



**ADDIS ABABA UNIVERSITY AND COLLEGE OF HEALTH SCIENCE
SCHOOL OF MEDICINE DEPARTMENT OF SURGERY, PLASTIC AND
RECONSTRUCTIVE SURGERY UNIT**

**MAGNITUDE, PATTERN AND MECHANISM OF INJURY IN PATIENTS
WITH HAND FRACTURE AMONG ACUTE HAND INJURY PATIENTS
VISITING ALERT COMPREHENSIVE SPECIALIZED HOSPITAL,
ADDIS ABABA, ETHIOPIA**

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Principal Investigator: Dr Habtamu Tadele Yenealem

Plastic and reconstructive surgery resident

Email: tadelehabetamu0@gmail.com

Phone: +251918550953

Advisors:

1. Dr. Yeageremu Kebede

Assistant professor of Plastic and reconstructive surgery, SOM, CHS, AAU

ALERT Comprehensive Specialized Hospital

Email: yeageremu132@gmail.com

Phone: +251911456853

2. Dr. Abraham Gebereegziyabeher

Assistant Professor of Plastic, Reconstructive and Hand surgery, SOM,
CHS, AAU

ALERT Comprehensive Specialized Hospital

Email: abnati14@yahoo.com

Phone: +251911784447

3. Dr. Hellina Legesse

Plastic and reconstructive Surgeon

ALERT Comprehensive Specialized Hospital

Email: Legeshellina@gmail.com

Phone: +251911435515

I. Abstract

Background: Hand fracture is one of the most common injuries globally. It represents a significant public health concern due to its higher incidence with predilection to young working group who are mostly to bread winners of the family and associated economic burden from loss of working days and treatment cost. It occurs as result of road traffic accidents, machine injuries, bullet, falling down accident and direct blow injuries.

Objective: The aim of this study is to assess the prevalence of hand fracture, mechanism of injury, timing, pattern of fracture with in anatomic locations and fracture characteristics.

Methodology: A cross-sectional retrospective chart review was conducted on charts of patients with hand fracture visiting Trauma unit, ALERT comprehensive specialized Hospital between February 1, 2024 and January 31, 2025 GC. Data collected from medical records and radiology reports using standardized questionnaire's'. After data cleaning and coding, data were entered into SPSS version 23. Findings were summarized with descriptive statics and significance of distribution with in the variable tested with Pearson chi-square of Goodness of fit.

Results: Among 796 acute hand injury patients, 506 63.6%) had hand fracture. It occurred predominantly in young adults (17-40 years (73.4%)) and males (84.1%). Most fractures involved right right-hand (54.1%) and dominant hand (79.7%). Digital bones were the most commonly fractured bone of the hand (79.7%). Distal phalanx was the most common phalangeal fracture in all digits. Complete (94.7 %,) and open (76.8 %,) fractures are commonest fracture characteristics. Pearson chi-square of Goodness of fit test was done for fracture the pattern of distribution with in Anatomies and fracture characteristics, the findings were significant. Majority of fractures occurred in the afternoon after noon (54.1%) and on weekdays (83.5 %,.). There was no significant seasonal variation though there is slight increment in winter and autumn. Machine-related (53.1%) and crush injuries (24.2%) were the leading mechanisms.

Conclusion: Hand fractures are most commonly found in patients with acute hand injury. It affects most commonly right and dominant hand. Machine injuries contribute to majority of majority of hand fractures, highlighting the need for preventive strategies in industries and timely management t reduce morbidity and preserve function.

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II. Abbreviation and Acronyms

ACSH: ALERT comprehensive specialized Hospital

M: Male

F: Female

RTA: Road traffic accident

FDA: Falling down accident

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1. Introduction

1.1. Background of the study

The hand is part of upper limb distal to forearm with skeletal and soft tissue framework. The skeleton of the hand consist of carpal bone, metacarpals and phalanges in fingers and thumb¹. Generally there are 8 carpal bones arranged in 2 rows, 5 metacarpals, 3 phalanges for each fingers and 2 phalanges for thumb. Hand has grasping, manipulation, sensation, nonverbal communication and Aesthetic functions².

Fracture is loss in structural continuity of bone which results from direct injury, repetitive stress or abnormal weakening of the bone³. There are different classifications of fracture based on different parameters. Based on integrity of the overlaying skin, it can be classified as open and closed fracture. Based on pattern of fracture line⁴ it can be transverse, oblique, spiral, comminuted. Considering anatomic location it can be carpal, metacarpal and digital fracture. The metacarpals, base, shaft, neck and head fracture. The phalanges it can be proximal phalanx, middle phalanx, distal phalanx and within each specific location it can be base, shaft and head fracture. Regarding the joints it can be intra-articular or extra-articular. There is also different classification for pediatric fracture considering growth plate involvement.

Hand fractures are one of the commonest orthopedic fractures globally accounting for 99 fractures per 100,000 persons/year with women being 65 per 100,000 persons/year and men 136 per 100,000 persons/year⁵. These fractures often result from Road traffic accidents, direct blows, bullet injuries and machine injuries and can range from simple factures to more complex involving multiple bones and soft tissue with questionable viability of the limb. It can occur to peoples of all age but certain demographic factors, occupations, and activities can influence the frequency and severity of fracture.

In Ethiopia the burden of musculoskeletal fractures including hand fracture are increasing due to increased incidence of trauma including RTA and occupational injuries as result of increased industrialization particularly in manual labor sectors. Although there has been studies in Ethiopia on acute hand injuries reflecting 27%-39.1%^{6,7,8} of hand fractures there is no dedicated study on

hand fracture which encompasses the magnitude of fracture, pattern of fracture among fracture characteristics and anatomic distribution, mechanism of injury and timing of injury.

Hand fractures often require careful management including timely surgical therapy and physical therapy to prevent long term disability. The outcome of therapy is closely related to factors such as fracture severity, location, and patient comorbidity, timely medical and surgical care. Additionally the etiology of hand fracture, age, sex, occupation and hobby significantly plays crucial role in shaping treatment strategies and outcome.

1.2. Statement of problem

Despite the rate of hand injuries is decreasing in developed countries, low middle and middle income countries have witnessed increasing incidence of hand injuries over the past 27 years⁹.

Hand fracture is significant public health concern in Ethiopia due to high prevalence accounting for 39.1%⁸ hand fracture among patients with hand injuries. It also associated with loss of working days with time injury to returning to regular activity averaged 56 days¹⁰ and potentials of long term disability of the victim.

Even though there is high prevalence of hand fractures in our setting, there remains limited understanding of the specific distribution, patterns and etiologies of these hand injuries where there is young workforce population is majorly involved who are backbone of income to the family and the country.

1.3. Justification of the study

Though there is high prevalence of hand fracture both in Ethiopia and Africa, there remains significant gap in comprehensive region specific data on magnitude, pattern and etiology of these fractures. Most of the existing literatures on hand fractures tend to focus on developed countries where health care infrastructure, and risk factors are different from sub-Saharan Africa and

Ethiopia. As result is limited information on causes, magnitude and patterns hand fractures distribution in our setting and broader sub-Saharan Africa context.

In Ethiopia while there are some researchers conducted on general fractures and hand injuries, studies dedicated on hand fracture are scarce. The magnitude, etiology and pattern of hand fractures across different population groups remain unexplored.

In summary, addressing this gap is critical to understand the full picture of hand fracture in patients visiting ALERT comprehensive specialized hospital which is national referral center for hand fracture patients, enabling better prevention, treatment strategies and ensuring that health care policies and resources are tailored to unique need of this population.

1.4. Significance of study

This study is highly invaluable as it will provide paramount data on magnitude, etiology and pattern of hand fracture in Ethiopia, an area that has been under investigated in this context. This research finding will help health care providers to identify high risk groups and improve diagnosis, treatment and rehabilitation protocol. This finding will also inform hospital administrators to do proper resource allocation and service expansion to ensure that interventions are tailored to specific need of the patient. Researchers can also be motivated by the findings and use it as base line data to for further exploration. Policy makers can also use the finding to put strategies addressing this segment of population by designing prevention protocols and expanding facilities for management and rehabilitation of these injuries. Ultimately the finding will fill the critical gap in knowledge and help reduce long term health and economic burden of hand fractures in Ethiopia and similar settings of sub-Saharan Africa.

