Addis Ababa University

College of Health Sciences

Department of Orthopedics and Trauma Surgery

FUNCTIONAL OUTCOMES OF DISTAL HUMERUS FRACTURES MANAGED WITH ORIF, ASSOCIATED FACTORS AND OVERALL COMPLICATIONS AMONG PATIENTS ATTENDED TIKUR ANBESSA HOSPITAL, ADDIS ABABA, ETHIOPIA.

BY

ABAY BIRHAN

(MD, final year orthopedics and trauma surgery resident)

Advisor: Dr. MISGANA TEMESGEN

(MD, Assistant Professor of Orthopedics and Trauma surgery, orthopedics trauma and arthroplasty surgeon)

A Thesis submitted to the department of Orthopedics and Traumatology, AAU, CHS in Partial fulfillment of the requirement for the specialization certificate in Orthopedics and Trauma surgery.

October 2024

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ADVISOR'S APPROVAL SHEET

This is to certify that the thesis entitled **"functional outcomes of operatively managed distal humerus fractures with ORIF and overall complications among patients who attended Tikur Anbessa hospital, Addis Ababa, Ethiopia"**is submitted in partial fulfillment of the requirements for the Specialization Certificate in Orthopedic surgery to the department of orthopedic surgery and Trauma surgery, Addis Ababa University college of health science and has been carried out by Abay Birhan under my supervision. Therefore, I recommend that the student has fulfilled the requirements and hence hereby can submit the Thesis to the Department.

Name of main advisor: Dr. Misgana Temesgen(MD)

Signature

Date

Name of co-Advisor:

Signature:

Date:

Acknowledgment

My deepest gratitude goes to my advisors Dr. Misgana. (Orthopedics trauma and arthroplasty surgeon) for continued guidance, unlimited support and constructive criticism through the whole process of my research preparation and giving me valuable comments.

I would like to thank TASH department of orthopedics and trauma surgery and professor Biruk (consultant orthopedics and trauma surgeon and head of department) for accepting my research topic and giving me greater opportunity to practice this clinical research and encouraging me to be involved in clinical research. Finally to everyone who has contributed directly or indirectly to the success of this research.

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Tables and Figures

Acronyms

AAU: Addis Ababa University

AO-ASIF: Arbeitsgemeinschaft für Osteosynthesefragen Association for the Study of Internal Fixation

CHS: College of Health Sciences

DM: diabetes mellitus

Ex. Fix: External fixator

FDA: fall down accident

GA classification: Gustillo Anderson classification

HO: heterotopic ossification

HTN: hypertension

MCL: medial collateral ligament

LCL: lateral collateral ligament

MEPI: mayo elbow performance index

LCL: lateral collateral ligament

ROM: range of motion

RTI: Road Traffic Injuries

RVI: retroviral infection

SOM: School of Medicine

SSI: surgical site infection

TASH: Tikur Anbessa Specialized Hospital

TEA: total elbow arthroplasty

Abstract:

Background: Approximately 7% of all adult fractures involve the elbow and distal humerus fracture account for 2% of all fracture;with a bimodal distribution affecting young males and elderly females. Nationwide epidemiological data regarding distal humerus fractures are scarce. Surgical management through open reduction and internal fixation (ORIF) is a gold standard and widely practiced, but outcomes remain controversial due to postoperative complications such as stiffness and pain. In this study we will assess the functional outcomes of distal humerus fractures managed with ORIF using the Mayo Elbow Performance Index (MEPI).

Objective: To evaluate the functional outcomes and complications distal humerus fractures management with ORIF at Tikur Anbessa Specialized Hospital.

Method: A retrospective cross-sectional study was conducted on 53 patients who underwent ORIF for distal humerus fractures between January 2021 and January 2024 at Tikur Anbessa specialized hospital. We collected our data from patient evaluation, medical chart review and assessed the outcome using MEPI score.

Results: From the 53 patients, 62.3% achieved good outcomes, 11.3% had excellent results, 13.2% had fair outcomes, and 13.2% had poor results. Common complications included residual pain (65.5%), elbow stiffness (55.2%), and nerve injuries (13.2%).

Discussion: Most patients had good to excellent functional outcome following ORIF. However, postoperative pain and stiffness remain prevalent, highlighting the need for early rehabilitation and physiotherapy

Keywords: Distal humerus fracture, ORIF, range of motion, rehabilitation, MEPI Score.

1. Introduction

1.1 Background of the study

A distal humerus fracture is defined as a fracture with an epicenter that is located within a square whose base is the distance between the epicondyles on an anteroposterior radiograph.[1]

Fractures of the elbow constitute about 7% of adult fractures; distal humerus fractures account for less than half of all elbow fractures.[2,3]. It is one of the most technically demanding injuries especially when they are multifragmented and in osteopenic bone, and have complex anatomy with limited options for internal fixation[4,5]. Post operatively most patients are complicated by elbow stiffness, weakness, and pain. Achieving painless, stable, and functional elbow joint is the main goal of management [6]. Understanding surgical indications, good soft tissue handling, proper choice of surgical approach, achieving anatomic articular reduction, and creating rigid fixation construct that allows early ROM is very important for a good outcome[1,6]. Albin Lambotte in 1913 is pioneer with the idea of an aggressive approach, with ORIF against non-operative treatment for distal humerus fractures and he illustrated the principles of osteosynthesis and believed anatomic reduction is important for good functional recovery[1,2]. But, surgical site infection and hardware failure were very common which significantly affected the outcome. In 1937, Eastwood described the technique of closed reduction under a general anesthetic and brief immobilization in a collar and cuff and followed 14 patients among them 12 returned to their original occupation. He said that we don't need perfect anatomical reduction in order to achieve a good result. Evans, in 1953, named this mode of treatment "bag of bones" and thought that although it may be appropriate for the elderly patient, it was not good for the young active patient. The choice between operative and nonoperative management remained a controversy for the years to follow. In 1969, Riseborough and Radin reported that operative treatment was unpredictable and was associated with poor outcomes, and therefore, they advocted nonsurgical management. Likewise Brown and Morgan, reported satisfactory results with nonoperative management of 10 patients with distal humerus fractures in 1971. They managed patients with early active motion and at final follow-up they had mean flexion extension arc of 98 degrees[1]. In the last quarter century, the principles set out by the Arbeitsgemeinschaft für Osteosynthesefragen Association for the Study of Internal Fixation (AO-ASIF) group including anatomic articular reduction and rigid internal fixation allows for healing and early postoperative motion which improved the outcome significantly[7,8]. In the last decade as understanding of elbow anatomy increased, improvements in surgical approaches, new innovative fixation devices, and an evolution of postoperative rehabilitation protocols results good outcome after surgical management. Open reduction and stable fixation is considered the standard of care for distal humerus fracture management in younger patients using modern fixation principles[9,10]. Regarding the choice of implant Single columnar plating, Recon plating and conventional plates have more fixation failures [11]. fixation using double anatomical locking compression plates in in orthogonal plane is the preferred technique for distal humerus fractures[6,12-15]. Paratricepital, triceps splitting, triceps reflecting, and olecranon osteotomy are the most common posterior surgical approaches to distal humerus fracture fixation with each of them providing different degree of articular exposure. Option of surgical approach depends on the complexity of the fracture especially the condition of intra-articular fragment and surgeons experience[16–18]. At old ages, because of poor bone quality and comminution of the articular surface and metaphysis restoration of the anatomy and obtaining rigid internal fixation is difficult and prolonged rehabilitation, propensity for stiffness, and increased reoperation rate associated with ORIF may convert a previously independent individual into a role of dependence[2]. Tyllianakis M. recommends careful

