DSpace Institution

DSpace Repository **http://dspace.org**

General Surgery Thesis

2025-01

Assesement Of Functional Outcome And Associated Factors Of Proximal Humerus Fracture Operative Management Among Adult Patients At Public Referral Hospitals In Bahir Dar, Ethiopia, 2021-2024gc

Marie, Biniyam

http://ir.bdu.edu.et/handle/123456789/17684

Downloaded from DSpace Repository, DSpace Institution's institutional repository





BAHIR DAR UNIVERSITY COLLEGE OF MEDICINE AND

HEALTH SCIENCE SCHOOL OF MEDICINE

DEPARTMENT OF ORTHOPEDICS AND TRAUMA SURGERY

Assesement Of Functional Outcome And Associated Factors Of Proximal Humerus Fracture Operative Management Among Adult Patients At Public Referral Hospitals In Bahir Dar, Ethiopia, 2021-2024gc

BY: Biniyam Marie

(MD, ORTHOPEDICS AND TRAUMA SURGERY FOURTH YEAR RESIDENT)

A THESIS REPORT TO BE SUBMITTED TO BAHIR DAR UNIVERSITY COLLEGE OF MEDICINE AND HEALTH SCIENCES, DEPARTMENT OF ORTHOPEDIC AND TRAUMA SURGERY FOR THE PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR SPECIALTY IN ORTHOPEDIC AND TRAUMA SURGERY

JANUARY 2025 GC

BAHIRDAR, ETHIOPIA

BAHIR DAR UNIVERSITY COLLEGE OF MEDICINE AND HEALTH SCIENCES SCHOOL OF MEDICINE

DEPARTMENT OF ORTHOPEDICS AND TRAUMA SURGERY

Address

	Name	Address
Principal Investigator	Biniyam Marie (MD, Orthopedics & Trauma Surgery Resident, PGY IV)	Email: mariebiniyam@gmail.com Cell phone: **+251-0919711961**
Advisors	Dr. Misganaw Alemu (MD, Assistant professor and Consultant Orthopedic and trauma Surgeon)	Email: misgiealem@gmail.com Cell phone: **+251-0980513690**
	Ms.Tsion Adebabay (MPH/RH, Assistance Professor)	Email: Adebabaytsion@gmail.com Cell phone:**+251-09254565**
Study	Study design	Cross-sectional study
	Study project	Assessment of functional outcome and associated factors of proximal humerus fracture operative management
	Study area and period	TGSH and FHCSH, Department of Orthopedic and Trauma surgery, Bahir Dar, Ethiopia from January 2021 to December 2024GC

Declaration

I, the under signed, declared that this is my original work has never been presented in this or any other university; and that all the resources and materials used for the research, have been fully acknowledged.

Principal investigator (PI)

Name: Biniyam Marie (MD)

Signature _____

Date 25/07/2017 E.C

Advisors

1. Name: Dr. Misganaw Alemu

Signature _____

Dr Misganaw Alemu
Head Department
of Orthopedics

Date 28/10/2017

2. Name: Ms.Tsion Adebabay

Signature _____

Date _____

ACKNOWLEDGEMENT

First, I would like to to extend my sincere acknowledgement to Bahir Dar University, College of Medicine and Health Science, School of Medicine , Department Of Orthopaedics for preparing this educational program and giving me this golden opportunity to do this clinical research and its cooperation to the best ending of this study. I would also like to thank Tibebe Ghion Specialized Hospital and Felege Hiwot Comprehensive Specialized Hospital and registrar team for assisting and supporting me to access patient data and their welcoming face while we visited their institution to collect data .

Second, I would like to express my heartfelt gratitude to my Advisors Dr.Misganaw Alemu (MD, Assistant professor of Orthopedic and trauma Surgery) and Ms. Tsion Adebabay (MPH/RH, Assistance Professor) for their continued advice and constructive comments

Lastly, My great gratitude goes to all my colleagues who participated in data collection and supported me throughout my work.

Acronyms and Abbreviations

AO ……Arbeitsgemeinschaft für Osteosynthesefragen

BDU ……..……. Bahir Dar University

CI……..……. Confidence Interval

CRPP……Closed reduction and Percutaneous pinning

DASH……..Disabilities of the arm, shoulder and hand

EX FIX……. …….External fixation

ED/EOPD……..…….Emergency Department /Emergency Outpatient Department

FDA……..……Fall down accident

FHCSH…….FelegeHiwot Comprehensive Specialized Hospital

GA……..Gustilo Anderson for open fracture classification

GC…….……. Gregorian calendar

GP……..General Practitioner

IMN……Intramedullary nail

IRB……..Institutional review board

K-wire……..Kirschner Wire

LMICs……..….low-and Middle –Income Countries

OPD……Out patient departement

OR……..……..……Odds Ratio

ORIF……Open reduction and Internal fixation

ORPP……..Open reduction and Percutaneous pinning

OTA……Orthopedic Trauma Association

PHFs……Proximal Humerus Fractures

PHILOS……..Proximal Humerus Internal Locking System

PI…….……Principal Investigator

PROFHER……..Proximal Fracture of the Humerus Evaluation by Randomization

PROMIS……..Patient Reported Outcome Measure Information system

ROM……Range of Movement

RTA ……..Road Traffic Accident

SPSS……....…….Statistical Package for Social Science

TGSH…….……Tibebe Ghion Specialized Hospital

Table of Contents

BAHIR DAR UNIVERSITY COLLEGE OF MEDICINE AND HEALTH SCIENCES SCHOOL OF MEDICINE ii
Address ii
Declaration ..... **Error! Bookmark not defined.**
ACKNOWLEDGEMENT iv
Acronyms and Abbreviations v
Table of Contents vi
List of tables viii
List of figures ix
Abstract x
1. Introduction 1
1.1 .Background 1
1.2. Statement of the problem 3
1.3. Significance of the study 5
2. Literature Review 6
Functional Outcome and factors contributing on operative management of proximal humerus fracture 6
3. Conceptual framework 10
4. Objectives 11
4.1 General objective: 11
4.2 Specific objectives: 11
5. Methods and Materials 12
5.1 Study Design and Period 12
5.2 Study Area 12
5.3 Source Population 12
5.4 Study population 13
5.5 Eligibility criteria 13
5.6 Sample Size and Sampling Technique 13
5.7 Study Variables 14
5.8 Operational Definitions 15
5.9 Data Collection Tools and Data Collection Procedures 16
5.10 Data processing and analysis 16
5.11 Ethical Clearance 17
5.12 Dissemination: 17

6. Results 18
6.1 Sociodemographic characteristics 18
6.2. Clinical and operative characteristics of participants 19
6.3. Functional outcome of proximal humerus fracture operative management 22
6.4 Factors Associated with the Functional outcome 23
7. Discussion 25
8. Strength and limitation of the study 27
8.1. Strength of the study 27
8.2. Limitations of the study 28
9. Conclusions and Recommendations 28
9.1 Conclusions 28
9.2 Recommendations 28
10. References 30
11. Annexes 33
Annex I: Information Sheet 33
Annex II: Participant Consent Information Sheet in English 34
8.2 Annex 2-Consent Form in Amharic 35
Annex III: Data Collection Format Sheet 36
Annex IV : Functional Assessment Based on score 40

List of tables

Table 1 :- Conversion of raw sum of QuickDASH into PROMIS t score to catagorize the outcome 15

Table 2 Frequency and percentage distribution of sociodemographic status of operatively managed patients with proximal humerus fracture in TGSH and FHCSH, January 2025(N=105) 18

Table 3 Frequency and percentage distribution of clinical and operative data of operatively managed proximal humerus fracture patients in TGSH and FHCSH, January 2025 (N=105) 19

Table 4 :- Factors significantly associated with the functional outcome based on the Mann Whitney U test 23

Table 5 :-Predictor variables significantly associated with the functional outcome based on the kruskal Wallis Test and Post hoc test..... 24

Table 6 :- Data collection tool..... 36

Table 7 : The QuickDASH scoring system tool..... 40

Table 8 :- Raw QuickDASH Score to PROMIS T-Score Conversion Table for Physical Function Upper Extremity..... 41

List of figures

Figure 1 :- Conceptual frame work of Patient, trauma, clinical and outcome variables 10

Figure 2 : -Pie Chart showing the frequency and percentage of Type of Fixation used for proximal humerus fracture Operative management in adult (N=105) 21

Figure 3 :- Pie Chart showing the frequency distribution of the functional outcome of Proximal humerus fracture by QuickDash Score across each category of the outcome 22

Abstract

Background: Proximal humerus fractures account for 5-6% of all fractures. Historically nonoperative management was the mainstay of management which now has a trend to operative management. But debate still occurs as to whether these are best managed operatively or conservatively. This study will aim to address the functional outcome of operatively managed proximal humeral fractures and associated factors as evidence lack in our set up Tibebe Ghion and Felege Hiwot specialized hospital and Ethiopia as well.

Objective; To assess the functional outcome and identify associated factors of proximal humerus fractures managed operatively at public referral hospitals in Bahir Dar from January 2021 to December 2024

Methods: Hospital Based Cross-sectional study was conducted on 105 patients. All eligible patients were included in the study based on inclusion criteria. Data was collected using Kobo toolbox and exported to Statistical Package for Social Science version 25 for analysis. Frequency and percentage were used to summarize descriptive statistics. The Non parametric tests of Mann-Whitney U test and Kruskal Wallis test were used to determine association between variables. Variables with p value <0.05 were taken as statistically significant. Variables significant on Kruskal Wallis test were taken to post-hoc test.