2. Literature review

2.1. Magnitude of hand fracture

Considering both health care related and lost productive costs, fractures of the hand have high economic burden compared to other orthopedic injuries¹¹. Hand fractures roughly account 20% of all fractures with a global incidence of 179 per 100 000 individuals. Whereas the rate of these hand injuries is decreasing in developed countries, low and middle countries have experienced an increasing incidence of hand injuries over the past 3 decades⁹.

According to study done by Feehan et al¹² the annual incidence of hand fracture is 36/10000 with age adjusted incidence of 29/10000 in peoples over 20 and 61/10000 in peoples under 20 years old. Similar study from Nepal revealed that 46% of hand injuries are hand fractures¹³. Spanish researcher DOMINGUEZ-PRADO et al⁵, found hand fractures account for 7.6% of all traumatologic crises and 29.7% of all upper limb fractures. Similarly, hand fractures also make up 5.4% of all fractures according to kumar et al¹⁴ from India. Another study conducted in Netherlands by E. B. H. VAN ONSELEN¹⁵ et al Reveals that hand fractures make up 19% of all fractures.

Makobore et al¹⁶ study from Uganda indicates that 16% of hand injuries had hand fracture while wanjohi et al¹⁷ from Kenya indicates that there are around 56.4 cases per 1000 people.

In an Ethiopian context, Yosef et al found that hand fractures account 23.8% of extremity fractures. Around 37% of patients with hand injuries had hand fractures according to kassa et al⁷ and 29.7% of patients from Abebe et al⁶ study. Another study from Ahmed et al⁸ showed 39% of acute hand injuries had hand fracture.

2.2. Characteristics of the patient

According to Feehan et al¹² study the average age was 31 years old and men were 2.8 times more likely than women to sustain between the age of 15 and 40. Similarly Saudi Arabian study by Alhumaid et al¹⁸ showed 90% accounts for males. DOMINGUEZ-PRADO et.al⁵ investigation showed that there is male predominance with M:F ratio 5.5:1 until the age of 50 after then there is slight female predominance with M:F1:1.7. Likewise Kumar et al¹⁴ study showed that there is male predominance with M: F ratio 5:1 and mean age of patients was 24 years old. Moura et al¹⁹ from USA 65% of fractures occur in males with men's have highest incidence in their young age whereas in women's it occurs more in their old age. The median age patients were 44.7 years old. Another study from Sweden by Alfort et al 2023²⁰ the mean age of patients with hand fracture were 40years with higher median age in women and majority of patients were males. Norwegian study by Weum et al 2016²¹ also reveals the average age at presentation was 34 years old. Males account 70% of cases with commonest age being 10-60 years old and for females were 50-70 years old. United Kingdom paper by Stanton et al 2007²² reveals 795 of hand fractures occur in males with commonest age being 10-19 years. VAN ONSELEN et al 2003¹⁵ also showed the average age of patients was 32 and there was male predominance with M:F ratio of 1.8:1.

Wanjohi et al showed there is male predominance with 71.92% of patients and the mean age was 29 years old. From Ethiopia by Merkeb et al 2018²³ also reported male predominance accounting for 79.4% of cases.

2.3. Anatomic Distribution

Feehan et al 2006¹² showed 50% of fracture was phalangeal whereas 42% were metacarpal and 8% were multiple site fracture. Alhumaid et al 2019¹⁸ also reported right hand fracture was more prevalent (61.4%). Phalangeal fracture was most common (53.5%). Among fingers little and ring finger was most commonly involved and proximal phalanx is the commonest location to be fractured. From metacarpals 5th and 1st were most commonly involved. Similarly DOMINGUEZ-PRADO et al 2022⁵ reported as right hand the most commonly fractured but

metacarpals (58.8%) were the leading location than phalangeal (31.6%) and carpal bones (9.8%). Among metacarpals 5th metacarpal is commonest site with neck being commonest location in it whereas other metacarpals shaft is the commonest. Among carpal bones scaphoid was commonest. Kumar et al 2013¹⁴ also documented as there is slight right hand more involvement with right to left ratio 1.5:1 and majority fractures were phalangeal followed by metacarpal and carpal bones. Among phalanges proximal phalanx take majority of share followed by distal and middle phalanx. From carpal bones scaphoid is the commonest bone to be fractured and from metacarpals 5th metacarpal is the dominant fracture. In contrary to other studies study by Moura et al 2022¹⁹ showed majority of hand fractures happened on left hand (57%). From phalangeal fractures little finger (26%) was the most commonly involved and index finger was least commonly fractured. Shaft is also commonest site of phalangeal fracture. Study by Weum et al 2016²¹ showed left hand (54%) is the most commonly involved. This study also noted phalanges are the commonest site accounting 54% followed by metacarpals and carpals. From phalanges 5th finger proximal phalanx fracture is the commonest and 5th metacarpal is commonest metacarpal to be fractured. Among carpal bones triquetral fracture was most commonly seen followed by scaphoid. Swedish study Zander et al²⁴ 2023 by on carpal bone fracture showed scaphoid was dominant fracture accounting 60% followed by triquetrum (25%), hamate (5%) and trapezium (4%). Another study from United Kingdom by Stanton et al 2007²² showed metacarpal fractures are the commonest from which 5th metacarpal is the commonest. From phalanges 5th finger is the commonest followed by thumb and distal phalanx most commonly involved phalange. ONSELEN et al 2003¹⁵ noted on his investigation majority of fractures are phalangeal (59%). Among phalangeal locations distal phalanx were commonest followed by proximal phalanx and middle phalanx. From carpals scaphoid and among rays little finger were also commonly seen.

Study from Cameroon by Raphaela et al 2024²⁵ showed phalangeal fracture was commonest accounting for 58.14% of cases of hand fractures. Study from Kenya by Ndungu et al²⁶ also noted phalangeal fractures dominance which accounts 70.6% of cases. Another study also from similar setting W. O. KAISHA et al 2009²⁷ showed 72.4% fracture were phalanges while 25.0% were metacarpals and carpal bones were involved 2.6% cases. From metacarpals 2nd metacarpal was the most fractured (33.3%), followed by the 5th metacarpal 19%, with the third being least injured (9.5%) and from phalanges distal phalanx of the long finger was the most fractured bone (20%), and followed by the distal phalanx of ring finger (14.5%). Study by Wanjohi et al 2000¹⁷

evaluated just metacarpal and phalangeal fractures, reporting that 50.85% of fractures were metacarpal and 49.15% were phalangeal. From phalangeal fractures proximal phalangeal fracture is the commonest accounting for 65.5% followed by distal phalanx (24.1%) and Middle phalanx (10.4%). From metacarpal fractures 5th metacarpal is the most commonly involved (31.67%) followed by 2nd metacarpal (20%) and the least was 4th metacarpal (13.89%). Right hand was involved in majority of cases accounting for 60.5%, left hand 43.35% and both hands in 9.85% of cases. Majority of patients had 1 fracture per hand (67.8%).

Study done by Merkeb et.al 2018²³ showed the commonest hand fracture was phalangeal accounting 52.9% of hand fracture followed by carpal (23.6%) and metacarpal (23.6%). Another study from Yekatit 12 hospital medical college by Abebe et.al 2019⁶ on causes and types of hand injury which is retrospective shows 16.9% of hand fractures had distal phalanx fractures while 5.6% proximal phalanx fractures, in similar setting Study done by Kassa et.al 2025⁷ the most commonly fractured finger was the middle finger (33.3%), followed by the index finger (23.3%) and the thumb (20%). Study from Tikur Anbessa Hospital by Ahmed et.al⁸ the commonest digits to be fractured were the index (31.6%), usually at the level of distal phalanges (43.2%) or middle phalanges (33.7%).

2.4. Characteristics of hand fracture

Study from Saudi Arabia by Alhumaid et al 2019¹⁸ showed commonest fracture pattern was transverse fracture (48.1%) followed by oblique comminuted and spiral. On this same study two third of patients had compound fracture. Moura et al 2022¹⁹ also showed oblique and transverse fractures each account for 19% of fracture patterns. Around 28% hand fractures were compound fracture and 48% were intraarticular. Alfort et al 2023²⁰ on his study found that majority of fractures are closed proximal phalanx fracture of little finger and ring finger and there were around 17% compound fracture which affects more commonly distal phalanx and men. Intraarticular fractures are more common with middle phalanx fractures. Stanton et al 2007²² also showed oblique fractures are the commonest fracture (37%) and spiral fracture is the least one. 70% of fractures are intraarticular. In children's epiphyseal fracture is commonest.

