



## Do The Conventional Reconstruction Plates are Effective Method of Fixation in Treatment of Complex Distal Humeral Fractures?

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### Abstract

**Background:** Poor outcomes following insufficient fixation have been linked to distal humerus fractures with significant comminution, bone loss, and osteopenia. This study was performed to assess the effectiveness of reconstruction plates in treatment of distal humerus fractures either extraarticular or intraarticular types. **Materials and methods:** 15 people with distal humerus fractures participated in the study from March 2016 to April 2018. There was equal distribution of the patients. The distribution of sex was 9 men and 6 women, with a mean age of 42 years. Function and radiological results were evaluated after a minimum of 12 months of follow-up. **Results:** The mean time of the procedure was 131.9 minutes, while the patient hospital stay was 3 days. At the last check up, 13 patients had fully united. The final ROM was  $114.3 \pm 13.3$  and the MEPS was 68.7. **Conclusion:** In this prospective trial, use of the conventional plates resulted in excellent or good functional results, range of motion, and acceptable union rates. Conventional plates are a good method of fixation in treatment of the distal humerus fracture because of their lower cost and flexibility in contouring.

**Keywords:** Union rate, MEPS Score, Reconstruction Plates, Distal Humerus Fracture.

## **INTRODUCTION**

Distal humerus fractures with fragmentation in osteoporotic bone are relatively infrequent but create complexity that is surgically challenging [1]. Whilst these injuries do occur in young patients after high-energy trauma, the low-energy distal humerus fracture frequency in elderly women has markedly increased over the last few decades [2]. The complex anatomy of the distal humerus articular surface together with its relatively low amount of cancellous bone makes surgical intervention difficult.

These fractures present a challenge to trauma surgeons because of the fracture pattern variability, the difficulty in fracture-site exposure especially because of the proximity of the upper extremity nerves and the frequent comminution of the distal humerus. The restricted space for instrumentation at the distal segment makes it more difficult to achieve stable fixation. For those reasons patients were treated non surgically in the past, often resulting in a painful elbow with significant functional deficits [3]. The goal of operative treatment is to achieve adequate anatomical reduction especially at the joint surface with stable fixation to allow for early active motion [4].

Open reduction and internal fixation remain the treatment of choice, having mainly positive outcomes [5]. Which implants to choose, and the plates position remains a controversy. The aim of the study is to assess the effectiveness of the conventional reconstruction plates regarding the functional results which were measured by Mayo Elbow Performance score (MEPS), union rate and a functional range of motion.

## **MATERIALS & METHODS**

Patients were selected in this randomized experiment utilizing the traditional reconstructive plates. Based on the results of preoperative X-rays, CT scans, and intraoperative observations, fractures were categorized using the AO/OTA classification system.

15 patients in all, with a minimum follow-up of 9 months, were included in this trial during a 24-month period (9 men and 6 women). Using the closed envelop method, 15 patients were randomly assigned. Patients with skeletal immaturity, rheumatoid disease, open fractures, pathological fractures, neurovascular damage, and concomitant fracture of the ipsilateral upper limb were all excluded. Within 6.9 days, internal fixation and final open reduction were used to treat all the fractures.

During the surgical operation, the patients were positioned in the lateral position with the affected arm supported and the forearm dangling to enable at least 90 degrees of flexion. Ceftriaxone 1.5 gm intravenous was also administered as the induction dosage. Posterior approach was chosen to expose the fracture through Olecranon osteotomy in 11 patients, Triceps lifting in 2 patients and Triceps splitting in 2 patients. The ulnar nerve was frequently examined. Following temporary reduction and fixation with K-wires, the conventional reconstruction plates were used to accomplish final fixation. Using K-wire tension bands or cannulated cancellous screws, osteosynthesis of the olecranon osteotomy was performed. Following surgery, the elbow was immobilized at 90° flexion for two weeks .

Patients were encouraged to move their fingers while maintaining the limb in an elevated position. At the end of the two weeks, active range-of-motion exercises for the elbow and shoulder were begun according to the patient's discomfort threshold. All patients were given instructions to do active elbow flexion-extension and pronation-supination exercises as part of their physical treatment. Following surgery there was follow-up at 6 weeks, 6 months, and 12 months. As part of the follow-up, the patient was evaluated for pain, oedema, and range of motion (ROM) while sitting, with the unaffected elbow serving as the control. A goniometer was used to measure range of motion. The patient's functional status was evaluated in accordance with MEPS, and the radiological assessment was based on the union seen on the x-rays (Fig. 1).