Result: Among 105 study participants, 46.67% (N=49) had good outcome, 41.90%(N=44) participants had fair , 7.6%(N=8) had very good and 3.81%(N=4) had excelllent outcome otherwise no poor outcome score recorded using Quick Disabilities of the arm, shoulder and hand scoring system. Fractures of Right side, high grade open fracture, Use of External-fixation and kirschner wires for fixation, those requiring multiple debridements and presence of associated injuries and postoperative complications were significantly associated with decreased functional outcomes

Conclusion*:* The study reveal that while more than half (58.1%) of patients report good to excellent functional outcomes. This study also shows that the functional outcome following proximal humerus fixation signifcantly depends on the Fracture side, implant choice, post operative immobilization periods, grade of open fracture, number of debridements before definitive fixation and presence of associated injuries and complications.The rate of mid-term complications are also higher and more than half of the patients had residual shoulder stiffness.

Key words; proximal humerus fracture, Operative management, functional outcome,QuickDASH

1. Introduction

1.1 .Background

The humerus bone is the largest and most proximal long bone of the upper extremity which articulates proximally with the shoulder and distally with the elbow. Anatomically, the humerus bone can be divided into three parts in length: the proximal, middle, and distal third. The proximal humerus consists the humeral head, the greater and lesser tuberosities, and the upper portion of the humeral shaft. It also has two necks, the region of transition between the articular cartilage of the head of humerus and the tuberosities is the anatomic neck which represents the old epiphyseal plate, while the the weakened region immediately inferior to the tuberosities is the surgical neck. The Greater tuberosity lies posteriolaterally on the proximal humerus and provides attachment for the supraspinatus, infraspinatus and teres minor muscles. Whereas, the Lesser tuberosity lies anteriomedially and provides attachment for the subscapularis muscle. The tuberosities are separated by the bicipital groove, which serves as the track for the tendon of the long head of the biceps muscle(1-3).

Proximal humerus fractures are fractures occurring at or proximal to the surgical neck of the humerus(4). Fractures of the Proximal humerus have an estimated incidence 70 per 100 000 and account for 5- 6% of all fractures and 45-50% of all humeral fractures(5, 6). These fractures represent the third most common osteoporotic fracture among the aging eldely population, following hip and distal radius fractures.They are most commonly seen in older individuals above 60 years of age with some female gender predilection. These injuries have a bi-modal distribution with the first peak being seen in the young resulting from high-energy trauma,such as road traffic accidents or sporting accidents, and the second peak being seen in the elderly osteoporotic population from a fall from a height most commonly ground level fall on outstretched arm(5-9).

The commonly used classification system for proximal humerus fractures are Neer (1970) and the AO classification system. The Neer classification is based on the location, number and displacement of the four main anatomic segments of the proximal humerus. Using this, Neer defined fractures as one-part, two-part, three-part,

or four-part depending on fracture segment displacement of more than 1 cm or angulated more than 45 degrees(10). Where as, AO/OTA classification, developed in the 1980s, classifies proximal humerus fractures based on articular surface involvement, anatomic location, and dislocation but its complexity limits routine clinical use . This system divides PHFs into three main types and each with sub types: Type A-unifocal extra-articular; Type B-bifocal extra-articular and Type C-articular(2).The AO classification proved to be more complete and comprehensive than the Neer classification but both has lower interobserver reliability(11).

The acute treatment options for proximal humerus fractures are numerous and are typically guided by the patient's physiological status, the severity of fracture pattern, and the experience and skillset of the treating surgeon. The most commonly used methods include non-operative management with a sling immobilization for nondisplaced or minimally displaced fractures, surgical fixation with either open reduction internal fixation (ORIF), closed reduction percutaneous pinning(CRPP), intramedullary nailing(IMN), or shoulder arthroplasty (hemiarthroplasty (HA), total shoulder arthroplasty (TSA), and reverse total shoulder arthroplasty (RSA)) for more complex and displaced fractures. With the advent of locking plate technology and the development of proximal humerus locking plates, open reduction and internal fixation (ORIF) for the treatment of displaced and unstable proximal humerus fractures has garnered a great deal of recent clinical attention. Despite these advances, Controversy still exists and continues to be challenging regarding the surgical treatment options of complex fracture patterns especially in the elderly individuals(12-15).

In Ethiopia, though there is no evidence based treatment guideline in the country, plate of different type, k-wires, Screws, IM rods, Ex Fix, and conservative treatment with short period of sling immobilization are options to fix proximal humerus fractures based on indication.

However, Several complications can arise if not treated properly. Complications following proximal humerus fracture and management can be broadly classified as ones due to the fracture itself and ones due to the management options. Complications like stiffness, avascular necrosis and secondary osteoarthritis are often related to the severity of the fracture. Complications like malunion, implant failure and non-union are often related to the treatment option chosen(16, 17).

Treatment is aimed to achieve a good functional outcome and preventing Shoulder stiffness. The commonly used clinical outcome measurement tools for proximal humerus fractures include Constant-Murley score and DASH (Disabilities of the Arm, Shoulder, and Hand) score. The DASH score is a Patient reported outcome measure by emphasizing the impact on daily activities, encompassing physical function, symptoms, and social functioning. The DASH questionnaire assesses patient happiness and function on a scale from 1 (normal limb usage) to 5 (nonfunctional), depending on specific tasks. A quick DASH, made up of 11 questions from the original DASH, was created in recognition of its potential complexity(18-20).

1.2. Statement of the problem

Fractures of proximal humerus is one of the most common debilitating injuries and it accounts for 5-6% of all fractures(6, 21, 22). The incidence in total population has progressively increased because of aging population and is 70 per 100,000 persons per year but for over 60 years old, it is 400/100000 per year(23). It generally occur in elderly women because of decreased bone density mass and these fractures represent the third most common osteoporotic fractures following hip and distal radius fractures even in the study done in osteoporotic fractures here in Ethiopia(24).

The management of choice for proximal humerus fracture imposes a high challenge to surgeons and it remains controversial, especially in osteoporotic and elderly patients. Treatment options vary greatly from conservative or non operative management to operative management. Since 80 % of PHF are non displaced and can be treated nonoperatively like by Sling Imobilization with good functional results. However, the treatment for the remaining displaced PHF is still controversial. In fact, while operative treatment is generally recommended for displaced fractures in young and physiologically active patients even if older than 60 years, the appropriate treatment in the elderly population is still debated(14, 25-27).

The surgical management options for displaced proximal humerus fractures are open reduction and internal fixation (ORIF) using locking plates, CRPP with K-wires, Screws for one- part fractures, intramedullary nails (IMN), closed pinning, and Shoulder Arthroplasty. Surgical treatment with open reduction and internal fixation improves alignment and provides stability to the bone and surrounding soft tissues

and is generally indicated to allow early joint of motion and rehabilitation. The proximal humerus internal locking system (PHILOS) is an anatomical locking plate that was created by the AO/OTA to improve functional outcomes, particularly for osteoporotic patients. PHILOS enables angled stabilization with multiple interlocking screws than conventional plates. The ability of screws to lock provides better anchorage in the osteoporotic bone to a plate gives angular stability to the construct and maintains postoperative reduction during early functional rehabilitation and avoids joint stiffness and enhances functional outcome. Although open reduction, combined with stable internal fixation is achievable with PHILOS plate, a wide surgical exposure particularly in the complex fracture patterns risks nonunion and infection due to the compromise to the local blood supply(13, 28-30).

Studies generally showed that operative fixation has led to unpredictable results and associated with several complications that are resulted from the surgery and there are factors associated with prognosis, including fracture classification, co-morbidity, smoking, age and articular congruity. The most common complications associated with the Operative fixation of proximal humeral fractures include screw cut out into joint, screw loosening, breaking and backing out, avascular necrosis of the humeral head, post-traumatic arthrofibrosis with shoulder stiffness, subacromial impingement, non-union, malunion, transient axillary nerve palsies and wound site infection(31-33).

In Ethiopia, open reduction and internal fixation with locking plates is the main treatment option for most displaced Proximal humerus fractures. But there is no study done on functional outcome and associated factors in patients with proximal humerus fracture fixation in the country, particularly in the study area.

SO, this study will investigate on the functional outcome and associated factors of Proximal humerus fracture fixation at hospital level which will be helpful to understand the problem and design a mechanism to get rid of such problems and to choose better management options for these types of fractures. It also fills an existing gap in the literature and serves as a baseline study at our hospital and in Ethiopia as a whole for future studies.

1.3. Significance of the study

The incidence of Proximal humerus fracture is increasing in the country particularly from increasing amount of Bullet injuries and Road traffic accidents. Thus, the study will enable us to understand the magnitude of the problem and its associated factors which are paramount for resource allocation for decision-makers to device strategies on early prevention and control of the problem.

Currently most literature recommends treatment of Proximal humerus fractures by open reduction and Internal fixation (ORIF) using locking plates and screw. In developed countries where there is no implant shortage, they manage this fracture appropriately based on the clear indications. On the other hand, in resource-limited countries like Ethiopia there are tendencies to operate on patients with the implant at hand. For the above mentioned reasons and lack of research in the study area, Proximal humerus fracture fixation outcome is unpredicted. So knowing the outcome and identifying the factors associated with outcome of Proximal humerus fracture fixation helps professionals to prepare treatment protocol.

Overall, the study can used as a base line information for large scale studies. Moreover, the findings of the study help professionals in the area to improve the current clinical service practices by improving case management.

2. Literature Review

Functional Outcome and factors contributing on operative management of proximal humerus fracture

The critical analysis review by Jawa et al.,Conducted at a leading medical institution in the United States and published in Journal of Bone and Joint Surgery in 2016, critically examines various treatment options for proximal humeral fractures, focusing on both surgical and non-surgical approaches. The review synthesizes evidence from numerous studies to evaluate the effectiveness, risks, and outcomes associated with different treatment modalities. Jawa's analysis highlights that while surgical interventions, such as locking plates and intramedullary nails, can offer good outcomes for certain patient groups, non-surgical management often yields comparable results, especially in older patients with less complex fractures. The study emphasizes the importance of individualized treatment plans based on patient age, fracture type, and overall health to achieve the best possible outcomes(34).