From Kenyan study Ndungu et al²⁶ most metacarpal fractures were closed (75%) in contrast 62.5% phalangeal fractures were open fractures and all carpal bone fractures were closed. Another study from Kenya by Wanjohi et.al¹⁷ showed 55.9% fractures were open and 45.1% were closed fractures. From patterns of fracture, transverse fracture pattern were the dominant accounting 56.78% followed by comminuted (21.75%), oblique (20.34%) and segmental (1.13%) respectively. Intra-articular fractures were most common on distal aspect of bone (58.5%) compared to proximal aspect of bone.

Tikur Anbessa Hospital study by Ahmed et.al⁸ shows majority of hand fractures were compound (85%).

2.5. Mechanism of Hand Fracture

Retrospective study from Saudi Arabia by Alhumaid et al 2019¹⁸ shows the majority of etiology was falling down accident followed by RTA (40.5%), crush injury and machinery. Similarly a study by Kumar et al 2013¹⁴ reveals RTA was the commonest cause followed by sport activities. Whereas Moura et al 2022¹⁹ study on phalangeal fractures show that around 18% were related to occupational causes and <1% cases were related to explosion. Another cohort study from Sweden by Alfort et al²⁰ showed predominant cause of injury was falling down accident (29%) followed by crush injury. Another study by Weum et al 2016²¹ shows majority the cause was falling down accident followed by sport activities. In children's again falling down accident followed by sport and crush injuries. Only 6% of cases are due to occupational injury. Study from United Kingdom by Stanton et al ²² shows in 44% pediatric fractures sporting activity are the commonest but accounts only 24% in young adults, work related activities account for 15% of hand fractures in young adults and 29% in old adults. Road traffic accidents are more common in young adults and those on their retirement age.

2.6. Timing of Fracture

Study done by Kumar et.al¹⁴ from manipal, India and study from Spain by DOMINGUEZ-PRADO et.al⁵ shows no seasonal difference on its incidence, similarly another study from Amsterdam, Netherlands by E. B. H. VAN ONSELEN et.al¹⁵ shows relatively constant incidence except decrement in summer months. Another study from Norway done by Weum et.al²¹ showed there is clear seasonal variation with increased triquetral bone fracture during winter seasons and

increased metacarpal fractures during weekends especially 5th metacarpal . Similarly another study from Canada by Feehan et.al¹² showed there is increment in incidence of hand fracture during spring followed by summer.

3. Objective of Study

3.1. General Objective

To assess the magnitude, pattern of anatomical distribution and Characteristics of Hand Fracture and mechanisms of injury among Acute hand injury patients presenting to the trauma emergency unit of ALERT Comprehensive Specialized Hospital in Addis Ababa, Ethiopia, from February 1, 2024, to January 31, 2025.

3.2. Specific Objective

- ✓ To assess prevalence of hand fracture among hand injury patients.
- ✓ To assess the pattern of anatomic distribution and characteristics of hand fracture.
- ✓ To describe mechanisms of injury causing hand fracture

4. Materials and methods

4.1. Study Area

ALERT compressive specialized Hospital is a major referral hospital located in Addis Ababa, Ethiopia. It was established in 1934 and served population of approximately 3.5 million. Currently, ALERT Comprehensive Specialized Hospital Offers over 29 specialized medical services and is ranked as Ethiopia's third largest hospital based on patient flow. With staff of more than 2000, ALERT serves over 1500 patients daily and treats more than 450, 000 patients annually.

ALERT Hospital trauma center was inaugurated in 2015 as one of three dedicated trauma centers in the country. The facility is currently equipped with 20 emergency department beds, 38 inpatient trauma ward beds and 10 critical care beds. It has 3 dedicated trauma OR tables among which 1 table is dedicated for plastic and reconstructive surgery trauma cases including hand

fracture. Additionally there are isolated trauma OPD services that operated 5 days per week during business hours.

4.2. Study period

Charts of patients seen in the trauma unit between February 1, 2024, and January 31, 2025, were retrospectively reviewed

4.3. Study Design

Hospital based Cross-sectional retrospective Chart review.

4.4. Source population

All patients with acute hand injury visited ALERT Comprehensive Specialized Hospital trauma emergency unit.

4.5. Target population

All individuals with hand fracture visiting ALERT comprehensive specialized Hospital trauma emergency unit.

4.6. Study population

All selected patients with hand fracture visited ALERT Comprehensive Specialized Hospital trauma emergency from February 1, 2024 to January 31, 2025 that lacks exclusion criteria and meets inclusion criteria

4.7. Eligibility Criteria

4.7.1. Inclusion Criteria

Charts of all patients with hand fracture who visit ALERT Comprehensive Specialized Hospital trauma emergency unit from February 1, 2024 to January 31, 2025 GC

4.7.2. Exclusion Criteria

- Incomplete and lost medical records.
- Patients whose radiology images and reports are not available.
- Patients with dislocation but no fracture.
- Patients with pathologic fracture

4.8. Study Variables

4.8.1. Independent Variable

- ✓ Age
- ✓ Sex
- ✓ Residence
- ✓ Timing of Hand fracture

4.8.2. Dependent Variable

- ✓ Magnitude of hand fracture
- ✓ Pattern of distribution and characteristics of hand fracture
- ✓ Mechanism of injury

4.9. Sample Size Determination and Sampling Technique

4.9.1. Sample size determination

During the study period, 506 patients with hand fractures presented to the trauma unit of ALERT Comprehensive Specialized Hospital (February 1, 2024 – January 31, 2025). The required sample size was calculated using the population proportion formula using proportion of 37% from study done by Kassa et al(2025) at AaBET Hospital yielding 237 patients, with an additional 10% to account for potential non-response.

4.9.2. Sampling technique

Systematic random sampling was used to select the study participants. From the total of 506 patients, every second patient was included in the study to achieve the calculated sample size of 237.

4.10. Operational Definition

- **Hand** is defined as part of upper limb distal to forearm containing skeletal framework of carpal, metacarpal, and phalanges of fingers and thumb
- **Acute Hand injury:** Hand injury occurred within 1 month.
- **Dominant Hand:** The hand preferred by the patient for daily activities such as writing, eating, and throwing

4.11. Data collection Procedure

A structured data extraction tool was developed by adapting variables from relevant literature to collect information from patients' medical records. Two general practitioners were trained by the principal investigator on the proper use of the tool and data collection procedures. Data were collected from October 5 to 29, 2025 GC. The collected data were checked for consistency and completeness before coding and analysis. Questionnaires with missing or inadequate information were cross-checked against patients' medical records, and those still found inadequate information were excluded. All documents were securely stored for possible verification

4.12. Data processing and Analysis

The collected data were checked for completeness and consistency, coded, and entered into Statistical Package for the Social Sciences (SPSS) version 23 for analysis. Descriptive statistics were used to summarize the data: frequencies and percentages for categorical variables, and means with standard deviations or medians with interquartile ranges for continuous variables, depending on the data distribution. The significance of the distribution within variables was assessed using Pearson's Chi-square goodness-of-fit test, with p-values < 0.05 considered statistically significant. There was incomplete data on Hand dominance and time of injury each accounting 11.1% and 6.3%.respectively. The missing data was handled by excluding the missing from analysis.

4.13. Ethical Consideration

The study proposal was submitted to the Black Lion Hospital, Surgery Department Research Ethics Committee, Addis Ababa University, and ethical clearance was granted with meeting reference number: DOS/REC/156/2025/2017. An official letter of cooperation was obtained from the Plastic and Reconstructive Surgery Department of ALERT Comprehensive Specialized Hospital, and approval for the use of patient medical records was granted by the Research and Academic Directorate of ALERT Comprehensive Specialized Hospital. All data were handled confidentially, and patient identifiers were anonymized to ensure privacy.

4.14. Result dissemination plan

The findings of this study will be shared through peer-reviewed scientific publications, presentations at conferences, hospital meetings, and community engagement programs. Additionally, collaborations with relevant stakeholders and dissemination via online platforms will be used to ensure wide accessibility. This comprehensive strategy aims to inform the scientific community, healthcare professionals, local communities, and other interested audiences, thereby maximizing the impact of the research

5. Result

5.1. Magnitude of Hand Fracture

Among 796 patients who visited ALERT comprehensive specialized Hospital trauma unit, 506(63.6%) had hand fracture.