preoperative planning, trans olecranon approach for good visualization, routine ulnar nerve exploration and stable internal fixation facilitating early active rehabilitation, remain the gold standard for the treatment of intra-articular fractures of the distal humerus[19]. Conservative treatment can be justified in cases of hemiplegia sequelae involving the ipsilateral upper limb, advanced osteoporosis and fractures with extensive bone loss but to avoid fixation failure, stiffening is almost assured and arthrolysis will have to be performed later on[20,21]. Primary total elbow arthroplasty (TEA) has evolved to become a viable treatment option for elderly patients with articular fragmentation, comminution, and osteopenia. This days, distal humerus hemiarthroplasty is being considered the management option for distal humerus fractures, including capitellum and trochlea fracture.[22]

1.2 statement of the problem

Distal humerus fractures are complex injuries that often result in significant functional impairment if not managed appropriately. Achieving stable rigid fixation and starting early range of motion is very crucial for a good outcome. [23,24]. Poor outcomes may also occur due to malunion, nonunion, contracture, avascular necrosis, heterotopic ossification (HO), hardware failure, and symptomatic prominent hardware[25,26]. Identifying the most common complications and associated factors in the treatment of distal humerus fractures locally might help to design a mechanism to avoid them. In our country open reduction and internal fixation is the main treatment option for most distal humerus fractures. To my knowledge there is no study done on functional out come after open reduction and internal fixation of distal humerus fracture in the country, particularly in the study area.

Thus, this study aims to assess the functional outcomes of patients with operatively managed distal humerus fractures, with a focus on identifying factors that influence recovery and evaluating patient satisfaction with their post-operative function

1.3 Significance of the Study

Tikur Anbessa specialized hospital is the pioneer institution nationwide for treating distal humerus fracture operatively and non-operatively. Distal humerus fractures, comprise approximately 2% of all fractures and most of this fractures are treated operatively but local data specific to this topic is scarce therefore as an institution serving numerous numbers of this study will be necessary to know the final postoperative functional outcome of distal humerus fracture.

1.4 basic research question

1. What is the functional outcome of patients following operative management of distal humerus fractures with ORIF?
2. What are the factors which determine the postoperative functional outcome of patients with distal humerus fracture?

2. Literature review

For better functional results precise preoperative planning, adequate surgical approach, anatomical inter-fragmentary stabilization, dual plating, and early post-operative physiotherapy help in restoring painless and functional elbow for distal humeral fractures. There are few regional and international studies on the functional outcome after operative management of distal humerus fracture and associated factors.

10-year descriptive retrospective study was done by **Fokam P and his colleagues** in Douala General Hospital (DGH) and Laquintinie Hospital Douala (LHD), Douala, Cameroon from March 2010 to March 2020 on outcomes of operative and conservative management for distal humerus fracture and was assessed using Mayo elbow assessment index. 62 patients were recruited with a mean age of 37±13.37. The age range mostly affected was 18-30years. 53.2 % were male and 46.8 % were female. Most fractures (54.8%) are due to road traffic accidents (RTA). Surgery was done for 72.6% of patients. The result was poor outcome (MAYO<60) in 70 % of patients managed conservatively while excellent outcome was only seen on 19 patients which were all managed surgically (p=0.001)[(27)]

According to a study done by **S. Pascal Chigblo1 et,al** in orthopedics and trauma department at Hubert Koutoukou MAGA National Teaching Hospital in Cotonou, Benin from 2001 to 2015 with 38 distal humerus fracture patients managed with Lecestre plate with a minimum follow-up of 12 months,10 patients were extraarticular, 2 patients were partial articular and 26 were complete articular. The mean age was 33.6 years and 27 were male. Most of the cause is road traffic accidents constituting 31 cases. The mean time of surgery was 21 days. Average Mayo elbow performance score (MEPS) was 66.3 points. It was excellent in 8 patients, good in 13 patients, fair in 10 cases and bad for 7 patients. Radial nerve paresis occurred in 3 patients, in 2 patients there was loss of reduction; 2 patients had SSI, non-union in 3 patients, 4 had malunion in varus.[(28)]

On a study done by **Jan Korner et.al** with 63 patients older than 60 years of age with median age of 73 years (range, 61– 92 years) **to assess the** results distal humerus fractures after open reduction and internal fixation Between January 1989 and July 2001 at level 1 trauma centers of two German university hospitals, 29 patients were complete intra articular, 5 were partial articular and 11 were extra articular fractures. Clinical and radiological follow-up was obtained after atleast 24 months of followup for 45 patients. 36 patients were female and 9 were male. With Mayo Elbow Score assesment, 9 patients achieved an excellent result, 17 patients had good result, for 13 patients it was fair and 6 patients had poor outcome. The median MEPI score was 83 points (43– 100). From 19 patients with fair and poor outcome 12 were immobilized for more than 14 days[(2)].