A Systematic Review by Benjamin Miltenberg, published in the Journal of Shoulder and Elbow Surgery in 2022, provides an in-depth evaluation of the outcomes associated with the surgical management of fracture dislocations in the proximal humerus. The review included 12 studies with 294 patients, revealing a mean age of 53.4 years and an average follow-up of 2.9 years to determine the efficacy and safety of open reduction and internal fixation (ORIF) for these complex injuries. Miltenberg's analysis reveals that while ORIF generally results in favorable functional outcomes, the procedure carries a notable risk of complications, including post-operative stiffness, avascular necrosis, and implant-related issues. The study underscores the need for precise surgical technique and careful post-operative management to enhance patient outcomes(35).

In a systematic review published in 2020, Soler-Peiro et al. evaluated the outcomes of conservative treatment for 3-part and 4-part proximal humeral fractures. The study included 133 patients (79% women) with a mean age of 74.3 years, treated at the Upper Extremity Unit of the Hospital in Spain. The authors found that most 3-part fractures treated conservatively achieved fracture consolidation with fair-to-good functional results and few complications, while 4-part fractures had a higher rate of consolidation but poorer functional outcomes. The review

highlights that conservative treatment can lead to satisfactory results in non-displaced fractures, but displaced fractures may require surgery based on patient age, functional expectations, and the risk of complications like nonunion, malunion, and avascular necrosis(36).

In Germany in 2010 Geiger et al. conducted a prospective study examining the functional outcomes and complications associated with PHILOS plate fixation in treating proximal humeral fractures involving 28 patients (20 females, 8 males; mean age 60.7±12.9 years). The study found that results were excellent or good in 16 patients (57.1%), moderate in one patient (3.6%), and poor in 11 patients (39.3%) with a mean DASH score of 28.3±24.3. Eleven complications (39.3%) were seen during the follow-up period. Reoperation was required in eight patients (72.3%). Complications included avascular necrosis of the humeral head in two patients (7.2%), subacromial impingement in six patients (21.4%), loosening of a locking head screw in one patient (3.6%), and transiently decreased radial nerve sensation in two patients (7.2%). Subacromial impingement was mainly caused by the superior plate position. while the PHILOS plate provided satisfactory functional outcomes for patients, complications were not uncommon. Despite these challenges, the study concluded that PHILOS plate fixation remains a viable option for managing these fractures, though careful consideration must be given to potential risks(37).

In 2021 Maresca et al. conducted a review at the Orthopaedic and Traumatology Unit of Riuniti Hospital in Ancona, Italy to discuss the principal complications associated with operative and nonoperative treatment of proximal humeral fractures. The authors noted that PHF exhibit a considerable percentage of complications, ranging from 0-79%, caused by factors such as incorrect treatment indication, avascular necrosis of the humeral head (13%), inappropriate surgical technique (40%), infections (1-4.5%), nonunion, malunion, and systemic conditions like pulmonary embolism (5%). The failure rate was found to significantly increase with the number of risk factors present, with age, anatomic reduction, and restoration of medial cortical support being the most influential parameters. The review highlighted the lack of consensus in the literature regarding optimal treatment for these challenging fractures(38).

In a systematic review and meta-analysis by Oldrini et al.,in 2022. The research was carried out at the Service of Orthopaedics and Traumatology, Department of Surgery, EOC, in Lugano, Switzerland the authors investigated the complications and reintervention rates associated with the use of the Proximal Humeral Internal Locking System (PHILOS) plate for proximal humerus

fractures. The study included 4200 patients from 76 studies. The overall complication rate was 23.8%, with screw cut-out being the most frequent complication (4.1%), followed by avascular necrosis of the humeral head (3.1%) and subacromial impingement (1.5%). Reintervention rates were 10.5% in the overall population and 19.0% in older patients. These findings highlight the need for further investigation to understand patient and fracture risk factors and compare the PHILOS plate with other management options for proximal humerus fractures(33).

Another prospective study done in Dr. RN Cooper Hospital in Mumbai, India to assess the outcomes and complications associated with the use of the Proximal Humerus Internal Locking System (PHILOS) for treating proximal humeral fractures. The study included 17 patients (8 men and 9 women) aged 19 to 82, with a follow-up showing a mean Constant score of 57.4. The results indicated that 16% had excellent outcomes, while 24% experienced poor outcomes, with complications such as malreduction (29.4%) and screw perforation (23.5%) being prevalent. The authors concluded that while PHILOS plates can yield satisfactory results, the high complication rate necessitates advanced surgical skills for optimal outcomes(32).

In 2020 Vipin Kumar and colleagues conducted a study in Lucknow, India, to evaluate the functional outcomes of PHILOS plate fixation in patients with displaced proximal humeral fractures. The study included 30 patients, and the findings suggested that the PHILOS plate is an effective method for treating such fractures, leading to satisfactory functional recovery. The results highlighted the procedure's ability to provide stable fixation and facilitate early mobilization, ultimately improving patient outcomes(39).

At a tertiary care hospital in India, PK George and his colleagues conducted a study in 2021 to evaluate the functional outcomes and complications associated with the management of proximal humerus fractures using a proximal humerus locking plate. The study involved 35 patients who underwent open reduction and internal fixation, with assessments made using the Constant and DASH scores. Results indicated significant improvements in functional outcomes over six months, particularly in younger patients and those with less complex fractures. Complications were minimal, highlighting the effectiveness of locking plate fixation in achieving stable fracture management and early mobilization(40).

A study done in china published in 2020, Zhu et al. discussed the plate fixation strategies for complex proximal humeral fractures. The authors highlighted the importance of restoring medial

support to provide solid stability and reduce complications in these challenging fractures. Several augmentation options were presented, including calcar screws, bone grafts, bone cement, dual plate fixation, and fracture impaction. The review emphasized that frequent complications, such as varus collapse and screw cutout, pose a great challenge in the surgical management of complex proximal humeral fractures. The authors concluded that careful patient selection, principle-based surgical techniques, and appropriate augmentation methods are crucial for successful outcomes when treating complex proximal humeral fractures with locking plate fixation(41).

A retrospective analytical study on outcome of plate osteosynthesis in the management of adult proximal humeral fractures was conducted by J. M. Muthuuri at The Mombasa Hospital in Mombasa, Kenya between January 2000 and December 2009. This study found that 42 out of 1454 fractures (2.9%) were proximal humeral fractures. The majority occurred due to falls (71%) and were predominantly two-part fractures (74%). Plate osteosynthesis was performed in 32 cases, with a 75% satisfactory recovery rate. However, 15% of patients experienced significant shoulder stiffness. The study concluded that plate osteosynthesis is effective for managing these fractures, highlighting the need for arthroplasty in severe cases, particularly among patients with osteoporosis(42).

A multicenter retrospective study by Hermann V. Feigoudozoui and colleagues was conducted between January 2016 and March 2021 in Abidjan, Côte d'Ivoire, involved 103 patients with proximal humerus fractures classified as type 3 and 4 according to the Neer classification. The treatment approach was surgical, and outcomes were assessed using the Constant score. All fractures healed, with varying clinical outcomes: excellent (24.3%), very good (37.9%), good (16.5%), average (12.6%), and poor (13.6%)(43).

3. Conceptual framework

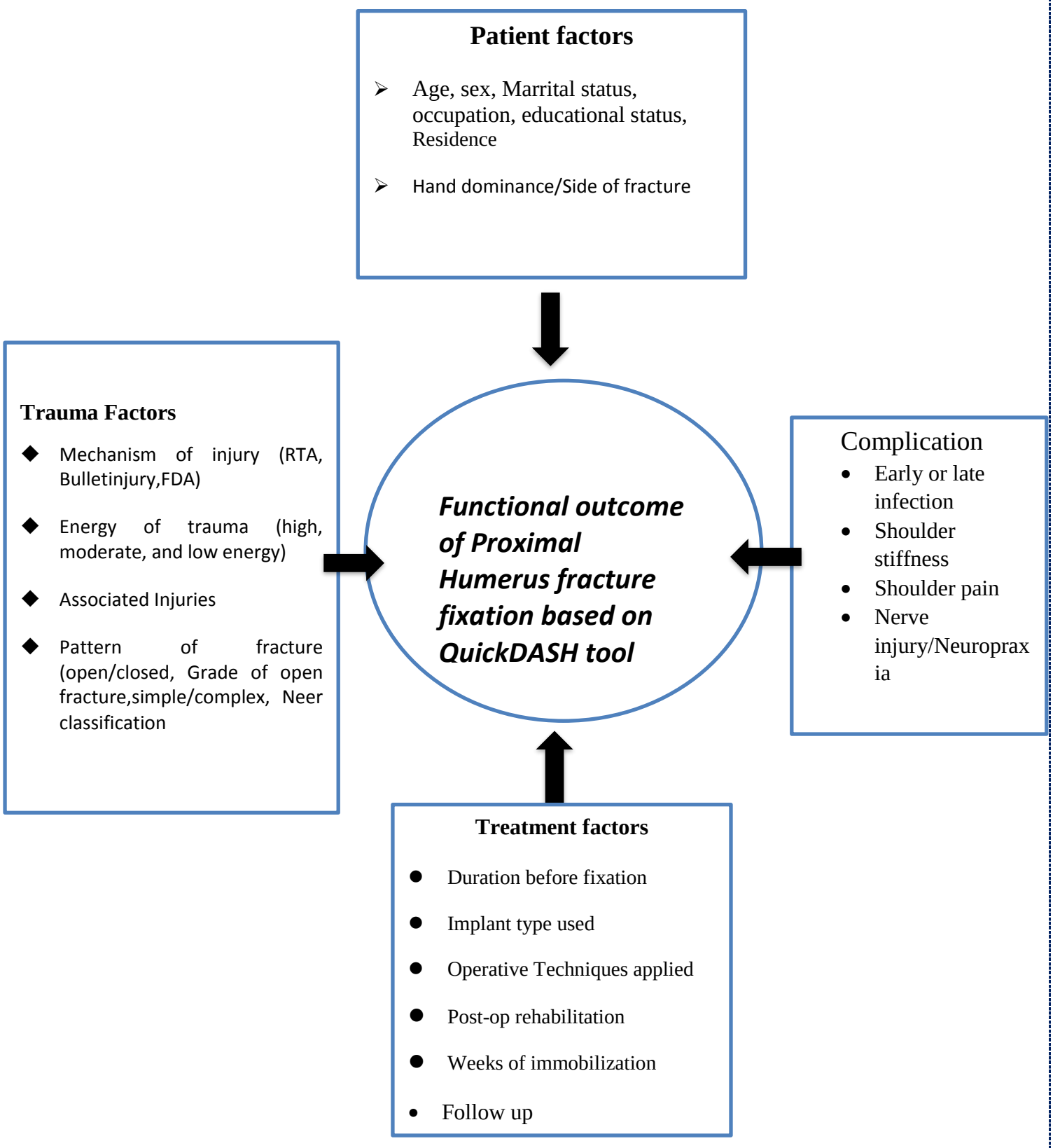

Figure 1:- Conceptual frame work of Patient, trauma, clinical and outcome variables

