of distal humerus fractures. The rationale for utilization of parallel plating is that longer screws can be placed from a medial to lateral direction as opposed to a screw placed through a posterolateral plate. Based on these observations, the Mayo Clinic Group proposed the idea of parallel plating utilizing the principles of enhancing fixation of the distal fragments and achieving stability at the supracondylar level. In our study, we have not met implant failures and the orthogonal construct has enabled early mobilization in our cases (Figure 1).

Road traffic accidents (RTAs) predominated as the most common mechanism of injury, followed by accidental fall. 71% had history of RTA and 24% had accidental fall and 5% had assault as mechanism of injury (Table 1).



Figure 1: Mayo elbow performance index of study patients

Males predominantly had RTAs as mechanism of injury whereas females predominantly sustained accidental fall (Table 2).

All patients in our study were classified by AO classification. There were 21 patients in all out of which 10 patients were classified as Type A, 11 patients as Type C and no patients as Type B (Type A2 - 6, Type A3 - 4, Type C1 - 1, Type C2 - 6, and Type C3 - 4) (Table 3).

In our study, fracture Types (A1, B1, B2, and B3) were excluded as their surgical management differed. A1 type fractures are fixed with screws alone and B type fractures are single column fractures fixed with single column plates and were excluded from our study. Among the included fracture Types A2 and C2 types predominated. C1 type was the least common.

Elbow stiffness was the most common complication encountered in four patients. We had infection, delayed union, hardware prominence in one case each. All fractures united within the study period. There were no cases of nonunion (Table 4).

DISCUSSION

The functional elbow is very essential for an individual for social and economic thriving. Fractures of the distal humerus may directly affect the functional movement of elbow especially intercondylar (intra-articular) fracture. The relationship of the radiohumeral joint and ulnohumeral joints must be perfect for a good functional outcome.

The majority of distal humerus fractures presenting to our center were resulting from RTAs (75%) compared to a majority of fall history seen by Robinson *et al.* This is probably reflective of the fact that several trauma cases are

Table 1: Distribution of mode of injury

Mode of injury	Incidence (%)
Fall	24
Assault	5
RTA	71

RTA: Road traffic accident

Table 2: Gender versus mode of injury

Mode of injury	Male	Female
RTA	12	1
Fall	2	4
Assault	2	1

RTA: Road traffic accident

Table 3: Fracture type distribution

OTA Classification	Type A	Type B	Type C
1	0	0	1
2	6	0	6
3	4	0	4

OTA: Occupational Therapy Assistant

Table 4: Distribution of complications in study patients

Complications	Number of cases
Elbow stiffness	4
Infection	1
Delayed union	1
Hardware	1

referred to our center which is the tertiary referral center for trauma care of this region. The high male:female ratio seen in our center (4:1) as compared to 1:1 recorded by Robinson *et al.* is resultant of the high number of trauma cases treated in our centre, and the fact that males are more prone for RTAs compared to females because in our society females travel less.⁴

Fracture configuration according to the OTA type had a significant bearing on the outcome in distal humerus patients treated surgically. Group C had a poorer outcome than group A patients.⁵ This has again stressed the importance and prognostic significance of the OTA classification. Study by Robinson *et al.* revealed that the most common fracture type was OTA Class A and C which our study concurs.⁴

The restoration of elbow function is dependent on three salient features: Exposure, fixation, and the post-operative rehabilitation, with later two are of primary consideration. Adequate exposure is necessary for visualization of the bone injury and fixation of the fracture fragments.⁶ The optimal exposure is provided by posterior approach with extra-articular osteotomy of the olecranon.

Olecranon osteotomy was done in 11 of our cases. Three of them were fixed with tension band wiring (TBW) and eight of our cases were fixed with cancellous screws.⁷ This allowed us complete examination of the articular surfaces of trochlea, capitellum, olecranon, and radial head. It also gives access to the medial and lateral supracondylar ridges. Full evaluation of the fragments of the fracture and reduction can then be performed. Although, nonunion of the extra-articular osteotomy may be regarded as a potential complication of this exposure, TBW of the osteotomy has provided sufficient stability of the olecranon for immediate use of the elbow through a secure range of motion without the occurrence of nonunion.⁸ 19 cases in our study were operated with orthogonal plating which provided absolute stability for early mobilization.⁷ The posterolateral plate used commonly was the Asian DCP which requires little contouring whereas the medial plate required heavy contouring and the more malleable 1/3 tubular plate was used for the purpose. Several authors have documented 20-25% rate of unsatisfactory result following orthogonal plating of distal humerus fractures.⁹ Rationale for utilization of parallel plating is that longer screws can be placed from a medial to lateral direction as opposed to a screw placed through a posterolateral plate.¹⁰ Based on these observations, the Mayo Clinic group proposed the idea of parallel plating utilizing the principles of enhancing fixation of the distal fragments and achieving stability at the supracondylar level. In our study, we have not met implant failures and the orthogonal construct has enabled early mobilization in our cases.

CONCLUSION

Increased incidence of distal humeral fractures is due to increasing RTA. Distal humeral fractures occurred more commonly in 2nd and 3rd decade. The predominance of

males is seen in these fractures. ORIF with bicolumn plating can be considered as the treatment of choice if there is no contraindication for this, because it helps in maintaining length, opposition, axial alignment, and rotation alignment of articular fragments so that a good range of motion can be achieved. Excellent results are achieved with this method in terms of mobility and union without deformity. Bicolumn fixation helps in achieving a good functional outcome anatomical reduction, rigid stabilization, and early mobilization that are essential features of these types of intra-articular fractures.

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