Pajarinen J and Björkenheim JM. Followed 18 complete intraarticular distal humerus fracture patients for whom ORIF was done for average period of 24.7 months (range, 10-41 months; SD, 9.3 months) with mean age, 44.4 years; SD, 19.1 years; range, 16-81 years. The result was excellent or good for 56 % of patients and all patients younger than 40 years had excellent or good result. Poor outcome were associated with male sex, the triceps-splitting approach, and immobilization exceeding 3 weeks, age over 50 years, poor bone quality, and open_fracture .[(29)]

The finding of McKee et.al from their study on 25 patients with mean age of 47 years and intraarticular distal humerus fracture managed with bicolumnar fixation was decreased mean muscle strength compared to the normal side at elbow flexion measured at 90 degrees (74 percent of normal, p = 0.01) and elbow extension measured at 45 degrees (76 percent of normal, p = 0.01), 90 degrees (74 percent of normal, p = 0.01), and 120 degrees (75 percent of normal, p = 0.01) and mean flexion extension arc was 108 degrees (range, 55 to 140). The average duration of follow-up was 37 months (range, 18 to 75). The average DASH score was 20 points, indicating mild residual impairment. Reoperation was done for Six patients (24 percent) and three of them had removal of symptomatic implant from olecranon osteotomy site.[30]

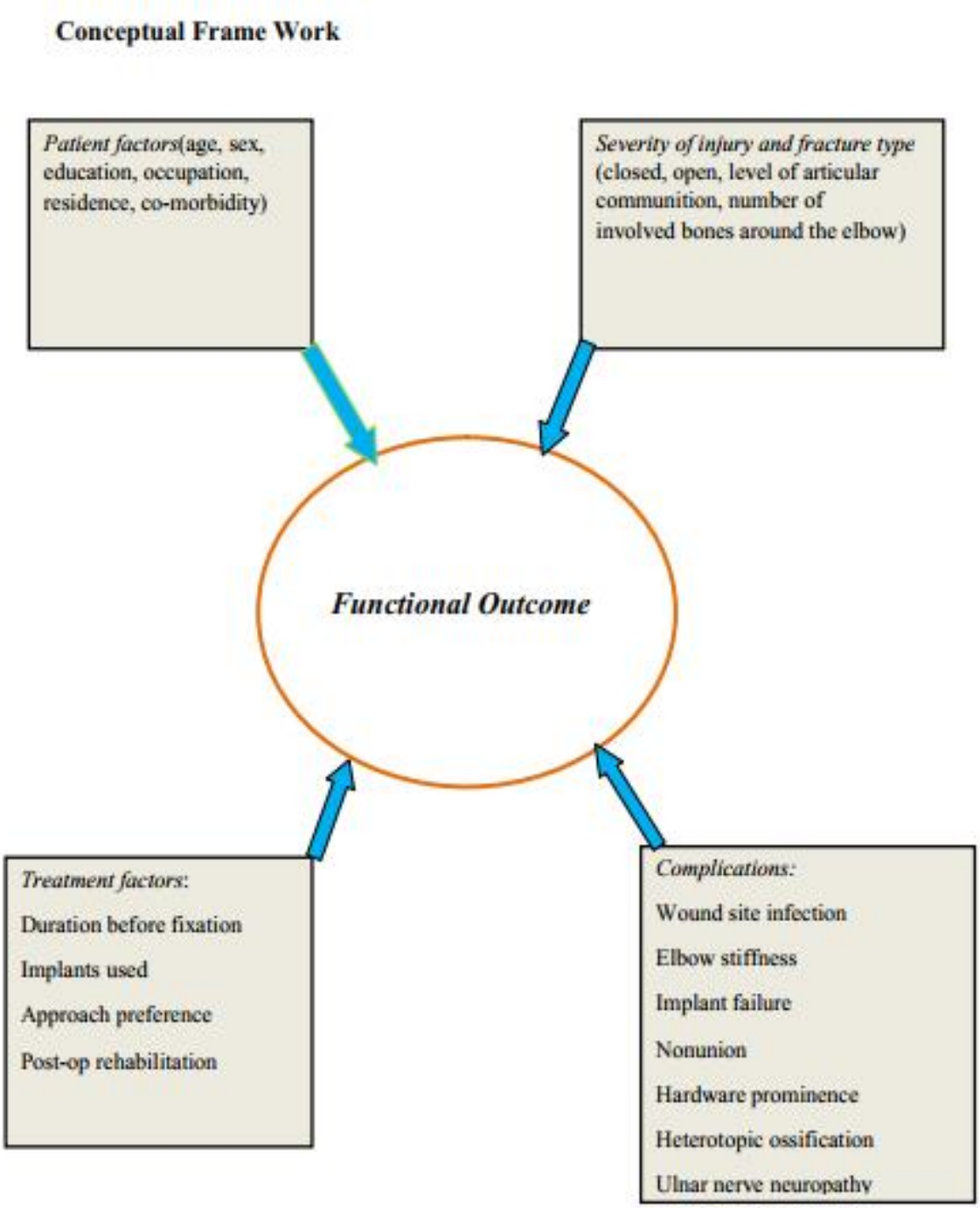
Jason M. Erpelding, MD, et al assessed the outcome of 37 distal humerus fractures managed with ORIF using paratricepital approach at University of Nebraska Medical Center, Omaha, Nebraska From January 2002 to January 2009 .regarding fracture type 6 were extraarticular, 21 was partial articular and 17 were complete articular. Outcome were assessed using radiograph and MEPI score. All 37 fractures healed primarily.3 of them had stiffness and release was done. The median flexion-extension arc was 126 degree (range 60 to 141. Average MEPI was 91.5 points, indicating excellent scores with mild impairment. The median percent loss of triceps strength was 10% (range, 0% to 49%) as compared to the normal elbow.[18]

Jagadish et.al.2023 studied on Functional Outcome of Distal Humerus Fractures Treated with ORIF using Bicolumnar Plating in a Tertiary Care hospital and the result was 47% excellent MEPS followed by 33% of good MEPS and 13% had a Fair MEPS score. Only 7% of patients had poor MEPS. Based on individual scores 33.3% had 90 MEPS and 16.6% cases had 85 MEPS. Only 2 patients had 55 MEPS in the study[31].

Vazquez et.al, 2010 prospectively assessed the incidence of ulnar nerve neuropathy after ORIF of distal humerus on 69 patients at New York university hospital from November 1999 to January 2006 with a minimum follow up of 12 months and the incidence of immediate post-operative ulnar neuropathy was 10.1 % and at final follow up the incidence was 16 % and there was no associated risk factor identified. [34]

From the literatures we reviewed operative management of distal humerus fracture is the gold standard management with favorable outcomes especially in young patients with early intervention and aggressive physiotherapy. Poor outcomes are associated with being male sex, the triceps-splitting approach, and immobilization exceeding 3 weeks, age over 50 years, poor bone quality, and open fracture.

3. Factors affecting functional outcome



4. Objective

4.1 General Objective:

To assess the functional outcome of operatively managed distal humerus fracture with ORIF at TASH

4.2 Specific objective

- To identify common complications after operative management of distal humerus fracture
- To assess associated factors regarding the clinical outcome of operative management of distal humerus

5. Methodology

5.1 Study Area

Tikur Anbessa Hospital is the highest health institution in Ethiopia and east Africa. It is located in capital city of Ethiopia, Addis Ababa.