4. Objectives

4.1 General objective:

- To assess the functional outcome of proximal humerus fracture operative management and its associated factors at Public referral Hospitals in Bahir Dar

4.2 Specific objectives:

- To evaluate the functional outcomes of fixation of proximal humerus fracture
- To determine factors affecting the functional outcome of proximal humerus fracture operative management

5. Methods and Materials

5.1 Study Design and Period

Hospital based Cross-sectional study design was used to conduct the study on patients admitted to public referal hospitals in Bahir dar from January 2021– December 2024 GC with the diagnosis of proximal humerus fracture and treated operatively using different implants.

5.2 Study Area

The study was conducted at TGSH and FHCSH, Both of which are located in Bahir Dar, the Capital City of the Amhara regional state, which is 565 km away from Addis Ababa, the Capital City of Ethiopia. TGSH is one of the biggest specialized university hospitals in Amhara region which started giving service in January 2019 G.C delivering different speciality clinical services to the region. The hospital has more than 500 beds in all its wards and over 67 beds in orthopedics and trauma surgery unit. Currently, there are a total of 9 orthopedic surgeons (General orthopedic surgeons, 2 trauma surgeon, 1 Pediatric orthopedic surgeons and 2 fellow trauma surgeon) and 29 residents specializing in orthopedic surgery. Orthopedic operations are done 5 days in a week on elective base and daily for emergency cases. The department have its own 2 major operation room with two operating tables and one C-arm fluoroscopy machine. Felege Hiwot Comprehensive Specialized Hospital is also a tertiary public regional hospital and started giving service in 1955 and it was initially built to serve around 25,000 people. Currently, it has 9 wards and 435 beds for inpatient management, and outpatient clinics, and it is serving an estimated 5-7 million people. FHCSH Orthopedics department had 3 General Orthopedic Surgeons and the 29 residents from TGSH also serve here with rotations. FHCSH Orhopedic surgery depatment also equipped with 50 beds and 3 major operation rooms. Both the Elective and the emergency trauma caseload are high in both hospitals. The study was done among trauma cases who visited TGSH and FHCSH with diagnosis of Proximal humerus fractures.

5.3 Source Population

All Patients visited TGSH and FHSH with a diagnosis of Proximal humerus fracture from January 2021 to December 2024 G.C.

5.4 Study population

Selected Patients visited TGSH and FHCSH with a diagnosis of Proximal humerus fracture who are managed operatively are enrolled in this study.

5.5 Eligibility criteria

5.5.1 Inclusion criteria

✓ All Adult patients who sustained Proximal humerus fracture and operatively managed

✓ Patients with complete medical record and their Phone number recorded in their chart

✓ Whose follow up status is clearly known (clearly documented post operation status on follow up chart)

5.5.2 Exclusion criteria

- Patients who has incomplete medical recorded data
- Age less than 18 years old
- Patient with Comorbidities
- Non operatively treated fractures

5.6 Sample Size and Sampling Technique

There was no specific data on the outcome of proximal humeral management in Ethiopia. But in a retrospective analytical study done Kenya by J. M. Muthuuri on outcome of plate osteosynthesis in the management of adult proximal humeral fractures was conducted at The Mombasa Hospital in Mombasa, between January 2000 and December 2009. This study found that 42 out of 1454 fractures (2.9%) were proximal humeral fractures(42). So the minimum number of samples required for this study was determined by using single population proportion formula assuming margin of error (e) of 2% since the proportion is less than 45%

$$n = Z^2 p(1-p) / e^2$$

n = the minimum required sample size

p = the percentage occurrence of the outcome (good in this case) = 2.9% = 0.029

e = Absolute precision or tolerable margin of error= 2% (0.02)

z = standard normal distribution (Z=1.96), CI of 95%

Sample size : $n = \frac{Z^2 p(1-p)}{e^2} = \frac{1.96^2 x 0.029(1-0.029)}{(0.02)^2}$ = 270.439036≈ 271

Considering non response rate of 10%

The total sample size(n) Will be = (271+ (10% * 271) = 298

But, the total source population during this study period is 160 (N<10,000) from both hospitals.

By using finite population correction formula(Nf))=n/1+n-1/N= 104.333

The final sample size will be 105

All eligible patients with proximal humerus fracture who are operatively managed and fulfilling the inclusion criteria, from January 2021 –December 2024 at the orthopedic department of TGSH and FHCSH were included in the study.

5.7 Study Variables

5.7.1 Dependent Variables:

- Functional outcomes of Proximal humerus fracture fixation using QuickDASH score

5.7.2 Independent Variables

- Age
- Sex
- Place of Residence (urban or rural)
- Marrital status
- Educational Status
- Occupation
- Mechanism of injury
- Side of fracture
- Nature of fracture

- Grade of open fracture
- Fracture Severity type (Neer classification)
- Time from injury to surgery
- Surgical approach
- Implant type used
- Postoperative Immobilization period
- Physiotheraphy Linkage

5.8 Operational Definitions

- Proximal humerus fracture: Fracture of the humerus starting from the surgical neck of the humerus and extending into the head of the humerus.
- **Operative management :** Immobilization of fractured bone surgically using different implants till the fracture heals.
- Public Referral Hospitals in Bahir Dar: include TGSH and FHCSH
- **DASH (Disabilities of the Arm, Shoulder and Hand)):** Scoring system used to measure the functional outcome of upper limb injuries like proximal humerus fracture.
- QuickDASH questionnaire: made up of 11 questions from the original DASH and used to assesses patient function on a scale from 1 (normal) to 5 (nonfunctional), depending on specific tasks. The QuickDASH score ranges from 10 to 55 and it can not be calculated if there is greater than 1 missing item from the 11 questionnaires.
- **Functional Outcome**: The patient physical ability or recovery to the pre-injury activity level. The outcome could be Catagorized in to excellent, very good, good, Satisfactory or poor based on conversion of raw sum QuickDASH score into PROMIS T-score using this conversion table(44, 45)

Table 1:- Conversion of raw sum of QuickDASH into PROMIS t score to catagorize the outcome

category	QuickDASH Raw sum	PROMIS T-score
Excellent	10 and 11	58 and above
Very Good	12 and 13	50 - 57
Good	14 – 19	42 - 49
Fair	20 – 27	35 - 41
Poor	28 – 55	35 and below

- **Follow Up**: A patient at least having one follow up after discharge from the hospital is considered to have follow up

5.9 Data Collection Tools and Data Collection Procedures

Data was collected using a semi-structured data collection tool including all the variables of sociodemographic, clinical factors and QuickDASH score (Annex). Training was given for residents about the data collection tool and how to collect data. The data was collected from surgical log book, patient charts and by directly interviewing the patients through phone calls as needed after phone number accessed from their chart based on the above inclusion & exclusion criteria for the study participants. Data was collected by trained residents and supervised by the principal investigator. The data collector was reading the questions and interpret for the subjects and recorded their responses. Part of the questionnaire which was interviewed was written in English first, translated to Amharic and then back to English. Coding of individual checklist was checked before data entry in to the software.

5.10 Data processing and analysis

The data was collected using Kobo data collecion toolbox software and checked for completeness then data coded, entered and cleaned using Epidata version 3.1 and exported for analysis using SPSS version 25 software. Frequency was used to summarize descriptive statistics. Means and percentage used for numerical variables. Raw summed score of QuickDASH was converted to PROMIS T-Score by using conversion table and interpreted based on the operational definition. The data which is ordinal initially checked using Parametric tests for fitness and Functional outcome checked for normality of distribution but it did not fulfill the assumptions of the parametric tests for analysis. SO, the nonparametric tests of Mann-Whitney U test for binary categorical variable and Kruskal-Wallis for independent variables with more than 2 categories and spearman correlation test for continuous variables undertaken. All statistical tests were taken significant at p value of less than 0.05. Those factors which were significantly associated with the dependent variable based on the Kruskal-Walli's test were assessed using the post-hoc test. Tables and Pie charts were used as data presentation and dissemination.

5.11 Ethical Clearance

Ethical clearance was obtained from institutional review board (IRB) of Bahir Dar University research ethics committee with protocol number 3045/2024. Then this ethical clearance and a permission letter was sent to the departments of both hospitals to obtain consent to perform data collection about the selected patients. After the purpose and objective of the study have been informed, oral consent was obtained from each study participants. Confidentiality was ensured from all the data collectors and investigator by avoiding personal identification on the questionnaire and the information found in the patient chart was kept secured.

5.12 Dissemination:

The finding of this study will be presented as one of the partial fulfillments of specialty certificate in the department of orthopedic surgery, Bahir Dar University. Upon approval, Finding of the study will be shared with ARHB, ESOT, and other concerned bodies. For broader dissemination, the manuscript would be submitted to one of the peer-reviewed journals for publication.

