Evaluation of outcome of distal humerus fracture fixation by two-locked plates

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Abstract

Objective: The objective of the study was to evaluate the results of operative management of distal humerus fracture fixation by two-locked plates. Materials and method:

This was a retrospective study involving 72 patients with distal humeral fractures who were managed surgically by fixation with two-locked parallel plates at Al- Gamhoria Teaching Hospital, and two private hospitals, in Aden, Yemen, between January 2018 and December 2020.

The data was entered into a computer and analyzed using SPSS program version 17. For variables difference, chi-square tests, and P values were calculated. A p- value of < 0.05 was considered statistically significant.

Results: The total study patients were 72 and they were (79.2%) males and (20.8%) with a ratio of male to female of 3.8:1.

The mean age of the patients was 37.8 ± 15.3 years and the age ranged between 11 and 75 years.

Most of the patients (69.4%) were of age ≤ 40 years, while more than 40 years old represented (30.6%). Causes of fractures were gunshots (56.9%) followed by road traffic accidents (37.5%). Left side was predominant with (62.5%). Type of injuries were open with (73.6%) and closed with (26.4%).

Partially articular fractures were in (86.1%) of cases and complete articular fractures were in (13.9%) cases. Transpositions of ulnar nerve were found in (65.3%) cases. Ulnar nerve neuropraxia was found in (5.6%) cases and the Range of Motion (ROM) was limited (pron. – sup 30-45/flex – exten 30 – 130) in (29.2%) cases and no range of motion in (9.7%) cases. Non-union was found in (4.2%) cases while superficial infection was in (5.6%) cases. Stiffness was found in (9.7%) cases.

Conclusion: This study revealed that managing the distal humeral fractures by internal fixation of two Parallel-Plates gives satisfactory results.

Key words: distal humerus, fracture,
internal fixation, locking plate, outcome

Introduction

Fractures of the distal humerus are complex and challenging injuries to treat. Humeral shaft and extra-articular supracondylar humerus fractures in adults comprise 16 % of humeral shaft and 10 % of distal humerus fractures [1]. Most of these are either simple spiral diaphyseal fractures or are complicated by extension into the articular surface. The main goal of treatment of extra-articular distal humerus fractures is to restore alignment and achieve stable fixation to allow for early elbow range of motion (ROM), which is crucial for a good functional outcome [2].

Severe comminution, bone loss, and osteopenia predispose distal humeral fractures to unsatisfactory results due to inadequate fixation. Poor outcomes include contracture, secondary to prolonged immobilization thought to be necessary to protect the fixation, and nonunion. In an effort to reproducibly obtain stable fixation in the presence of osteoporosis or comminution, we have developed an improved fixation technique for fractures of the distal part of the humerus based on principles that enhance fixation in the distal fragments and provide compression at the supracondylar level [3,4,5,6].

Treatment recommendations for this injury have been adopted primarily from studies of intra-articular distal humerus fractures. Many authors have advocated managing these fractures surgically with open reduction and internal fixation (ORIF) and immediate elbow motion [7]. Double-plating techniques using two 3.5-mm plates in orthogonal (90–90) or parallel (180°) patterns are generally accepted [8].

Objective: The objective of the study was to evaluate the results of operative management of distal humerus fracture fixation by two-locked plates, and the complications.

Materials and Method

This was a retrospective study involving 72 patients with distal humeral fractures who were managed surgically by fixation with two-locked parallel plates at Al- Gamhoria Teaching Hospital, and two private hospitals, in Aden, Yemen, between January 2018 and December 2020.

The technique was specifically designed to satisfy two principles: (1) fixation in the distal fragments should be maximized and (2) screw fixation in the distal segment should contribute to stability at the supracondylar level.

The medical records of the patients were retrospectively reviewed to acquire demographic data, mechanism of injury, distal humerus fractures characteristics, postoperative outcome and complications.

The data was entered into a computer and analyzed using SPSS program version 17. For variables difference, chi-square tests, and P values were calculated. A p- value of < 0.05 was considered statistically significant.

Results

The total study patients were 72 and they were 57 (79.2%) males and 15 (20.8%) with a ratio male to female of 3.8:1; as appears in Figure 1.