Orthopedics and trauma surgery department in Tikur Anbessa hospital with its own 4 stair building with more than 110 beds and is the mother department of orthopedics in Ethiopia being leader for many more institutions across the country with 28 specialist and subspecialist physicians, 2 fellows, 58 residents and other supporting staff members. It has its own OPD serving patients 5 days a week in the morning and afternoon with annual visit of more than **11,000** patients. The operation theater has 4 fully functional tables and surgery will be done from Monday to Friday in all tables with one of them open 24/7 for emergency procedures.

5.2 Study period

January 2021 to January 2024

5.3 Study design

Retrospective cross sectional study

5.4 source and study population

5.4.1 Source population

All distal humerus fracture patients managed operatively

5.4.2 Study populations

All distal humerus fracture patients managed operatively in the study period

5.5 Sample Size Determination and sampling technique

5.5.1 Sample size determination

The sample size will be calculated using the formula for of single population proportion.

$$n = \frac{\left(Z_{\alpha/2}\right)^2 p(1-p)}{d^2}$$

Where,

- n is the sample size,

- α is the critical value corresponding to 95% confidence interval(CI),

- P is the estimated prevalence rate for the population which is 2% - 0.02

- d is the margin of error to be tolerated for which 5% is taken.- 0.05

Zα/2 is the standard normal variable at 1-α % confidence level -1.96

n= $((1.96)^2 * (0.02*0.98))/0.05^2$ =46

5.5.2 Sampling technique and data collection

All distal humerus fracture patients managed operatively in the study period

Data will be collected from OR log book, by examining patients, on patient cards, on computer follow up and on X-ray of patients in the computer system.

5.5.3 Inclusion criteria

All distal humerus fracture patients managed operatively with ORIF in the study period

5.5.3 Exclusion criteria

Follow up less than 6 months

Pediatric patients < 16 yrs.

Patients having associated injuries

Lost from follow up

5.6 Variables

5.6.1 Dependent Variable:

Functional result of distal humerus fracture treatment with open reduction andinternal fixation

5.6.2 Independent Variables:

- ✓ Age
- ✓ Sex
- ✓ Educational level
- ✓ Residence/place(urban or rural)

- ✓ Occupation
- ✓ Mechanism of injury
- ✓ Presence of co-morbidity (diabetes mellitus, HIV)
- ✓ Fracture severity(level of articular(joint surface) involvement)
- ✓ Fracture type (open or closed)
- ✓ Duration before fixation
- ✓ Duration after fixation
- ✓ Surgical approach
- ✓ Implant type that is used
- ✓ Postoperative rehabilitation
- ✓ Follow up

5.7 Operational Definitions:

Open Reduction and Internal Fixation (ORIF): Immobilization of fractured bonesurgically using different implants till the fracture heals.

Ao classification of distal humerus fracture: it is standardized classification method for distal humerus fracture which classifies distal humerus in to 3 major types:

Type A: extra articular meaning there is no joint extension

Type B: the fracture extends to the joint but there is still metaphysis to diaphysis continuity

Type C: complete intra articular fracture with methaphyseal to diaphyseal discontinuity

Mayo Elbow Performance Score (MEPS): A scoring system to measure the functional outcome of distal humerus fracture.

Grade of reduction: the quality of reduction on immediate post op radiograph and graded as A: anatomic, B: <2mm stepoff and C: >2mm stepoff

Functional Outcome: The patient's physical ability or recovery to the pre-injury activity level. The outcome could be excellent, good, fair or poor

based on four parameters (pain, stability, elbow range of motion and ability to perform routine dailyactivities)

Followed up: A patient who had at least one follow up after discharge from the hospital is considered to be followed up

5.8 Data analysis and quality control

5.8.1 Data analysis

Data was entered manually in excel sheet and imported to SPSS.

Data analyzed using computerized statistical program SPSS version 26 then frequencies calculated for descriptive analysis of socio-demographic variables (age, sex, educational status, occupation, and residence area….).
Odd ratio was used for comparative association between each risk factors and functional outcome.

5.8.2 Data Quality Control

Continuous evaluation and tallying of the collected data carried out by principal investigators

5.9 Ethical Consideration and Dissemination plan

- ✓ TASH Research Ethics Review Committee (DRERC) provided ethical clearance and approval for this study. Letter of Permission & support requested and obtained from the Department head to access the patient's medical record chart.
- ✓ The final result from the study will be submitted to Department of Orthopedics and Traumatology, Tikur Anbessa Hospital, Addis Ababa University in the form of written report and will be presented for the concerned bodies.

6. Results

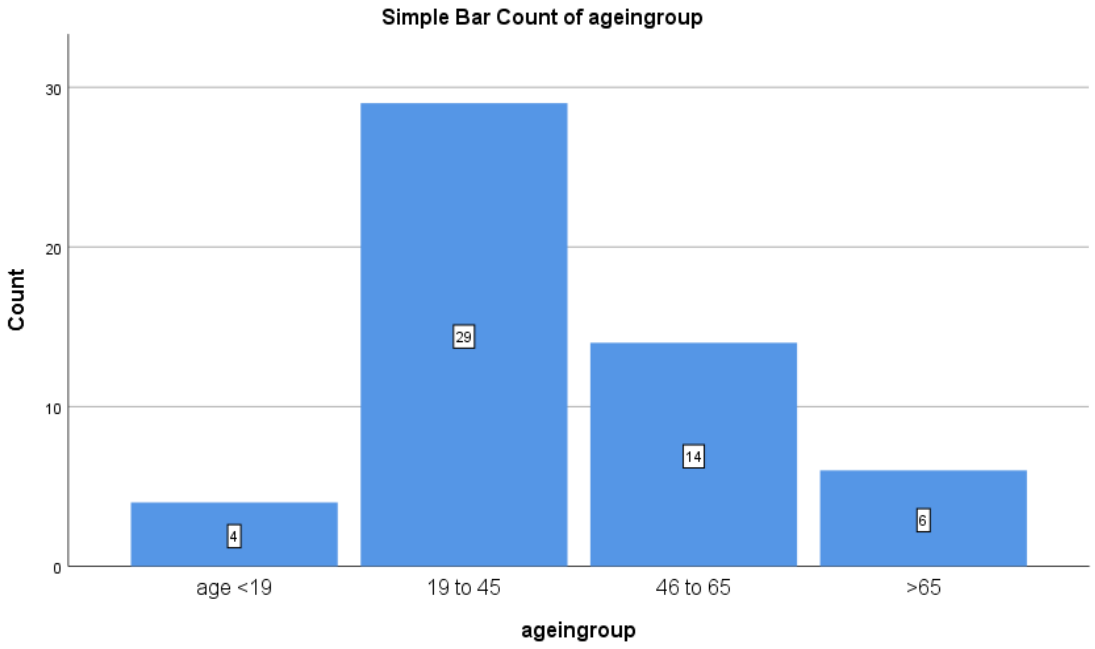
6.1 Patient social demographic characteristics

53 patients with distal humerus fractures managed with ORIF at Tikur Anbessa Hospital were evaluated. The patient demographic data showed most distal humerus fractures occurred in young active individuals, particularly those aged 19 to 45, accounting 54.7% from the total sample. Only a small portion of patients (7.5%) were below the age of 19 and 26.4% were between the ages of 46 and 65 with the mean age of 42.79 years. Elderly population, aged over 65, accounted for 11.3% of the cases. The gender distribution was nearly equal, with slightly more males (52.8%) than females (47.2%), implying the higher risk of trauma among males.