6. Results

6.1 Sociodemographic characteristics

A total of 105 adult patients with proximal humerus fracture treated by operative management were included in the study. Males were predominately involved with a male to female ratio of 5.18:1 and the mean age of the study participants was 33.23 year (range: 18-70). Most of the participants are farmers (34.3%) and soldiers (30.5%) by occupation. Greater proportions of participants are from urban area(57.1%). (See Table 2)

Table 2 Frequency and percentage distribution of sociodemographic status of operatively managed patients with proximal humerus fracture in TGSH and FHCSH, January 2025(N=105)

Variable	Category	Frequency	Percent
Sex	Male	88	83.8
	Female	17	16.2
Residence	Urban	60	57.1
	Rural	45	42.9
Marital status	Single	37	35.2
	Married	68	64.8
Educational level	Higher education	16	15.2
	Secondary education	24	22.9
	Primary education	34	32.4
	Illiterate	31	29.5
Occupation	Farmer	36	34.3
	Soldier	32	30.5
	Government Employee	16	15.2
	Merchant	9	8.6
	Others*	12	11.4

Others*=student(4), house wife(5), daily laborer(3)

6.2. Clinical and operative characteristics of participants

The Leading cause of injury was Bullet injury (72.4%) followed by Road traffic accident (16.98%). Open fractures are significantly more common than closed fractures in the study, making up approximately 74.3% of the total (78 out of 105cases). The commonest pattern of fracture was Neer 2 part fractures accounting 72.4%. Out of 105 patients, a total of 41.9% were treated with Open reduction and internal fixation using PHILOS(N=26),DCP(N=12) and screws(N=6).74.3% were linked to physiotheraphy postoperatively (See Table 3)

Table 3 Frequency and percentage distribution of clinical and operative data of operatively managed proximal humerus fracture patients in TGSH and FHCSH, January 2025 (N=105)

Variable	Category	Frequency	Percent
Mechanism of injury	Bullet injury	76	72.4
	RTA	18	17.1
	FDA	11	10.5
Fracture side	Left	46	43.8
	Right	59	56.2
Time of arrival to hospital after the injury	With in 24 hrs	45	42.9
	24- 72 hrs	32	30.5
	3-7 days	15	14.3
	More than 1week	13	12.4
Fracture Severity type	2 part	76	72.4
	3 part	24	22.9
	4 part	5	4.8
Fracture Nature	Open	78	74.3

	Closed	27	25.7
Presence of Associated Injury	No	72	68.6
	yes	33	31.4
Grade of open fracture	Grade II	23	29.5
	Grade IIIA	55	70.5
Time from injury to Antibiotics for open fractures	Less than 6 hrs	10	12.8
	6 to 24 hrs	22	28.2
	24 to 72 hrs	28	35.9
	More than 3 days	18	23.1
Number of debridement before definitive surgery for open fractures	One	27	34.6
	Two	41	52.6
	Three or More	10	12.8
Surgical Approach	Anterior-Deltopectoral	32	46.4
	Lateral-Deltoid splitting	37	53.6
Weeks of Immobilization after fixation	1to 3 week	32	30.5
	3 to 6 week	47	45.8
	More than 6weeks	26	24.7
Physiotheraphy Linkage	Yes	78	74.3
	No	27	25.7
Postoperative complications	None	65	61.9
	Infection	17	16.2
	Neuropraxia	11	10.5

	Reoperation/revision surgery	12	11.4

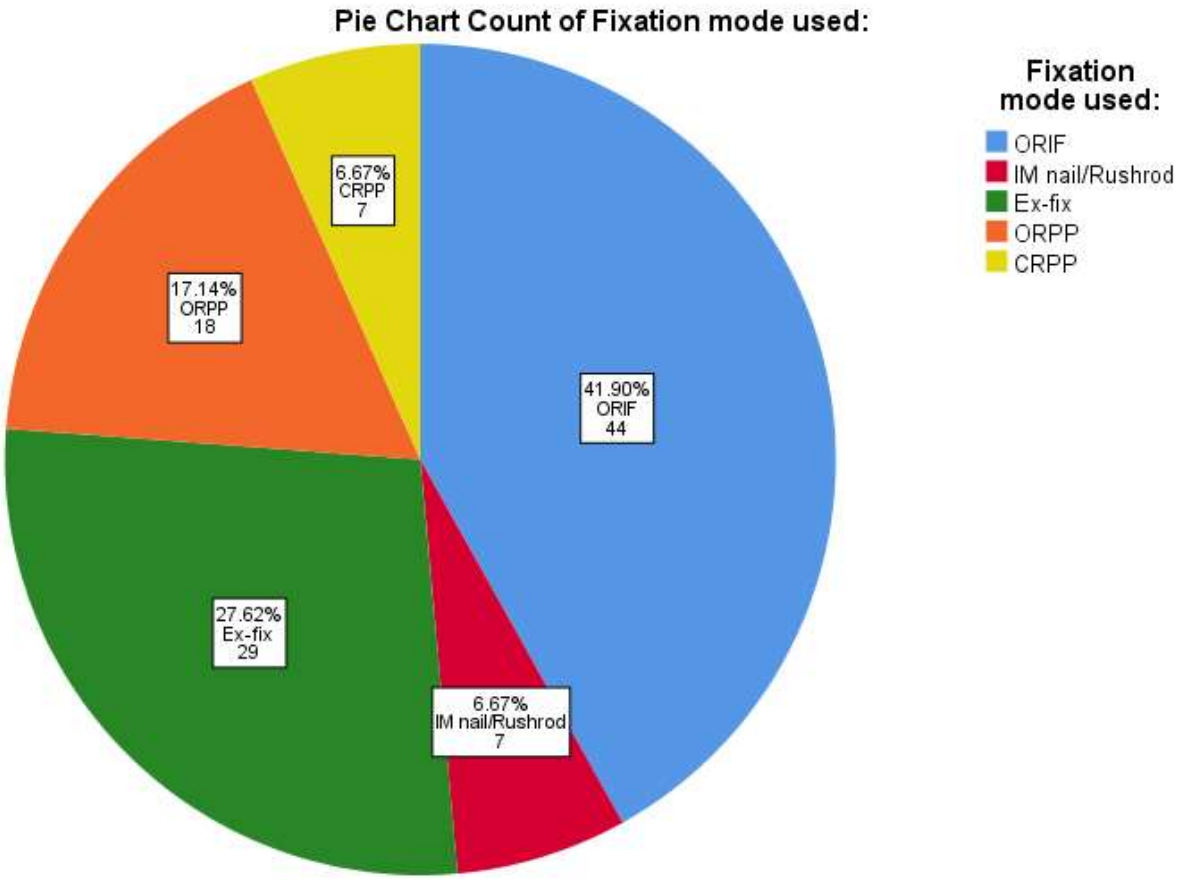

Figure 2: -Pie Chart showing the frequency and percentage of Type of Fixation used for proximal humerus fracture Operative management in adult (N=105)

6.3. Functional outcome of proximal humerus fracture operative management

Based on the QuickDASH scoring system among a total of 105 participants 46.67% (N=49) had good outcome, 41.90%(N=44) participants had fair , 7.6%(N=8) had very good and 3.81%(N=4) had excelllent outcome otherwise no poor outcome score recorded. Over all more than half of the participants(58.1%) had good to excellent outcome (see Figure 3).

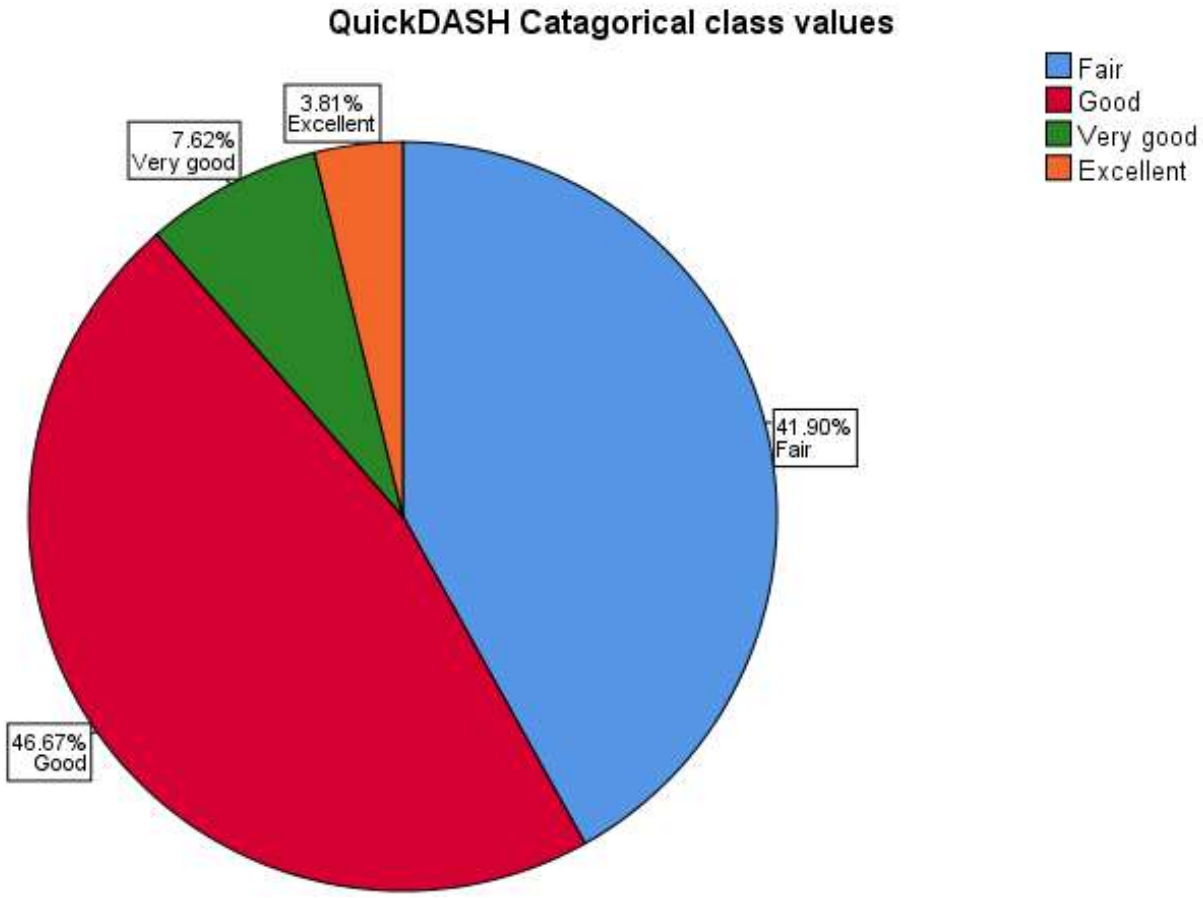

Figure 3:- Pie Chart showing the frequency distribution of the functional outcome of Proximal humerus fracture by QuickDash Score across each category of the outcome

The Cronbach's alpha coefficient for the 11 item QuickDASH questionnaire is 0.91. This shows questionnaire items have relatively high internal consistency.