The mean age of the patients was 37.8 ± 15.3 years and the age ranged between 11 and 75 years. The mean age of male patients was 37.7 ± 15.0 years and the age ranged between 11 and 75 years, while the mean age of females was 38.1 ± 16.9 years and the age ranged between 19 and 70 years; as shown in Table 1.

Table 2 illustrates the distribution of age groups of patients and the distal humerus fracture characteristics. Most of the patients 50 (69.4%) were of age ≤ 40 years, while more than 40 years old represented 22 (30.6%). Causes of fractures were gunshots 41 (56.9%) followed by road traffic accidents 27 (37.5%) and falls 4 (5.6%). Left side was predominant with 45 (62.5%). Type of injuries were open with 53 (73.6%) and closed with 19 (26.4%). Skin loss was found in 10 (13.9%) cases distributed as follows: extensive 2 (2.8%), minimal 5 (6.9%) and moderate 3 (4.2%).

Partially articular fractures were in 62 (86.1%) cases and complete articular fractures were in 10 (13.9%) cases. Transpositions of ulnar nerve were found in 47 (65.3%) cases.

Table 3 and Figure 2 summarize the postoperative outcomes and the complications.

Ulnar nerve neuropraxia was found in 4 (5.6%) cases and the Range of Motion (ROM) was limited (pron. – sup 30-45/flex – exten 30 – 130) in 21 (29.2%) cases and no range of motion in 7 (9.7%) cases. Non-union was found in 3 (4.2%) cases while superficial infection was in 4 (5.6%) cases. Stiffness was found in 7 (9.7%) cases.

