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Epidemiology and management of forearm bone fractures: Case study of patients treated at Mushie General Referral Hospital

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ABSTRACT

Introduction

Fractures of the forearm bones (radius and ulna) are common injuries in both children and adults and may result in functional limitations if inadequately managed. In low-resource settings such as Mushie, Democratic Republic of the Congo, limited information is available on their incidence, causes, and outcomes.

Purpose

This study aimed to describe the epidemiological characteristics, causes, management, and short-term outcomes of forearm fractures treated at Mushie General Referral Hospital in 2021.

Methods

We conducted a retrospective descriptive study including all patients admitted for a fracture of the radius and/or ulna between 1 January and 31 December 2021. Data collected from medical records included age, sex, fractured bone, affected side, fracture type, mechanism of injury, treatment modality, duration of treatment, and early outcomes (union, nonunion, malunion). Proportions were reported with 95% confidence intervals using Wilson's method. Chi-square and binomial tests were applied to compare proportions.

Results

A total of 44 forearm fractures were recorded, representing 3.4% of all surgical procedures (n = 1278) and 21.1% of all fractures (n = 208). Most patients were boys (63.6%), with the highest frequency in the 6–10-year age group. The radius alone was involved in 56.8% of cases, the ulna alone in 25.0%, and both bones in 18.2%. The left upper limb was affected in 63.6% of cases. Road traffic accidents were the leading cause (50.0%), followed by falls from trees and play-related injuries. Orthopaedic management was used in 75.0% of cases, with a union rate of 84.1%; nonunion and malunion occurred in 6.8% and 9.1% of cases, respectively.

Conclusion

Forearm fractures represent a significant proportion of traumatic injuries at this semi-rural hospital, predominantly affecting young boys. The high incidence of road traffic accidents underscores the need for targeted prevention strategies and improved trauma care capacity in similar low-resource settings.

INTRODUCTION

Fractures of the radius and ulna are common forearm injuries affecting both children and adults. They represent a significant challenge in traumatology, particularly due to their high frequency in various contexts, such as falls, road traffic accidents, and sports or occupational activities. Recent international studies have reported an increase in their incidence, particularly in low- and middle-income countries, where prevalence remains poorly understood (Gutzeit et al., 2021; Klein, 2025; Viberg et al., 2023).

In children, fractures of the distal extremities are among the most frequent, with a notable increase observed since 2020 (Khosla et al., 2003; Korup et al., 2022). In adults, especially the elderly, these injuries often fall under the category of osteoporotic fractures, reflecting compromised bone health (Cosman et al., 2014; Nellans et al., 2012).

Recent studies comparing therapeutic approaches indicate comparable efficacy between conservative (orthopaedic) treatment and surgical methods. In children, due to ongoing growth and the potential for bone remodeling, conservative management is generally preferred, whereas in adults, surgical management is often chosen, with several available modalities (Karatas et al., 2025; Kronk et al., 2025; Wang & Chen, 2024). Some authors advocate surgery as the primary treatment approach (Diawara et al., 2022; Sharma et al., 2025).

In low-resource countries, particularly in Central Africa, forearm fractures frequently affect a younger population exposed to high-energy trauma, such as road traffic accidents or falls from heights (Al-Sadek et al., 2016; Chung & Spilson, 2001). Despite their prevalence, most available data originate from high-income regions, leaving a gap in understanding the epidemiology, management, and outcomes of these injuries in resource-limited settings.

In semi-rural areas such as Mushie, where access to transportation, imaging modalities, and surgical equipment is often limited, documenting these aspects is essential for optimizing care and developing effective prevention strategies. Therefore, the objective of this study is to analyse the epidemiology, management, and outcomes of forearm fractures at Mushie General Hospital in 2021. This research aims to address the lack of local data, better understand the specific characteristics of these injuries in a resource-limited context, and facilitate the development of regionally adapted treatment protocols.

METHODS

Study Design

This was a retrospective descriptive study conducted using medical records from the surgical department of Mushie Hospital Center over a one-year period (1 January to 31 December 2021). The study methodology involved an exhaustive analysis of all cases of forearm bone fractures recorded during this period.

Participants and Inclusion Criteria

All patients aged 0–58 years who were hospitalized with a confirmed fracture of the radius or ulna, diagnosed by radiography, were included. The admission date encompassed the entire study period, without restrictions on fracture type. Incomplete or erroneous records were excluded. The final sample comprised 44 cases, representing all patients treated at the centre during this period.