Regarding occupational and educational status of our patients majority of the patients were engaged in moderate physical activity (30.2%), followed by light physical activity (26.4%) and heavy physical activity (22.6%). Sedentary individuals account 20.8% of the sample. In terms of education, the largest group (37.7%) had higher education, followed by uneducated individuals and high school graduates, each accounting for 26.4%. 5.7% of our patients were smokers and 17% of patients had either diabetes, hypertension or both.

Table 1: Patient social demographic characteristics

Parameters	Categories	Frequency	Percent (%)
Age of patients	<19	4	7.5
	19-45	29	54.7
	46-65	14	26.4
	>65	6	11.3
Sex of patient	Female	25	47.2
	male	28	52.8
Occupation	Sedentary	11	20.8
	Light physical activity	14	26.4
	Moderate physical activity	16	30.2
	Heavy physical activity	12	22.6
Education status	Uneducated	14	26.4
	Elementary	5	9.4
	High school	14	26.4
	Higher education and above	20	37.7
Residency	Addis Ababa	35	66
	Region	18	34
Comorbidity	DM and HTN	9	17
	RVI	1	1.9
	Hypothyroidism	1	1.9
Substance use	Smoking	3	5.7
	Alcohol use	2	3.8

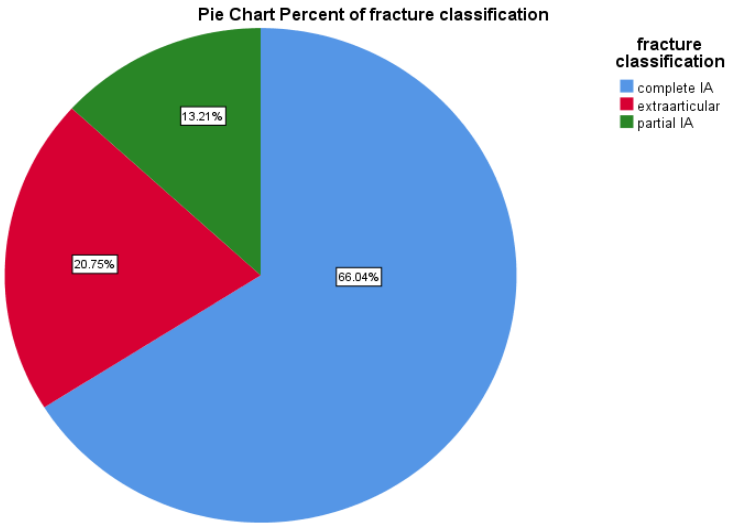


6.2 Injury status

According to our finding 52.8% of our patients are left side injuries and majority (86.6%) of fractures are closed with the most common cause of injury being fall down accidents (FDA),49.1% of the fractures, followed closely by road traffic accidents (RTAs) at 41.5%. Bullet injuries (5.7%) and fighting injuries (3.8%) were less common causes of fractures. The data indicates that high-energy trauma, such as RTAs, is a significant contributor to the incidence of distal humerus fractures, particularly among younger individuals. The majority of fractures were classified as complete intra-articular fractures (66%), with extra-articular and partial intra-articular fractures making up 20.8% and 13.2%, respectively.

Table 2: injury characteristics of the patient

Parameters	Categories	Frequency	Percent (%)
Side injured	Left	28	52.8
	Right	25	47.2
Soft tissue status	Closed	46	86.8
	Open(GA type I)	2	3.8
	Open(GA type II)	1	1.9
	Open(GA type IIIA)	4	7.5
Energy	High	40	75.5
	Low	13	24.5
Mechanism of injury	Road traffic accident(RTI)	22	41.5
	Fall down accident(FDA)	26	49.1
	Bullet injury	3	5.7
	Fighting injury	2	3.8
Fracture classification	Complete intraarticular	35	66
	Extra articular	11	20.8
	Partial intraarticular	7	13.2



6.3 Surgical details and postsurgical status

Most of our patients were operated using paratricepital approach accounting (67.9%), followed by the chevron osteotomy (32.1%). Implant wise, bicolumnar fixation was done for 77.4% of cases, and single column fixation in 20.8%, and screw fixation in only 1.9%. the average duration of the time from injury to surgery is 8.26 days and the average duration of follow up is 17.58 months. The average time of immobilization were 3.32 days. The quality of fracture reduction was generally good, with 75.5% achieving Grade A reductions, indicating near-anatomical reconstruction. Among the complications we noticed, 11.3% of patients experiencing surgical site infections, 9.4% had ulnar neuropraxia, 3.8% radial nerve injury, 15.1% of patients have heterotopic ossification and 20.8% experiencing delayed union.

Functional outcomes were assessed using the Mayo Elbow Performance Index (MEPI) and majority of patients (62.3%) had good outcomes, and 11.3% achieved excellent results. However, 13.2% of patients experienced fair outcomes, and another 13.2% had poor outcomes and the mean MEPI score of 78.02. Despite the overall positive results, a significant portion of patients reported residual pain (73.6% with mild pain) and stiffness (55.2%) with mean flexion-extension arc of 93.58 degree. Elderly patients, patients with open fracture, complete intra articular fracture and patients for whom chevron osteotomy was done have lower MEPI score.