5.2. Patient characteristics

The median age of patients was 25 years old (interquartile range of 20-33). The majority of patients were younger adults (17-40 years, 73.4%), followed by children (15.5%) and older adults (41-65 years, 10.6%). Retired/ elderly patients involvement were rare (0.5%) ($p < 0.001$). Among 207 patients, 174 patients (84.1%, $p < 0.001$) were male which is significantly higher than females. Additionally, 194(93.7%) of the patients were urban areas.

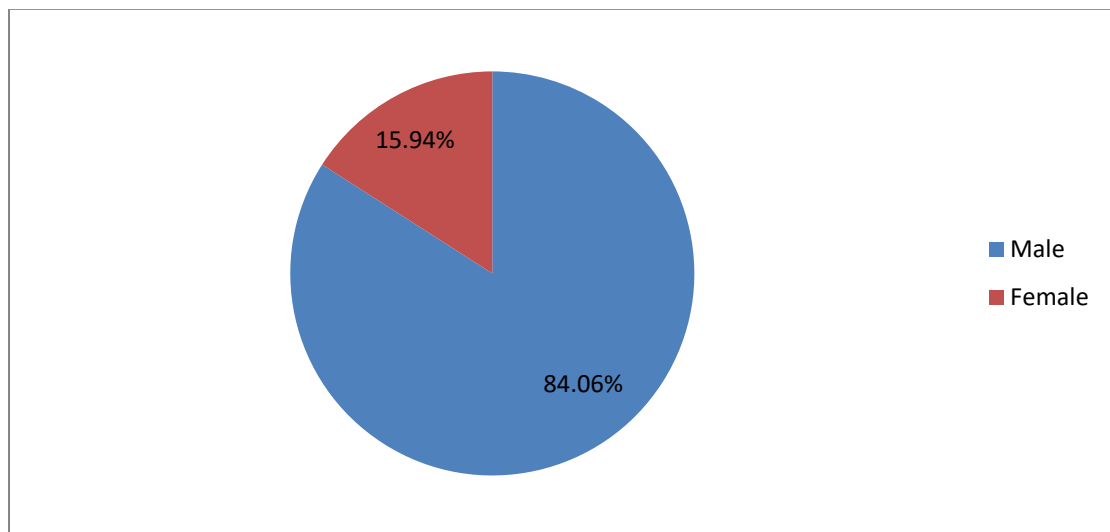


Figure1: Pi-chart of Sex proportion of patients

5.3. Anatomic distribution of hand fracture

Among 207 patients hand fractures were more frequent on right hand ($n = 112$, 54.1%) than left hand ($n = 94$, 45.4%) or both hands ($n = 1$, 0.5%) ($p < 0.001$). Regarding dominant hand involvement, it was involved in majority of patients ($n = 165$, 79.7%) whereas non-dominant hand was affected in 18 case (8.7%) and both hand in 1 case (0.5%)($p < 0.001$).

Digital bones were the most commonly fractured (79.7%), followed by metacarpal (15%), combined (4.3%) and carpal bones (1%)($p < 0.001$). among digital fractures ($n = 172$), index

finger was most commonly injured (41, 27.4%), followed by middle finger(33, 23.5%), multiple fingers (33, 19.2%), ring finger (21, 12.2%), little finger (21, 12.2%), and thumb (23, 13.3%) ($p = 0.037$). distal phalanx fracture were the most common in all fingers occurring in 41.9% of index finger, 64.2% of middle finger, 55.6% of ring finger, 52.8% of little fingers and 66.7% of thumbs. The head of the phalanx was the most commonly affected site, accounting for 44.8% of cases. Fractures involving multiple phalangeal locations were observed in 25.6% of cases while base and shaft accounted for 15.1% and 14.5% respectively. This distribution was statically significant ($p < 0.001$).

The 5th metacarpal was most commonly fractured (27.6%) followed by 4th (22.4%), 3rd (20.7%), 2nd (20.7%), and 1st (8.6%). However, the distribution was not statically significant ($p = 0.199$). Metacarpal shaft fractures were the most common (51.3%) followed by neck and multiple site fractures (15.4% each), head fracture (10.3%) and base fracture (7.7%)($p < 0.001$).

Of 20 carpal bone fractures identified, the majority were scaphoid fracture (5 case) followed by capitate and triquatrium each with 4 cases.