Justification of Sample Size

The sample of 44 cases corresponds to all recorded incidents during the study period. This study does not perform power calculations, but instead provides a comprehensive description of the population treated in this context.

Variables and Definition of Healing

Collected variables included age, sex, fractured bone (radius, ulna, or both), affected side (right or left), fracture type, etiology, treatment modality, treatment duration, and outcome (union or complications). Union was defined as radiological confirmation of bone healing by a radiologist, without residual angular deformity or rotation, and associated with satisfactory functional recovery, particularly of the pronation–supination range of motion. The union period was defined as the time between treatment initiation and radiological confirmation.

Data Collection and Processing

Data were manually extracted from hospital records and registers. Incomplete or incorrectly filled records were excluded. Data were entered into Excel 2010 and analysed using Excel and Python (version 3.8; SciPy 1.5.4 and pandas 1.1.5 packages).

Statistical Analysis

Proportions and 95% confidence intervals were calculated using Wilson's method, which is more accurate than Wald's method for medium-sized samples. Proportions were compared with hypothetical values using the exact binomial test. Categorical variable distributions were analysed using the chi-square test. Statistical significance was set at α = 0.05, consistent with standard statistical literature (Hosmer & Lemeshow, 2013).

Justification and Potential Biases

The small sample size (44 cases), representing all patients treated at the centre during the study period, limits the generalizability of results. Selection of hospitalized patients with complete medical records could introduce selection bias. The retrospective design and absence of longitudinal data may increase the risk of documentation or confounding biases.

Ethical Considerations

Data were anonymized to prevent patient identification. According to local and international guidelines, research using anonymized secondary data does not require formal ethical approval. Nevertheless, all procedures adhered to ethical principles for public health research, including confidentiality, privacy, and integrity.

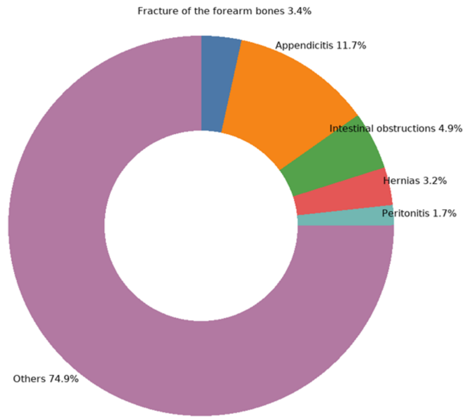
RESULTS

Table 1:
Distribution of Forearm Bone Fractures and Other Surgical Pathologies

Surgical Pathologies	Number of Cases	Frequency (%)
Fracture of the forearm bones	44	3.4
Appendicitis	150	11.7
Intestinal obstructions	63	4.9
Hernias	41	3.2
Peritonitis	22	1.7
Others	958	74.9
Total	1278	100

This **Table** shows the distribution of fractures of both forearm bones relative to other surgical pathologies treated in the department. Frequencies are expressed as a percentage of all surgical cases (n = 1278).

Figure 1:
Distribution of forearm bone fractures and other pathologies



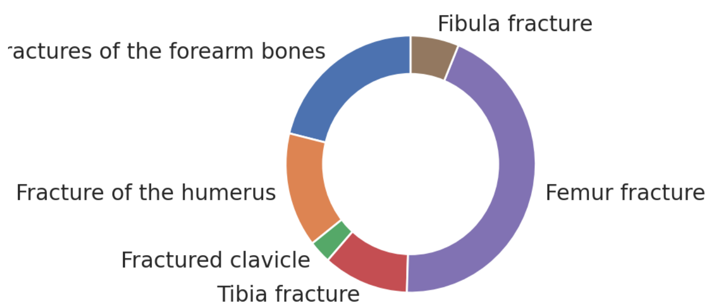
Fractures of the forearm bones represent 3.4% of all surgically treated cases (44/1278).

Table 2:
Distribution of Bone Fractures of the Forearm and Other Sites

Fractures	Number of Cases	Frequency (%)
Forearm bones	44	21.1
Humerus	30	14.4
Clavicle	6	2.8
Tibia	23	11.0
Femur	92	44.2
Fibula	13	6.2
Total	208	100

This **Table** shows the distribution of forearm fractures relative to other anatomical fracture sites. Frequencies are expressed as a percentage of all fractures.