6.4 Factors Associated with the Functional outcome

Among the list of predictor variables which were found to be associated with the Mann-Whitney U test were Side of Fracture, Presence of Associated Injury, Grade of open Fracture were significantly associated with the functional outcome (Table 4).

Table 4:- Factors significantly associated with the functional outcome based on the Mann Whitney U test

Predictors	**Category**	**N**	**Mean Rank**	**Sum of Ranks**	**p-value**	**Z-value**	**Effect Size(r)**
Side of Fracture	Left	46	59.58	2740.50	**0.031**	-2.151	0.210
	Right	59	47.87	2824.50			
Presence/Absence of Associated Injury	No	72	58.83	4236.00	**0.001**	-3.193	0.312
	Yes	33	40.27	1329.00			
Grade of open Fracture	Grade II	23	54.41	1251.50	**0.000**	-4.154	0.470
	Grade IIIA	55	33.26	1829.50			

Other variables which shows high association were number of debridements before definitive fixation, Type of fixation, prolonged Weeks of immobilization after fixation and Post op complications with a p value of 0. 000 respectively for all based on the Kruskal Wallis test (Table 4).

Table 5:-Predictor variables significantly associated with the functional outcome based on the kruskal Wallis Test and Post hoc test

Predictors	**Category**	**N**	**Mean Rank**	**Kruskal-Wallis H(Chi-Square)**	**p-value**	**Effect Size(η2)**
Number of Debridement done before definitive fixation	One	27	49.09	16.538	0.000	0.194
	Two	41	38.30			
	Three or more	10	18.50			
Mode of Fixation	ORIF	44	68.22	44.132	0.000	0.401
	IM nail/Rushrod	7	62.36			
	Ex-fix	29	25.71			
	ORPP	18	50.92			
	CRPP	7	66.43			
Weeks of Immobilization after fixation	1 to 3week	32	73.73	46.217	0.000	0.433
	3 to 6 weeks	47	54.77			
	More than 6 weeks	26	24.29			
Post Operative complications	None	65	65.33	37.883	0.000	0.345
	Infection	17	25.24			
	Neuropraxia	11	30.95			
	Reoperation/revision surgery	12	45.75			

Based on the post-hoc analysis of Mode of fixation the statistically significant difference was between ORIF and Ex-fix(P=0.000), CRPP and Ex-fix(P=0.000), Rushrod and Ex-fix(P=0.016) and ORPP and Ex-fix(P=0.024). The post-hoc analysis of Weeks of Immobilization after fixation also shows the statistically significant difference was between More than 6 weeks of Immobilization with 1 to 3 weeks and 3 to 6 weeks of immobilization(P=0.000) and in the post-

hoc analysis of Number of Debridement before fixation also shows the statistically significant difference was between three or more debridements with one debridement(P=0.000) and two debridements(P=0.019). Lastly, the post-hoc analysis of postoperative complications also shows the statistically significant difference was between No complication with infection(P=0.000) and Neuropraxia(P=0.001).

7. Discussion

The internal consistency of the 11 item QuickDASH questionnaire tool is very high for all of its items. The Cronbach's alpha coefficient for the tool is 0.91 which shows the questionnaire items have relatively high internal consistency. Similar result was also shown in various studies done to assess the tool validity, Reliability and Responsiveness of the QuickDASH in Adults with upper limb injuries and confirms its high internal consistency (Cronbach's alpha > 0.90) and construct validity across various upper extremity disorders, supporting its widespread use in clinical settings(46)

The functional outcome is generally fair and above in most of the participants and more than half(58.1%) of the participants have good to excellent outcomes and there is no poor outcome score recorded.The rate of long term complications are also higher and more than half of the patients had residual shoulder stiffness. A Systematic Review study done on 2022 by Benjamin Miltenberg to evaluate the outcomes associated with the surgical management of fractures of the proximal humerus also reveals that while ORIF generally results in favorable functional outcomes, the procedure carries a notable risk of complications, including post-operative stiffness, avascular necrosis, and implant-related issues(35).

Several factors were identified as significantly influencing the functional outcomes of proximal humerus operative management using QuickDASH tool. These include Fracture side laterality, High grade open fractures, presence of associated injuries, number of debridements before definitive fixation, Mode of fixation, post operative immobilization periods, and postoperative complications.

In this study fractures on the left side were associated with better functional outcomes (mean rank = 59.58) compared to the right side (mean rank = 47.87), with a small effect size (r = 0.210) (Mann-Whitney U: 1054.5, P = 0.031). This could be attributed to individuals with dominant

hand injuries experienced more significant functional impairments and lower satisfaction rates post-treatment compared to non-dominant hand injuries.

The study found 74.3% of the fracures are open fractures, all caused by bullet injuries, 29.5% are Grade II , 70.5% are Grade IIIA. The data indicated significant differences in functional outcome across fracture severity, as determined by the Mann whitney U test($p = 0.000$). The mean rank analysis showed that Patients with Grade II fractures had significantly better outcomes (mean rank = 54.41) compared to Grade IIIA (mean rank = 33.26). The large effect size ($r = 0.470$) suggests the severity of the soft tissue injury critically affects the rehabilitation process. The study also show Patients with open fractures undergoing fewer debridements (mean rank = 49.09 for one debridement) exhibited better outcomes compared to those requiring multiple debridements (mean rank = 18.50 for ≥ 3 debridements) as determined by the kruskal wallis test and post hoc analysis ($p = 0.000$). This is likely due to the cumulative tissue trauma associated with repeated procedures. The moderate effect size ($\eta^2 = 0.194$) emphasizes the importance of achieving adequate debridement in the initial surgery to minimize the need for subsequent interventions. Early intervention and meticulous soft tissue handling in severe fractures could improve long-term functionality. In a retrospective, case series, single-center study done in a total 7 cases of Grade III A proximal humerus fractures who underwent surgical treatment with external fixation and arthrodiastasis. The study mean Quick DASH was 36.2 (15.9–58) and show promising short-term and mid-term results with low complication rates, low levels of postoperative pain, and moderate functional results(47).

In our study, 44 patients were treated with open reduction and internal fixation (ORIF), 18 patients managed with ORPP,7 patients fixed with CRPP another 7 patients treated with rush rod, while 29 patients received external fixation. This study highlights the significant differences in functional outcomes between these treatments methods, as determined by the Kruskal-Wallis H test (chi-square = 44.132, $p = 0.000$) and Post hoc analysis. ORIF demonstrated better outcomes, with a mean rank of 68.22, compared to EX-FIX, which had a mean rank of 25.71. The large effect size ($\eta^2 = 0.401$) indicates that implant choice is a critical determinant of functional recovery. ORIF provides superior anatomical reduction and stability, enhancing healing and early rehabilitation with less risk of malunion. In contrast, EX-FIX requires longer immobilization, delaying rehabilitation and potentially leading to worse functional outcomes. This finding is in line with Asystematic review and metaanalysis study done on 2022 on surgical

management of proximal humerus fracture which reveals superiority of ORIF to other treatment options and comparable to Intramedullary nailing in clinical outcomes, ROM, and complication rate(48).

This study also shows patients without associated injuries achieved better QuickDASH scores (mean rank = 58.83) than those with injuries (mean rank = 40.27)on (Mann-Whitney U: 768.0, P = 0.001). The moderate effect size (r = 0.312) underscores the impact of additional injuries on functional recovery. This finding highlights the need for comprehensive management of multi-trauma patients to optimize functional recovery. And the absence of complications (mean rank = 65.65) was associated with superior QuickDASH scores by the Kruskal-Wallis H test (chi-square = 37.883, p = 0.000) and Post hoc analysis. The occurrence of Complications such as infection, neuropraxia, revision surgeries or hardware failure significantly impaired functional recovery, with a large effect size ($\eta^2 = 0.345$). Astudy done by Christiano et al. reported that postoperative complications were significant predictors of higher Disability of the Arm, Shoulder and Hand (DASH) scores, underscoring the importance of meticulous surgical technique and postoperative care(49).

Among the 105 patients treated for proximal humerus fractures, 30.5% were immobilized for the first 1 to 3 weeks, 45.8% were immobilized for 3 to 6 weeks while 24.7 % were immobilized for more than 6 weeks. The results reveal a significant difference in outcomes based on the timing of post-operative immobilization on Kruskal-Wallis H test (chi-square = 46.217, p = 0.000) and Post hoc analysis. Patients immobilized for 1–3 weeks (mean rank = 57.44) had better outcomes compared to those immobilized for longer durations. This suggests that prolonged immobilization negatively impacts functional recovery. The large effect size ($\eta^2 = 0.433$) highlights the need to balance stability and early mobilization in postoperative protocols. Highlighted by a prospective observational cohort study done on 33 patients to asses rehabilitation outcomes after proximal humeral fracture which shows improved outcomes after patients started early rehabilitation and physiotheraphy(50).

8. Strength and limitation of the study

8.1. Strength of the study

The strength of this study is that it is the first study to assess the functional outcome of proximal humerus fractures fixation in the study area and in our country.

It serves as a baseline for future research

8.2. Limitations of the study

This study has its own limitations that should be considered while interpreting the findings. The small sample size, being a cross-sectional study, use of non-parametric tests for determining association could make it difficult to generalize.