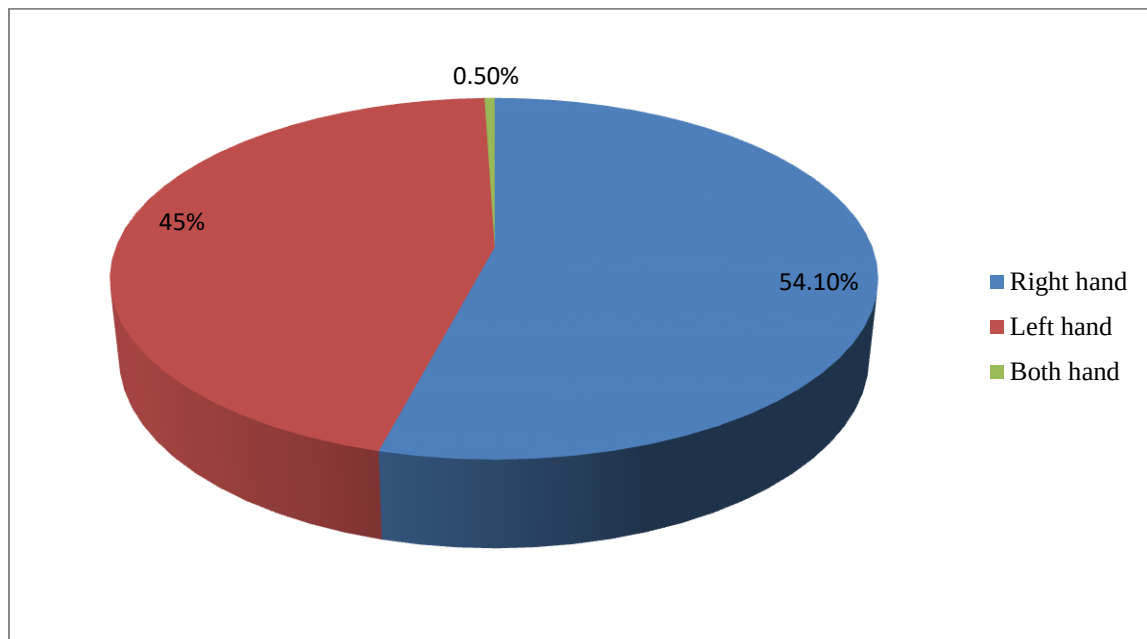


Figure 2: Hand Laterality of fractured hand

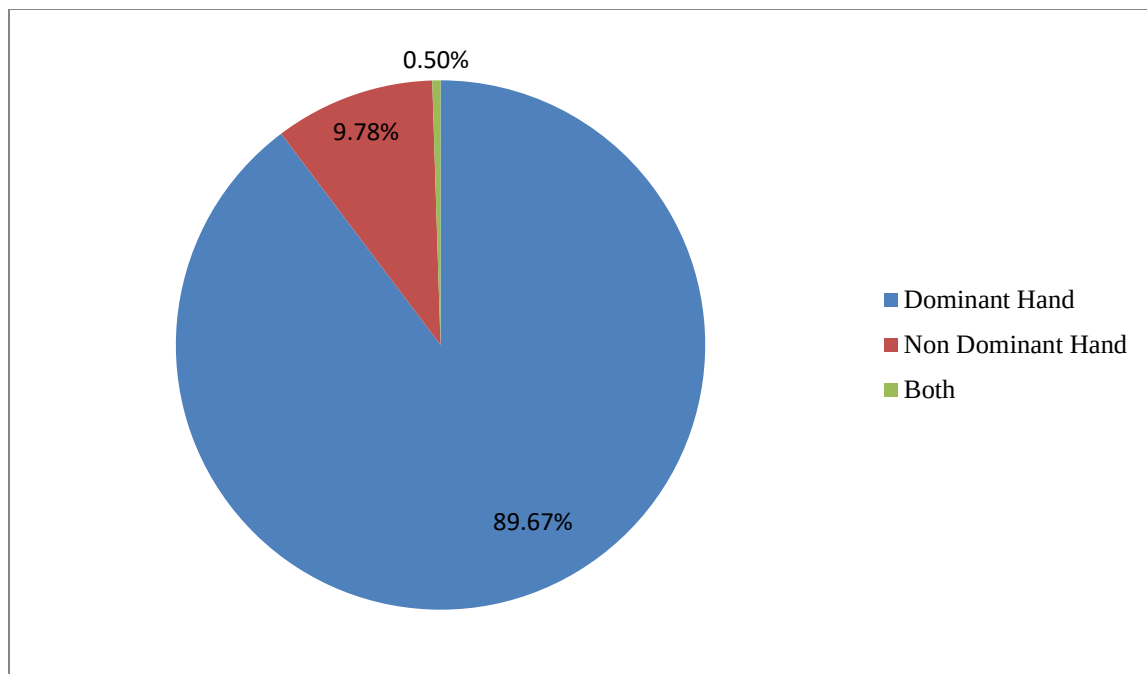


Figure 3: Hand dominance of fractured Hand

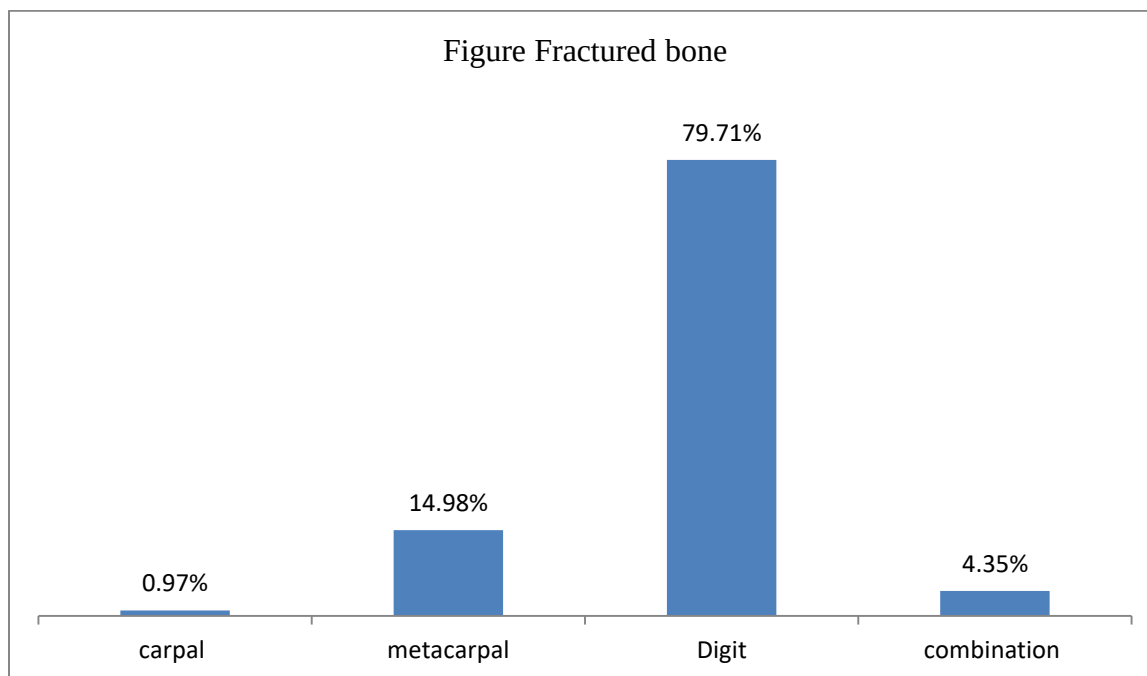


Figure 4: Fracture bone of the hand.

Table 1: Digital bone fracture frequency and proportion

	Frequency	Percentage
Index finger	62	27.4%
Middle finger	53	23.5%
Ring finger	45	19.9%
Little finger	36	15.9%
Thumb	30	13.3%
Total	30	100%

Table 2: Metacarpal Fracture frequency and percentage

	Frequency	Percentage
First metacarpal	5	8.6%
Second metacarpal	12	20.7%
Third metacarpal	12	20.7%
Fourth metacarpal	13	22.4%
Fifth metacarpal	16	27.6%
Total	58	100%

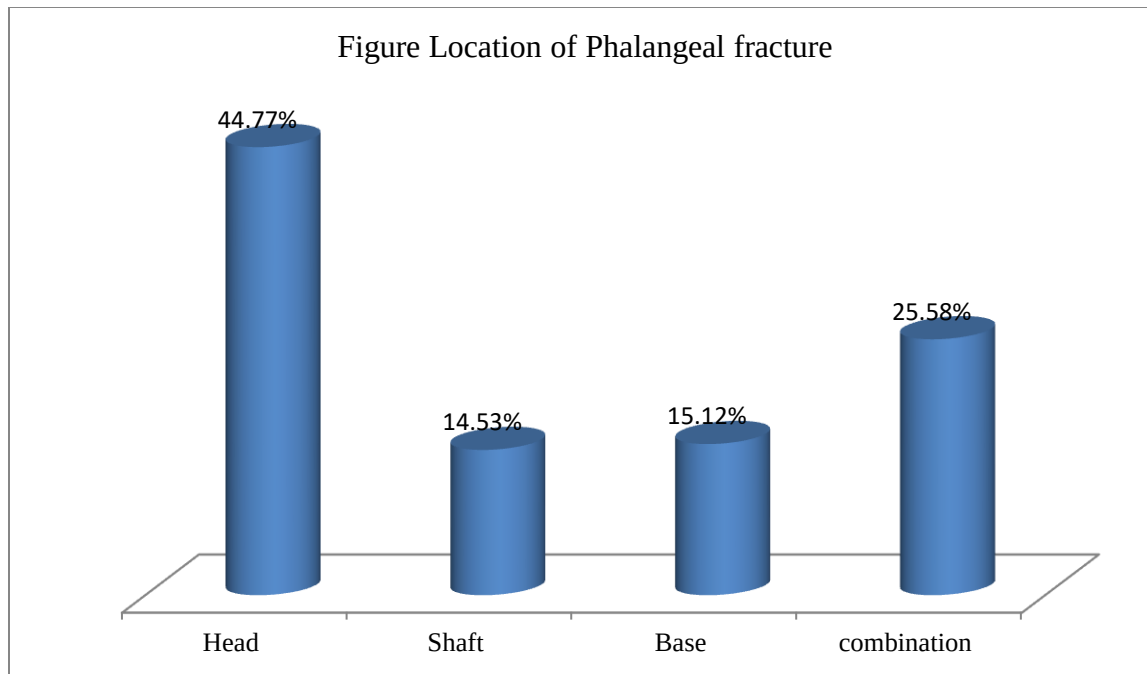


Figure 5: fracture location of phalangeal bones.

5.4. Characteristics of Fracture

Among the fracture types complete fracture was most common accounting for 945 of cases followed by incomplete (1.9%) and combined patterns(3.4%). Open fractures were also predominant, representing 76.8% of cases, while closed fractures accounted for 17.9% and combined patterns for 5.3%. In terms of fracture orientation comminuted fracture was the most common (40.1%), followed by oblique (17.9%), transverse (14%), amputation type (8.2%) and spiral type was the least type (3.4%). Regarding the joint involvement 71.5% were extra-articular followed by intra-articular (16.4%) and mixed pattern (12.1%). Most fractures were non displaced (43%), whereas displaced fractures account for 30.9 Pearson Chi-Square tests for goodness-of-fit was done for fracture characteristics which differed significantly by type, nature, orientation, stability, and joint involvement (all $p < 0.001$).

Variable	Categories	Frequency	Percentage (%)
Based completeness of fracture	Complete	196	94.7%
	Incomplete	4	1.9%
	Combined	7	3.4%
	Total	207	100%
Nature of fracture (based on extent of overlying skin)	Open	159	76.8%
	Closed	37	17.9%
	Combined	11	5.3%
	Total	207	100%
Orientation of fracture line	Transverse	29	14%
	Oblique	37	17.9%
	Spiral	7	3.4%
	Comminuted	83	40.1%
	Amputation	17	8.2%
	Combined	34	16.4%
	Total	207	100%
Joint involvement	Extra articular	148	71.5%
	Intra-articular	34	16.4%
	Combined	25	12.1%
	Total	207	100%

5.5. Mechanism of Hand Fracture

Machine injury was the leading cause of hand fracture occurring in 110 cases (53.1%) followed by crush injury in 50 cases (24.2%) and Falling down accident (6.8%) ($p < 0.001$).

