Section: Orthopaedics

Original Research Article

FUNCTIONAL OUTCOME OF DISTAL HUMERUS FRACTURE IN ADULTS FOLLOWED WITH BICOLUMNAR FIXATION-A PROSPECTIVE STUDY

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ABSTRACT

Background: Distal humerus fractures in adults are very difficult and challenging to treat due to intra articular and inter condylar involvement. For management of these fractures various surgical techniques and approaches have been advocated time by time. This aim of this study was to analyze the clinical and functional outcomes of bicolumnar fixation in adult patients with distal humerus fractures. **Materials and Methods:** In this study 20 patients with distal humerus fractures treated with bicolumnar fixation were enrolled. At the final follow up at one year the final functional results were analyzed on the basis of Mayo elbow performance score. Secondary outcome were time to radiological union, incidence of complications (infection, hardware failure, stiffness), and range of motion. **Result:** Mean time to union was 16 weeks. 17 (85%) patients were pain free at 12 months. 3 patients complained of mild pain while lifting heavy objects, 90% of patients had arc of motion greater than 100 degrees at elbow and 100% of patients had stable elbow and 95% of patients were able to do their daily activities. 90% patients had excellent/good score with mean score of MEPS of 89.75. Complications encountered in 7 (35 %) patients, as the most common complication was elbow stiffness which occurred in 3 (15 %) patients. **Conclusion:** Bicolumnar fixation appears to be an effective modality of treatment for distal humerus fractures. **Clinical Significance:** This study contributes valuable evidence supporting bicolumnar fixation as a clinically effective and functionally rewarding treatment modality for distal humerus fractures in adults.

INTRODUCTION

Distal humerus fractures represent a challenging orthopedic injury, accounting for approximately 2% to 6% of all fractures and one third of humerus fractures.[1] Robinson reported that the incidence of distal humerus factures in adults was 5.7/100000 per year in a 10 year follow up study.[2] These injuries often result from high-energy trauma in younger individuals and low-energy falls in elderly populations with osteoporotic bone.[3] Due to the complex anatomical structure of the distal humerus, including the thin cortices, irregular geometry, and involvement of both the articular and metaphyseal regions, effective surgical management is critical to restoring elbow function.[4]

The goal of surgical fixation is to achieve stable fixation that allows for early mobilization while minimizing complications such as joint stiffness, non-union, or mal-union. Good to excellent outcomes were seen in distal humerus fractures managed with Open reduction and internal fixation through an olecranon osteotomy.[5,6] Single columnar plating, Recon plating and conventional plates are less stable to loads have more fixation failures. Locking Compression plates give good results than Dynamic compression plates and are more beneficial. Distal Humeral Fractures are most amenable to bicolumnar fixation with 2 pre contoured anatomical locking compression plates in 90 degrees.[7] The advent of dual plating, also known as bicolumnar fixation, has emerged as the gold standard technique. This method utilizes separate plates on the medial and lateral columns of the humerus to provide optimal mechanical stability.

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This study aims to analyze the clinical and functional outcomes of bicolumnar fixation in adult patients with distal humerus fractures using validated scoring systems and radiological assessments. The investigation will also evaluate postoperative complications, time to union, and factors influencing the prognosis of surgical treatment.

MATERIALS AND METHODS

This prospective observational study was conducted on adult patients presenting with distal humerus fractures treated with bicolumnar fixation in Department of Orthopedics at Alfalah School of Medical Science and Research Centre from 2020-2022. The inclusion criteria were: age >18 years, both male and female patients with distal humerus fractures, patients who were medically fit and willing for surgery. Patients with less than 18 years of age, co-existing ipsilateral limb fractures, fractures with neuro-vascular injuries, pathological fractures and patients who refused to give informed written consent were excluded from the study.

In this study a total of 20 patients were enrolled. All patients were admitted, evaluated and operated with bicolumnar fixation. Written, informed consent was obtained preoperatively after explaining the procedure, risks, benefits and the rehabilitation.

Surgical Procedure: All surgeries were performed under general or regional anesthesia with the patient in a ateral position with an arm on a sidebar. A posterior approach was used and a midline longitudinal incision was made. The ulnar nerve was identified and isolated in all cases. Olecranon osteotomy technique for better articular exposure was followed. Anatomic reduction was achieved using temporary Kirschner wires for provisional fixation. Dual plates were placed on the medial and lateral columns in an orthogonal or parallel configuration depending on surgeon preference and fracture morphology. Locking compression plates and standard screws were used, ensuring fixation across the supracondylar region and articular surfaces. The osteotomy was repaired with tension band wiring if applicable and wound was closed in layers with a drain in situ.