9. Conclusions and Recommendations

9.1 Conclusions

This study shows the functional outcome following proximal humerus fixation based on QuickDASH score signifcantly depends on the Fracture side , implant choice, post operative immobilization periods, grade of open fracture, number of debridements before definitive fixation and presence of associated injuries and complications.The rate of mid-term complications are also higher and more than half of the patients had residual shoulder stiffness. In general, the functional outcomes reported in this patient group showed more than half (58.1%) of patients have either good to excellent outcome based on QuickDASH tool which showed a very high internal consistency.

9.2 Recommendations

To the department of orthopedic and trauma surgery and Hospial administrators at TGSH & FHCSH

Establish clear guidelines for the early diagnosis and prompt treatment and rehabilitation of proximal humerus fractures

practice strict measures to avoid infection in patients with open fractures.

Begin post-operative rehabilitation as early as possible

Encourage a team-based approach involving orthopedic surgeons, rehabilitation specialists, and nursing staff to Continuously assess the patient's progress during both the post-operative phase and rehabilitation.

To Federal Ministry of Health and Health Bureaus

To develop guidelines for the management of orthopedic injuries and infection prevention protocols and to enhance health care delivery for trauma patients

To promote a Community based-wide physiotherapy in outpatient or community rehabilitation programs

For Researchers

It is a potential area to conduct long-term prospective studies to evaluate the impact of early intervention, choice of implant and rehabilitation timing on patient outcomes and recovery. Investigate the findings in larger, more diverse patient populations to validate the results, to measure the determinants of the outcome and increase the generalizability of the study outcomes.

10. References

1. Bhadbhade V, Channabasava C. Clinical profile of proximal humeral fractures. Natl J Clin Orthop. 2019;3:85-7.
2. Buckley RRE, Moran CG, Apivatthakakul T. AO principles of fracture management. (No Title). 2017.
3. Hinson JA. Anatomy and classification of proximal humerus fractures. Proximal Humerus Fractures: Evaluation and Management: Springer; 2014. p. 1-22.
4. Lous U, Bigiliani C. The shoulder, Vol-Charles Rockwood, Frederick A. Fractures of proximal humerus. Rockwood CA, Matsen Philadelphia: WB Saunders.1990:278-334.
5. Court-Brown CM, Caesar B. Epidemiology of adult fractures: a review. Injury. 2006;37(8):691-7.
6. Court-Brown CM, Garg A, McQueen MM. The epidemiology of proximal humeral fractures. Acta Orthopaedica Scandinavica. 2001;72(4):365-71.
8. Palvanen M, Kannus P, Niemi S, Parkkari J. Update in the epidemiology of proximal humeral fractures. Clinical Orthopaedics and Related Research (1976-2007). 2006;442:87-92.
9. Goyal S, Ambade R, Singh R, Lohiya A, Patel H, Patel SK, et al. A Comprehensive Review of Proximal Humerus Fractures: From Epidemiology to Treatment Strategies. Cureus. 2024;16(4).
10. Neer CS. Four-segment classification of proximal humeral fractures: purpose and reliable use. Journal of shoulder and elbow surgery. 2002;11(4):389-400.
11. Gracitelli ME, Dotta TA, Assunção JH, Malavolta EA, Andrade-Silva FB, Kojima KE, et al. Intraobserver and interobserver agreement in the classification and treatment of proximal humeral fractures. Journal of Shoulder and Elbow Surgery. 2017;26(6):1097-102.
13. Klug A, Gramlich Y, Wincheringer D, Schmidt-Horlohé K, Hoffmann R. Trends in surgical management of proximal humeral fractures in adults: a nationwide study of records in Germany from 2007 to 2016. Archives of orthopaedic and trauma surgery. 2019;139:1713-21.
14. Slobogean GP, Johal H, Lefaivre KA, MacIntyre NJ, Sprague S, Scott T, et al. A scoping review of the proximal humerus fracture literature. BMC musculoskeletal disorders. 2015;16:1-10.
15. Spross C, Meester J, Mazzucchelli RA, Puskás GJ, Zdravkovic V, Jost B. Evidence-based algorithm to treat patients with proximal humerus fractures—a prospective study with early clinical and overall performance results. Journal of shoulder and elbow surgery. 2019;28(6):1022-32.
16. Brorson S, Alispahic N, Bahrs C, Joeris A, Steinitz A, Audigé L. Complications after non-surgical management of proximal humeral fractures: a systematic review of terms and definitions. BMC musculoskeletal disorders. 2019;20:1-7.
17. Smith AM, Mardones RM, Sperling JW, Cofield RH. Early complications of operatively treated proximal humeral fractures. Journal of shoulder and elbow surgery. 2007;16(1):14-24.
19. Richard GJ, Denard PJ, Kaar SG, Bohsali KI, Horneff JG, Carpenter S, et al. Outcome measures reported for the management of proximal humeral fractures: a systematic review. Journal of Shoulder and Elbow Surgery. 2020;29(10):2175-84.
20. Sigirtmac IC, Oksuz C. Systematic review of the quality of the cross-cultural adaptations of Disabilities of the Arm, Shoulder and Hand (DASH). La Medicina del lavoro. 2021;112(4):279.
22. Depalma AF, CAUTILLI RA. Fractures of the upper end of the humerus. Clinical Orthopaedics and Related Research®. 1961;20:73-93.
23. Hessmann M, Gehling H, Gotzen L, editors. Proximal humerus fracture in advanced age. Langenbecks Archiv fur Chirurgie Supplement Kongressband Deutsche Gesellschaft fur Chirurgie Kongress; 1996.

24. Hailu S, Tesfaye S, Alemayehu G. Osteoporosis-related appendicular fractures in Tikur Anbessa Specialized Hospital, Ethiopia: a prospective observational study. Archives of Osteoporosis. 2023;18(1):21.
26. Gupta AK, Harris JD, Erickson BJ, Abrams GD, Bruce B, McCormick F, et al. Surgical management of complex proximal humerus fractures—a systematic review of 92 studies including 4500 patients. Journal of orthopaedic trauma. 2015;29(1):54-9.
27. Handoll HH, Elliott J, Thillemann TM, Aluko P, Brorson S. Interventions for treating proximal humeral fractures in adults. Cochrane Database of Systematic Reviews. 2022(6).
29. Haidukewych GJ. Innovations in locking plate technology. JAAOS-Journal of the American Academy of Orthopaedic Surgeons. 2004;12(4):205-12.
30. Jo Y-H, Lee K-H, Lee B-G. Surgical trends in elderly patients with proximal humeral fractures in South Korea: a population-based study. BMC Musculoskeletal Disorders. 2019;20:1-8.
32. Jagiasi J, Joshi A, Gupta A. Philos Plate: Its Complications and Functional Outcome.
33. Oldrini LM, Feltri P, Albanese J, Marbach F, Filardo G, Candrian C. PHILOS synthesis for proximal humerus fractures has high complications and reintervention rates: a systematic review and meta-analysis. Life. 2022;12(2):311.
34. Jawa A, Burnikel D. Treatment of proximal humeral fractures: a critical analysis review. JBJS reviews. 2016;4(1):e2.
35. Miltenberg B, Masood R, Katsiaunis A, Moverman MA, Puzzitiello RN, Pagani NR, et al. Fracture dislocations of the proximal humerus treated with open reduction and internal fixation: a systematic review. Journal of Shoulder and Elbow Surgery. 2022;31(10):e480-e9.
36. Soler-Peiro M, García-Martínez L, Aguilella L, Perez-Bermejo M. Conservative treatment of 3-part and 4-part proximal humeral fractures: a systematic review. Journal of orthopaedic surgery and research. 2020;15:1-9.
37. Geiger EV, Maier M, Kelm A, Wutzler S, Seebach C, Marzi I. Functional outcome and complications following PHILOS plate fixation in proximal humeral fractures. Acta Orthop Traumatol Turc. 2010;44(1):1-6.
38. Maresca A, Senesi L, Cerbasi S, Pascarella R. Complications of proximal humeral fractures. Lo Scalpello-Journal. 2021;35:20-6.
39. Kumar V, Khan AA, Shah R, Shamim S, Mishra NK, Khan IS. Assessment of functional outcome of PHILOS plate in proximal humerus fracture. J Evid Based Med Healthc. 2020;7(26):1218-22.
40. George P, Dasgupta B, Bhaladhare S, Reddy B, Jain A, Jogani A. Functional outcome and complications in management of proximal humerus fractures operated with proximal humerus locking plate. Malaysian Orthopaedic Journal. 2021;15(2):47.
41. Sun Q, Wu X, Wang L, Cai M. The plate fixation strategy of complex proximal humeral fractures. International Orthopaedics. 2020;44:1785-95.
42. Muthuuri J. Outcome of plate osteosynthesis in the management of proximal humeral fractures in adults. East African Orthopaedic Journal. 2011;5(1).
43. Feigoudozoui HV, Parteina D, Mapouka M, Gnamkey M, Koné SGNg. An audit of treatment of proximal humerus fractures type 3 and 4 of Neer classification in a resource-poor setting in Sub-Saharan Africa. Journal of Musculoskeletal Surgery and Research. 2024;8(3):204-9.
44. Cizik AM, Zhang C, Presson AP, Randall D, Kazmers NH. Linking QuickDASH and PROMIS Upper-Extremity Computer-Adaptive Test Scores in Hand Surgery: A Crosswalk Study. The Journal of Hand Surgery. 2024.
45. Elsman EB, Roorda LD, Crins MH, Boers M, Terwee CB. Dutch reference values for the patient-reported outcomes measurement information system scale v1. 2-global health (PROMIS-GH). Journal of Patient-Reported Outcomes. 2021;5(1):38.
46. Resnik L, Borgia M. Reliability, validity, and responsiveness of the QuickDASH in patients with upper limb amputation. Archives of physical medicine and rehabilitation. 2015;96(9):1676-83.