Figure 2:
Distribution of bone fractures of the forearm and other fracture sites



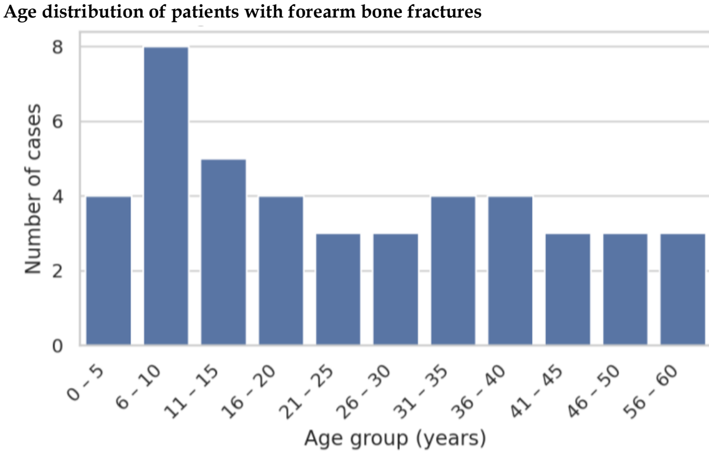
Forearm fractures represent 21.1% of all fractures (44/208).

Table 3:
Age Distribution of Patients with Forearm Fractures

Age (years)	Number of Cases	Frequency (%)
0–5	4	9.0
6–10	8	18.1
11–15	5	11.3
16–20	4	9.0
21–25	3	6.8
26–30	3	6.8
31–35	4	9.0
36–40	4	9.0
41–45	3	6.8
46–50	3	6.8
51–55	0	0
56–60	3	6.8
Total	44	100

Age distribution of patients with forearm fractures. Frequencies are expressed as a percentage of all forearm fractures (n = 44).

Figure 3.
Age distribution of patients with forearm bone fractures



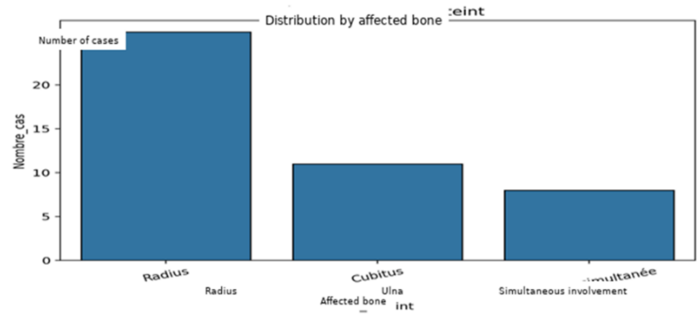
The 6–10-year age group had the highest frequency (18%, 8/44).

Table 4:
Distribution According to Bone Involvement

Fractured Bone	Number of Cases	Frequency (%)
Radius alone	25	57
Ulna alone	11	25
Both bones	8	18
Total	44	100

Distribution of fractures according to whether the radius, ulna, or both were affected. Frequencies are expressed as a percentage of all forearm fractures (n = 44).

Figure 4:
Distribution of forearm bone fractures according to bone involvement



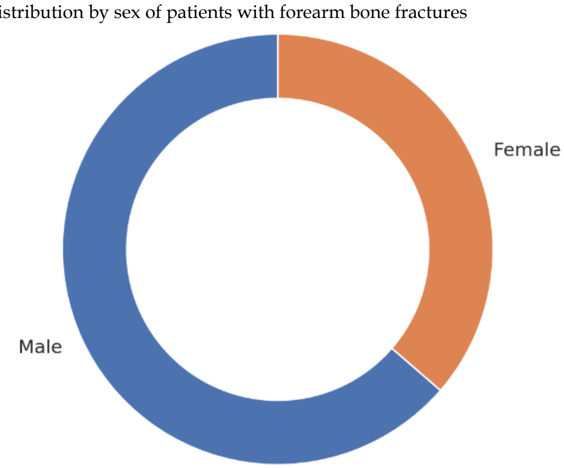
Radius fractures were most common (59%), followed by ulna (25%) and combined involvement (18%). Chi-square test (hypothetical equal distribution): $\chi^2 = 12.4$, $p = 0.002$.

Table 5:
Distribution by Sex

Sex	Number of Cases	Frequency (%)
Male	28	63.6
Female	16	36.4
Total	44	100

Sex distribution of forearm fractures. Frequencies are expressed as a percentage of all cases (n = 44).