Shapiro-Wilk test was used to check for normality in the quantitative variables' inferential analyses, and independent t-test was used when there were two independent groups with normally distributed data. Chi square tests for proportional differences and Fisher's Exact tests for variables with small, predicted numbers were used in inferential analysis for independent variables in qualitative data.

## **RESULTS**

23 cases were assessed for eligibility in our study to enrol the required 15 cases, 7 cases were excluded (5 did not meet the inclusion criteria and 2 refused to participate). The enrolled 15 cases were allocated into the conventional group and mean followed up

was 12 months. The demographic data of the eligible patients were shown in (**Table 1**).

The study group's trauma characteristics were as follows: 13 (86.6%) of the patients had experienced high energy trauma, whereas 2 (13.3%) had experienced low energy trauma. The average number of days between the injury and fixation was 6.9 in the traditional group. The mean surgery time was 131.9 minutes, and the average blood loss 543.9 ml. The use of the reconstruction plates as a method of fixation showed good results regarding the demographic information, trauma, and operation features.

At the final follow up the range of movement was shown in (Table 2). The mean MEPS was 68.7 with mean union rate was 13 patients (86.7%) (Table3). The use of the reconstruction plates as a method of fixation showed good results in regard to the union rate, ROM, MEPS.

Postoperative complications showed in (Table 4), The mean of hospital stay was 3.0 days. Implant failure was found in 2 patients (13.3%). The use of the reconstruction plates as a method of fixation showed good results in regard to the postoperative stay, complications, and implant failure.

## **DISCUSSION**

The current gold standard of care for active people is double plate osteosynthesis. However, there is disagreement in the literature on the type of plate applied and the arrangement of these plates. Numerous biomechanical experiments comparing locking compression plates and conventional 3.5 reconstruction plates in various configurations have been published with

contradictory findings. In the past, the AO group has advised using perpendicular, standard reconstruction plates for therapy. Where the medial column plate is positioned medial to the supracondylar ridge and the

lateral column plate is positioned posteriorly. Locking compression plates and traditional reconstruction plates have been compared in several biomechanical experiments, with varying degrees of success [7].

**Table (1): Demographic characteristics among the studied group**

Vatiables		Conventinoal (N=15)
<b>Age (years)</b>	<b>Mean±SD</b>	42.0±8.0
	<b>Range</b>	30.0–56.0
<b>Sex (n, %)</b>	<b>Male</b>	9 (60.0%)
	<b>Female</b>	6 (40.0%)
<b>BMI (kg/m<sup>2</sup>)</b>	<b>Mean±SD</b>	25.7±3.5
	<b>Range</b>	19.3–30.5
<b>Dominence (n, %)</b>	<b>Right</b>	13 (86.7%)
	<b>Left</b>	2 (13.3%)
<b>DM (n, %)</b>		5 (33.3%)
<b>HTN (n, %)</b>		3 (20.0%)
<b>CLD (n, %)</b>		2 (13.3%)
<b>Smoking (n, %)</b>		5 (33.3%)

**Table (2): Range of motion (°) among the studied group**

Vatiables		Conventinoal (N=15)
<b>Extension</b>	<b>Mean±SD</b>	19.3±14.1
	<b>Range</b>	5.0–40.0
<b>Flexion</b>	<b>Mean±SD</b>	123.7±12.3
	<b>Range</b>	100.0–145.0
	<b>Range</b>	90.0–135.0

**Table (3): Union, pain, and Mayo score among the studied group**

Vatiables		Conventinoal (N=15)
Union	Month-3	11 (73.3%)
	Month-6	13 (86.7%)
Mayo score (/100)	Mean±SD	68.7±22.5
	Range	30.0–100.0

**Table (4): Postoperative stay and complications among the studied groups**

Vatiables		Conventinoal (N=15)
Stay (days)	Mean±SD	3.0±0.8
	Range	2.0–4.0
Infection		2 (13.3%)
Ulnar neve injury		1 (6.7%)
Olecranon non-union		1 (6.7%)
Heterotropic ossification		1 (6.7%)
Implant failure		2 (13.3%)



Figure (1)

Numerous studies assessed the traditional 3.5 reconstruction plates in various configurations have been published with contradictory findings. In the past, the AO group has advised using perpendicular, standard reconstruction plates for therapy. Where the medial column plate is positioned medial to the supracondylar ridge and the lateral column plate is positioned posteriorly. Since there is no agreement on whether newer plates are better than conventional plates regarding biomechanical stability of

different plate and screw constructs, individual surgeon preference and experience frequently determine the choice of implant and implant position for internal fixation of distal humerus fractures [8].