47. Satizabal Azuelo C, Cabrera Méndez MP, Rozo López GA, Trouchon Jimenez SdC, Sanchez Cruz D. The use of transarticular external fixation by arthrodiastasis in complex open proximal humeral fractures at Hospital Militar Central Colombia: A case series. Trauma. 2024;26(4):316-21.
48. Hohmann E, Keough N, Glatt V, Tetsworth K. Surgical treatment of proximal humerus fractures: a systematic review and meta-analysis. European Journal of Orthopaedic Surgery & Traumatology. 2023;33(6):2215-42.
49. Christiano A, Pean C, Konda S, Egol K. Functional outcome after proximal humerus fracture fixation: understanding the risk factors. Acta Orthop Belg. 2017;83(1):1-7.
50. Taylor NF, Wintle E, Longden C, van de Water AT, Shields N. Rehabilitation outcomes after proximal humeral fracture: An observational study. Physiotherapy Practice and Research. 2021;41(2):121-31.

11. Annexes

Annex I: Information Sheet

Title of the Research Project –Assesesment of Functional outcome and associated factors of proximal humeral fractures operative management at Tibebe Ghion and Felege Hiwot Specialized Hospital, Bahir Dar, Ethiopia, from 2021-2024 GC.

Name of Investigator – Biniyam Marie (MD, Orthopedics and trauma surgery 4th year resident)

Name of the Organization – Bahir Dar university, College of medicine and health sciences

Name of the Sponsor - Bahir Dar University

Introduction - This information sheet is prepared with the aim of explaining to study participants about the research project purpose, data collection procedures and get permission to conduct the research

Purpose of the Research Project – To assess the functional outcome of Operative management of Proximal humeral fractures and associated factors at Tibebe Ghion and Felege Hiwot Specialized Referral Hospital, Bahir Dar, Ethiopia from January 2021– December 2024 G C

Procedure - In order to achieve the above objective, information which is necessary for the study will be taken from the surgical log book, medical records of the patients and direct interview of the patient in person during their follow up or by phone call.

Risk and /or Discomfort - Since the study will be conducted by taking appropriate information from medical chart, it will not inflict any harm on the patients. The name or any other identifying information will not be recorded on the data collection format and all information taken from the chart as well as from patient interview will be kept strictly confidential and in a safe. The data stored in to the computer also secured by password. The information retrieved will only be used for the study purpose.

Annex II: Participant Consent Information Sheet in English

I have been invited to take part in this study for the assessment of functional outcome of operative management of proximal humerus fracture and its associated factors in adults at Tibebe Ghion and Felege Hiwot Specialized Hospitalconducted by Dr, Biniyam Marie. My role in this study is to complete an attached data collection tool. I acknowledge that the research procedures have been explained to me and that any questions that I have asked to have been explained to my satisfaction. I have been informed of the alternatives to participation in this study including the right to not participate. I also understand that I may not benefit directly from the research and that my participation is totally voluntary. I have also been informed that the confidentiality of the information I will provide will be safeguarded and my privacy and anonymity will be ensured in the collection, storage, and publication of the research material.

I have fully understood the aims, methods, and conditions to participate in this study; I therefore consent to my participation.

Participant's signature: …… Date……

Data collectors Name …….. signature: …… Date……

8.2 Annex 2-Consent Form in Amharic

<u>የ ታካሚ ፈቃድ መጠየ ቂያ</u>

ይሕ መጠይቅ በ ዶ/ር ቢንያም ማሬ በጥበበ ጊዮን ስፔሻላይዝድ ሆስፒታል የ 4ኛ ዓመት የ አጥንትና የመገ ጣጠሚያ ስፔሻላይዜሽን ተማሪየ ተዘጋጀ ሲሆን :: እዚህ የ ተገ ኙት በአዋቂች የ ላይኛው ክንድ ትከሻ አካባቢ አጥንት ስብራት በ ተለያየ የ ወሰ ጥ እና የ ዉጭ ብረት ሕክምና ከ ተደረገ ላቸው በኃላ ያለዉን ዉጤት ለ ማጥና ት ነ ዉ :: እርስ ወም የ ተመረጡት የ ደረሰ ብዎት ስብራት የ ዚህን ጥና ት መስፈር ት ስለ ሚያ ሚለ ነ ዉ :: ለ መሳ ተፍ ሲዎስ ኑ ስለ ጥና ቱ ምን ነ ት, አ ላ ማ, ጉ ዳ ት, ጥቅ ም እና ስጋ ት በ መሉ ከ ተረ ዱና ካ መኑ በ ት በ ኃላ ይሁን :: የ ርሰ ው ተሳ ትፎ ራሰ ዎን ብቻ ሳ ይሆን ለ ዎደ ፊ ት ተመሳ ሳ ይ ጉ ዳ ት ላ ለ ባ ቸው ሰ ዎቺ ም ጭ ምር ነ ዉ :: ስ ለ ተሳ ተፉ አ መሰ ግ ና ለ ሁ ::

<u>የ ተሳ ታፊ ፈ ቃድ</u>

ከ ላ ይ ያ ለ ው መረ ጃ በ አ ማር ኛ በ ..... ተገ ል ፆ ል ኛ ል :: ጥ ያ ቄ ወ ቼ በ በ ቂ ሁ ኔ ታ ተ ብ ራ ር ተ ወ ል ኛ ል :: በ ዚ ህ ጥ ና ት ለ መሳ ተ ፍ ተ ስ ማ ም ቻ ለ ሁ ::

<u>የ ተሳ ታፊ ው</u>

ፊ ር ማ.....

ቀ ን ....

<u>የ መረ ጃ ሰ ብሳ ቢ ው</u>

ስ ም .....

ፊ ር ማ.....

Annex III: Data Collection Format Sheet

Table 6:- Data collection tool

Cases	**Case 1**	**Case 2**	**Case 3**	**Case 4**
Card No.				
Age				
Sex 1. Male 2. Female				
Residence 1. Urban 2. Rural				
Marital Status 1. Single 2. Married 3.Divorced 4. Widowed				
Educational status 1..Illiterate 2..Primary education 3. Secondary education 4.Higher education				
Occupation 1. Farmer 2. Soldier 2. Government Employee 4. Merchant 5.. Others				
Mechanism of the injury 1. RTA				

2. Bullet injury 3. Fall down injury 4. others				
Fracture side 1. Left 2. Right 3. Both sides				
Arriving time to hospital from the injury 1. Within 24hrs 2. 24-72 hrs 3. 3-7 days 4. 1-2 weeks 5. More than two weeks				
Type of fracture involvement (Neer type) 1. 2 part 2. 3 part 3. 4 part				

Is the fracture is open or closed ? 1. Open 2. Closed				
If the fracture is open,what is the GustiloAnderson type 1. Type 1 2. Type 2 3. Type 3(A, B, C)				
If fracture is Open, how many debridements done before definitive fixation? 1. None 2. One 3. Two				

4. Three or more				
If the fracture is open : time from injury to antibiotics 1. Less than 6hours 2. 6-24hours 3. 24-72hours 4. more than 3days				
Time to definitive surgery after injury 1. First week 2. 1 to 2 weeks 3. More than 2 weeks				
Fixation mode for: 1. ORIF 2. IM nail/Rush rod 3. Ex Fix 4. k-wires (ORPP) 5. K-wires (CRPP)				
If ORIF was done, fixation options used 1. Anatomic proximal humerus plate (PHILOS) 2. DCP plate 3. Screws only				

Surgical approach: 1.Anterior-deltopectrol 2. Lateral-deltoid splitting				
How many weeks were the patient has been on non weight bearing after fixation 1. One week				

2. 1-3wk 3. 3-6weeks 4. 6weeks and more				
Any complication on immediate post-operative days 1. None 2. Infection 3. Nerve injury/Neuropraxia 4. Reoperation/Revision surgery				
Did the patient have a regular follow up? 1. Yes 2. No				
Did the patient linked to physiotherapy? 1. Yes 2. No				
If the answer for above question is yes ,when 1. 2wks 2. 6wks 3. 12 wks 4. More than 12wks				
Time laps from fixation done to data collection: 1. Less than 3 months 2. 3 to 6 months 3. 6 to 12 months 4. More than 12 months				

Any current complaint 1. shoulder stiffness 2. Shoulder pain 4. Wound site pussy discharge/infection 5. Others				

Annex IV : Functional Assessment Based on score

Table 7: The QuickDASH scoring system tool

Parameter	Score				
	1	2	3	4	5
Open a tight/new jar					
Severity of arm, shoulder, or hand Pain in the last week					
Severity of arm, shoulder, or hand Tingling (pins and needles) in the last week					
Difficulty of Sleeping because of pain in your arm, shoulder, or hand during the past week?					
Difficulty of doing Social activities with family and neighbors due to your arm, shoulder, or hand problem interference during the past week					
Wash your back					
Forceful recreational activities(playing hocky, hammering, tennis....)					

Heavy houshold chores(cleaning/ washing floors, walls, etc)					
Carry a shopping bag /briefcase					
Use a knife to cut food					
Limited in work or daily activities due to your arm, shoulder, or hand problem during the past week					

Scoring: 1: no difficulty; 2: mild difficulty; 3: moderate difficulty; 4: severe difficulty; 5: unable.

Table 8 :- Raw QuickDASH Score to PROMIS T-Score Conversion Table for Physical Function Upper limb

QuickDASH Raw Score	PROMIS UE T-Score
11	60.5
12	54.9
13	51.8
14	49.4
15	47.4
16	45.8
17	44.4
18	43.2
19	42.1
20	41.1
21	40.1
22	39.2
23	38.4

24	37.6
25	36.8
26	36.0
27	35.3
28	34.6
29	33.9
30	33.2
31	32.5
32	31.8
33	31.1
34	30.5
35	29.8
36	29.1
37	28.4
38	27.8
39	27.1
40	26.4
41	25.7
42	24.9
43	24.2
44	23.4
45	22.5
46	21.7
47	20.7
48	19.7
49	18.7

50	17.5
51	16.2
52	14.9
53	13.3
54	11.7
55	9.8