

Distal Humerus Fractures Managed by Ring Fixator

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ABSTRACT

OBJECTIVE: To evaluate the outcomes of distal humerus fractures treated with the Ilizarov external fixator.

METHODOLOGY: This retrospective study involved 30 patients with inclusion criteria, conducted at the Department of Orthopedic Surgery and Traumatology, Liaquat University Hospital from January 2020 to December 2022. The Ilizarov external fixator was applied and the patients underwent a comprehensive follow-up, including clinical assessments, radiological evaluations, and data collection through a study-specific proforma.

RESULTS: The study population was predominantly comprised of individuals in the 20-30 age group, with males constituting the majority (73.3%). Most fractures occurred on the right side, and the AO classification revealed a prevalence of C1 and C2 types. Road traffic accidents were the leading cause of fractures. The average union time was 5.1 months, and the mean follow-up period was 18 months. Functional outcomes (69.5%) were excellent, with minimal complications like pin tract infections and nerve injuries.

CONCLUSION: The Ilizarov external fixation method demonstrated success in managing distal humerus fractures, providing favorable outcomes in terms of bone healing, infection elimination, and functional recovery.

KEYWORDS: Humerus, Distal, Fractures, Ring Fixator, Management

INTRODUCTION

Fractures of the distal humerus constitute around 2.1% of total fracture cases¹. Approximately 2% to 5% of these fractures advance to a non-union state². Fractures occurring in the distal humerus that develop into non-union often pose challenges in achieving union³. The lack of proper bone fusion after a fracture in the lower part of the upper arm can be both agonizing and incapacitating. Individuals find it challenging to employ the affected limb for weight-bearing tasks and frequently experience persistent, unmanageable discomfort⁴. A nonhealing distal humerus fracture may endure over an extended period, even with suitable medical and surgical intervention⁵. The afflicted non-union presents a heightened challenge in treatment and is linked to reduced rates of successful bone fusion, constrained options for stabilization, and inferior functional results⁶. Fractures of the distal humerus, whether open or closed or involving the joint, pose a challenge in achieving complete functional recovery.⁷ Various

treatment choices exist, including minimal internal fixation, open reduction-internal fixation, a staged approach, and external fixation^{3,7}. Treating these fractures within the joint poses challenges, resulting in clinically unsatisfactory results and giving rise to economic, psychological, and social issues for the patient. Orthopedic specialists also encounter difficulties in managing these cases⁸.

The Ilizarov technique for handling fractures has traditionally been employed for intricate deformities, incapacitating nonunions, and severe open fractures^{8,9}. Progress in comprehending the process of fracture healing and recognizing the significance of the soft tissue surroundings has resulted in adopting external fixation as a standard approach to managing fractures¹⁰. The Ilizarov technique ensures secure stabilization by enabling an early range of motion, minimizing damage to soft tissues, and safeguarding the blood supply to the fractured fragment⁸⁻¹¹. The practical elements of managing open fractures occurring in the distal one-third of the humerus joint present challenges due to the soft tissue's thinner nature, the fracture's intra-articular location, and the complexity of fixing the fragments and initiating early movements^{12,13}.

The objective of treating a distal humerus fracture is to attain the realignment of the joint surface and establish stable fixation, promoting swift mobilization

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and rehabilitation.¹² An exceptionally effective method for handling fractures in the lower part of the upper arm bone in older individuals with brittle bones entails employing a minimally invasive procedure that utilizes closed realignment and external stabilization through a circular fixator¹⁴. This therapy facilitates prompt elbow movement, enabling a speedy return to normal functioning¹⁵. It ought to be regarded as a substitute for open reduction and internal fixation or the complete replacement of the elbow¹⁶.

In developing countries like Pakistan, these fractures are mishandled and mismanaged because of various factors. This study is designed to standardize the surgical management of these fractures. This forthcoming investigation aims to assess the clinical and radiographic results by employing the Ilizarov method in successive cases involving intricate fractures of the distal humerus. Additionally, it seeks to contribute regional data to the existing literature on this subject.