Figure 5:
Distribution by sex of patients with forearm bone fractures



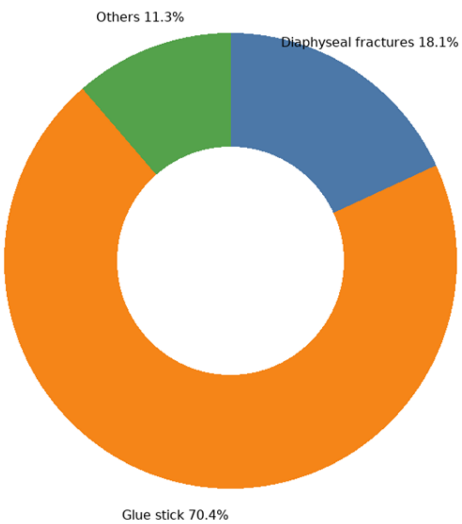
Male predominance was observed (63.6%). Wilson 95% CI: [48.9, 76.2]. Chi-square test: $\chi^2 = 3.273$, $p = 0.0704$; exact binomial test: $p = 0.0961$.

Table 6:
Distribution According to Fracture Type

Type	Number of Cases	Frequency (%)
Diaphyseal	8	18.1
Pouteau-Colles	31	70.4
Other	5	11.3
Total	44	100

This **Table** presents the distribution of forearm bone fractures according to fracture type, distinguishing among Colles' fractures, diaphyseal fractures, and other types. Frequencies are expressed as a percentage of all forearm bone fractures (n = 44). Binomial tests were used to compare the observed proportion of Colles' fractures against reference values of 50% and 65%.

Figure 6:
Distribution of forearm bone fractures according to fracture type



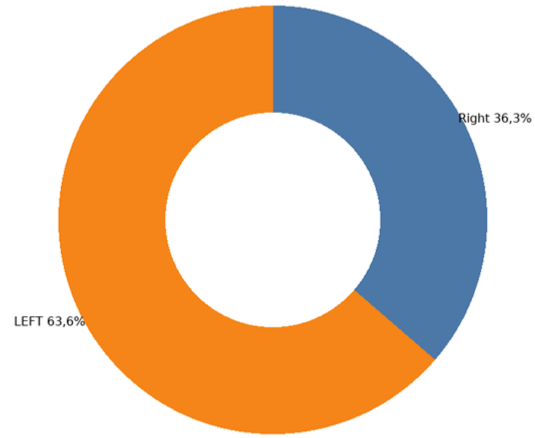
Pouteau-Colles fractures accounted for 31 of 44 cases (70.4%), with a 95% confidence interval of 56.4–81.5%. The binomial test against a reference proportion of 50% yielded p = .010, indicating statistical significance.

Table 7:
Distribution According to Affected Limb

Limb	Number of Cases	Frequency (%)
Right	16	36.4
Left	28	63.6
Total	44	100

This **Table** presents the distribution of forearm bone fractures according to the affected limb (right or left upper limb). Frequencies are expressed as a percentage of all forearm bone fractures (n = 44).

Figure 7:
Distribution of forearm bone fractures by affected limb



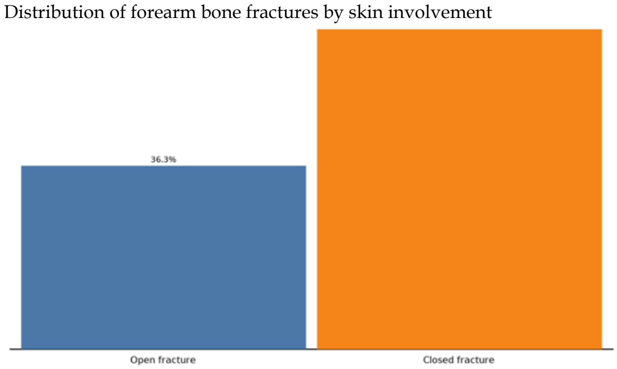
The left upper limb was most frequently affected, accounting for 28 of 44 cases (63.6%).

Table 8:
Distribution According to Skin Involvement

Type	Number of Cases	Frequency (%)
Open fracture	16	36.4
Closed fracture	28	63.6
Total	44	100

This **Table** presents the distribution of forearm bone fractures according to skin involvement, distinguishing between open and closed fractures. Frequencies are expressed as a percentage of all forearm bone fractures (n = 44).