Figure 1: Distribution of study patients related to sex

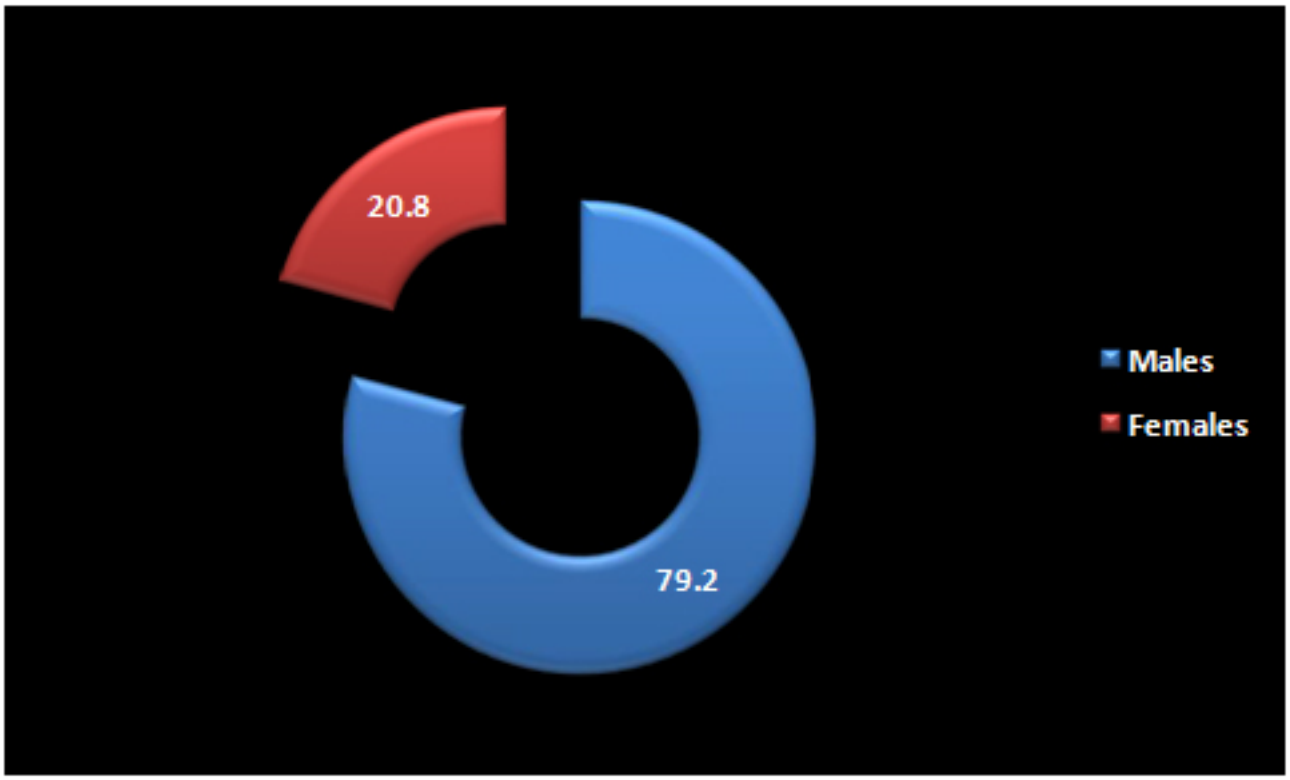


Table 1: Mean age of patients related to sex

Sex	No	(%)	Mean age (years)	SD* (years)	Minimum (years)	Maximum (years)
Female	15	(20.8)	38.1	±16.9	19	70
Male	57	(79.2)	37.7	±15.0	11	75
Total	72	(100)	37.8	±15.3	11	75

* SD = Standard deviation; P = 0.000

Table 2: Distribution of age groups and the distal humerus fracture characteristics (n=72)

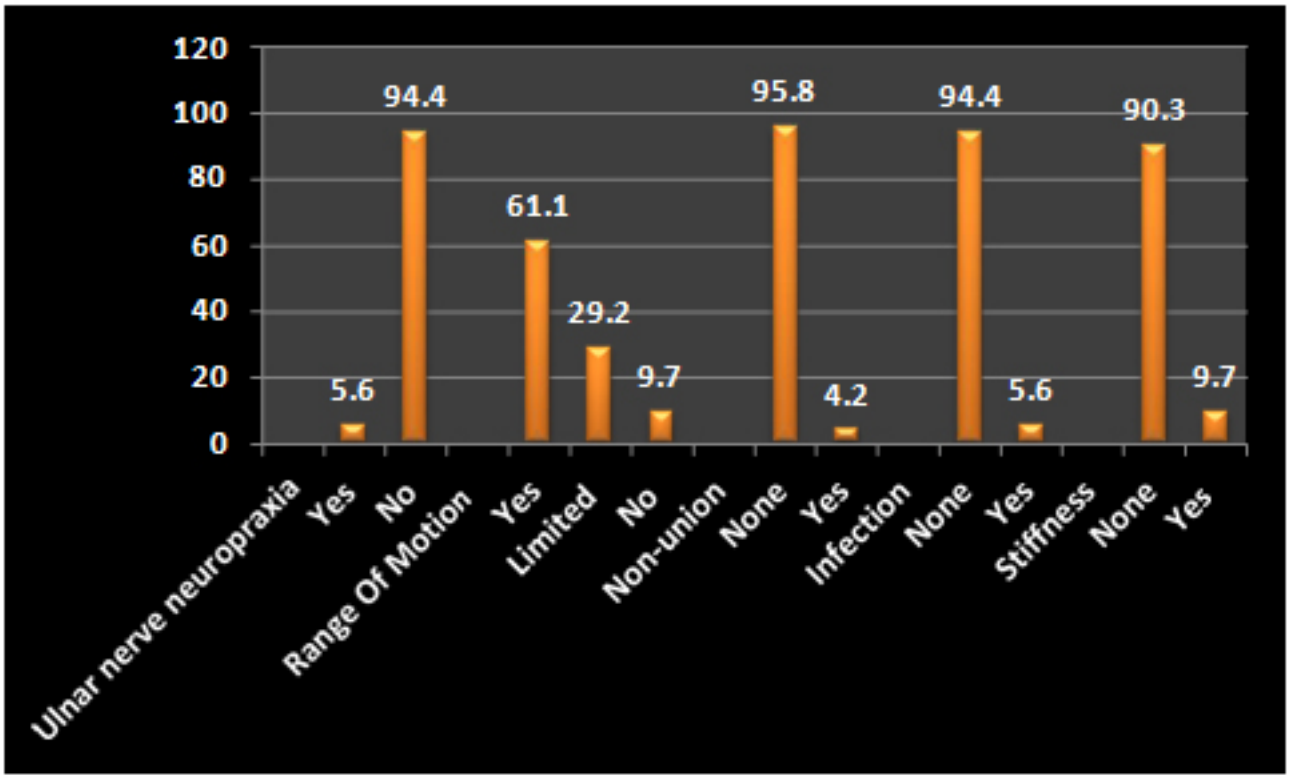
Variables	No	%
Age group:		
≤20	10	13.9
21-30	12	16.7
31-40	28	38.9
41-50	9	12.5
51-60	5	6.9
≥61	8	11.1
Cause:		
Falls	4	5.6
Gunshots	41	56.9
Road traffic accidents	27	37.5
Side:		
Left	45	62.5
Right	27	37.5
Type:		
Closed	19	26.4
Open	53	73.6
Skin loss:		
Extensive	2	2.8
Minimal	5	6.9
Moderate	3	4.2
None	62	86.1
Partially articular:		
No	10	13.9
Yes	62	86.1
Complete articular:		
No	62	86.1
Yes	10	13.9
Transposition of ulnar nerve		
No	25	34.7
Yes	47	65.3