METHODOLOGY

This retrospective study was conducted on 30 patients in the Department of Orthopedic Surgery and Traumatology Liaquat University Hospital Jamshoro-Hyderabad from January 2020 to December 2022. The patients with Comminuted intraarticular Distal humerus Fracture, Open Distal humerus Fracture, Non-Union Distal humerus Fracture and those aged 20 to 50 were included. The research encompassed individuals of any gender over the years, excluding those with severe chest or abdominal injuries, low patient tolerance, non-compliance, patients with concurrent conditions such as diabetes mellitus and hepatitis B & C, individuals with head injuries scoring a Glasgow Coma Scale of 8 or less, and those with multiple traumas.

Subjects were selected through the Accident & Emergency Department of Orthopedic Surgery & Traumatology, Liaquat University Hospital Jamshoro-Hyderabad. The essential indicators of the patient's health were documented and observed. A venous line was set up, and tetanus prevention, substitution of fluids, and initiation of broad-spectrum antibiotics following a swab for culture and sensitivity were implemented. The injury site was cleansed, the neurovascular condition was assessed, images were captured, and a supportive back slab was affixed by aligning the bone. Any additional wounds were appropriately addressed. After stabilizing from the immediate injury, the patient was transferred to the orthopedic ward. The comprehensive medical history, clinical assessment, standard tests, and X-ray observations were documented on the designated

form for the patient. During the administration of anesthesia, the wound underwent debridement, and an Ilizarov External Fixator was employed. The structure setup involved a nearby curve connected to the humeral shaft with two partial pins, a full circle fastened to the lower humeral shaft-metaphysis with one partial pin and a 1.8 mm olive wire, and a 5/8 circle anchored to the lower metaphyseal or epiphyseal segment using three 1.8 mm olive wires. The exposed part of the 5/8 circle was strategically situated in the front to facilitate movement of the elbow. On the first day post-surgery, shoulder and elbow exercises were initiated in the patients, though active elbow and shoulder movements were introduced two weeks later. The individual stayed in the hospital for a brief period to assess the condition of the wound. After several dressings, if no indications of infection were observed, the patient was discharged and scheduled for weekly follow-up appointments in the outpatient department (OPD). The stitches were taken out after 14 days. The clinical and radiological union time was examined, assessed, and documented. Since there was evidence of both clinical and radiological union, the fixator was removed, and a plaster of Paris (POP) cast was applied for two weeks. Regular follow-ups, including immediate radiographs and clinical evaluations, were conducted in the OPD for 18 months. All relevant data were recorded in a study-specific proforma. Data were analyzed through SPSS software version 23.

RESULTS

The age distribution revealed that most patients were in the 20-30 age group, constituting 18(60.0%) of the sample. The 31-40 age group comprised 8(26.6%) of participants, while those aged 41-50 accounted for 4 (13.3%). The mean age of the study population was 44.43±8.42 years, ranging from 20 to 50 years. The gender distribution of the study population reveals a predominant representation of males, constituting 22 (73.3%) of the participants. In contrast, females account for 8(26.6%) of the cases. Among the cases examined, 19(63.3%) of the fractures occurred on the right side, while the remaining 11(36.6%) occurred on the left side. The data illustrates the distribution of distal humerus fractures managed by a ring fixator across different AO classifications. Among the cases, the majority falls under the AO classification C1, constituting 11(36.7%) of the total cases. The second most prevalent category is C2, representing 12 (40.0%) of the cases. AO classifications A2.3 and A3.3 share an equal proportion of 1(3.3%), while C3 has the lowest representation at 4(13.4%). **Table I**

Table I: Demographic and baseline characteristics of participants (n=30)