Table 3: Surgical details and postsurgical status

Parameters	Categories	Frequency	Percent(%)
Surgical approach	Paratricepital	36	67.9
	Chevron osteotomy	17	32.1
Type of implant used	Bicolumnar fixation	41	77.4
	Single column fixation	11	20.8
	Screw fixation	1	1.9
Quality of reduction	Grade A	40	75.5
	grade B	11	20.8

	grade C	2	3.8
Post-surgical complication	Surgical site infection(SSI)	6	11.3
	Wound dehiscence	2	3.8
	Ulnar neuropraxia	5	9.4
	Radial nerve injury	2	3.8
	Delayed union	11	20.8
	Non union	4	7.5
	Implant failure	2	3.8
	Symptomatic implant	12	22.6
	Hetertotopic ossification	8	15.1
	Reoperation	6	11.3
Pain level	No	5	9.4
	Mild	39	73.6
	Moderate	7	13.2
	Severe	2	3.8
Range of motion(ROM)	<50 degree	6	11.3
	50-100 degree	23	43.4
	>100 degree	24	45.3
Rehabilitation	Home exercise	30	56.6
	Physiotherapy	23	43.4
Daily function	Difficulty in combing hair	13	24.5
Follow up	6month to 1 year	20	37.7
	1 to 2 year	19	35.8
	More than 2 years	14	26.4
Patient satisfaction	Very satisfied	7	13.2
	Satisfied	28	52.8
	Neutral	9	17
	Unsatisfied	9	17
MEPI score	Poor(<60)	7	13.2
	Fair(60-74)	7	13.2
	Good(75-89)	33	62.3
	Excellent	6	11.3

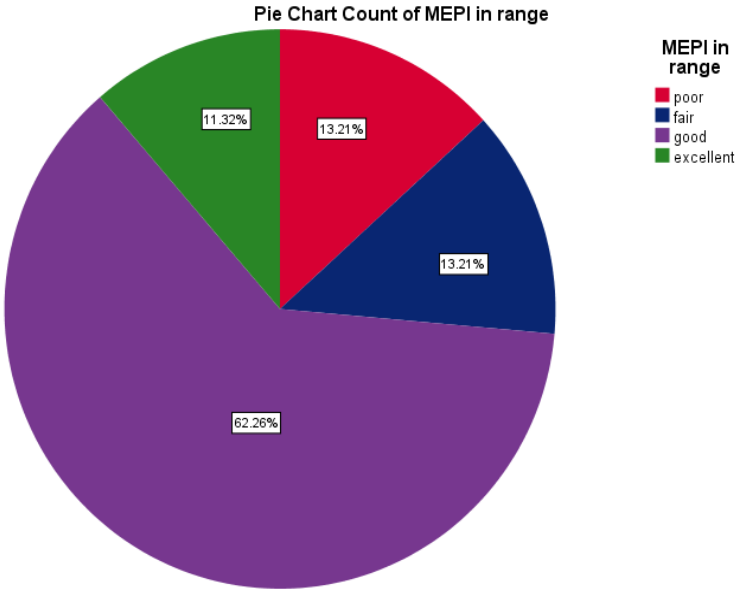


Table 4: Different parameters with MEPI in range Cross tabulation

Parameters	Categories	MEPI in range				
		poor	fair	good	excellent	P value
Fracture classification	complete IA	5(14.3%)	7(20%)	20(57.1%)	3(8.8%)	.393
	extra articular	2(18.2%)	0(0) %)	7(63.6%)	2(18.2%)	
	partial IA	0	0	6(85.7%)	1(14.3%)	
Age in group	age <19	0	0	3(75%)	1(25%)	-.195
	19 to 45	4(13.8%)	4(13.8%)	16(55.2%)	517.2%)	
	46 to 65	2(14.3%)	2(14.3%)	10(71.4%)	0	
	>65	1(16.7%)	1(16.7%)	4(66.7%)	0	
Residency	Addis Ababa	3(8.6%)	4(11.4%)	23(65.7%)	5(14.3%)	.404
	Region	4(22.2%)	3(16.7%)	10(55.6%)	1(5.6%)	
Energy of injury	High	7(17.5%)	4(10%)	23(57.5%)	6(15%)	.107
	Low	0	3(23.1%)	10(76.9%)	0	
Mechanism of injury	Bullet	1(33.3%)	0	2(66.7%)	0	.787
	FDA	3(11.5%)	4(15.4%)	17(65.4%)	2(7.7%)	
	fighting injury	0	0	1(50%)	1(50%)	
	RTI	3(13.6%)	3(13.6%)	13(59.1%)	3(13.6%)	
side injured	Left	2(7.1%)	5(17.9%)	17(60.7%)	4(14.3%)	.373
	Right	5(20%)	2(8%)	16(64%)	2(8%)	
soft tissue status	Closed	5(10.9%)	7(15.2%)	30(65.2%)	4(8.7%)	.05
	open(I)	0	0	1(50%)	1(50%)	
	open(II)	0	0	0	1	
	open(IIIA)	2(50%)	0	2(50%)	0	
type of implant used	Bicolumnar fixation	7(17.1%)	7(17.1%)	24(58.5%)	3(7.3%)	.255
	screw fixation	0	0	1	0	
	single column	0	0	8(72.7%)	3(27.3%)	
surgical approach	chevron osteotomy	5(29.4%)	5(29.4%)	6(35.3%)	1(5.9%)	.004
	paratriceptal	2(5.6%)	2(5.6%)	27(75%)	5(13.9%)	

quality of reduction	Grade A	3(7.5%)	5(12.5%)	26(65.0%)	6(15.0%)	.012
	grade B	2(18.2%)	2(18.2%)	7(63.6%)	0	
	grade C	2(100.0%)	0	0	0	
type of rehabilitation	home exercise	6(20.0%)	6(20.0%)	16(53.3%)	2(6.7%)	.071
	physiotherapy	1(4.3%)	1(4.3%)	17(73.9%)	4(17.4%)	
surgical site infection	Yes	3(50.0%)	1(16.7%)	2(33.3%)	0	.034
	No	4(8.5%)	6(12.8%)	31(66.0%)	6(12.8%)	
implant failure	No	6(11.8%)	7(13.7%)	32(62.7%)	6(11.8%)	.296
	yes(changed to EX.fix)	0	0	1(100.0%)	0	
	yes(revised)	1(100%)	0	0	0	

Table 5: mean and standard deviation values of different parameters

		duration of immobilization	age of the patient	date of surgery after injury	flexion arc	MEPI score	when was the surgery	post op hospital stay
N	Valid	53	53	53	53	53	53	53
	Missing	0	0	0	0	0	0	0
Mean		3.23	42.79	8.26	93.58	78.02	17.58	4.49
Median		3.00	40.00	7.00	95.00	80.00	14.00	4.00
Std. Deviation		2.913	17.129	6.499	27.287	13.095	8.522	1.067

7. Discussion summary

From our study the majority of our patients had favorable outcome after ORIF was done for distal humerus fracture, with 73.6% of patients having good to excellent results on the MEPI assessment scale. It is consistent with the study done by Holdsworth et.al on the outcome of fracture of distal humerus in 1990 at university hospital in Nottingham with 57patients which shows 76 % good to excellent outcome[32]. Other studies which affirm ORIF as a gold standard management option for restoring elbow function in patients with distal humerus fractures also showed similar results. Despite these positive outcomes, it is still challenged by postoperative complications in significant number of patients, mainly pain and stiffness, which need ongoing attention in clinical management. Factors which associated with poor outcome were open fracture, poor reduction, surgical site infection, complete intra articular fractures, delayed presentation, chevron osteotomy, Elderly patients and high energy injuries.