Figure 8:
Distribution of forearm bone fractures by skin involvement



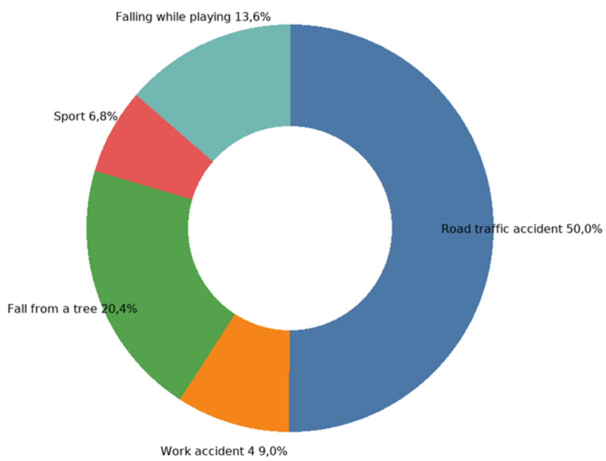
Closed fractures were more common (63.6%).

Table 9:
Etiology of Forearm Fractures

Etiology	Number of Cases	Frequency (%)
Road traffic accident	22	50
Workplace accident	4	9
Fall from tree	9	20.4
Sports	3	6.8
Fall while playing	6	13.6
Total	44	100

This Table presents the etiological factors of forearm bone fractures, including road traffic accidents, falls, and occupational or sports-related injuries. Frequencies are expressed as a percentage of all forearm bone fractures (n = 44). Road traffic accidents are the leading cause, accounting for 50% of cases.

Figure 9:
Distribution of forearm bone fractures according to etiology



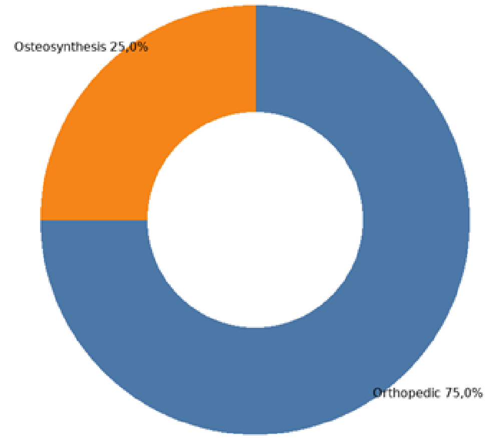
Road traffic accidents were the leading cause of forearm fractures (50%).

Table 10:
Treatment Modalities

Treatment	Number of Cases	Frequency (%)
Orthopedic	33	75
Osteosynthesis	11	25
Total	44	100

This Table presents the distribution of treatment modalities used for forearm bone fractures, distinguishing between orthopedic (conservative) management and osteosynthesis. Frequencies are expressed as a percentage of all forearm bone fractures (n = 44).

Figure 10:
Distribution of forearm bone fractures by treatment modality



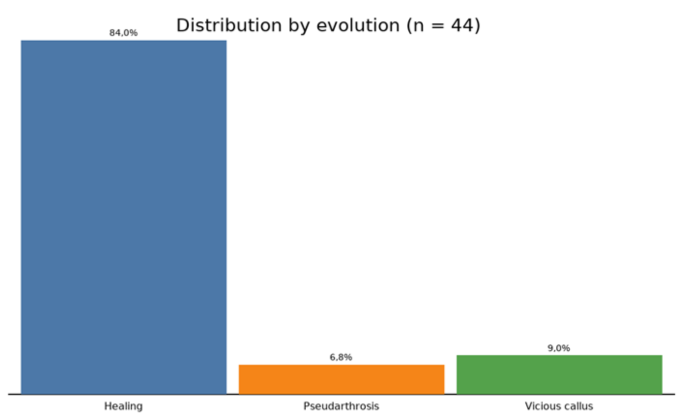
Most fractures were treated conservatively (75%).

Table 11:
Clinical Evolution

Outcome	Number of Cases	Frequency (%)
Healing	37	84.1
Pseudarthrosis	3	6.8
Malunion	4	9.1
Total	44	100

This Table presents the clinical course of patients with forearm bone fractures, including union, nonunion, and malunion. Frequencies are expressed as a percentage of all forearm bone fractures (n = 44). Binomial tests were used to compare the observed union rate with reference values (50% and 80%).