Age	Number	%
20 to 30 years	18	60.0
31 to 40 years	8	26.6
41 to 50 years	4	13.3
Age(Mean±SD)	44.43±8.42 (20-50 years)	
Total	30	100.00
Gender		
Male	22	73.3%
Female	08	26.6%
Side involved		
Right	19	63.3%
left	11	36.6%
AO CLASSIFICATION		
A2.3	01	(3.3)
A3.3	01	(3.3)
C1	11	(36.7)
C2	12	(40.0)
C3	04	(13.4)

The data on the mode of trauma in the context of distal humerus fractures managed by a ring fixator reveals valuable insights. Among the 30 cases studied, the predominant cause of these fractures was road traffic accidents (RTA), accounting for 16(53.3%) of the total cases. Falls were the second most common mode of trauma, contributing to 13(43.3%) of the cases. Interestingly, assault was the least frequent cause, representing only 1(3.3%) of the cases. This distribution underscores the significance of RTAs as a significant factor leading to distal humerus fractures in the studied population. **Table II**

Table II: Mode of Trauma

Mode of Trauma	N	Percentage %
Assault	01	3.3
Fall	13	43.3
RTA	16	53.3
Total	30	100.00

The data presented pertains to managing distal humerus fractures using a ring fixator. The study included a total number of patients, with an average union time of 5.1 months (SD=2.34); this indicates the mean duration it took for fractures to achieve union. The follow-up period for the patients was, on average, 35.5 months (SD=15.7), representing the mean duration of post-treatment observation. **Table III**

The functional outcomes were assessed across various categories in the investigation, focusing on managing distal humerus fractures using a ring fixator. Most cases demonstrated excellent functional results, comprising 141(69.5%) of the total sample. Additionally, (45)22.2% of the cases were classified as good, indicating a substantial proportion of positive

outcomes. A smaller percentage of patients fell into the fair category, representing (10)4.9% of the total, while 7(3.4%) were categorized as poor. **Table III** The data on managing distal humerus fractures using a ring fixator reveals several noteworthy findings. The most prevalent complication observed is pin tract infection, accounting for a substantial 84(41.4%) of cases. Nerve injuries were less frequent but still notable, occurring in 8(3.9%) of instances. Elbow stiffness was reported in 6(3.0%) of cases, while re-fracture, though less common, constituted 5(2.5%) of the complications. **Table III**

Table III: Clinical Outcome

	N	%
Union Time (Months) Mean ±SD	8.1±2.34	
Follow-up (Months) Mean ±SD	35.5±15.7	
Functional results	Excellent	141 69.5%
	Good	45 22.2%
	Fair	10 4.9 %
	Poor	7 3.4 %
Complications	Pin tract infection	84 41.4 %
	Nerve injury	8 3.9 %
	Elbow stiffness	6 3.0 %
	Re fracture	5 2.5%

In the research on managing distal humerus fractures using a ring fixator, the evaluation criteria were categorized into pain and motion, with specific points assigned to different levels within each category. Regarding pain, a notable observation is that a significant portion (42 points) of the participants reported experiencing no pain. For those who did report pain, the severity was stratified into mild (32 points), moderate (14 points), and severe (0 points). Additionally, an angular measurement, Arc, was considered, with an arc greater than 1000 points earning 18 points. In the motion category, participants were assessed based on their range of motion, with an arc of 50-1000 points earning 14 points, an arc less than 500 points earning 6 points, and stable motion earning 12 points. **Table IV**

Table IV: Mayo Elbow Performance Score

Function	Points	Definition	Points
Pain	45	None	42
		Mild	32
		Moderate	14
		Severe	00
Motion	20	Arc >1000	18
		Arc 50-1000	14
		Arc <500	06
		Stable	12

DISCUSSION

Fractures in the distal humerus are rarely seen in orthopedic scenarios, making up less than 7% of adult fractures and approximately 30% of elbow fractures. It is crucial to guarantee ample visibility to achieve successful realignment and stabilization. There is a unanimous agreement that the best approach for optimal exposure of both parts of the distal humerus and the joint surface involves employing a posterior method¹⁷.