There are few regional studies done on this topic with more or less similar outcome with our study, in a study done by S. Pascal Chigblo et al. in Benin, on 38 patients, the results showed 55.3% of patients had good to excellent functional outcomes on MEPI assessment scale, consistent with our findings. But, the study also reported a higher incidence of poor outcomes, probably because of delays in surgical timing, as the mean time to surgery was 21 days, compared to our study's focus on early intervention which was 8.26 days[28]. Similarly, Fokam P. and his colleagues undergone a 10-year retrospective study in Douala, Cameroon, where 72.6% of patients achieved good outcomes following surgical management similar to our finding. They also found that conservative management was associated with significantly poorer outcomes, supporting the importance of operative treatment for these fractures[27].

Residual pain and stiffness were seen in 90% and 55.7% of our patients respectively which is consistent with findings from these African studies. In the study from Benin, stiffness was a major complaint, with 29 patients reporting some degree postoperative decrease in range of motion[28]. A prospective study done in India in 2020 on 30 patients with score of excellent, good, fair and poor in 56.7%, 26.7%, 10%, & 6.6% respectively showed complications of 7% stiffness and 20% residual elbow pain which is better than our finding [31]. This suggests that despite the availability of ORIF, postoperative rehabilitation remains a challenge across the region. Rehabilitation programs if properly followed, are shown to significantly decrease these complications. According to our study as patients who did formal physiotherapy had better functional outcomes compared to those who underwent home exercises alone. The mean flexion-extension arc was 93.6 degree which resulted mild functional impairment in most of our patients and 22.6% of our patients had symptomatic implant and most of them are from chevron osteotomy site implant, similar outcome was also seen on the study done by Mckee et.al[30]

Type of the fracture also affected our outcomes, as patients with complete intra-articular fractures showed more postoperative complications than partial articular and extraarticular fractures. This goes with results from the Benin and Cameroon studies, where intra-articular fractures required more complex surgical approaches and were associated with higher

incidence of stiffness and delayed union[27,28]. Functional outcome is also affected by whether the fracture is open or closed especially Gustillo Anderson type III are associated with poor outcomes, consistent with the study done by Min et.al. 2010 (33). A study done in South Africa by Deepak V. also focused the difficulty in achieving satisfactory results in patients with complex intra-articular fractures, further emphasizing the need for meticulous surgical technique and rehabilitation protocol.

Nerve injuries, specifically ulnar neuropraxia and radial nerve injury, were seen in 9.4% and 3.8% of patients respectively in our study. Ulnar nerve injury was also seen in 12% of patients postoperatively in the study by Fokam et al. it was also evident on a study done by Vazquez and his colleagues to assess the incidence of immediate post-operative ulnar neuropathy using medical record documentation which was 16 % at final follow up (11 of 69 patients) [27,34]. Nerve complications are a known risk in ORIF due to the proximity of neurovascular structures in the distal humerus, particularly in cases where extensive surgical exposure is required. While most cases resolve with time, this remains an important area for future improvement in surgical approaches.[34]

Overall, our results suggest that while ORIF provides satisfactory functional outcomes for most patients, we need improvements in postoperative care, particularly on pain management and rehabilitation. Similar to findings from other African studies, residual pain and elbow stiffness remain significant challenges. Future research across the region should explore the role of standardized rehabilitation protocols and advanced physiotherapy techniques in improving functional outcomes. Early intervention and structured follow-up programs should also be emphasized to prevent complications like nerve injury and stiffness. Early operations within 24 hours resulted in significantly less heterotopic bone formation and better overall function than did delayed treatment[35]

8. Strength and limitation of the study

8.1Strengths

This is the first study in the area on the largest teaching hospital in the country which can directly be applicable to the region and we tried to do comprehensive literature review comparing outcomes from different regions and institutions. We included important variables like patient demographics, injury mechanisms, and treatment approaches and the outcome was measured with standardized outcome measurement tool, MEPI and analyzed with SPSS. The paper highlights postoperative complications such as residual pain, stiffness, and nerve injuries, providing useful insights into potential areas of clinical improvement.

8.2 Weaknesses:

It was single centered retrospective study based on patients' records and need to call patients to come for evaluation and there is potential for missing data, which can reduce the accuracy of the findings. We did it on 53 patients, which may not be representative enough to generalize the findings to the broader population of distal humerus fractures in a high-trauma setting like Ethiopia and The mean follow-up period was 17.58 months, which may not capture long-term complications or functional outcomes, especially in cases of delayed healing and nonunion cases

The surgeries were done by different surgeons with different level of experience and pos operative rehabilitation protocols (home exercises vs. physiotherapy), does not asses what specific rehabilitation protocol was the patient following. We did not asses long-term complications like arthritis or secondary fractures.

9. Conclusion and recommendation

9.1 conclusion

According to this study the majority of patients with distal humerus fractures treated with open reduction and internal fixation (ORIF) at Tikur Anbessa Hospital achieved good to excellent functional outcomes. The Mayo Elbow Performance Index (MEPI) scores showed that 73.6% of patients had favorable results, highlighting the effectiveness of ORIF as the standard of care for these complex fractures. However, significant postoperative complications, such as residual pain, elbow stiffness, and nerve injuries, were observed, indicating areas where improvement is needed, particularly in postoperative care and rehabilitation.

The findings also suggest that fracture type, surgical approach, and timely rehabilitation are key determinants of the functional outcome. Patients with complete intra-articular fractures and those who experienced delays in rehabilitation faced more complications and poorer functional recovery. The study underscores the importance of early surgical intervention, structured rehabilitation programs, and comprehensive follow-up to optimize outcomes and minimize long-term disability.

While this study provides valuable insights into the management of distal humerus fractures in Ethiopia, it also highlights the need for further research, particularly in low-resource settings. More extensive studies with larger sample sizes and longer follow-up periods are necessary to refine treatment protocols and address the challenges in achieving consistently excellent outcomes

9.2. Recommendations:

Based on our finding the timing of surgical intervention plays a crucial role in the functional outcome of distal humerus fractures. Early surgical management, particularly within the first few days after injury, should be prioritized to minimize complications such as delayed union, nonunion, and prolonged stiffness. Efforts should be made to streamline the admission and surgical processes, especially in high-trauma settings like Tikur Anbessa Hospital and post operatively enhanced postoperative rehabilitation should be integral part of postoperative care as it is crucial to decrease residual pain and stiffness which remain significant postoperative challenges, affecting the overall functional outcome.