Table 3: Mechanism of hand fracture

	Frequency	Percentage
Machine injury	110	53.1%
Crush injury	50	24.2%
FDA	19	9.2%
RTA	14	6.8%
Stick injury	9	4.3%
Bullet and blast	3	1.4%
Others	2	1%
Total	207	100%

5.6. Timing of Hand fracture

The majority of fractures occurred in the afternoon (13:00-18:59), accounting for 54.1% of the cases, followed by the morning period (07:00–12:59) with 29.9%, while the lowest occurrence was after midnight at 3.6%. Most fractures took place on weekdays, representing 83.5% of all cases. Hand fractures occurred all year round with slightly higher counts in winter(n = 60, 28.99%) and autumn (n = 56, 27.05%) and slightly lower counts in spring (n = 40, 19.32%) and summer (n = 51, 24.64%).

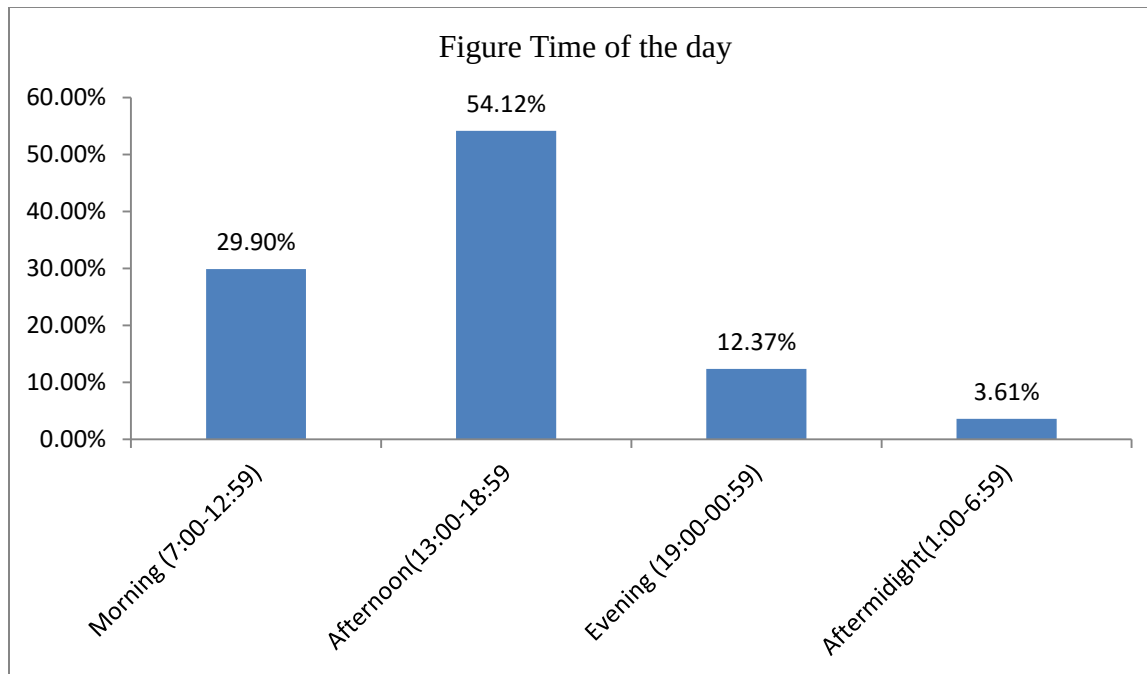


Figure 6: Time of the day of fracture happened.

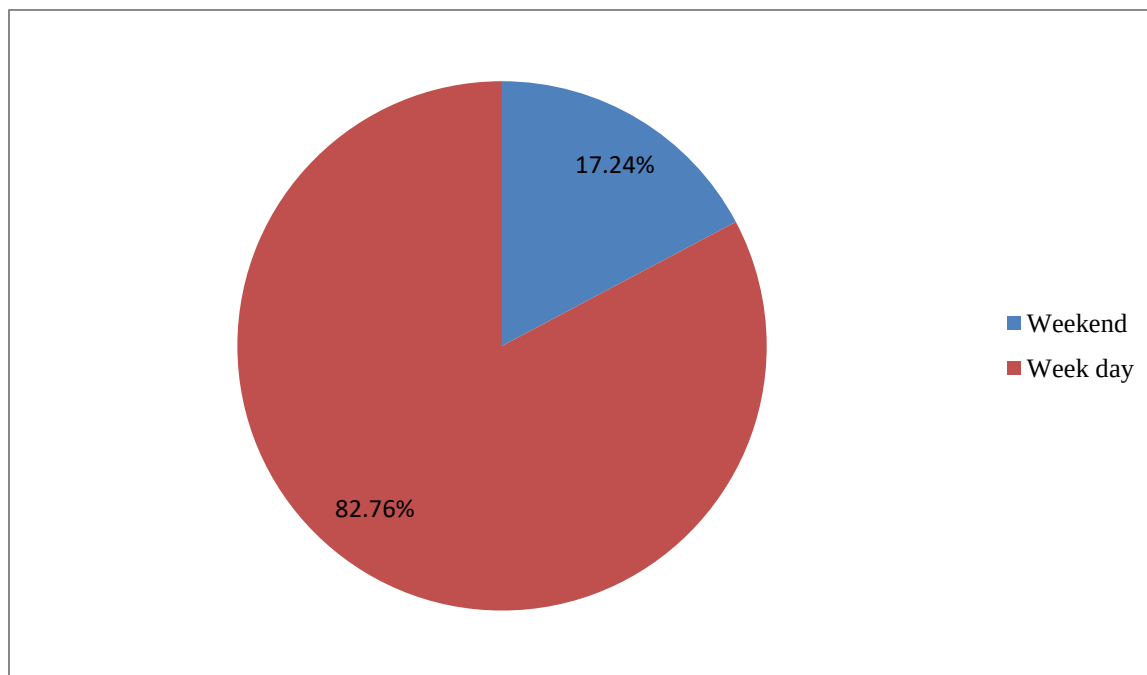


Figure 7: Day of the week fracture happened

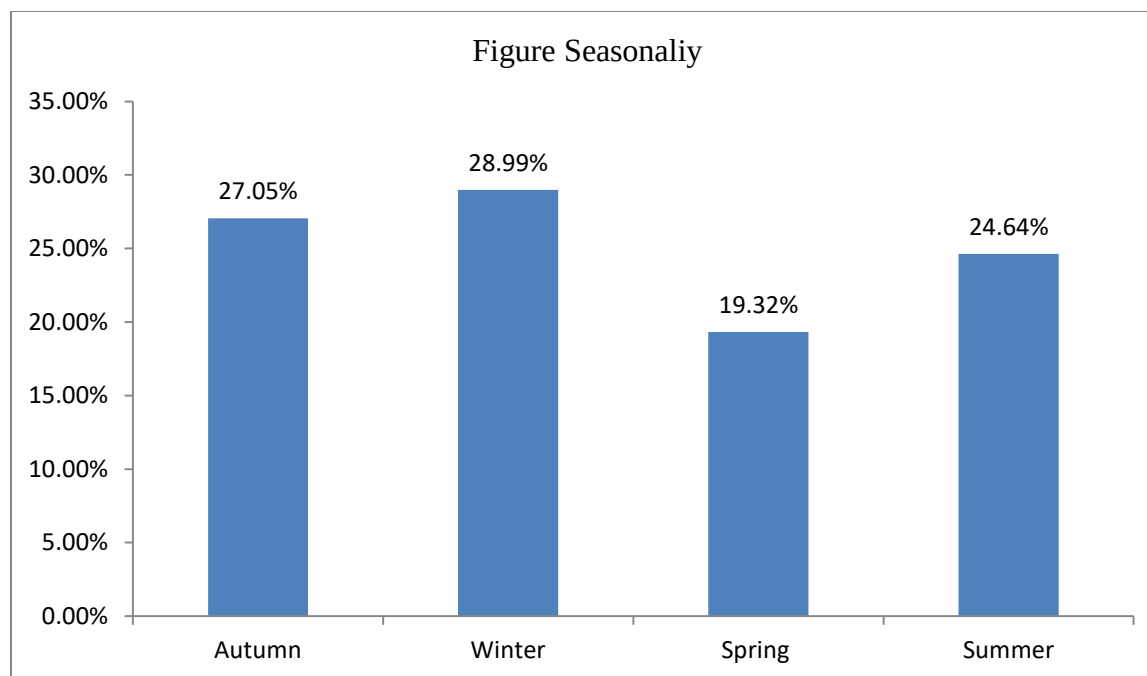


Figure 8: Season of fracture occurred.