Postoperatively limb elevation was advised and adequate analgesia given. Active finger movements were encouraged as soon as the patient recovered from GA. Arm sling pouch was used to support the limb for 2-3 weeks with intermittent gentle active assisted ROM exercises for elbow and pendulum exercises for shoulder out of sling were advised.

The follow up examination of patients was done weekly for 1st and 2nd weeks and then fortnightly for next six weeks, thereafter every 4 weeks till union was achieved. At one week follow up wound condition and soft tissue condition/swelling was checked. Intermittent ROM of shoulder elbow and shoulder were encouraged. At the follow-up of 6 weeks extensive physiotherapy was started to regain full ROM of shoulder and elbow. Radiographs were obtained to look for fracture union and hardware integrity. Shoulder and Elbow ROM were monitored. At the final follow up at one year the final functional results were analyzed on the basis of Mayo elbow performance score. Secondary outcome were time to radiological union, incidence of complications (infection, hardware failure, stiffness), and range of motion.

Data were analyzed using SPSS software. Continuous variables were expressed as mean ± standard deviation, and categorical variables were reported as percentages.

RESULTS

The mean age of patients in our study was 40.6 (range 22-63) years. There were 13 (65%) males and 7 (35%) were females. Majority of the patients10 (50%) in this study were in the age group of 31-40 years. RTA as mode of trauma was present in 13 (65 %) patients whereas fall was the mode of trauma in 7 (35 %) patients [Table 1].

In this study mean operative time was 90 (range 80-120) minutes. In our study all fractures united. Mean time to union was 16 weeks [Table 2].

Based on MEPS, 17 (85%) of patients were pain free at 12 months. 3 patients complained of mild pain while lifting heavy objects, 90% of patients had arc of motion greater than 100 degrees at elbow and 100% of patients had stable elbow and 95% of patients were able to do their daily activities [Table 2].

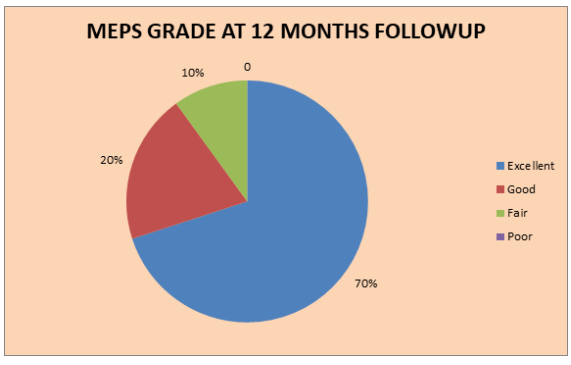

Table 1: Demographic characters of patients

Characters		No. of patients	Percentage
Gender	Male Female	13 07	65 35
Age group (Years)	20-30 31-40 41-50 51-65	2 10 5 3	10 50 25 15

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Side	Right Left	13 07	65 35
Mode of injury	RTA Fall	13 07	65 35

Table 2: Union time and results based on MEPS

Parameters	Time	No. of patients	Percentage
Time to union	12-16 weeks 17-21 weeks >21 weeks	12 7 1	60 35 5
Pain	None Mild Moderate Severe	17 3 0 0	85 15 0 0
Range	>100 Degree 50-100 Degree <50 Degree	18 2 0	90 10 0
Stability	Stable Moderately unstable Grossly unstable	20 0 0	100 0 0
Function	Able to comb hair Able to feed oneself Able to perform personal hygiene tasks Able to put on shirt Able to put on shoes	18 19 19 18 17	90 95 95 90 85

70% of patients had excellent MEPS, 20% had good score and 10% had fair score. Thus 90% patients had excellent/good score. Mean score of MEPS was 89.75. Excellent result of MEPS was found in younger patients and those patients who followed ROM exercises protocol. Fair result was found in two patients who were elderly and had pain during early weeks due to which ROM exercises where delayed [Figure 1].

In this study complications encountered in 7 (35 %) patients, as the most common complication was elbow stiffness which occurred in 3 (15 %) patients, Paraesthesia in ulnar nerve sensory area in 2 (10%) patients, hardware related complication in 1 (5%) and Infection in 1 (5%) patients.

DISCUSSION

Distal humerus fractures are among the most challenging orthopedic injuries due to their complex anatomical structure and the functional demands of the elbow joint. Surgical management aims to restore anatomy, achieve stable fixation, and enable early mobilization to optimize outcomes. Our study contributes to the growing body of evidence supporting bicolumnar fixation with dual plating as an effective surgical strategy for managing these fractures.