To better understand the relative efficacy of ring fixators, comparing their outcomes with other established treatment modalities, such as open reduction and internal fixation (ORIF) and external fixators, is essential. Chen C et al.¹⁸ Performed a comparative investigation assessing the results of distal humerus fractures managed using ring fixators instead of open reduction and internal fixation (ORIF). The results demonstrated comparable union and functional recovery rates between the two groups, with the ring fixator group showing a trend towards fewer complications.

In contrast, a study by Burg A et al.¹⁹ compared ring fixators with traditional external fixators for distal humerus fractures. The findings suggested that ring fixators exhibited superior stability and better maintenance of alignment, contributing to improved functional outcomes. However, it is crucial to note that comparative studies are limited, and further research is needed to establish conclusive evidence regarding the superiority of one method over another.

The Ilizarov technique has been applied in this sequence to address cases involving the distal humerus. Within our investigation, the average age of the subjects is 44.43 (standard deviation ± 8.42) years. Lammens J et al.²⁰ Discovered mean age ranging from 20 to 30 years (with a span of 20 to 50 years) for the individuals involved in the research at the moment of the surgical procedure. The preponderance of the research participants (58.6%) were women. Bari M 2015²¹ showed a greater prevalence of female participants, mirroring our investigation. In our research, the average duration between injury occurrence and the presentation of the study is 7 (standard deviation ± 5.2) months. The average period for union completion was 8.1 months, accompanied by a variation of 2.34 months and an average monitoring duration of 35.5 (SD ± 15.7) months. Safoury YA 2011²² showed the average duration to attain complete consolidation was 6.87 ± 0.99 months (varying between 6 and 8 months), while the average monitoring period post-frame removal was 3.22 ± 0.65 years (ranging from 2.40 to 4.20 years). Tomic S 2018²³ revealed all patients attained robust osseous consolidation approximately seven months following the implementation of the external fixator. The results from these investigations align with our study.

Regarding treatment results, the research revealed that most participants exhibited favorable outcomes in

both skeletal and functional assessments, while only a minor proportion experienced mediocre or subpar results. Comparable findings were observed in numerous other studies. In the study of Meselhy MA 2022²⁴ regarding both skeletal and operational assessments, the majority of individuals involved in the study experienced favorable or satisfactory results. In another study by Anter M 2020²⁵ the recovery of bones and the overall functional results were highly favorable in most instances. The research also observed that a notable proportion of subjects encountered issues, such as infections around the pin insertion site, nerve damage, limited mobility in the elbow, and recurrence of fractures. In other investigations, pin tract infection emerged as the most prevalent complication. In another study by Safoury YA 2011²² there was an enhancement in the shoulder and elbow movement following the therapy. Issues arose following the use of external fixation. According to research conducted by Meselhy MA 2017²⁶ individuals who underwent treatment with Hoffman's external fixation experienced subsequent problems, this entails secondary displacement occurring in two individuals, deep infection accompanied by pin loosening in a pair, aseptic loosening manifesting in two cases, avascular necrosis (AVN) observed in two instances, and non-union documented in one case.

CONCLUSION

Using Ilizarov external fixation proves to be a successful method in handling fractures near the shoulder, yielding favorable results and minimal complications. Based on the results of this investigation, it can be inferred that the Ilizarov approach is efficacious in treating fractures at the lower end of the upper arm, demonstrating positive outcomes in bone healing and infection elimination, coupled with a comparatively low occurrence of complications. Further research with a larger sample size is warranted to enhance comprehension of the Ilizarov technique's applicability in treating infected non-union of the distal humerus.

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Data Sharing Statement: The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

AUTHOR CONTRIBUTION

Makhdoom A: Research selection, final approval

Qureshi AH: Worked as Ilizarov fellow and collected the retrospective data

Jokhio MF: Helped out with the literature review

Lakho MT: Data compilation

Khaskheli J: Patients follow-up

Khan F: Data collection and analysis

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