6. Discussion

6.1. Magnitude of hand fracture

In this study out of 796 hand injury patients 506 had hand fracture (63.6%). Compared to other studies done by other investigators from Ethiopia and sub-Saharan Africa like kassa et al. (2025)(37%)⁷, Abebe et al (2019)(29.7%)⁶, Ahmed et al. (2020)(39%)⁸ and Makobore et al.(2015)(16%)¹⁶, our finding is higher which might be explained by fact that the study was conducted in a referral center with a high volume of plastic, reconstructive, and hand surgery cases and being trauma center.

6.2. Patient characteristics

The median age of patients were 25 years old years (IQR: 20–33), indicating that hand injuries predominantly affect young adults(18–41 years old) in their most active years, consistent with patterns reported by Kassa et al(2025)⁷ and Makobore et al.(2015)¹⁶. Males were disproportionately affected comprising 84.1% of cases which aligns with the findings of Tiruneh et al. (2020)³, Abebe et al. (2019)⁶, Moura et al. (2022)¹⁹. Kumar et al. (2013)¹⁴ and other studies have reported similar findings, reflecting greater exposure of this age groups to high-risk

occupational, and other activities. The majority of patients resided in urban areas, suggesting that trauma burden is concentrated in settings where higher population density and industrialization is expanded, a trend also noted by Makobore et al. (2015)¹⁶.

6.3. Anatomic Distribution of hand fracture

In this study the right hand was slightly more affected (54.1%) than left side(45.4%) while bilateral hand involvement was rare(0.5%) which suggests frequent use of right hand for majority of activities. This pattern aligns with findings of Makobore et al. (2015)¹⁶, Kassa et al. (2025)⁷, Alhumaid et al. (2019)¹⁸, and Dominguez Prado et al(2022)⁵, although Moura et al. (2022)¹⁹ reported a predominance of left-hand injuries. Such variation might be explained by differences in population handedness and injury pattern. The dominant hand was most commonly fractured (79.7%) which might be due to frequent use of dominant hand for day to day activities. This finding was consistent with Tiruneh et al. (2020)³ and Abebe et al. (2019)⁶.

Digital bones were most frequently fractured hand bone(79.7%), with index finger and middle finger most commonly affected similar to the findings of Stanton et al. (2007)²², Feehan et al.(2006)¹², and Moura et al. (2022)¹⁹. However metacarpal bone was the most commonly fracture in studies done by Dominguez et al(2022)⁵. This difference might be explained by variation in injury mechanism and population characteristics across studies. Distal phalanx is the predominant in our study which is more likely due to its exposed anatomic nature. These finding is consistent with fracture consistent with E.B.H. Van Oselen et al. (2017)¹⁵. In contrast other studies such as Kumar et al(2013)¹⁴ and Alhumaid et al(2019)¹⁸ reported proximal phalanx fracture are commonest. The difference might be due to difference in injury mechanism.

Among metacarpals 5th metacarpal was the most commonly observed fractured bone (27.6%), in line with observation by Wanjohi (2000)¹⁷, Alhumaid et al.(2019)¹⁸, and Kumar et al. (2013)¹⁴. Within metacarpals shaft fracture was the most commonly observed (51.3%) a finding consistent with reports of Wanjohi (2000)¹⁷ and Kumar (2013)¹⁴, however Doninuegez et al.(2022)⁵ reported metacarpal neck fracture as commonest. This discrepancy might be explained by difference in etiology of fracture.

Carpal fractures were uncommon (1%), with the scaphoid being the most commonly fractured carpal bone, as described by Zander et al. (2023)²⁴ and Kumar (2013)¹⁴.

6.4. Characteristics of fracture

In this study complete fractures were the most common (94.7%) and open fractures predominant (76.8%) reflecting high energy mechanisms are commonest in consistent with Tiruneh et al. (2020)³, and Makobore et al. (2015)¹⁶. Comminuted fractures were also most common fracture orientation line(40.15%) followed by oblique, transverse, amputation, and spiral fractures, consistent with patterns of studies done by Moura et al.(2022)¹⁹ whereas Alhumaid et al(2019)¹⁸ and Stanton et al(2007)²² reported different pattern with commonest finding transverse and oblique respectively. This difference can be explained by different injury mechanism where our patients are mostly caused by machinery injuries related to more severe type of fracture. Most fractures were non-displaced (43%), consistent with Stanton et al. (2007)²².

6.5. Mechanism of Hand Fracture

In this study machine injuries (53.1%) and crush injuries(24.2%) were the leading causes of hand fracture. These findings are consistent with Kassa et al. (2025)⁷, Tiruneh et al. (2020)³, and Makobore et al. (2015)¹⁶. In contrast in another regional studies such as done by Shrestha et al. (2019)¹³ and Alhumaid et al. (2019)¹⁸, noted falls or sports-related injuries as more common, likely reflecting differences in workplace safety practices; in our setting, the high rate of machinery-related injuries may be partly due to inadequate use of safety measures among workers.

6.6. Timing of injury

In this study hand fractures were most commonly occurred in the afternoon (54.1%) and weekdays suggesting due increased risk of injury during occupational and domestic workloads peak and physical fatigue and mental exhaustion in the afternoon and working culture of our society to stick to work on week days. Regarding seasonal variation in consistent with other studies like Kumar et al.(2013)¹⁴ and Domínguez-Prado et al.(2022)⁵ it occurs all year round and no seasonal difference. However, Feehan et al. (2006)¹² observed higher incidence in spring and summer, and Weum et al. (2016)²¹ noted more fractures in winter. These differences likely reflect regional variations in dominant injury mechanisms and climate; in our context, the predominance of machinery and occupation-related injuries may occur consistently throughout the year, reducing the effect of seasonal changes on fracture frequency.

7. Conclusion

This study demonstrated hand fractures were a significant proportion of acute hand injury accounting for 63.6% the majority of patients were young adult males. The majority of fracture occurred on right hand and dominant hand. Digital bones were the most commonly fracture with complete, open and extra articular fracture types dominating. Machine and crush injuries were the leading mechanisms. These findings underscore the high burden of hand fracture in this setting and emphasize the need for targeted preventive strategies, timely diagnosis, and appropriate management to reduce morbidity and preserve hand function.

8. Recommendation

Strengthening workplace safety through enforcement of protective measures, regular safety training and mandatory use of personal protective equipment is essential to reduce hand fractures, particularly machine related injuries. Policy makers should also prioritize occupational health regulations and routine inspection of high risk work places. Health facilities should also equip themselves for early detection and treatment of these injuries through adequate imaging and trained personnel especially common underdiagnosed carpal fractures. Further research focusing on treatment strategies, long-term functional outcomes, complications and rehabilitation effectiveness is recommended to give evidence based treatment to hand fracture sustained patients.

9. Strength of study

- ✓ To the best of my knowledge there is no published similar study in Ethiopia.
- ✓ We did detailed breakdown and assessment of distribution of fracture among anatomic locations and fracture characteristics.

10. Limitation of study

- ✓ Hospital-based design: The findings may not fully represent the community burden of hand fractures as some injuries may not come Health care system and were not captured.

- ✓ Single-center design: Referral pathways may have influenced the case mix, as some fracture cases could have been managed in other healthcare facilities. This may limit the representativeness and generalizability of the findings.
- ✓ Potential under diagnosis of carpal fractures: Limited skill in clinical diagnosis and imaging availability, especially advanced modalities, may have led to underreporting of certain carpal injuries such as scaphoid fractures.
- ✓ Lack of functional outcome assessment: The study did not evaluate treatment and post-treatment recovery, complications, or long-term disability, limiting interpretation of clinical outcomes.
- ✓ Cross-sectional nature: Causal relationships or temporal trends could not be established.