To evaluate the efficiency of traditional reconstruction plates in obtaining satisfactory functional results as determined by the Mayo Elbow Performance score (MEPS), union, range of motion, and complications, our study was done. Most of the review's literature reveals that anatomical distal

humerus locking plates are now popular. Due to their angular screw stability and anatomically pre-contoured shape, these newer plates are an appealing alternative to conventional reconstruction plates, however there isn't enough proof to consistently advise using locking screws.

For distal humerus fractures. According to this study, the traditional reconstruction plates showed satisfactory functional results in terms of the demographic information, features of the trauma, operation methods, or length of the operation.

In 2010, Ashwood et al. performed research. 26 individuals in a row with trans articular shear fractures of the lateral distal humerus, primarily affecting the capitellum, reported between 1997 and 2007. Prospectively gathered data on the fracture pattern and stabilization techniques in these various fractures was used to ascertain whether variables would have an impact on the result. In this series, they have discovered several variables, including severe capitellar articular injury and damage to the supporting bone architecture, that are linked to poor prognosis. Posterior comminution of the lateral condyle, numerous articular fragments, and the necessity for further surgery or a dorsal plate are all indicators of worse outcomes. It is challenging to distinguish between the consequences of the operation and the injuries. All patients experienced union, bone grafting wasn't frequently necessary, and the lateral column was supported posteriorly with a 3.5 reconstruction buttress plate. This work demonstrates that it is feasible to restore the articular surface and achieve appropriate

fixation by using the reconstruction plates, even in distal humerus fractures that are complicated [9].

In 2017 Patel et al, the locking and non-locking constructs were compared based on clinical and radiological outcome, fixation failure, and sequelae in a prospective analysis of 31 patients with distal humerus fractures. Regarding fixation effectiveness, clinical and radiographic results, and problems, locking plates did not offer a statistically significant benefit [10].

A retrospective analysis was done by Pantalone et al. in 2017 on 35 patients who needed ORIF for distal humerus fractures utilizing the double plating method and were >60 years old. 18 patients had treatment with reconstruction plates, Up to 49% of individuals had heterotopic ossification, however in most cases, this did not affect how well the elbow joint functions [11].

Clavert et al. 2013, who conducted two investigations, one a prospective multicentric research with 53 patients and the other a retrospective multicentric analysis with 289 patients, both over 65 and with a recent distal humerus fracture, compared non-locking versus locking plate designs. They were contrasting the outcomes of fixing using locking compression plates vs reconstruction plates According to their findings, 92% of patients with type C fractures and 100% of patients with type A and B fractures had fracture union [12].

On 35 patients with intraarticular distal humerus fractures, Shin et al. (2010) [14] conducted a randomized clinical trial. In this clinical trial, 17 patients were treated with 2 orthogonal plates (group I); a



3.5-mm reconstruction plate was contoured to fit along the posterior aspect of the lateral column and the medial column. According to their findings, 81 group I patients had an average postoperative arc of flexion of 1060 and an average elbow flexion of 1190. Eleven patients in group I (65%) were able to regain complete elbow mobility.

According to our investigation, the use of the conventional plates resulted in excellent or good functional results, range of motion, and acceptable union rates. which is consistent with the previous researchs.

Limitations in this study, including the short follow-up which prevented us from concluding the follow-up of patients who underwent further procedures. Small sample size as a bigger sample size will allow for more precise subgroup analysis and the identification of new factors that the small sample size could have missed.

## CONCLUSIONS

In this prospective trial, use of the conventional plates resulted in excellent and good functional results, range of motion, and acceptable union rates. Conventional plates are a good method of fixation in treatment of the distal humerus fracture because of their lower cost and flexibility in contouring.

## DECLARATIONS

- **Funding**

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- **Conflicts of interest/Competing interests**

The authors have no conflicts of interest to declare that are relevant to the content of this article.

- **Availability of data and material: Yes**
- **Code availability Not applicable.**
- **Ethics approval:**

The research has been approved by the clinical committee at the Orthopaedic department and by the Ethical committee of the Faculty of Medicine, Cairo university.

- **Consent to participate**

All the patients signed a consent to be participating in this randomized control trial.

- **Consent for publication**

Authors consented to proceed for publication of the uploaded scientific material.

- **Authors' contribution**

- **Setting the research plan and the operative procedures that will be involved in the study:**

Mahmoud Elbakry & Amr Samir Rashwan

- **The operating surgeons:**

Omar Soliman, Mostafa Mahmoud, Mohammed Samir Gobba, Mahmoud Elbakry

- **Writing the introduction, Patients and Method**

Islam Sarhan & Mahmoud Elbakry

- **Statistical analysis and writing the results.**

Mohammed Samir Gobba & Mahmoud Elbakry

- **Writing the discussion and the abstract**

Islam Sarhan

Mahmoud Elbakry

- **Final paper revision**

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