Table 3: Distribution of postoperative outcome and complications (n=72)

Variables	No	%
Ulnar nerve neuropraxia:		
Yes	4	5.6
No	68	94.4
Range Of Motion (ROM):		
Yes	44	61.1
Limited (pron – sup 30-45/flex – exten 30 – 130)**	21	29.2
No	7	9.7
Non-union:		
None	69	95.8
Yes	3	4.2
Infection:		
None	68	94.4
Yes	4	5.6
Stiffness:		
None	65	90.3
Yes	7	9.7

** (pron – sup 30-45/flex – exten 30 – 130) = (pronation – supination 30o – 45o/flexion – extension 30o – 130o)

Figure 2: Percentage of postoperative outcome and complications



Discussion

Distal humeral fractures are difficult management problems on account of the complex anatomy of the elbow, small sized fracture fragments and the limited amount of subchondral bone [9,10].

The risk of functional impairment following a displaced distal humeral fracture is high, and it is now generally accepted that the most favorable outcome of displaced intraarticular fractures is provided by surgical reconstructive procedure [10,11].

Open reduction and internal fixation (ORIF) is the treatment of choice for these fractures [7,12]. Achieving rigid internal fixation and anatomical reconstruction by restoring the two columns and the articular surface is essential for allowing early motion, adequate bone healing and avoiding future cartilage degeneration [13]. In young patients, open reduction and internal fixation with plate fixation of both columns is the gold standard.

Precontoured anatomical locking plates, orthogonal plates (90°:90°), or parallel plates (medial and lateral supracondylar ridges) are currently the most popular choices of treatment for distal humerus fractures [14].

However, despite evolution of ORIF techniques for distal humerus fractures, an overall complication rate up to 35% has been reported [7,15].

In our current study the total study patients were 72 and they were (79.2%) males and (20.8%) with a ratio male to female of 3.8:1. Trikha et al [16] reported in their study that male patients were 66.7% and the female patients were 33.3%, with a ratio male to female of 2:1.

To some extent, similar to our findings was reported by Gupta et al [17] in their study where there were (72.5%) males and (27.5%) females with a ratio male to female of 2.6 : 1.

In our study the mean age of the patients was 37.8 ± 15.3 years and the age ranged between 11 and 75 years.
This finding was in agreement with that result reported by Gupta et al [17] in which the mean age of their study patients was 38.4 years and the age ranged between 18 – 73 years.

In our study we found that the most of the patients (69.4%) were of age ≤ 40 years, while more than 40 years old represented (30.6%).

Prakashappa et al [18] found in their study that the mean age of the study patients was 39.7 and the age range was between 21 to 80 years.

In our present study we found the left side involvement of fractures was predominant with (62.5%).

Similar to our finding was that reported by Trikha et al [16] in which left limb involvement was (61.1%).

Prakashappa et al [18] found that out of 30 patients there were 19 (63.3%) fractures in the left side and 11 (36.7%) fractures in the right side.

In our study the causes of fractures were gunshots 41 (56.9%) followed by road traffic accidents 27 (37.5%) and falls 4 (5.6%). Gunshots injuries in our country are the result of the spread of weapons and violence as a result of the ongoing war. Gupta et al [17] mentioned in their study that the majority of cases were due to road traffic accidents in the younger age group and direct fall onto elbow was a common mode of injury in the older age group.