11.Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this study

12.Reference

- ¹ Moore, K. L., Dalley, A. F., & Agur, A. M. R. (2018). Clinically oriented anatomy (8th ed.). Wolters Kluwer.
- ² Hirt B, Seyhan H, Wagner M, Zumhasch R. Hand and wrist anatomy and biomechanics: a comprehensive guide. Stuttgart ; New York: Thieme; 2017.
- ³ Tiruneh, Chalachew & Regasa, Gemechs & B.L., Wamisho,. (2020). Clinical profile and patterns of extremity fractures in ortho- pedics department in tikur anbessa specialized hospital. Ethiopian Medical Journal. 58. 159-165
- ⁴ Chirali IZ. Sports Injuries. In: Traditional Chinese Medicine Cupping Therapy [Internet]. Elsevier; 2014 [cited 2025 Apr 14]. p. 211–30. Available from: <https://linkinghub.elsevier.com/retrieve/pii/B978070204352900014X>
- ⁵ Dominguez-Prado DM, Ferradas-Garcia L, Perez-Alfonso E, Balvis-Balvis P, Lopez-Lopez JA, Castro-Menendez M. Epidemiology of Bone Fractures in the Hand in Adult Population Using the ICD-10 Classification. ACHOT [Internet]. 2022 Aug 15 [cited 2025 Apr 7];89(4):252–9. Available from: <http://achot.cz/doi/10.55095/achot2022/041.html>
- ⁶ Abebe MW. Common causes and types of hand injuries and their pattern of occurrence in Yekatit 12 Hospital, Addis Ababa, Ethiopia. Pan Afr Med J [Internet]. 2019 [cited 2025 Apr 7];33. Available from: <http://www.panafrican-med-journal.com/content/article/33/142/full/>
- ⁷ Kassa R. The Burden of Hand Injury at a Major Public Referral Hospital in Addis Ababa Ethiopia. Collective Journal of medicine [Internet]. 2025 Mar 13 [cited 2025 Apr 12];01–8. Available from: <https://rscope.org/collective-journal-of-medicine/fulltext/articleimages/ART0068/the-burden-of-hand-injury-at-a-major-public-referral-hospital-in-addis-ababaethiopia>
- ⁸ E. Ahmed. The Management Outcome of Acute Hand Injury in Tikur Anbessa University Hospital, Addis Ababa, Ethiopia East and Central African Journal of Surgery Volume 15 Number 1
- ⁹ Crowe CS, Massenburg BB, Morrison SD, et al. Global trends of hand and wrist trauma: a systematic analysis of fracture and digit amputation using the Global Burden of Disease 2017 Study. Inj Prev 2020;26(Suppl 1):-24. doi: 10.1136/injuryprev-2019-043495 pmid: 32169973
- ¹⁰ Kasdan, Morton L. MD1; June, Lisa A. BA2. Returning to Work after a Unilateral Hand Fracture. Journal of Occupational Medicine 35(2):p 132-135, February 1993.
- ¹¹ de Putter CE, Selles RW, Polinder S, et al. Economic impact of hand and wrist injuries: healthcare costs and productivity costs in a population-based study. J Bone Joint Surg Am. 2012;94:e56
- ¹² Feehan, L. M., & Sheps, S. B. (2006). Incidence and Demographics of Hand Fractures in British Columbia, Canada: A Population-Based Study. The Journal of Hand Surgery, 31(7), 1068.e1–1068.e9. doi:10.1016/j.jhsa.2006.06.006
- ¹³ Shilu Shrestha,1 Subidha Tamrakar,2 Ashok K Banskota Outline of Hand and Wrist Injuries Presenting to an Emergency of a Tertiary Care Centre in Nepal JNHRC Vol. 17 No. 3 Issue 44 Jul - Sep 2019.
- ¹⁴ Kumar K. Scenario of hand fractures in a tertiary hospital: a prospective study. Musculoskelet Surg [Internet]. 2013 Apr [cited 2025 Apr 7];97(1):57–60. Available from: <http://link.springer.com/10.1007/s12306-012-0231-2>

- ¹⁵ Van Onselen EBH, Karim RB, Hage JJ, Ritt MJPF. Prevalence and Distribution of Hand Fractures. *Journal of Hand Surgery* [Internet]. 2003 Oct [cited 2025 Apr 13];28(5):491–5. Available from: <https://journals.sagepub.com/doi/10.1016/S0266-7681%2803%2900103->
- ¹⁶ Makobore P, Galukande M, Kalanzi E, Kijjambu SC. The Burden of Hand Injuries at a Tertiary Hospital in Sub-Saharan Africa. *Emergency Medicine International* [Internet]. 2015 [cited 2025 Apr 13];2015:1–5. Available from: <http://www.hindawi.com/journals/emi/2015/838572/>
- ¹⁷ Wanjohi, A. A retrospective study on pattern and outcome of metacarpal and phalangeal fractures of the hand as seen in Kenyatta National Hospital. MMed. (Surgery). Dissertation 2000. University of Nairobi
- ¹⁸ Alhumaid FA, Alturki ST, Alshareef SH, Alobaidan OS, Alhuwaymil AA, Alohaideb NS, et al. Epidemiology of hand fractures at a tertiary care setting in Saudi Arabia. *SMJ* [Internet]. 2019 Jul [cited 2025 Apr 7];40(7):732–6. Available from: <https://smj.org.sa/lookup/doi/10.15537/smj.2019.7.24286>
- ¹⁹ Moura SP, Meulendijks MZ, Veeramani A, Szapary H, Gomez-Eslava B, Hoftiezer YAJ, et al. Epidemiology and Fracture Patterns of Traumatic Phalangeal Fractures. *Plastic and Reconstructive Surgery - Global Open* [Internet]. 2022 Aug 4 [cited 2025 Apr 7];10(8):e4455. Available from: <https://journals.lww.com/10.1097/GOX.00000000000004455>
- ²⁰ Alfort H, Von Kieseritzky J, Wilcke M. Finger fractures: Epidemiology and treatment based on 21341 fractures from the Swedish Fracture register. Migliorini F, editor. *PLoS ONE* [Internet]. 2023 Jul 14 [cited 2025 Apr 7];18(7):e0288506. Available from: <https://dx.plos.org/10.1371/journal.pone.0288506>
- ²¹ Weum S, Millerjord S, De Weerd L. The distribution of hand fractures at the university hospital of north Norway. *Journal of Plastic Surgery and Hand Surgery* [Internet]. 2016 May 3 [cited 2025 Apr 7];50(3):146–50. Available from: <http://www.tandfonline.com/doi/full/10.3109/2000656X.2015.1137923>
- ²² Stanton JS, Dias JJ, Burke FD. Fractures of the Tubular Bones of the Hand. *J Hand Surg Eur Vol* [Internet]. 2007 Dec [cited 2025 Apr 13];32(6):626–36. Available from: <https://journals.sagepub.com/doi/10.1016/J.JHSE.2007.06.017>
- ²³ Merkeb Y. Assessment of extremity bone fractures and associated factors among adult patients in debre markos referral hospital, east gojjam zone, northern ethiopia. 2018;
- ²⁴ Zander MEL, Swärd E, Björkman A, Wilcke M. Carpal fractures: epidemiology, classification and treatment of 6542 fractures from the Swedish Fracture Registry. *Journal of Hand Surgery (European Volume)*. 2023;49(4):470-476. doi:10.1177/17531934231202012
- ²⁵ Raphaela NJ, Clovis F, Olivier MK, Ibrahima F, Daniel HE, Marcellin NN. Epidemiological, clinical, and etiological aspects of hand wounds at the Bonassama district Hospital. *Int J Orthop Sci* [Internet]. 2024 Oct 1 [cited 2025 Apr 13];10(4):401–4. Available from: <https://www.orthopaper.com/archives/2024.v10.i4.3669/epidemiological-clinical-andetiological-aspects-of-hand-wounds-at-the-bonassama-district-hospita>
- ²⁶ Ndungu WA, Nairobi UO. Pattern Of Hand Injury In Patients Seen At Kenyatta National Hospital
- ²⁷ Kaisha W, Khainga S. Causes And Pattern Of Unilateral Hand Injuries. *E Af Med Jnl* [Internet]. 2009 Oct 13 [cited 2025 Apr 13];85(3). Available from: <http://www.ajol.info/index.php/eamj/article/view/9634>