Figure 11:
Distribution of forearm bone fractures by clinical outcome



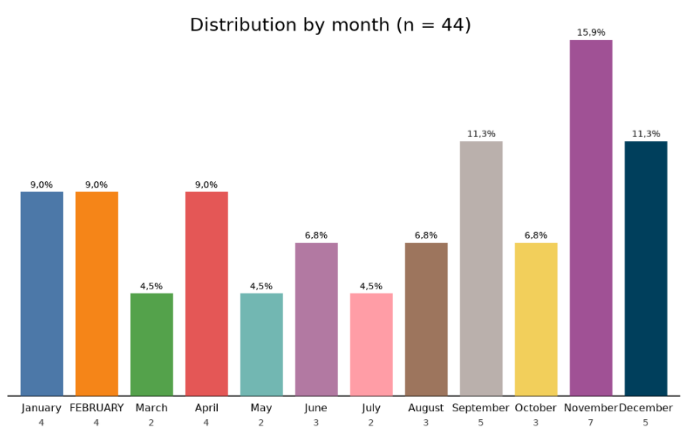
Recovery (union): 37 of 44 cases (84.1%), 95% CI [71.6, 91.7]. The binomial test showed a statistically significant difference compared with 50% ($p < .001$) but no statistically significant difference compared with 80% ($p = .577$).

Table 12:
Monthly Distribution

Month	Cases	Frequency (%)
January	4	9.0
February	4	9.0
March	2	4.5
April	4	9.0
May	2	4.5
June	3	6.8
July	2	4.5
August	3	6.8
September	5	11.3
October	3	6.8
November	7	15.9
December	5	11.3
Total	44	100

This **Table** presents the monthly distribution of forearm bone fractures over a one-year period. Frequencies are expressed as a percentage of all forearm bone fractures (n = 44).

Figure 12:
Monthly distribution of forearm bone fractures during the study year



Admissions peaked in September, November, and December.

DISCUSSION

Main Results

In 2021, forearm fractures accounted for 3.4% of all surgical procedures and 21.1% of all fractures treated at Mushie Hospital, primarily affecting young individuals (0–20 years) with male predominance (63.6%), consistent with findings by Mallmin and Ljunghall (1992). The radius was most frequently involved, particularly in Colles fractures, and high-energy trauma (road traffic accidents, falls, sports) was the main cause. Conservative treatment predominated (75%) with an 84.1% consolidation rate.

Comparison with Literature

These results align with studies highlighting increased incidence of distal radius fractures among youth in low-resource settings (Cintean et al., 2023; Ryan et al., 2010; Abdoul et al., 2024). Male predominance and radius involvement are frequently reported where high-risk activities are common (Mallmin & Ljunghall, 1992). Road traffic accidents are consistently the leading cause (Bombah et al., 2023; Towoezim et al., 2023). Campagne (2022, 2025) emphasises that forearm fractures often occur during falls or sports, causing significant pain and functional impairment.

Biological and Biomechanical Considerations

Fracture patterns are influenced by protective reflexes during falls, explaining the predominance in the dominant or left limb (Chung & Spilson, 2001). Colles fractures often result from the wrist being extended during a fall, exposing the radius to compressive and flexion forces. High incidence in young patients reflects trauma from lifestyle and local environmental factors rather than osteoporosis.

Limitations

Retrospective design, small sample size, and single-centre data limit causal inference and generalizability. Manual data collection may introduce documentation bias.

Recommendations

To reduce fracture incidence:

- Strengthen road safety and community awareness.
- Regulate driver licensing and alcohol testing.
- Improve workplace safety measures.
- Provide youth-friendly sports and leisure facilities.
- Educate parents on child supervision.
- Modernize hospital equipment and record management.

Future Research

Prospective, multicenter studies with larger samples are required to determine true prevalence, long-term treatment outcomes, and risk factors. Evaluating socio-economic impacts will aid development of targeted prevention strategies.

CONCLUSION

Forearm fractures represented 3.4% of surgical cases and 21.1% of all fractures in 2021 at Mushie Hospital. They predominantly affected young males (0–20 years), with the radius being the most common site (especially Colles fractures). Most fractures were treated conservatively (75%) with a favourable healing rate (84.1%), though complications such as nonunion (6.8%) and malunion (9.1%) occurred.

These findings highlight the need for injury prevention, improved trauma care, and public health interventions, including road safety enforcement, workplace safety, parental supervision, and modernized hospital facilities. Future research should focus on multicentre prospective studies and the socio-economic impact of fractures in the region.

Ethical Approval: Nil required.

Conflicts of Interest: None declared.

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