Prakashappa et al [18] found in their study the causes of injuries were 15 (50%) cases due to Road traffic accidents and 15 (50%) cases due to falls.

In our current study we found the transpositions of ulnar nerve were in 47 (65.3%) cases.

Ilyasi et al [19] reported in their study that due to the characteristic intra-articular involvement, displacement, and poor control of fracture fragments with closed treatment, we typically treat these fractures operatively. They added, pre-operative evaluation begins with assessment of the neurovascular status. The ulnar nerve function in particular is documented. If the injury occurred through a high-energy mechanism a full trauma evaluation is warranted and attention is given to all organ systems.
Ulnar neuropathy as a complication of distal humerus fractures, preoperatively and/or postoperatively, has been reported with a magnitude ranging from 0% to 51% with an average of 13% [7,20,21,22]. This can occur either at the time of the injury, intraoperatively, secondarily to postoperative immobilization, due to swelling, to scar tissue development and thickening in the fibro-osseous tunnel, or due to hardware irritation [21].

In our current study we found postoperatively the forearm rotation was normal in 40 (61.1%) patients except for 21 (29.2%) who had limited ROM (pronation – supination 30° – 45°/flexion – extension 30° – 130°) and no range of motion in 7 (9.7%) cases.

Sanchez-Sotelo et al [23] mentioned that in treating elbow fractures, if postoperative motion of elbow fails to progress as expected, a program of patient- adjusted static splinting is instituted as soon as the soft tissues are healed. They also, reported that 8 (23.5%) of the elbows in their study were treated with such a program, which was commenced after the third or fourth week. The torque across the elbow that was applied with such a patient adjusted splint was low enough to cause discomfort but not pain and therefore was not of concern with regard to the security of the fracture fixation.

In our present study there were 3 (4.2%) non-union cases.

Nonunion after ORIF of distal humerus fractures has been reported to be between 2% and 10% [54dam] with many cases involving the supracondylar region.

Modern studies of dual plate fixation have demonstrated union rates ranging from 89% to 100% [13,24].
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In other cases, high-energy trauma, high comminution and poor bone stock in geriatric patients were cited as reasons for nonunion. Particularly in elderly patients, fracture union rather than motion is the first priority, because motion can be restored by later contracture release if the fracture heals [25].

Helfet et al [26] analyzed the results of 52 surgically treated nonunions and they noticed that 75% of these were the result of unsuccessful internal fixation.

Furthermore, they suggested that elbow stiffness which frequently accompanies nonunions must be addressed during the revision surgery [26].

Jupiter reported that in cases with nonunion after surgically treated distal humerus fractures, ulnar nerve dysfunction can be significant due to scar formation encasing the ulnar nerve. Therefore, ulnar nerve exploration and transposition was recommended [27].

We found in our study superficial infection in 4 (5.6%) cases.

The incidence of wound complications after fixation of distal humerus fractures is substantial, with significant morbidity. The elbow is at risk for serious wound complications after surgery because of significant soft tissue damage, its relatively thin soft tissue envelope, postoperative swelling, and shear forces occurring when early motion is commenced [28].

Infection should be suspected in any patient with persistent drainage and delayed union or nonunion of the fracture. Furthermore, in a review of fractures fixed with parallel plates, Sanchez-Sotelo et al [29] identified three patients (9%) who underwent additional surgical procedures for wound-related complications.

In another study, Kundel et al documented minor wound complications in 8 of 99 patients (8%) and more serious infections in 10% [30].

In the current study there was stiffness in 7 (9.7%) cases. Stiffness is the most common sequelae after open reduction and internal fixation humeral fractures and is often observed even after optimal stable fixation and proper rehabilitation. Sanchez-Sotelo et al [29] treated complex distal humeral fractures with the parallel plate technique and reported only 41% of elbows obtained at least 30° of extension and 130° of flexion.

While some authors reported that about one-third of patients failed to regain functional arc of motion after open reduction and internal fixation of intercondylar fractures, most patients can expect to have good to excellent results [31,32].

Conclusion

This study revealed that managing the distal humeral fractures by performing the surgical intervention using the internal fixation of two Parallel-Plate gives satisfactory results.

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