In this study, the majority of patients were male with a mean age of 40.6 years, aligning with other research indicating a bimodal distribution of distal humerus fractures, with younger individuals typically sustaining high-energy trauma and older patients suffering low-energy falls. Our results are comparable to the study led by Shin SJ et al,[8] where average age of subjects was 42 years in his study. The most common mechanism of injury was road traffic accidents (RTA), comparable to the studies laid by Shao-hua Li et al. (2011),[9] and Imran mang et al. (2014).[10] In their studies, they found that fractures occurred more likely due to high-velocity RTA. These findings are consistent with reports from Robinson et al and Watson et al,[2,3] and other authors emphasizing the need for robust fixation in younger patients with higher functional demands and in elderly individuals with compromised bone quality.

Wilkinson and Stanley recommended in their studies that olecranon osteotomy exposes the articular surface fully than other approaches.[11] Jupiter stated in his study that chevron olecranon osteotomy is the workhorse for exposing the articular surface.[5] Gofton and Kundel used Chevron olecranon osteotomy and obtained good to excellent outcomes.[6,12] In our study all surgeries utilized the posterior approach with olecranon osteotomy, providing superior visualization of the articular surface. This technique is well-documented for its advantages in achieving accurate articular reduction and stable fixation. Dual plating in orthogonal or parallel configurations using locking compression plates (LCPs) was employed. In our series, all fractures achieved radiological union, with a mean union time of 16 weeks, demonstrating the reliability of this technique. Our results are comparable to the study done by Kiran GU et al. (2017),[13] where average time of fracture union was achieved in 16.4 weeks.

Functional outcomes were assessed using the Mayo Elbow Performance Score (MEPS), with 90% of patients achieving good to excellent scores, comparable to the studies done by Gofton, Kundel and Aslam all obtained excellent to good functional outcome in their studies.[6,14,15] Younger patients and those adhering to a structured rehabilitation protocol had significantly better outcomes, supporting the critical role of early mobilization in preventing stiffness and optimizing recovery. The high proportion of patients (90%) with an arc of motion greater than 100 degrees underscores the

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effectiveness of bicolumnar fixation in restoring elbow function.

The common complications seen following surgical management of distal humerus fractures as noted by Jupiter in a review article include elbow stiffness, infection, non-union, ulnar neuropathy and heterotopic ossification (HO).[5] In our series complications were observed in 35% of patients, with elbow stiffness being the most common (15%). This aligns with literature noting stiffness as a frequent challenge in distal humerus fracture management. Ulnar nerve paraesthesia was noted in 10% of cases, a recognized risk with posterior approaches requiring careful ulnar nerve handling. Hardware-related issues and infection each accounted for 5% of complications, consistent with rates reported in similar studies. These findings highlight the importance of meticulous surgical technique and vigilant postoperative monitoring to mitigate complications.

The strengths of this study include its prospective design and standardized follow-up protocol. However, limitations include the small sample size and single-center setting, which may affect the generalizability of the results. Additionally, the study's reliance on MEPS, although widely used, may not fully capture the nuanced functional and quality-of-life outcomes experienced by patients.

CONCLUSION

This study reinforces the efficacy of bicolumnar fixation using dual locking plates for distal humerus fractures, providing reliable union rates, excellent functional outcomes and appears to be an effective modality of treatment for distal humerus fractures. Early mobilization and adherence to a rehabilitation protocol are paramount in achieving optimal results. Future studies with larger cohorts and long-term follow-up are recommended to further refine surgical techniques and improve patient outcomes.

Clinical Significance of the Study: Distal humerus fractures in adults are complex due to their intra-articular involvement and challenging anatomical reconstruction. The study highlights the clinical relevance of bicolumnar fixation in achieving favorable functional outcomes.

Effective Functional Recovery: With 90% of patients regaining an arc of motion >100 degrees and a high mean Mayo Elbow Performance Score (MEPS) of 89.75, the study reinforces bicolumnar fixation as a reliable method for restoring elbow function.

Pain Relief and Return to Daily Activities: The fact that 85% of patients were pain-free and 95% could perform daily activities suggests that this surgical approach enables a near-complete return to normal function.

Low Complication Rates: While 35% experienced complications, the most common being elbow stiffness (15%), other serious issues like infection or hardware failure were not predominant, indicating a relatively safe procedure.

Stable Joint Reconstruction: With 100% of patients achieving elbow stability, bicolumnar fixation ensures mechanical integrity, which is crucial for long-term joint preservation.

Clinical Implications: Supports the use of bicolumnar fixation as a standard approach for distal humerus fractures in adults, particularly in ensuring stability and good range of motion.

This study contributes valuable evidence supporting bicolumnar fixation as a clinically effective and functionally rewarding treatment modality for distal humerus fractures in adults.

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