Complications such as ulnar neuropraxia, surgical site infections, and hardware-related issues were notable in this study. Surgical techniques that minimize nerve injury, meticulous handling of soft tissues, and strict infection control protocols should be emphasized. In cases where complications arise, early detection and management are critical to prevent long-term disability. Regular follow-up is essential to monitor the progression of healing, functional

recovery, and early identification of complications. It is recommended that health institutions develop comprehensive follow-up programs for patients treated for distal humerus fractures. This includes periodic assessment of pain, range of motion, and overall function using validated tools like the MEPI.

Despite the positive outcomes, there is a need for more extensive research in Ethiopia to better understand the long-term functional outcomes and complications associated with ORIF of distal humerus fractures. Future studies should include multi centered prospective study with larger sample sizes, longer follow-up periods, and focus on the development of locally applicable treatment and rehabilitation protocols. Starting national trauma registry could improve data collection, providing valuable insights into the epidemiology and management of distal humerus fractures in Ethiopia.

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11. Annex I

11.1 Participant Consent Information Sheet

Title of the project: clinical outcome of operatively managed distal humerus fracture at TASH

Name of Researchers: _____

Position of researchers: _____

Contact Address of researchers: _____

I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason, I agree to take part in the above study.

Name of participant (optional)_____ date _____ signature _____

11.2 Questioner

Questioner on out-come of operative treatment of distal humerus fractures and overall complication rate

- Are you willing to participate in this study?
  a) Yes ☐
  b) No ☐
- Date of interview: -----day-----month----year Name/signature of data collector: ----------

Socio-demographic information of respondent

1. Sex
   1. Male ☐ 2. Female ☐

2. Age:

   ☐ Under 19

   ☐ 19-45

   ☐ 46-65

   ☐ Over 65

3. Residence
    a. Addiss Ababa ☐
    b. Out of addis ababa ☐
4. Educational status
    a. Uneducated ☐
    b. Elementary school ☐
    c. High school ☐
    d. Diploma ☐
    e. Bsc/BA and above ☐

5. Occupation
    a. Sedentary ☐
    b. Light physical activity ☐
    c. Moderate physical activity ☐
    d. Heavy physical activity ☐

Pretreatment information

6. Impact of energy
    a. High ☐
    b. Low ☐
7. Comorbidities
    a. DM ☐
    b. RVI ☐
    c. CKD ☐
    d. Others
    e. No ☐
8. Alcohol use
    a. Yes ☐
    b. No ☐

9. Smoking
    a. Yes ☐
    b. No ☐
10. Side of the limb involved
    a. Right ☐
    b. Left ☐
11. Status of the fracture
    a. Open ☐
        If yes GA classification…
    b. Closed ☐
12. Fracture classification
    a. Extra articular ☐
    b. Partial articular ☐
    c. Complete articular ☐

13. Mechanisms of injury
    a. Falling down accidents ☐
    b. Road traffic accidents ☐
    c. Violence or fighting injuries account ☐
    d. Sport injury ☐
    e. Others……

Surgical treatment details

14. Date when surgery was done after injury
    a. On same day of injury ☐
    b. Within a week of injury ☐
    c. Within 3 weeks of injury ☐
    d. After 3 weeks of injury ☐

15. **when was the surgery:**
    a. Less than 6 months ☐
    b. 6 months to 1 year ☐
    c. Over 1 year ☐

16. Implants Used
    a. Bicolumnar fixation ☐
    b. Single column fixation ☐
    c. Screw fixation ☐
17. Surgical Approach used
    a. Paratricipital ☐
    b. Chevron osteotomy ☐
    c. Triceps splitting ☐
    d. Triceps reflecting ☐
    e. TRAP ☐

Postsurgical outcome

18. Hospital stays(in days)
    a. 5
19. Duration of immobilization (in days)..
20. Immediate Post op quality of reduction grading
    A. anatomic reduction
    B. step off <2mm
    C. step off >2mm

20. Rehabilitation Protocol Followed:

a) Hospital Physiotherapy ☐

b) Occupational therapy ☐
c) Home exercise by themselves ☐
d) Others (specify)----------

21. Complications
    a. Yes ☐
    b. No ☐
22 If yes, timing and type

a. Early (during 1st 6 wks)

i. Wound dehiscence☐
ii. Infection☐
iii. Reoperation☐
iv. none☐

b.Late ☐

23. Postoperative status
    a. current level of Pain
        i. Yes ☐
        ii. No ☐
        If yes severity
            i. Mild ☐
            ii. Moderate ☐
            iii. Severe ☐
    b. Daily functions performance like lifting objects, personal care and reaching overhead
        a. ☐ No difficulty
        b. ☐ Slight difficulty
        c. ☐ Moderate difficulty
        d. ☐ Severe difficulty
    c. Flexion arc in degree

    d. Elbow instability
        i. Stable ☐
        ii. Mild instability (<10 degree varus valgus instability) ☐
        iii. Gross instability (greater than or equal to 10 degree varus valgus instability) ☐
    e. Neuropathy
        i. Yes ☐
        ii. No ☐
        If yes (specify nerve injured----------)
    f. SSI (Surgical site infection)
        i. Yes ☐
        ii. No ☐
    g. Implant failure
        i. Yes ☐
        ii. No ☐
        If yes specify type of implant failure (----------)
    h. Symptomatic implant if yes what was done…….
        i. Yes ☐

ii. No ☐

24. Fracture Healing
    a. Adequate Union ☐
    b. Delayed union ☐
    c. Non union ☐

25. **Overall, how satisfied are you with the outcome of your surgery?**
    ☐ Very satisfied
    ☐ Satisfied
    ☐ Neutral
    ☐ Dissatisfie
    ☐ Very dissatisfied

26. **MEPI score:**

Table 6: MEPI score assessment tool [36]

1. How intense is the pain?	**Score**
None (45)	
Mild (30)	
Moderate (15)	
Severe (0)	
2. Range of motion	
Arc of motion greater than 100° (20)	
Arc of motion between 50-100° (15)	
Arc of motion less than 50° (5)	
3. Stability	
Stable (10)	
Moderately unstable (5)	
Grossly unstable (0)	
4. Function(daily activity)	
Can comb hair (5)	
Can eat food (5)	
Can wear shoes (5)	
Can perform hygiene (5)	
Can wear shirt (5)	
Total Score	
Excellent(>90), Good(75-89), Fair(60-74) andPoor(<60)	